PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII

SAN FRANCISCO
PUBLISHED BY THE ACADEMY
1928–1929

COMMITTEE ON PUBLICATION

Col. George C. Edwards, *Chairman*

Dr. C. E. Grunsky   Dr. Barton Warren Evermann, *Editor*

TABLE OF CONTENTS

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVII, No. 1, pp. 1-29, plate 1, 11 text figures June 22, 1928

I

NOTES ON LOWER TERTIARY DEPOSITS OF COLOMBIA AND THEIR MOLLUSCAN AND FORAMINIFERAL FAUNA

BY

F. M. ANDERSON

Honorary Curator, Department of Paleontology

Introduction

Tertiary deposits are widely spread throughout the general area of the northern Andes in Colombia and Venezuela, occupying extensive basins in the present drainage systems of Lake Maracaibo, the Orinoco, and the Magdalena rivers. The chief interest of this paper centers in the early Tertiary deposits of the Magdalena and its tributaries, and especially in those of the Eocene and their environments.

It would appear from the distribution, materials and structural features of the earliest Tertiary known here, and their relations to the later Cretaceous formations, that their habitat was already prepared for them prior to their deposition. Extensive earth movements, folding and faulting of the older rocks, accompanied by uplift and denudation, had taken place before the close of Cretaceous time, and a great system of valleys with intervening ranges of mountains and coastal lowlands had been developed, into which, or upon which, the sea was led by early Tertiary subsidence, spreading contemporaneous deposits far inland.

From a study of the estuarine and non-marine Eocene (and Oligocene ?) deposits of Colombia, it appears that the surface relief of this region during the early Tertiary was not high, that the climate, while moist, was without excessive precipitation, and the country perhaps well forested.

The drainage basin of the Magdalena and its environs now present a varied topographic and geologic composition, a complete study of which would doubtless furnish the basis for a study of the neighboring basins and in large part the intervening Andean mountain system. The Tertiary deposits within the drainage area of the Magdalena range in age from early or middle Eocene to Pleistocene, and in character from clearly marine strata through estuarine to purely lacustrine and land-laid beds.

On the basis of the various facies of these deposits, as well as that of present and past topographic conditions, the valley of the Magdalena itself may be divided into three distinct sections, constituting the lower, central and upper valleys of the river. The valley between El Banco and the coast could be subdivided, but for the present will be known as the lower valley.

The central valley extends from El Banco southward to the narrows above the Rio Nare. The upper valley extends southward from Honda to far above Neiva, or in fact, to where the valley closes to a mere cañon.

Basement Rocks

The basement upon which the Tertiary deposits rest differs in different parts of the country. In the interior, about the non-marine and estuarine provinces, the basement rocks include Cretaceous strata, granitoid and other crystalline rocks, and semi-metamorphic slates, limestones and quartzites. Crystalline rocks outcrop along a low range of hills connecting the Cerros de San Lucas, west of the river, with the Sierra de Santa Marta, crossing the course of the Magdalena near El Banco, where they outcrop on both sides of the river in low hills.

West of the river the marine Tertiary deposits are in part bordered on the south by crystalline rocks in the San Lucas and Ayapel ranges, and on the west in part by similar rocks in the San Jeronimo range, which also occur at a few scattered points, as in the Cerro de Maco. Cretaceous beds occur in contact with marine Tertiary about the Santa Marta range and at a few other localities west of the Magdalena, judging from lithology. For the most part the basement rocks are either Cretaceous or older, possibly including some of Paleozoic age not yet recognized as such. Volcanic rocks older than the Tertiary have also been described in the western Cordillera, and in the Sierra de Perija.

EOCENE DEPOSITS

The Eocene deposits within the drainage areas of the Magdalena illustrate better than any other the three distinct facies of deposition, since they include not only marine deposits well characterized by faunas, but also non-marine, or lacustrine deposits far in the interior, and in intervening stations where the drainage found exit from the interior, there are partly marine, or estuarine deposits, also characterized by a fauna of brackish water aspect, with no clearly marine species, but associated with veins of coal and carbonaceous beds, and with petroliferous strata.

Marine Eocene. The Eocene deposits of the lower valley of the Rio Magdalena, and westward along the coast to the Gulf of Uraba, are almost entirely marine, if we except certain coal-bearing beds that seem to represent temporary conditions of deposition in the midst of the series. These coal-bearing strata outcrop about San Andres, and appear to underlie much of the San Jorge valley east of the San Jeronimo range.

In the Coloso range east of the Gulf of Morrosquillo, and in the higher hills west of the Sinú valley, as in the Cerros de las Palomas, there are cherts limestones and hard sandstones of the type found about San Andres and the Cerro de Tofeme, that doubtless belong in the Eocene. Between Lorica and Monitos, near the village of San Blas, an outcrop of rusty gray or yellowish sandstone contains numerous Eocene types of Mollusca, such as Venericardia, Turritella, Ostrea, etc.

This sandstone is clearly associated with the cherts and limestones of the Cerros de las Palomas.

El Carmen section. In southern Bolivar a general section of the Lower Tertiary deposits was made, extending from the basal beds near Cansona, by way of El Carmen eastward toward Zambrano on the Magdalena. In this section the proved Eocene constitutes at least 4,500 feet of strata, or a little more than two-thirds of the Lower Tertiary below the known Miocene deposits. The known Eocene begins on the west at a pronounced fault scarp, which a little farther north exposes older crystalline rocks in the Cerro de Maco, while toward the east it is covered by later Tertiary beds including Miocene and possibly Oligocene deposits. The Eocene series shown in this section may be roughly divided into the following subdivisions or zones, as heretofore described[1]:

	Thickness (Feet)
G,—Clay shale, sandy clay shale, white siliceous shale, probably organic; not known to be the top	1,000
F,—Concretionary sandy shale, sandstone, etc., with molluscan fossils, foraminifera, petrified wood, etc.	600
E,—Yellow thin-bedded sandstone, weathering red	400
D,—Whitish shale, with lenses and thin beds of limestone, etc., (Tofeme member) with thin beds of lignite and carbonaceous matter near bottom)	800
C,—Earthy or hard, thin-bedded, siliceous shales, marly shale, limestone, etc., containing molluscan fossils	800
B,—Yellow concretionary sandstone	500
A,—Heavy beds of sandy conglomerate (near Cansona) with boulders of sandstone, chert and eruptive rocks of dioritic nature, all well rounded	400
Total	4,500 feet

Fig. 1.

Fig. 1. East to west sectional sketch through El Carmen. Horizontal scale, 1 inch = 3.4 miles; vertical scale, X 6.8.

[1] Anderson, F. M., Bull. Am. Assoc. Petr. Geol., Vol. 10, 1926, p. 390.

Structure. The structure of these beds is shown in the accompanying profile, which crosses two or more anticlinal folds, the central being the most prominent and extensive. It is traceable for nearly 100 miles in a direction of N. 30° E., from near San Andres northward to Calamar. Where the section crosses this fold two miles west of El Carmen it is deeply cut by erosion, exposing three or more of the upper members of the foregoing series. West of the axis of this fold the beds sink in a syncline that may be co-extensive. Toward the north it extends to an unknown distance, possibly to Calamar, and southward it may find its continuation in the Sincelejo syncline described by Beck[2] near San Andres.

Throughout most of its course this trough is occupied by later beds which cover the known Eocene. In places these may be Oligocene in age, but in other places they are certainly Miocene. However, these superimposed beds are not always in contact with the same horizon of the Eocene. Denudation evidently followed the folding of the Eocene series.

West of the syncline in the Carmen section the entire Eocene series rises in a high monoclinal range of hills (1800 ft.?), the west slope of which represents the great fault scarp mentioned before. Near San Juan the series is faulted along a parallel line nearer the syncline, but rises farther west upon the crystalline rocks of the Cerro de Maco. The fault line passing near Cansona extends northward toward Calamar, and southward forms the west escarpment of the Coloso range facing the Gulf of Morrosquillo, and with some offsets may be followed by the way of Palmito into the Sinu valley far above Monteria. This has been called the "Bolivar fault."

Molluscan fauna. The fauna of the marine Eocene series can be only partially given at present, though a sufficient number of determinable species was found to indicate the stratigraphic position of some of the beds in the general section of the Andean Eocene, and perhaps that of the Gulf coast and of western Europe.

From horizon F, in the upper part of the series, and overlying the red beds of horizon E, a limited fauna was obtained from a point some six miles southwest of El Carmen, on the

[2] Beck, Elfred, Econ. Geol., Vol. 16, 1921, pp. 464-467.

west flank of the high anticlinal ridge, which contained the following species:

Aturia colombiana, n. sp.	*Ostrea* cf. *Alabamiensis* Lea
Crassinella (*Gouldia*) *minuta*, n. sp.	*Cerithiopsis*, sp.
Cardium cf. *triangulatum* de Laub.	*Pseudoliva* sp.
Venericardia alticosta (?) Conrad	*Phos* sp.
Corbula sp.	*Numulites carmenensis*, n. sp.

The numuloid foraminifera occur here in great numbers in a concretionary bed of sandstone containing also some molluscan species. Overlying this are sandy shales with layers of sandstone containing the large oysters, the valves of which as seen in fragments are more than two inches in thickness and perhaps a foot in length.

West of the syncline this horizon rises at the foot of the monoclinal range a little below Caracoli, and is identifiable not alone by its fauna, but also by its relation to the underlying red bed. At a point about six miles west of El Carmen, a considerable fauna was collected from concretionary beds in sandy shale, though the collection is far from being exhaustive. It includes some of the species found at the former locality and many others, a list of which with the appropriate citations to the literature follows on another page. It may be worth recording that with these fossils were found fragments of carbonized wood and much shell débris. Many genera and species were observed in the field, some of which were not collected, and the list includes a few of these, especially a form of *Venericardia planicosta* Lam.

In horizon C of the Carmen section, a mile or more north of Caracoli were found a number of fossils in a calcareous sandstone, including a *Dosinia, Mactra, Crassatelites* (?), and *Venericardia,* near *V. planicosta.*

Horizon F has been found at other neighboring places both north and south of El Carmen, as near San Jacinto, and at Las Palmas. Species of *Clavilithes, Volutospira, Turritella* and other genera are common in this horizon. Foraminifera, to be described later, characterize these beds in all of the observed outcrops, and were found at a depth of 900 feet in the well drilled three miles south of San Jacinto by the Standard Oil Company of California.

Another locality found near Arroyo Hondo by John H. Ruckman in 1914 contains numerous molluscan species, including *Venericardia* rel. *planicosta* and foraminifera which Dr. T. W. Vaughan has regarded as probably Eocene.[3] The horizon exposed here is believed to be about that of F in the Carmen section, and it is underlaid by a great thickness of Tertiary shale.

List of fossils found six miles west of El Carmen, Department of Bolivar, Colombia

GASTROPODA

1. *Actæon* (*Tornatellæa*) cf. *quercollis* HARRIS, 1896; Bull. Am. Pal., Vol. I, No. 4, p. 747 (188); Midway group.
2. *Akera bolivarensis*, n. sp.; Horizon F.
3. *Amauropsis perovata* (CONRAD), 1846; Proc. Acad. Nat. Sci. Phila., Vol. 3, p. 21, pl. 1, fig. 16.—HARRIS, Bull. Am. Pal., Vol. 1, No. 1, p. 49, pl. 1, fig. 4; Claiborne group.
4. *Ancilla* (*Olivula*) cf. *scamba* (CONRAD), 1833; Foss. Shells Tert. Form., Vol. 1, No. 2, p. 25, pl. 10, fig. 4; Claiborne group.
5. *Ancilla* (*Olivula*) *staminea* (CONRAD), 1832; Foss. Shells Tert. Form., Vol. 1, No. 2, p. 25, pl. 10, fig. 5; Claiborne group.
6. *Athleta* (*Volutospina*) cf. *petrosa* (CONRAD), 1835; Foss. Shells Tert. Form., Vol. 1, No. 3, p. 29; 2d Ed., p. 41, pl. 16, fig. 2; Claiborne group.
7. *Athleta* (*Volutospina*) *caracoli*, n. sp.; Horizon F.
8. *Cadulus* sp.
9. *Calyptrea* cf. *aperta* (Sol.) HARRIS, 1899; Bull. Am. Pal. Vol. 3, No. 11, p. 84, pl. 11, figs. 13-16; Wilcox group.
10. *Cerithiopsis conica* ALDRICH, 1897; Bull. Am. Pal., Vol. 2, No. 8, p. 178, pl. 1, fig. 4; Claiborne group.
11. *Clavilithes* cf. *harrisi* WOODS, 1922; Geol. and Pal. N. W. Peru, p. 97, pl. 13, fig. 6; Clavilithes series.
12. *Dentalium samanicum* BERRY, 1926; Nautilus, Vol. 40, No. 1, pp. 19-20, text figs.; ? Negritos group.
13. *Dentalium* sp.; Horizon F.
14. *Eulima* ? sp.; Horizon F.
15. *Levifusus* cf. *pagoda* (HEILPRIN), 1880; Proc. U. S. Nat. Mus., Vol. 3, p. 149, pl. 1, fig. 1; Eocene, Alabama.—HARRIS, 1896, Bull. Am. Pal. Vol. 1, No. 4, p. 207, pl. 9, fig. 8; Wilcox group.
16. *Lysis* GABB., sp. not known: Calif. Pal., Vol. 1, p. 138; Eocene.
17. *Natica aperta* WHITFIELD, 1865; Am. Jour. Conch., Vol. 1, p. 265.—HARRIS Bull. Am. Pal., Vol. 3, No. 11, p. 90, pl. 11, fig. 27; Wilcox group.

[3] Vaughan, T. W., Bull. U. S. Nat. Mus. No. 103, 1919, p. 197.

18. *Natica* cf. *eminula* CONRAD, 1833; Foss. Shells Tert. Form., Vol. 1, No. 2, p. 46—HARRIS, Bull. Am. Pal., Vol. 1, No. 4, p. 233, pl. 12, fig. 20.
19. *Olivancillaria* cf. *peruviana* WOODS, 1922; Geol. and Pal. N. W. Peru, p. 106, pl. 16, figs. 5-6; Lobitos group.
20. *Pseudoliva*, sp.; Horizon F.
21. *Pyrula* cf. *juvensis* WHITFIELD, 1865.—HARRIS, Bull. Am. Pal., Vol. 1, No. 4, p. 216, pl. 10, figs. 5-6; Claiborne group.
22. *Rostellaria* (*Cowlitzia*) rel. *canalifera* (GABB), 1864;—GABB, Calif. Pal. Vol. 1, p. 123, pl. 29, fig. 228; Tejon group.
23. *Sigaretus* cf. *bilix* CONRAD, 1833; Am. Jour. Sci., Vol. 23, p. 344.—HARRIS, Bull. Am. Pal. Vol. 1, No. 1, p. 7; Claiborne group.
24. *Solariella* cf. *louisiana* DALL, 1893; Trans. Wag. Fr. Inst., Vol. 3, p. 407, pl. 23, fig. 1; Wilcox group.
25. *Surcula* (*Drillia*) *carmenensis*, n. sp.; Horizon F.
26. *Terebra* cf. *plicatula* LAMARCK;—COSSMANN and PISSARRO, Iconog. Coq. foss. l'Eocene, etc., Vol. 2, pl. 53, figs. 231-1; Lute-Barton.
27. *Teinostoma subangulata* (MEYER), 1886.—HARRIS, 1899, Bull. Am. Pal. Vol. 3, No. 11, p. 101, pl. 12, figs. 20-22; Wilcox group.
28. *Turritella humerosa* CONRAD, 1835; Trans. Geol. Soc. Penn., p. 340, pl. 13 fig. 3.—HARRIS, Bull. Am. Pal., Vol. 1, No. 4, p. 224, pl. 11, figs. 10-13; Claiborne group.
29. *Turritella obruta* CONRAD, 1833; Foss. Shells Tert. Form. p. 45; 2d Ed. p. 45, pl. 15, fig. 12; Claiborne group.

PELECYPODA

30. *Acila ovula* (LEA), 1833; Cont. Geol., p. 80, pl. 3, fig. 59.—HARRIS, 1896, Bull. Am. Pal. Vol. 1, No. 4, p. 168, pl. 4, fig. 5; Midway group.
31. *Arca rhomboidella* LEA, 1833; Cont. Geol., p. 74, pl. 2, fig. 52.—HARRIS, 1919, Bull. Am. Pal. Vol. 6, No. 31, p. 51, pl. 21, figs. 11-17; Claiborne group.
32. *Callista* (*Macrocallista*) *dickersoni* WOODS, 1922; Geol. and Paleont. N. W. Peru, p. 71, pl. 4, figs. *6a*-*6b*; Clavilithes series.
33. *Cardium* aff. *triangulatum* DE LAUB.—COSSMANN & PISSARRO, Iconog. Coq. foss. de l'Eocene, etc., pl. 18, fig. 69-20; Lutetian stage.
34. *Corbula* cf. *arnoldi* WOODS, 1922; Geol. and Paleont. N. W. Peru, p. 74, pl. 5, figs. 7, 8, *8a*; Turritella series.
35. *Corbula alabamiensis* LEA, 1883; Cont. Geol. p. 451, pl. 1, fig. 12, etc.—HARRIS, 1919, Bull. Am. Pal. Vol. 6, No. 31, p. 185, etc.; Claiborne group.
36. *Cytherea perovata* CONRAD, 1833; var. *Aldrichi* HARRIS, 1895, Bull. Am. Pal., Vol. 1, p. 48, pl. 1, fig. 1; Claiborne group.
37. *Glycymeris caracoli* ANDERSON, n. sp.; Horizon F.
38. *Mactra parilis* CONRAD, 1833; Foss. Shells Tert. Form., Vol. 1, No. 3, p. 68, pl. 19, fig. 8; Claiborne group.

39. *Tellina greggi* HARRIS, 1897; Bull. Am. Pal. Vol. 2, No. 9, p. 264, pl. 14' fig. 19; Wilcox group.
40. *Tellina* cf. *rostralis* (LAMARCK.) COSSMAN and PISSARRO, Iconog. Coq. foss. de l'Eocene, etc., Vol. 1, pl. 5, fig. 35-2; Bartolian stage.
41. *Tellina* cf. *subtriangularis* ALDRICH; Bull. Am. Pal., Vol. 1, No. 2, p. 70, pl. 5, figs. 8, 8*a*; Eocene.
42. *Venericardia alticosta* CONRAD, 1833; Am. Jour. Sci., Vol. 23, p. 342; Claiborne group.
43. *Venericardia* rel. *planicosta* LAMARCK; WOODS, 1922, Geol. and Paleont. N. W. Peru, p. 66, pl. 4, figs. 1-4; Clavilithes series.
44. *Venericardia* cf. *subrotunda* (CONRAD), 1847-50; Jour. Acad. Nat. Sci. Phila. Vol. 1, p. 129, pl. 14, fig. 11; Eocene.
45. *Volupia bolivarensis*, n. sp.; Horizon F.

CORAL

46. *Stephanocœnia peruviana* VAUGHAN, 1922; Geol. and Paleont. of N. W. Peru, p. 133, pl. 23, figs. 1, 1*a*, etc.; Clavilithes series.

FORAMINIFERA

47. *Numulites carmenensis*, n. sp.; Horizon F.

CRUSTACEA

48. *Xanthopsis* (?) sp.; Horizon F.

Correlation. The total thickness of the proved Eocene section of Colombia, as seen west of Carmen, greatly exceeds that of the Gulf Coast states and is nearly double in volume. It is considerably less, however, than the estimated thickness of the Negritos formation described by Bosworth[4] for the region of northwest Peru, which he divides into two faunal series, dominated respectively by the genera Clavilithes and Turritella. Above the Negritos formation which is estimated at 7,000 feet is found the Lobitos, the thickness of which is given as 5,000 feet, all of which are included in the Eocene.

The Clavilithes series alone, which seems to be the most characteristic as well as the thickest group, is estimated at 4,000 feet. In the Carmen section of Colombia the only part which thus far affords any criteria for direct correlation is horizon F, beneath which there is a total of about 2,900 feet of strata; in the midst of this appear the lignitic beds of horizon D. Lithologically the Colombian section can not be satis-

[4] Bosworth, T. O., Geol. and Pal. N. W. Peru, pp. 17 and 23.

factorily compared with that of Peru, although shales predominate in both, with only a minor proportion of sandstones.

It will be noted in the foregoing list of species from horizon F that many of them have been identified with forms found in the Clavilithes series, as described by Woods.[5] Several of them have also been compared to, or identified with, Claiborne species of the Gulf Coast, while a few of them are found also in older groups. The Negritos formation is compared by Woods with the Wilcox and the lower Claiborne groups. It would appear from these facts that horizon F may represent a part of the Clavilithes series, and belongs somewhere in the Claiborne group, while the lower horizons find their place in the Wilcox, and therefore in the lower part of the Negritos formation.

In a recent short paper, Werenfels,[6] referring to the Tertiary section near Tolu Viejo, east of the Gulf of Morrosquillo, describes a group of strata under the name "Toluviejo Series" which he refers to an upper Eocene horizon upon the basis of foraminifera contained therein. The diagram below represents the present author's interpretation of the section compared to that of Werenfels and Beck[7] for the Tertiary column of northern Colombia.

Estuarine deposits. In the central valley of the Magdalena, as in the district of the lower Sogamoso, a great series of strata has been found, which, upon stratigraphic evidence, is to be correlated with the marine Eocene described above, or possibly in part with Oligocene strata, although the latter are not proved to be greatly developed in the nearby marine province of the Tertiary. This series of strata contains a brackish water fauna in its lower part, and beneath it veins of coal and carbonaceous beds, where it rises upon the flanks of the Cerro de la Paz at the eastern border of the valley. Hettner classed this series with his Guaduas Beds,[8] although he regarded it as of Cretaceous age. Some American geologists[9] have since applied the name "La Paz Beds" to the series, but to the writer

---

[5] Woods, H., (Op. cit.) pp. 52-56.

[6] Werenfels, A., Eclogæ geol. Helvit., Vol. 20, 1926, pp. 79-83.

[7] Beck, Elfred, Econ. Geol., Vol. 16, 1921, p. 463.

[8] Hettner, A., Die Kordillere von Bogata, 1892, Appendix 8c.

[9] Huntley, L. G., Trans. Am. Inst. Min. & Met. Eng., Vol. 68, 1922, p. 1014, etc.

Interpretation of Independent Sections of the Tertiary in Northern Colombia

Elfred Beck	A. Werenfels	F. M. Anderson	
	Sincelejo sandstone	Pliocene	
	— Unconformity —	— Unconformity —	
San Antonio sandstone Formation 1500 feet	Savana sandstone 3937 feet	Miocene series 4000 feet, or more.	MIOCENE
Huertas limestone series 1000 feet	Cerrito Formation 3937 feet		
Bombo shales, 500 feet (and other supposed Oligocene beds)	Pacini shales 3280 feet	Hard gray shale; sandstone and conglomerate ? 2000 feet	? OLIGOCENE
(Unconformity)		Unconformity	
	Toluviejo series 1312 feet	Horizon *G*, 1000 feet	EOCENE
	Arroyo seco Formation	Horizon *F*, 600 feet	
		Horizon *E*, 400 feet	
Tofeme Formation 1500 feet		Horizon *D*, 800 feet	
		Horizon *C*, 800 feet	
Palmito limestone 200 feet		Horizon *B*, 500 feet	
		Horizon A, 400 feet	

it appears better to still use the name first proposed by Hettner. The thickness of the series as found on the Sogamoso, the tributaries of the Rio Colorado, and southward has been given as 10,000 feet or more, though it is not known that this estimate does not include beds later in age than the Guaduas. In this district the series for the most part is sandy, becoming more shaley near the bottom. The coal veins and carbonaceous beds are entirely within the shale group which constitutes perhaps a third of the series. The coal veins are overlaid by dark clay shales several hundred feet in thickness, in which are found molluscan species of brackish water character, including *Melania, Ampullaria, Corbula, Cyrena,* etc. As yet no description of this fauna has appeared, though large collections have been made at various places. Another feature of this series that may have some correlative value is the occurrence in it of petroliferous strata, which are believed by the writer to be indigenous, and to furnish all the production of oil obtained in this district.

The Guaduas series rises on the Cerro de La Paz to an altitude of 2,500 feet or more, carrying the coal veins which have been mined here in a small way. The series rests unconformably upon Guadalupe and older Cretaceous strata as has been proved in other districts.

Upper valley. In the upper valley of the Magdalena the Guaduas series has a great development along the west foot of the east cordillera, where it has suffered much folding and faulting; this has exposed here also the coal veins and carbonaceous beds near its base. The beds are similar in all essentials to those of the Rio Colorado and the lower Sogamoso.

Not far above the coal veins near San Juan de Rio Seco Messrs. Downs McCloskey and Thomas Wark found a horizon of brackish water Mollusca which contained among others the following species:

Melanella karsteni, n. sp.	*Corbula cebada*, n. sp.
Ampullaria guaduasensis, n. sp.	*Corbula scheibei*, n. sp.
Corbula hettneri, n. sp.	Carbonized wood, etc.

Other forms, not identifiable, were also found. The material was a dusky gray shale, somewhat fractured and stained in the joints with iron oxide, though not containing much iron elsewhere. In this district also the Guaduas beds rest upon Guadalupe unconformably, as has been shown by Dr. Robert Scheibe[10] for the district of Tocaima a little to the south. In both the central and upper valleys of the Magdalena the Guaduas beds are overlaid by thick aggregates of strata presumably of Miocene age. In the central valley this series is known as the "Oponcito" series, and in the upper valley the name "Barzalosa" beds has been used to designate its equivalent. Plant beds near Santa Ana, apparently at the base of the series, have furnished numerous species which Berry[11] has referred to the Miocene. This assignment seems to meet stratigraphic requirements.

The relation of the Guaduas beds to the Cretaceous below, and to overlying beds which are here referred to the Miocene, both in the central and upper valleys of the Magdalena, would imply its lower Tertiary age; but since the marine Tertiary, as shown later, contains little Oligocene, but an abundance of Eocene, it is presumable that the Guaduas represents the latter rather than the Oligocene.

Lacustrine deposits. On the high plateau of the eastern cordillera, not only in the Sabana de Bogata, but in other similar and somewhat connected valleys, Guaduas beds occur enclosing coal veins and carbonaceous strata though as far as known no marine or brackish water faunas. In this region they are believed to be entirely lacustrine in origin, and are not overlaid by later beds of Miocene age. If the Barzalosa series has any representation on the plateau it has not been shown.

On the eastern slope of the cordillera, in the drainage area of the Orinoco, Guaduas beds have been described by Hettner,[12] as at Medina and farther north, though no mention is made of any Mollusca in them.

Coal-bearing beds of Eocene age are well known in the basin of Maracaibo Lake where they are petroliferous. Here, however, they are said to contain Eocene foraminifera, and

---

[10] Scheibe, R., Doc. de la Com. Cient. Nac., 1922, pp. 155-177.
[11] Berry, E. W., Bull. Geol. Soc. Am., Vol. 35, 1924, p. 782.
[12] Hettner, A., Die Kordillere von Bogata, 1892, Appendix 6-c.

are therefore marine, in part at least, and may perhaps be the equivalent of the coal bearing marine Eocene series of Colombia.

Oligocene Deposits

In view of the fact that Oligocene rocks occur in considerable volume in neighboring countries and on some of the islands of the West Indies, they should be expected to appear also in Colombia, at least in the marine province of the Tertiary. So far there has been only meagre evidence of their occurrence here.* Limestones with numerous species of foraminifera have been found, as on the tributaries of the Rio Sinú near Tolu Viejo, at San Andres, and in the higher hills north of Arenal, Bolivar, and no doubt in other Departments. Most of the authentic determinations of these, however, have shown them to be upper Eocene. Some samples taken from San Andres have been pronounced by Vaughan to be Oligocene in age, but the strata in this section thus proved to belong to this period appears to be limited to a few hundred feet, perhaps including the "Bombo shales" of Elfred Beck. Thus far no other authentic report of Oligocene in this country has appeared, though the period seems to be well represented in the Canal Zone and in the Maracaibo basin. In the section drawn by Werenfels the Oligocene is doubtfully represented by a group of beds to which this author gives the name "Pacini shales," and to which he assigns a thickness of 3280 feet. The Tofeme group of Beck is correlated with a part of the Pacini shales.

It appears to the writer, however, that the Tofeme member belongs much lower in the section and to be really Eocene. Werenfels also places the Bombo shales with the upper part of the Pacini, and immediately following the Tofeme member but it appears to be more in harmony with known facts to suppose an uplift and erosion to have intervened between the two

*After the present paper had gone to press the author had opportunity to review the recent work of R. A. Liddle on the Geology of Venezuela. No complete adjustment can now be made of the views expressed herein to the stratigraphic column supplied by Liddle for the Maracaibo region, though this may be attempted as a background to a forthcoming paper on the Later Marine Tertiary Deposits of North Colombia.

groups, by which much of the Eocene may have been removed from the district studied by Beck.

At the west foot of the Coloso range and in the highly folded region west of the Sinú valley between known Eocene beds in the higher ranges and proved Miocene of the coastal border there is a series of somewhat indurated dark clay shales, sandstones and hard conglomerate that is believed to be in part Oligocene. The series may be known as the "Monitos shales," from the predominance in it of this lithologic type.

The relation of the Oligocene to the Eocene strata in Colombia is imperfectly known, and no clear evidence regarding it was discovered in the Carmen section. In the Maracaibo basin, according to Garner,[13] a small angular unconformity exists between Eocene and Oligocene deposits.

According to Liddle** a "marked structural and lithologic unconformity" exists between the lower Oligocene, Pauji formation, and the Eocene of western Venezuela.

In turn also in other places the San Luis limestone (middle Oligocene) rests directly upon Eocene deposits (p.242).

In Santo Domingo the relationship is similar, and according to Cooke[14] a period of diatrophism intervened between the deposition of Eocene and Oligocene deposits.

In the section near Sincelejo, as drawn by Beck[15] the Bombo shales rest immediately upon the Tofeme group of the Eocene, which latter in the Carmen section seems to represent in part horizons C and D, containing the lignitic and carbonaceous beds already mentioned.

As shown by Liddle the "Third coal horizon" in western Venezuela is generally believed to belong in the lower part of the series, and is associated with limestones, as is the case in northern Colombia. (p. 181).

It would appear from the view just given that the period of uplift and denudation following Eocene deposition had removed much of the upper Eocene from parts of the Colombian region as well as from other parts of the Caribbean borders, though perhaps not everywhere equally, before the deposition

---

[13] Garner, A. H., Trans. Am. Inst. Min. and Met. Eng., Vol. 71, 1925, p. 1364.

**Liddle, R. A. Geology of Venezuela and trinidad (Fort Worth), p. 241.

[14] Cooke, Wythe, A Geological Reconnaissance of the Dominican Republic, (prepared by the U. S. Geol. Surv., 1921, p. 80).

[15] Beck, Elfred, Econ. Geol., Vol. 16, 1921.

of Oligocene. This conclusion will receive even stronger support when we consider the non-marine deposits in the interior of Colombia, where Miocene deposits rest directly upon Eocene, with the entire omission of Oligocene strata, indicating that in these regions the uplift which followed Eocene deposition was prolonged into early Miocene time, or at least until the beginning of this period.

Description of Species

The Tertiary faunas of the northern Andes are imperfectly known at present, since they have been but little studied, and few contributions concerning them have appeared in the literature. The identification of species found in any recent collection must be made very largely without the aid of others authoritatively studied, and with but little aid from the literature covering the region itself. However, the geographic relation of the Andean region to the West Indies and to the nearer states during Tertiary times permits the faunas of these regions and their literature to be used for comparison and identification.

Good collections from the Eocene of Alabama, Texas and other states have been accessible in the present study, and much reliance has been placed upon the literature of the Gulf Coast province, the relationship of which to that of western Europe is well known. Among the more recent contributions covering the Eocene of the Andean region itself, may be mentioned the Geology and Paleontology of Northwest Peru by T. O. Bosworth, and the descriptions therein by Woods, Vaughan, Cushman and others, and a later short paper by Hanna and Israelsky.[16] Besides descriptions of numerous Eocene species, the former of these contains many references to earlier publications, and the latter a check-list of Peruvian Tertiary species and citations to literature, both of which are especially helpful, and have been relied upon as being the most trustworthy and convenient keys to the Eocene species of Colombia.

Several molluscan species found in the marine and estuarian provinces of the Rio Magdalena are new, and therefore in

[16] Hanna, G. D., and Israelsky, M. C., Proc. Calif. Acad. Sci., 4th Ser., Vol. 14, No. 2, 1925, pp. 37-72.

themselves little aid in horizon determination, although their association with better known forms is at least corroborative, and will be useful in later work in this region.

1. **Aturia colombiana** Anderson, new species

Plate 1, figure 10, text figures 2, 3

Shell of moderate size; robust, dimensions as given in text-figure; aperture oval, wider than high, sides a little expanded below middle; shell involute, umbilicus small, or closed; sutures as shown in figures, strongly reflexed above middle of coil; surface marked by strongly recurved lines of growth.

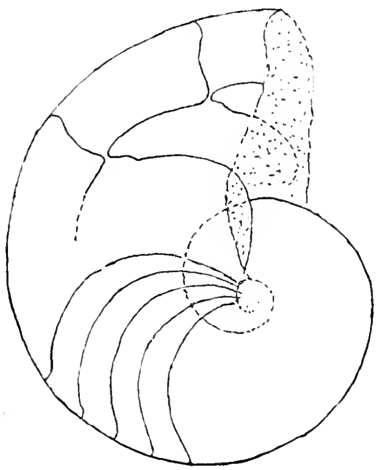


Fig. 2

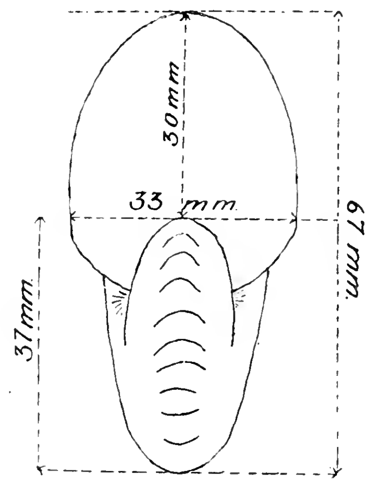


Fig. 3

Figs. 2, 3. Drawings of holotype specimen of *Aturia colombiana* Anderson, new species. Height of figured specimen, 67 mm.; greatest width, 33 mm.

This species is clearly allied to, and may be identical with, *Aturia vanuxemi* (Conrad) from the Eocene of South Carolina. The sutural features of the two species are extremely alike. The sectional drawing of Conrad's[17] figure 17, shows his species to be less rounded, and more sphenoidal in section.

[17] See Jour. Acad. Nat. Sci. Phila., Vol. 1, 1847-50, p. 129-30, pl. 14, figs. 15, 17.

When compared to *A. angustata* Conrad, its nearest ally on the Pacific Coast, from the Miocene (Oligocene?) of Astoria, Oregon, several good examples of which are in the Academy from that vicinity, *A. colombiana* is seen to be larger and more robust, with sutural differences, that while evident, yet clearly show relationship. The species is less closely related to any other known to the writer, being distinct from all of the California forms thus far discovered.

Holotype: No. 2697, Mus. Calif. Acad. Sci., from **six miles southwest of El Carmen, Bolivar, Colombia**, horizon F, of the Carmen section of the Eocene.

2. **Akera bolivarensis** Anderson, new species

Plate 1, figures 1, 2

Form of shell oval, robust, elongated, length 31 mm., width 16.5 mm.; spire truncated, very low; whorls four, separated from the body by shallow sulcus at the top; aperture ovate, narrowing at the top; shell thin, marked only by lines of growth; outer lip thin and entirely separated from the body; surface showing no spiral lines.

Holotype: No. 2687, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Department of Bolivar, Colombia,** horizon F of the Carmen section of the Eocene.

3. **Amauropsis perovata** (Conrad)

Plate 1, figure 6

Ampullaria ? perovata CONRAD, Proc. Acad. Nat. Sci. Phila. 1846, p. 21, pl. 1, fig. 16.—*Amauropsis perovata* (CONRAD) HARRIS, Bull. Am. Pal., Vol. 1, No. 1, 1896, p. 49, pl. 1, fig. 4.

Shell thin and polished; whorls five or more, rounded; spire high, sloping gracefully to apex, without deep sutures; outer lip simple, though with sharp edge; aperture ovate; surface showing only lines of growth. The shell somewhat resembles *Am. smithiana* Maury, from the lignitic fauna of Trinidad, and also *Natica aperta* Whitfield, as figured by Harris.[18]

[18] Bull. Amer. Paleo., Vol. 3, No. 11, p. 90, pl. 11, fig 27.

Plesiotype: No. 2691, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Department of Bolivar, Colombia,** horizon F, Carmen section of the Eocene.

4. **Athleta (Volutospina) caracoli** Anderson, new species

Plate 1, figure 5

Shell small, elongate pyriform; spire low, with nearly even slope, interrupted only by a slightly raised collar which covers the sutures; whorls five in type specimen; entire body whorl covered by prominent rib-like varices, which ascend the spire; on the body whorl these are crossed by spiral threads which form there laterally elongated beads; aperture narrow; outer lip apparently thin, inner lip encrusted, forming a callus which covers part of the body whorl; callus beaded on its outer part.

Syntypes: No. 2689, 2690, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Colombia,** horizon F, of the Carmen section of the Eocene.

This shell resembles *A. (Volutocorbis) scabricula* (Sol.) as illustrated by Cossmann and Pissarro,[19] but it is smaller and more delicate in sculpture.

5. **Clavilithes** cf. **harrisi** Woods

A single imperfect specimen of this species was collected, though others were seen in the field and recognized generically. The single specimen, with most of the spire missing, is about 35 mm. in length and 16 in width. Most of the shell has disappeared, but enough remains to show that the sculpture is simple, resembling that of the species figured by Woods under the above name. In outline also it resembles this species, though no positive identification can be made.

Locality: Six miles west of El Carmen, Bolivar, Colombia, associated with many other species in horizon F, of the Carmen section.

---

[19] Iconogr. Coq. foss. de l'Eocene, etc., Vol. 2, pl. 43, figs. 205-1.

6. **Surcula (Drillia) carmenensis** Anderson, new species

Plate 1, figures 3, 4

Shell small, turreted and fusiform; length of type 19 mm., width of body whorl 6 mm., height of spire (apex missing) 10 mm.; whorls six in number, not inflated, each rising in a slight collar on the preceding whorl; surface ornamented by spiral threads and lines, a median thread on each whorl being more prominent than the others, and nodose; nodes elongated spirally, showing, even on the cast, spiral lines not of equal strength, the two below the median being stronger than the others; canal long and tapering to a point, marked outwardly by spiral sculpture.

Holotype: No. 2688, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Bolivar, Colombia,** horizon F, Carmen section of the Eocene.

This shell resembles *Pleurotoma denticulata* (Edw.) Harris,[20] from Woods Bluff, Ala., but it is more slender, and the sculpture differs considerably.

7. **Crassinella (Gouldia) minuta** Anderson, new species

Text figures 4, 5

Shell minute, almost microscopic in size, length and height about equal, 0.5 mm.; outline sub-triangular; somewhat inflated, smooth, or showing only lines of growth; cardinal

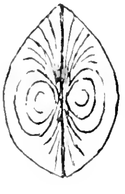


Fig. 4

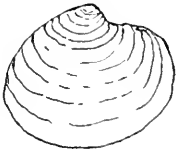


Fig. 5

Figs. 4, 5. Drawings of holotype specimen of *Crassinella* (*Gouldia*) *minuta* Anderson, new species X 12.5. Height of figured specimen, 1.7 mm.; length, 1.8 mm.; width, 1 mm.

[20] Bull. Am. Pal., Vol. 3, No. 11, pl. 1, fig. 21, p. 12.

teeth resembling those of *Astarte*. This shell was found in great numbers associated with *Aturia colombiana* and other marine Mollusca.

Holotype: No. 2723; *paratypes:* Nos. 2724-2733, Mus. Calif. Acad. Sci., from **six miles southwest of El Carmen, Department of Bolivar, Colombia,** horizon F, Carmen section of the Eocene.

8. **Glycymeris caracoli** Anderson, new species

Plate 1, figure 9

Shell of medium size, height 20 mm., length 21 mm., thickness 8 mm.; sub-triangular, not much inflated; beaks subcentral, or a little in advance of center; surface ornamentation consisting of concentric ridges, or interruptions of growth crossed by radial ribs that obscure the concentric sculpture; hinge of moderate strength, containing seven to nine cardinal teeth sloping inwardly toward the beak; radial ribs about 35, becoming obsolete near the margin of the shell; ribs rounded, slightly wider than the interspaces; inner margin of the shell crenulated.

Holotype: No. 2694; *paratypes:* Nos. 2695, 2696, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Bolivar, Colombia,** where it occurs in great numbers.

This shell resembles very closely the figures of *G. ignus* (De Gregorio) but it is less triangular, or more rounded in outline, with sculpture disappearing near the lower margin of the shell. *G. caracoli* may also be compared with *G. trigonella* (Conrad), (and therefore with *G. deltoidus* (De Gregorio), which Harris[21] includes as a synonym), from the Claiborne of the Gulf Coast Eocene.

9. **Ostrea** (large species)

No attempt is here made to describe this species, although its unusual size might seem to warrant doing so. Only fragments were found, some of which measured seven inches in length and two inches in thickness of single valves. In size and

[21] Bull. Am. Pal., Vol. 6, No. 31, p. 40.

other characters they recalled the *Ostrea titan* of the California Miocene. The species may be related to *Ostrea alabamiensis* Lea, which, according to Harris, is *Ostrea contracta* of Conrad;[22] this is said to attain a length of nearly two feet.

10. **Venericardia alticostata** Conrad

Venericardia alticostata CONRAD, 1833, Amer. Jour. Sci., Vol. 23, p. 342.

Shell of moderate size, sub-quadrate, length 33 mm., height 21 mm., thickness 20 mm.; beaks anterior, lunule small; ribs 20 in number, prominent, ornamentation not simple; ribs slightly grooved on the summit and sides, and having a secondary or intermediary riblet only occasionally. This fluted character of the ribs perhaps distinguishes this form from others, though it is believed not to be specific in value.

The species was found with many others some six miles west of El Carmen, Bolivar, in horizon F, just above the red beds of this section of the Eocene.

11. **Venericardia** rel. **planicosta** Lamarck

This species was recognized in the field but not collected. The shells were fragmentary, for the most part; some appeared to have been four inches in length and relatively thick, with broad smooth ribs similar to those figured by Woods[23] from the "Clavilithes series" of Peru.

12. **Volupia bolivarensis** Anderson, new species

Plate 1, figures 7, 8

Shell small, outline triangular; height 10.1 mm., length 10 mm., thickness of single valve 4 mm.; lunule small; beaks closely approaching each other, depressed, curving forward: surface ornamented by a few strong concentric folds, the central one being much heavier than the others; posterior end bearing a flange-like projection descending from the shell by a deep suture, sculptured by radial and concentric lines, and

---

[22] See Conrad, Proc. Acad. Nat. Sci. Phila. 1855, p. 269.

[23] Geol. and Paleont. of Northwest Peru, p. 66, pl. 4, figs. 1-4.

bearing a small lateral tooth within; cardinal tooth like *Phacoides.*

Holotype: No. 2692; *paratype:* No. 2693, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Bolivar, Colombia,** associated with many other species in horizon F of the Carmen section.

This genus has not hitherto been reported from American Eocene beds as far as known, though it has two or three representatives in western Europe.

13. **Melanella karsteni** Anderson, new species

Plate 1, figures 21, 22

Shell small, though not minute, stout, tapering; length 11.5 mm. width 5 mm.; spire elongate conical, whorls separated by distinct sutures, last whorl roundly angular; surface white or yellowish, polished, marked by faint lines of growth; aperture ovate, posterior angle not acute, base short; outer lip rounded at juncture with the basal border.

Holotype: No. 2722, Mus. Calif. Acad. Sci., from near **San Juan de Rio Seco, east border of the upper valley of the Magdalena River, Colombia,** from the lower part of the Guaduas beds, not far from horizon of the coal veins.

14. **Ampullaria guaduasensis** Anderson, new species

Plate 1, figures 19, 20

Shell of moderate size, length 20 mm., maximum width 16 mm., spire elevated, whorls four or five, flattened above, angulated, sides slightly rounded; surface not well known but apparently smooth; suture not distinct; aperture ovate, pointed behind, rounded in front; outer lip smooth and regular; umbilicus closed by a callus; body whorl flattened above, sloping gently outward to the angulated shoulder.

Holotype: No. 2721, Mus. Calif. Acad. Sci.; found with the preceding near **San Juan de Rio Seco, on the east border of the upper valley of the Magdalena River, Colombia,** in the lower part of the Guaduas beds, not far from the horizon of the coal veins.

15. **Corbula hettneri** Anderson, new species

Plate 1, figures 11, 12, 13, 14, text figures 10, 11

Shell of moderate size, length 13 mm., height 15 mm., thickness 10 mm.; variably triangular in outline; beaks high, incurved, closely approaching each other; umbones angulated; shell usually squarely truncated behind, rounded in front; surface marked by strong lines of growth, show-

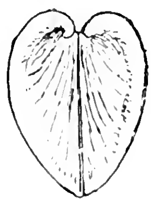


Fig. 10

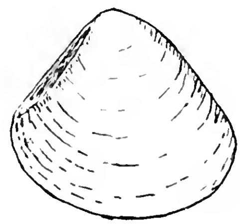


Fig. 11

Figs. 10, 11. Drawings of syntype specimen of *Corbula hettneri* Anderson, new species X 2. Height, 14.6 mm.; Length, 13.9 mm.; thickness, 10 mm.

ing a few periods of pause in development; sometimes inequivalve, the right valve being slightly larger, with more prominent beak; lunule small, ovate, or broadly lanceolate; prominent cardinal tooth on right valve, forming a sharp angle with posterior margin beneath the beak.

Syntypes: Nos. 2698, 2699; *paratypes:* Nos. 2700-2705, Mus. Calif. Acad. Sci.; found with the preceding species near **San Juan de Rio Seco, on the east border of the upper valley of the Magdalena River, Colombia,** near the base of the Guaduas group of brackish water beds.

16. **Corbula cebada** Anderson, new species

Plate 1, figure 15; text figures 6, 7

Shell small, length 7.5 mm., height 5.1 mm., thickness 3.6 mm.; outline as shown in the figure, posterior upper margin nearly straight, anterior slightly excavated, lower margin broadly rounded; slightly inequivalve, inflation moderate; no visible lunule; surface ornamented only with concentric lines of growth; beaks slightly in advance of the center of the shell.

Fig. 6

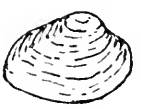


Fig. 7

Figs. 6, 7. Drawings of holotype specimen of *Corbula cebada* Anderson, new species X 2. Length of figured specimen, 7.5 mm.; width, 3.6 mm.; height, 5.1 mm.

Holotype: No. 2706; *paratypes:* 2707-2715, Mus. Calif. Acad. Sci.; **near San Juan de Rio Seco, on the east border of the upper valley of the Magdalena River, Colombia,** near the base of the Guaduas group, not far from the horizon of the coal veins.

This shell resembles *Corbula cuneata* Say from the Tertiary of Maryland. Without any more definite information as to the horizon and habitat of Say's species no positive identification can be made.

17. **Corbula scheibei** Anderson, new species

Plate 1, figures 16, 17, 18; text figures 8, 9

Shell small, sub-circular in outline, inflated; length 11 mm., height 10 mm., thickness 11 mm.; beaks low, rounded, closely approaching each other; surface smooth, marked only by fine lines of growth. This species resembles somewhat *Corbula galvestonensis* Harris[24] from the deep well drilled near Galveston. This Texas species seems to have come from the Neocene beds of that coast which were probably marine.

This species is named in honor of Dr. Robert Scheibe, who was for some years, and until the time of his unfortunate death, director of the work of the Comision Cientifica

[24] See Bull. Am. Pal., Vol. 1, No. 3, p. 94, pl. 2, figs. 4-4a.

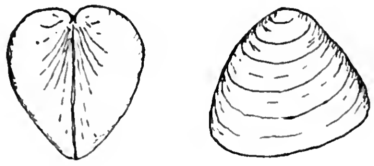


Fig. 8 Fig. 9

Figs. 8, 9. Drawings of holotype specimen of *Corbula scheibei* Anderson, new species X 2. Length of figured specimen, 11 mm.; height, 10 mm.; width, 10 mm.

Naçional in Colombia. He died in 1923 soon after his return from an extended excursion in the eastern cordillera made in pursuance of his duties.

Syntypes: Nos. 2716, 2717; *paratypes:* Nos. 2718, 2719, 2720, Mus. Calif. Acad. Sci.; **near San Juan de Rio Seco on the east border of the upper valley of the Magdalena River, Colombia,** near the base of the Guaduas group, and near the horizon of the coal veins.

18. **Numulites carmenensis** Anderson, new species

Plate 1, figures 23, 24

Test circular, lenticular in section, about four times as wide as thick; discoidal, all chambers being added to periphery; chambers a little longer in radial direction than parallel to circumference; partition walls thin and at outer end turned retractively backward; outer walls of last volution, irrespective of age, with long wing-like projections which extend to central short axis; thus each volution completely covers all preceding, the cover being composed of heavy rounded ridges becoming progressively smaller toward the center; surface smooth and shining. Diameter of holotype 3.4 mm.; diameter of largest one seen, 4.2 mm.; thickness 1 mm.

Holotype: No. 2509; *paratypes:* Nos. 2510, 2511, 2512, Mus. Calif. Acad. Sci., from **six miles west of El Carmen, Bolivar, Colombia**; horizon F of the Carmen section, probably Middle Eocene.

This species is very abundant in hard calcareous sandstone at several different localities. There is considerable difficulty in freeing the specimens from the matrix rock, and there is some indication that when fully mature the test does not present the radially ribbed appearance shown in the photographs, but is coarsely nodose; positive assurance that this is true can not be given because the sand grains adhere tenaciously to the exterior surface.

In 1924 Vaughan[25] listed nine species of *Nummulites* which had been recorded from America, and of these he referred all to other genera except *N. parvula* Cushman,[26] from the Eocene of St. Bartholomew, West Indies.

---

[25] American and European Tertiary larger Foraminifera. Bull. Geol. Soc. America, Vol. 35, p. 787.

[26] Carnegie Inst. Publ. 291, 1919, p. 51, pl. 4, fig. 3.

PLATE 1

Figs. 1, 2. *Akera bolivarensis* Anderson, new species; natural size; holotype, No. 2687 (C. A. S. type coll.), from Horizon "F", six miles west of El Carmen, Bolivar. Eocene; p. 18.

Figs. 3, 4. *Surcula (Drillia) carmenensis* Anderson, new species; natural size; holotype, No. 2688 (C. A. S. type coll.), from same locality as fig. 1; p. 20.

Fig. 5. *Athleta (Volutospina) caracoli* Anderson, new species; natural size; syntype, No. 2689 (C. A. S. type coll.), from same locality as fig. 1; p. 19.

Fig. 6. *Amauropsis perovata* (Conrad); natural size; plesiotype, No. 2691 (C. A. S. type coll.); from same locality as fig. 1; p. 18.

Figs. 7, 8. *Volupia bolivarensis* Anderson, new species; natural size; holotype, No. 2692 (C. A. S. type coll.); from same locality as fig. 1; p. 22.

Fig. 9. *Glycymeris caracoli* Anderson, new species; natural size; holotype, No. 2694 (C. A. S. type coll.); from same locality as fig. 1; p. 21.

Fig. 10. *Aturia colombiana* Anderson, new species; natural size; holotype, No. 2697 (C. A. S. type coll.), from Horizon "F," six miles southwest of El Carmen, Bolivar. Eocene; p. 17.

Figs. 11, 12, 13, 14. *Corbula hettneri* Anderson, new species; natural size; syntypes, No. 2698 and 2699 (C. A. S. type coll.), from Guaduas beds near San Juan de Rio Seco, upper valley of the Rio Magdalena. Fig. 11, posterior view, showing truncation, and fig. 12 showing exterior view of syntype No. 2698; fig. 13, exterior view of syntype No. 2699; fig. 14 same specimen, showing hinge. Eocene; p. 24.

Fig. 15. *Corbula cebada* Anderson, new species; X 3; holotype, No. 2706 (C. A. S. type coll.), from same locality as fig. 11. Figure shows form and sculpture of left valve. Eocene; p. 24.

Figs. 16, 17, 18. *Corbula scheibei* Anderson, new species; syntypes, No. 2716 and 2717 (C. A. S. type coll.), same locality as fig. 11. Fig. 16, syntype, No. 2716, X 3, shows hinge; fig. 17, exterior view of same specimen, X 1.5; fig. 18, syntype, No. 2717, view from above, natural size. Eocene; p. 25.

Figs. 19, 20. *Ampullaria guaduasensis* Anderson, new species; natural size; holotype, No. 2721 (C. A. S. type coll.), same locality as fig. 11. p. 23.

Figs. 21, 22. *Melanella karsteni* Anderson, new species; fig. 21 X 1.5; fig. 22 X 1; holotype No. 2722 (C. A. S. type coll.), from same locality as fig. 11. p. 23.

Fig. 23. *Nummulites carmenensis* Anderson, new species; X 7.5; paratype, No. 2510 (C. A. S. type coll.), from same locality as fig. 1. p. 26.

Fig. 24. *Nummulites carmenensis* Anderson, new species; X 7.5; holotype, No. 2509 (C. A. S. type coll.), from same locality as fig. 1. p. 26.


1
2
3
4
5
6
9
7
25
8
10
24
11
12
16
13
14
15
17
19
20
21
22
18

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 2, pp. 31-65, 34 text figures JUNE 22, 1928

II

NEW MYCETOPHILIDÆ TAKEN IN CALIFORNIA AND ALASKA

BY

M. C. VAN DUZEE

Buffalo, N. Y.

During the fore part of 1926 it was my privilege to study the fungus gnats in the collection of the California Academy of Sciences and to describe a few new forms from that material. I lodged most of February, March, April and part of May at Mill Valley, Marin County, California, and while there, took about 600 specimens of these little flies. Among these were 32 species which seem to be new; these are described in this paper. Most of the species before known to occur in California were also found in the material studied.

The drawings were made from dried specimens, therefore the hypopygial characters are not as exact as they would be from mounted slides, but I think it will be found that in almost, if not all, cases, where drawings were made, they are accurate enough to make the species readily recognizable and the determination certain.

It is with this hope that I offer this contribution to our knowledge of the Pacific Coast Mycetophilidæ.

June 22, 1928

1. **Bolitophila dubiosa** Van Duzee, new species

Male: Length 4.5 mm. Head, including face, brown with gray pollen; proboscis pointed at tip, nearly as long as face; palpi and antennæ brown, scape and part of first joint of flagellum of antennæ yellow; antennæ about as long as thorax and abdomen taken together. Thorax brown, subshining, with scutellum, edges of mesonotum and humeri yellow. Abdomen brown with posterior margins of segments and the hypopygium darker brown. Coxæ yellow with yellowish hairs and bristles; femora yellowish brown, tibiæ and tarsi brown; first joint of fore tarsi about same length as their tibiæ, remaining joints of fore tarsi slightly stouter than first and, taken together, about one-third as long; halteres brown. Wings grayish with the stigma brownish; subcosta nearly straight and slightly oblique, ending in the costa just before base of radial sector; R_{2+3} ending in radius at point where radius turns to join the costa; petiole of media scarcely as long as R-M crossvein; the M-Cu crossvein at about basal third of basal cell (cell R); anterior branch of cubitus coalescing for a very short distance with the media; posterior branch curving abruptly to meet wing margin about the length of base of radial sector beyond tip of first anal vein.

Female: Antennæ a little more than half length of abdomen; pleuræ yellow; abdomen paler brown than in male; fore tibiæ and basitarsi of nearly equal length, shorter than in male; last four joints of fore tarsi compressed, widened in middle, so as to be evenly rounded below from base to tip of each joint; venation as in the male except that the petiole of the media is as long as the R-M crossvein, and the posterior branch of the cubitus ends closer to end of first anal vein, being about length of the R-M crossvein beyond anal vein.

Type: Male, No. 2476, Mus. Calif. Acad. Sci., taken by the author, March 20, 1926, at **Mill Valley, Marin Co., California.** *Allotype,* female, in the author's collection, taken at same time and place as type.

Bolitophila dubiosa is something like *patulosa* Garrett, but differs in having the vein R_{2+3} straight, not curved, and, as I understand it, the hypopygial appendages differ, all the appendages in this form being very short and in the type mostly concealed, the hypopygium forming a nearly round tip to the abdomen.

2. **Apemon rufa** Van Duzee, new species

Female: Length 10 mm.; of wing 8 mm. Front, upper third of face, occiput and antennæ black; first two antennal joints, and lower two-thirds of face dark reddish; palpi, thorax, abdomen, coxæ, femora, tibial spurs and halteres yellow or reddish yellow; fore tibiæ yellowish brown, middle and hind tibiæ and all tarsi more brown; a narrow line on lateral edges of mesonotum, sutures of pleuræ, most of sternum, posterior face of metanotum, a dot at tip of each trochanter, and narrow hind margin of first abdominal segment, shining black; a brown spot on mesonotum, forming in one specimen three poorly defined vittæ; prothorax black with a reddish spot in front of humeri; hairs on thorax and abdomen short and yellow; first and second abdominal segments each about twice as long as their width at apex; claws small, black, with a small basal tooth and two very minute ones in middle; fore basitarsi to their tibiæ as 4 to 4.5. Wings strongly tinged with yellow; veins black, base of all veins and whole of subcostal vein yellow; subcosta ending on the costa at fully half length of basal section of radial sector beyond its base; humeral crossvein, petiole of media and R_{2+3} of about equal length, the latter a little oblique and ending 2½ times its length from tip of R_1; a narrow dark brown cloud covers basal two-thirds of basal section of radial sector; a brown crossband from the costa, reaching tip of R_1, extends back to middle of cell M_{1+2} but leaves base of the cell clear; a narrow cloud along basal part of M_3 vein; a lighter cloud at apex of wing extending from tip of R_{4+5} to tip of Cu_1.

Male: Length 8-11 mm. The allotype has the pleuræ, including the whole of prothorax, scutellum and whole of first basal segment black; hypopygium as figured by Dr. Johannsen in Bulletin 172, 1909, figure 97 and wing as figure 88; abdomen with sides of apical segments yellow.

Color of female differs somewhat, the pleuræ in one female being much darker and first abdominal segment mostly black. Described from three females and three males.

Type: Female, No. 2477, Mus. Calif. Acad. Sci., taken by E. P. Van Duzee, April 18, 1925, at **Mill Valley, Marin Co., California.** *Allotype,* male, No. 2478, taken by E. C. Van Dyke June 10, 1920, at Yosemite Valley, California. *Paratypes,* one male taken by M. C. Van Duzee, April 11, 1926, at Mill Valley, California; one male taken by E. P. Van Duzee, April 26, 1924, at Lagunitas, Marin Co., California; two females taken by J. A. Kusche, April 30, 1910, at Sobre Vista, Sonoma Co., California, and one female taken by E. C. Van Dyke, July 10, 1920, at North Bend, King Co., Washington.

This is the same as the males Dr. Johannsen had from Nevada that he thought might be the male of *pectoralis* Coquillett, but as we now have three females agreeing with these males in having the subcosta extending beyond the base of the radial sector and all without variation in this character, there seems to be no doubt that it is distinct.

3. **Platyura angustata** Van Duzee, new species

Male: Length 5 mm. Head, thorax and abdomen black, subshining; last four abdominal segments with yellow hind margins; on third, fourth and fifth segments the yellow is wide; humeri and base of wings yellow. Hypopygium (fig. 1) black, (the drawing shows only one of the claspers, which ends in a curved, slightly flattened spur); coxæ and femora yellow; tibiæ brownish yellow, tarsi brown; hairs on fore coxæ black, small, those at tip not much longer; all hair on thorax and abdomen black; claws with a long, sharp-pointed tooth near base; fore basitarsus nearly .88 as long as their tibia, the latter being as 89; joints of fore tarsi as 78-71-47-35-20; of middle ones as 140-51-34-23-18; joints of posterior pair as 121-54-33-25-20. Wings dark gray, tinged with brown, the apex from a little beyond R_{2+3} brownish, more conspicuously so towards the costa; R_{2+3} short and a little oblique; sections of the subcosta somewhat equal; subcostal crossvein twice, and tip of subcosta once, the width of the basal cell proximad of base of radial sector; the latter reaching the costa far before apex of wing; anterior branch of media ending in apex of wing; coalesced part of media as 19, petiole of media as 26. Knob of halteres black.

Female with three distinct black stripes on mesonotum and yellow lines between them; knobs of halteres black as in male, but varying to yellowish brown.

Type: Male, No. 2479, and *allotype*, female, No. 2480, Mus. Calif. Acad. Sci., taken by the author, April 5 and 17, 1926, at **Mill Valley, Marin Co., California.** Fourteen *paratypes* were also taken at same place in April, 1926.

Platyura angustata is very nearly like *scapularis* Johannsen. It varies much in amount of yellow on abdomen; coalesced part of media either a little shorter or even longer than petiole of media and the subcostal crossvein may be either a little before or distinctly beyond middle of subcosta, but differing from *scapularis* in having a longer and more curved spur at tip of claspers; knob of halteres black.

4. **Platyura nigribarba** Van Duzee, new species

Male: Length 5.2 mm.; of wing 4.7 mm. Head, antennæ and hairs of head and eyes, black. Antennæ distinctly flattened, intermediate joints about as long as wide. Thorax, knobs of halteres and abdomen black, the latter subshining; humeri and narrow hind margin of abdominal segments, widest on third and fourth, yellow; hairs on mesonotum black, those on sides long and dense, those on dorsum minute; scutellum with about eight slender, hair-like bristles on margin; hypopygium, its appendages and their hairs, black; claspers horn-like, stout, a little bent, with a hair at their middle on concave side.

Type: Male, No. 2481, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 5, 1924, at **Mill Valley, Marin Co., California.**

5. **Platyura equalis** Van Duzee, new species

Female: Length 6 mm.; of wing 5.2 mm. Head, mouth parts, thorax, abdomen, and legs yellow, tarsi a little darker; antennæ, except basal two joints, front, except just above the antennæ, and narrow subbasal cross-bands on second to sixth abdominal segments, black; abdominal cross-bands nearly interrupted on dorsum; knobs of halteres brown; four slender bristle-like hairs on margin of scutellum and several on its disk. Intermediate antennal joints slightly longer than wide; tibial spurs black; first joint of fore tarsi .7, second nearly .6 as long as their tibia; claws with a short tooth at base. Wings yellowish with a light brownish cloud at tip of radial sector; R_{2+3} short, slightly oblique, ending in the costa; distance of its tip from R_1, coalesced part of media, petiole of media, and basal part of radial sector equal; anal vein scarcely reaching the wing margin.

Type: Female, No. 2482, Mus. Calif. Acad. Sci., taken by E. P. Van Duzee, June 11, 1925, at **Corvallis, Oregon.**

6. **Macrocera clavinervis** Van Duzee, new species

Male: Length 6 mm.; of wing the same. Antennæ 12 mm. long, yellow, becoming brownish towards tip; head yellow, vertex brown; face with a few black hairs on lower edge; thorax yellow, three stripes on mesonotum, a spot on the pleuræ at root of wing, lower part of pleuræ, scutellum and center of metanotum, brown; abdomen yellow, more or less blackened at base, last two segments wholly black; hypopygium black, basal joint of claspers yellowish, apical joint brown with black teeth; hairs on thorax, abdomen and hypopygium black. Coxæ, femora, tibiæ and halteres yellow with black hair; tarsi brownish; hind coxæ with long black hairs on posterior surface; first joint of fore tarsi .75, second joint .50 as long as their tibia. Wings grayish; tip of subcosta not reaching as far as coalesced part of radial sector and media; this coalesced portion of equal length with petiole of media; tip of R_1 thickened, yellowish; R_{2+3} about half as long as the base of radial sector, its base opposite the tip of R_1.

Type: Male, No. 2483, Mus. Calif. Acad. Sci., taken by E. P. Van Duzee, July 7, 1919, at **Huntington Lake, Fresno Co., California.** *Paratype,* one male taken July 10, at same place.

7. **Macrocera hirtipennis** Van Duzee, new species

Male: Length 5 mm.; of wing the same. Head brown; face yellowish; antennæ yellow at base, becoming brown towards tip, more than 7 mm. long. Thorax reddish yellow with slight indications of three reddish stripes, its hair and bristles black; abdomen yellowish, posterior margin of segments black, one or two of apical segments almost wholly black. Claspers brown with two black claws at tip, formed about as usual in the genus. Coxæ, femora and tibiæ yellow; tips of middle and hind coxæ, of hind femora and of middle and hind tibiæ brown; tarsi brownish; fore metatarsi .75 as long, second joint nearly .50 as long as their tibiæ, the tibiæ being as 102, the joints of fore tarsi as 78-48-35-21-14. Knobs of halteres brown, their petiole and base of knob whitish. Wings hairy, more so beyond tip of R_1; anterior branch of cubitus where it joins the M-Cu crossvein nearly interrupted, as is also the radial sector where it starts to coalesce with the media; subcostal vein ending before apex of coalescing of radial sector with the media; R_{2+3} three-fourths as long as basal portion of radial sector including the coalesced part. A brown cloud covers petiole of media, but usually broken and faint, and a brown preapical fascia, sometimes very faint, extending across wing from R_{2+3}.

Female: Abdomen blackish with posterior margins of segments yellow; occiput yellow, vertex brown; wings with small brown clouds between the radial sector and base of media; clouds over petiole of media and preapical fascia distinct, although faint. Sometimes a very faint cloud at tip of wing.

Type: Male, No. 2484, and *allotype,* female, No. 2485, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 2, 1919, at **Santa Cruz, California.** *Paratypes,* seven males and females taken with the type; one male taken by the author at **Mill** Valley, April 8, 1926, and a pair taken by the author at Berkeley, California, May 16 and 20, 1915.

Hirtipennis is very much like *hirtus* Loew, but in that species the fore tibiæ are as 120 and the joints of fore tarsi as 100-55-20-14-11, making the basitarsus of the new form about .76 as long as their tibia, while in *hirtus* the basitarsus is .83 as long as their tibia.

8. **Tetragoneura longicauda** Van Duzee, new species

Male: Length 3.5 mm. Head, face and antennæ brown, scape of antennæ and palpi yellow; antennæ as long as abdomen, its hair long. Thorax yellow, pleuræ sometimes infuscated; mesonotum with three coalesced black stripes; scutellum reddish yellow with base black. Abdomen black, with long, scattering, yellowish hairs. Hypopygium (fig. 2) large, yellow, the long claspers partly infuscated. Halteres, coxæ and femora yellow; coxæ with yellow hair; tibiæ yellowish brown, trochanters and tarsi brown; fore tibiæ as 109; joints of fore tarsi as 101-46-25-14-12; joints of hind tarsi as 84-32-21-18-10. Wings nearly hyaline; cell R_1 very small, about as long as wide, placed beyond middle of wing; subcostal vein running very close to the radius and ending in it at a little more than half length of basal cell; petiole of media and R-M crossvein of nearly equal length, the former in nearly same line as R_{4+5}; costa extending beyond tip of R_{4+5} nearly half distance to tip of first branch of media; cubitus forking just before proximad end of R-M crossvein; anal veins distinct, quite long.

Female like the male except that cell R_1 is a little longer than wide, the antennæ a little shorter and abdomen more brown or reddish brown; ovipositor yellow.

Type: Male, No. 2486, and *allotype,* female, No. 2487, Mus. Calif. Acad. Sci., taken by the author March 13, 1926, at **Mill Valley, Marin Co., California.** *Paratypes,* one pair taken with the types.

This form differs from most species of the genus in having the anal veins conspicuous but not reaching the wing margin, the male forceps long and the tibiæ nearly bare, the setæ of posterior tibiæ being very minute, but I see no reason to separate it from the genus.

9. **Sciophila nitida** Van Duzee, new species

Male: Length 4 mm.; of wing 4.2 mm. Head, thorax, scutellum, abdomen and hypopygium black, quite shining; hairs on front, face, thorax, abdomen, halteres, coxæ and femora yellowish white, those on sides of mesonotum, margin of scutellum, sides and apical segments of abdomen long; hairs on upper part of sides of hypopygium long and deep black; antennæ black, scape yellow, intermediate joints twice as long as wide; coxæ, femora, tibiæ and tibial spurs yellow; tarsi yellowish at base, becoming brown apically; hypopygium large, its claspers small, yellowish with long black hair; inferior claspers with one long blunt bristle. Fore tibiæ without setæ, middle ones with two small ones on lower posterior surface and hind ones with four on upper anterior surface. Wings grayish; four times as long as the fore tibiæ; anterior veins brown, posterior yellow; media forking close to the crossvein; cubitus forking as far beyond the crossvein as length of its posterior branch; Cell R_1 small, square, subcostal crossvein placed near its outer end; subcosta ending in the costa the length of the cell R_1 beyond that cell; anal vein ending just beyond the fork of the cubitus.

Type: Male, No. 2488, Mus. Calif. Acad. Sci., taken by **Mr. C. L. Fox**, July 12, 1923, in the **Giant Forest, Tulare Co., California.**

10. **Mycomya hirticauda** Van Duzee, new species

Male: Length 4 mm. Head and antennæ dark brown; face, palpi, scape and first joint of flagellum yellow; basal joints of flagellum nearly twice as long as wide. Thorax wholly yellow or brownish yellow on dorsum, its hairs and bristles black, but some long hairs on sides more yellowish in certain lights. Abdomen shining black with hind margins of first five segments yellow, yellow margins of third, fourth and fifth segments wide, sixth segment wholly black; hairs on dorsum of abdomen short and yellowish. Hypopygium (fig. 3) brown, its superior claspers long and black with long black hair at tip on inner surface. Coxæ and femora yellow; fore coxæ with quite long black hair; spur of middle coxæ curved, about as long as coxa; all femora with a row of long black hairs below; tibiæ brownish yellow; setæ of posterior pair about as long as their diameter; tarsi brown; fore tibiæ as 84; joints of fore tarsi as 73-60-42-27-18; joints of middle tarsi as 80-48-30-20-16; those of posterior pair as 85-40-24-15-13. Wings with R_{4+5} ending in apex of wing; subcostal vein ending in the costa opposite or beyond distal end of small cell R_1, which is a little longer than wide and faintly tinged with brown; subcostal crossvein entering the small cell R_1 near its middle; petiole of the media 48, M_1 75, and M_2 60 fiftieths of a millimeter long; the cubitus forking distinctly before the R-M crossvein.

Female colored as in male, except that sixth abdominal segment has a narrow yellowish posterior margin; wings as in the male; lamellæ at tip of abdomen yellow. Described from two males and six females taken by the author.

Type: Male, No. 2489, Mus. Calif. Acad. Sci., taken March 6, 1926, *allotype,* female, No. 2490, Mus. Calif. Acad. Sci., taken March 11, 1926, both at **Mill Valley, Marin Co., California.** *Paratypes,* one male and five females taken with the types.

11. **Mycomya fulvitibia** Van Duzee, new species

Male: Length 3.5 mm. Head and antennæ brown; face, palpi, scape and first joint of flagellum yellow. Thorax wholly yellow, including the pleuræ, scutellum and metanotum; rarely with the scutellum brownish and with brownish stripes on dorsum of thorax; hairs of thorax and abdomen yellow; bristles of thorax black. First two abdominal segments yellow with a black spot on dorsum, that on first small; remainder of abdomen black on dorsum and on venter of sixth segment; third, fourth and fifth segments with wide, yellow posterior margins, sixth wholly black. Hypopygium (fig. 4) reddish; two pairs of straight median appendages and pair of long, cruciate bristles are the most striking characters. Coxæ, femora and halteres yellow; fore coxæ with quite long yellow hair; middle coxæ with a straight spur about as long as coxa; hind femora with a row of long yellow hairs below; tibiæ brownish yellow, bristles of posterior pair not as long as diameter of tibia; tarsi dark brown; length of fore tibiæ as 130, joints of fore tarsi as 90-44-25-16-12; joints of posterior tarsi as 90-40 19-6-6. Wings with R_{4+5} ending in the apex; subcostal vein ending in the costa, its crossvein entering the small cell R_1 at about its basal fourth, the small cell four times as long as wide and pointed at middle of its basal end; petiole of media 52, M_1 79 and M_2 65 fiftieths of a millimeter long; the cubitus forking opposite middle of small cell R_1.

Female nearly like male in color, except that sixth segment of abdomen is narrowly yellow on apical margin; lamellæ at tip of abdomen brown; venation of wing as in male except that the subcostal crossvein is at basal third of the small cell R_1.

Type: Male, No. 2491, Mus. Calif. Acad. Sci., taken by the author, March 13, 1926, at **Mill Valley, Marin Co., California.** *Allotype,* female, No. 2492, Mus. Calif. Acad. Sci., taken by author April 25, 1926, at Mill Valley. *Paratypes,* three specimens taken at same time and place as types.

12. **Mycomya nigrihirta** Van Duzee, new species

Male: Length 4.5 mm. Head, including the face, palpi and first four antennal joints yellow, front black in center. Thorax subshining, yellow, with three reddish brown stripes, its bristles and many of the small hairs black; hairs on abdomen yellow. Abdomen subshining yellow, first five segments with a large black spot on the dorsum, which reaches nearly their entire length, but leaves the posterior margin yellow; sixth segment black with a narrow, yellow posterior margin. Hypopygium (fig. 5) yellow, black only at base above; with a pair of long yellow appendages and two long straight bristles. Coxæ, femora and halteres yellow; tibiæ yellowish brown, tarsi brown; middle coxæ with a long, yellow, slender, curved spur, which is nearly as long as the coxa; fore coxæ with long, bristly, black hairs; posterior coxæ with a brown spot on outer surface, their black bristles longer than thickness of coxa; femora with a few long black hairs below; bristles of hind tibiæ about as long as diameter of tibia; length of fore tibiæ as 105; joints of fore tarsi as 93-75-43-28-19; those of middle ones as 103-46-27-19-16; joints of posterior pair as 96-50-29-19-16. R_{4+5} ending in apex of wing; subcostal vein ending in the costa opposite end of its crossvein, which is placed at middle of small cell R_1, this cell being just twice as long as wide; petiole of media 53, M_1 99, M_2 72 fiftieths of a millimeter long; cubitus forking a little before the R-M crossvein.

Type: Male, No. 2493, Mus. Calif. Acad. Sci., taken by the author, May 23, 1915, at **Berkeley, California**; one female, *allotype*, taken at same time and place in collection of the author.

13. **Mycomya californica** Van Duzee, new species

Male: Length 4.5 mm. Head brown; face, palpi and first joint of flagellum yellow, other joints of antennæ brown, basal joints of flagellum twice as long as wide. Thorax yellow with three coalesced, dark brown stripes, which cover most of dorsum; metanotum and a large spot on lower part of pleuræ brown; scutellum yellowish brown with one pair of marginal bristles; hairs on thorax and abdomen yellow, bristles black. Abdomen dark brown with hind margin of third to sixth segments narrowly yellow. Hypopygium (fig. 6) largely yellow (the drawing is partly a side view, the lower projection is yellow with three short hairs at tip, but the position in the figure does not show the character very well). Coxæ yellow, middle and hind pairs with a brown patch on outer surface, their hairs mostly black; spurs of middle coxæ as long as the coxa, slender, curved, pale yellow; femora yellow, middle pair with long hairs below; tibiæ and tarsi brown; posterior tibiæ with very short setæ; fore tibiæ 97, joints of fore tarsi as 109-71-45-24-13; those of middle ones as 104-44-26-14-10; joints of posterior pair as 105-50-26-15-12. Halteres yellow. Wings with R_{4+5} ending in the apex; the subcostal vein ending free, its crossvein near end and placed near middle of small cell R_1 which is three times as long as wide; petiole of media 56, first branch of media 94, second branch 65 fiftieths of a millimeter long; cubitus forking slightly before the R-M crossvein.

Female: One female, probably belonging with this male, agrees with it in wing characters and in having the fore basitarsus a little longer than their tibia.

Type: Male, and *allotype*, female, in the author's collection, taken by him, February 20, 1926, at **Mill Valley, Marin Co., California.**

14. **Mycomya fuscipalpis** Van Duzee, new species

Male: Length 4.2 mm. Head, including face and palpi, blackish brown; antennæ blackish, first joint of scape brownish yellow, second joint and base of flagellum yellow. Thorax blackish brown with brown pollen between the three shining vittæ, the posterior end of these vittæ and the corners of the scutellum whitish; scutellum with one pair of long marginal bristles; hairs of thorax black, those of abdomen more yellowish. Abdomen blackish, shining, hind margins of segments narrowly dark yellow, yellow margins on second and third segments wider than on others. Hypopygium (fig. 7) with a row of blunt spines between lateral flaps or claspers. Halteres yellow. Coxæ brownish yellow with black hair, spurs of middle pair about one-fourth as long as the coxa, hook-like, black at base, apical half yellow; femora yellow; black hairs on lower anterior edge of middle femora about as long as width of femora; fore tibiæ yellow, middle and hind pairs more brown; setæ on posterior tibiæ not as long as their diameter; tarsi dark brown; fore tibiæ as 100; joints of fore tarsi as 81-51-35-23-19; those of middle ones as 84-45-28-19-16; joints of posterior pair as 93-42-27-18-16. R_{4+5} ending in apex of wing; subcostal vein ending in costa beyond middle of small cell R_1, its crossvein being placed at middle of that cell, which is 1.8 times as long as wide; petiole of media five times as long as the R-M crossvein, it being 55, first branch of media 95 and second branch 80 fiftieths of a millimeter long; the cubitus forking a little before the R-M crossvein.

Type: Male, in the author's collection, taken by him March 6, 1926, at **Mill Valley, Marin Co., California.**

15. **Mycomya longispina** Van Duzee, new species

Male: Length 4-4.5 mm. Head brown; face, palpi, first three antennal joints, halteres, coxæ and femora yellow; basal joints of antennal flagellum about twice as long as wide. Thorax yellow or reddish yellow subshining with more or less distinct reddish brown or brown vittæ; scutellum, metanotum and pleuræ reddish yellow; abdomen shining, blackish brown; first five segments with yellow posterior margins; sixth segment wholly black; hairs of thorax and abdomen pale; bristles of thorax black, the four marginal bristles on scutellum yellowish brown. Hypopygium (fig. 8) dark reddish yellow, its most conspicuous character being the long black bristle arising from the terminal tubercle on the claspers and a sharply bent one near the base. Fore coxæ with minute yellow hair, posterior pair a little brown on outer surface and with a few long black bristles; middle coxæ with a slender spur, which is nearly straight, except at tip and as long as the coxa; anterior femora nearly bare below, middle and hind ones with long black hairs below; tibiæ and tarsi brown; setæ of posterior tibiæ very minute; fore tibiæ as 103; joints of fore tarsi as 95-50-31-19-12; those of middle ones as 92-39-23-14-12; joints of posterior pair as 86-34-20-12-10. Wings; R_{4+5} ending in apex of wing; the subcosta ending in the costa opposite end of its crossvein, which is placed before basal third of small cell R_1, and is three times as long as wide; petiole of media 55, first branch of media 81 and second 63 fiftieths of a millimeter long; the cubitus forking beyond the R-M crossvein.

Female almost like male, except that the subcostal vein reaches the costa beyond the tip of its crossvein, which is sometimes placed nearer middle of small cell, and the petiole of the media is a little shorter.

Type: Male, No. 2494, and *allotype,* female, No. 2495, Mus. Calif. Acad. Sci., taken by the author, March 13, 1926, at **Mill Valley, Marin Co., California.** Eleven *paratypes* also were taken by the author at same place between February 27 and March 21.

16. **Mycomya abbreviata** Van Duzee, new species

Male: Length 4-4.5 mm. Head brown; face brown above, its lower three-fourths more or less yellow; palpi, scape of antennæ and basal joint of flagellum pale yellow, remaining joints of flagellum brown, its basal joints about twice as long as wide. Thorax brown with gray pollen, omitting a more shining median vitta, which runs to a point posteriorly; scutellum yellowish brown; metanotum and lower half of pleuræ brown, upper half of pleuræ and large spots on the humeri yellow; hairs and bristles of thorax and abdomen black; abdomen brown above, posterior margins of segments more yellowish; venter and lower portion of sides yellow. Hypopygium (fig. 9) and its appendages mostly black, but with two yellow, projecting organs, seen on right hand of figure; coxæ, femora and halteres yellow; middle and hind coxæ each with a brown spot on outer surface, posterior pair with black bristles as long as their diameter; fore coxæ with small black hairs and black bristles; middle coxæ with a long, slender, curved, whitish spur, which is as long as the coxa; all femora with a row of long black hairs below; setæ of posterior tibiæ shorter than their diameter; tibiæ and tarsi brown; anterior tibiæ as 117; joints of fore tarsi as 138-77-48-28-19; of middle tarsi as 108-55-31-21-16; joints of posterior tarsi as 119-51-30-18-14. R_{4+5} ending in apex of wing; subcosta ending free, its crossvein near the end and placed just before middle of the small cell R_1, which is nearly two and a half times as long as wide; petiole of media 58, anterior branch of media 105, and posterior branch 85, fiftieths of a millimeter long; the cubitus forking under the proximal end of the R-M crossvein.

Female about as in male, but hairs on under side of femora shorter, except on middle ones; the fore basitarsi appear a little longer in proportion to the tibiæ; the thorax is often more yellow with brown vittæ, and the abdominal segments have hind margins distinctly yellow. Described from three males and 10 females.

Type: Male, No. 2496, and *allotype,* female, No. 2497, Mus. Calif. Acad. Sci., taken by the author, March 13, 1926, at **Mill Valley, Marin Co., California;** all *paratypes* were taken same day and place, except one male, which was taken by the author, March 25, 1926, at San Francisco, California.

17. **Trichonta fusciventris** Van Duzee, new species

Length 3 mm. Brownish black; humeri a little yellow; face, palpi, scape of antennæ, fore coxæ and femora, except the extreme tips, yellow; middle and hind coxæ and tibiæ yellowish brown. Hypopygium (fig. 10) large, its claspers with a long bristle at tip, inner surface of outer lobes with a few stout, short, bristles inserted on little conical tubercles; hind coxæ without a basal seta; hind tibiæ without bristles; anterior femora as 22; their tibiæ as 26; joints of anterior tarsi as 21-11-8-5-5. Wings grayish, slightly tinged with brown on apical third; subcostal vein long, running close to R_1 and nearly if not quite uniting with it at tip beyond middle of basal cell; cubitus forking about opposite middle of petiole of media; anal vein ending a little before fork of cubitus; costa ending at or a very little beyond tip of radial sector; setulæ of wings not arranged in distinct rows. Lateral ocelli close to eye margin, middle one minute, placed in a groove near antennæ.

Type: A unique male, in the author's collection, taken by him, March 13, 1926, at **Mill Valley, Marin Co., California.**

18. **Polylepta modesta** Van Duzee, new species

Female: Length 4 mm.; of wing 4.2 mm. Head and face black; palpi brown; antennæ yellowish brown, yellow at base; second joint of scape with a long bristle, intermediate joints three to four times as long as wide; ocelli forming a rather high triangle. Dorsum of thorax yellow with three broad brown stripes; scutellum brown, pleuræ more blackish; abdomen black with rather wide yellowish hind margins to the segments; hairs and bristles of thorax and abdomen black; halteres, fore coxæ, femora and tibiæ yellow, middle and hind coxæ darker; tarsi dark yellowish; fore coxæ with long, black, bristle-like hairs, posterior ones with three black, rather long hairs on apical half of outer surface; trochanters yellow with a black spot below, anterior ones with a black bristle; tibial spurs black, small; fore tibiæ without setæ, those of middle and hind tibiæ very small. Wings grayish; R_{4+5} gently bent back at tip, ending in the apex of wing, the costa not prolonged beyond its tip; small cell R about 1½ times as long as wide, wider in front than posteriorly, both short veins being a little oblique; subcostal crossvein placed at basal third of small cell, the subcosta ending abruptly at crossvein; petiole of media fully as long as its anterior branch; the cubitus forking under base of radial sector, its petiole about equal in length to its anterior branch; anal vein weak, ending nearly under the fork of the cubitus.

Type: Female, No. 2498, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, March 24, 1919, at **Carmel, California.**

19. **Neuratelia flexa** Van Duzee, new species

Male: Length 5 mm. Head dull black; scape of antennæ, lower edge of face and palpi yellow, remainder of antennæ blackish. Thorax and abdomen subshining, black; pleural suture very narrowly yellow, root of wing yellowish; all hairs and bristles of thorax, abdomen and coxæ yellow; hind coxæ with one long and a very short basal seta. Hypopygium black (fig. 11), small, with short claspers. Coxæ and femora yellow, tibiæ darker yellow, tarsi brown; tips of posterior femora above and narrow tips of their tibiæ brownish; fore basitarsus 1.19 times as long as their tibia, the tibiæ being as 95; joints of fore tarsi as 113-64-44-24-15; those of posterior tarsi as 77-54-32-17-10. Halteres yellow with a blackish brown knob. Wings dark grayish; subcostal vein extending about one-third its length beyond the base of radial sector and slightly further than fork of cubitus; base of radial sector and the R-M crossvein of nearly equal length; radial sector much bent, the costa not or scarcely extending beyond its tip; apex of the wing half-way between tip of radial sector and tip of anterior branch of media (about as Dr. Johannsen figures the wing of *silvatica* Johannsen); first anal vein ending quite abruptly, nearly opposite basal third of posterior branch of the cubitus; subcostal crossvein indistinct.

Type: Male, taken by the author, April 21, 1926, at **Mill Valley, Marin Co., California,** in author's collection.

This would run to *silvatica* in Dr. Johannsen's table of species (Fungus Flies of North America, Part iii, p. 262) but differs from that species in the shorter claspers, black knob of the halteres and in having the basi-tarsi less than one-fifth longer than the tibiæ, not one-fourth longer as in *silvatica;* the bend in the radial sector is also slightly less than in that species.

20. **Boletina crassicauda** Van Duzee, new species

Male: Length 5-6 mm.; of wing 5-5.5 mm. Head black; palpi yellow; antennæ black, basal two joints yellow, intermediate joints four times as long as wide. Thorax and abdomen dull black with all hair and bristles yellow and rather long; humeri and halteres yellow, sometimes the posterior edge of several segments of abdomen very narrowly whitish. Hypopygium large, black; claspers long, flattened on basal two-thirds, with many black hairs on edge and pale hairs on outer surface, with a rather sharp bend near tip, on and beyond which there are no hairs. Coxæ, femora and tibiæ yellow; tarsi infuscated; trochanters black; tibial spurs yellow; fore tarsi fully twice as long as their tibiæ, posterior ones a little longer than their tibiæ; claws with a tooth at base. Wings grayish; costa slightly extending beyond tip of R_{4+5}; cubitus forking opposite end of the R-M crossvein; subcostal vein ending in the costa opposite base of radial sector; petiole of media and R-M crossvein of equal length.

Female like male in color and wing characters. Ovipositor yellowish.

Type: Male, No. 2499, and *allotype*, female, No. 2500, Mus. Calif. Acad. Sci., collected by Dr. G. Dallas Hanna, September 10, 1920, at **Unalaska, Alaska.** *Paratypes,* seven males, same data.

Runs to *Boletina nacta* Johnn. in his table of species but differs in form of claspers, and in having the palpi, humeri, and two basal joints of antennæ yellow.

21. **Boletina atra** Van Duzee, new species

Male: Length 3.5-4.5 mm.; of wing 3.5-4 mm. Head, thorax, abdomen and antennæ wholly black and rather dull; hind coxæ, more or less of middle pair, and all trochanters blackish; tarsi and knees brown, the first tarsal joints more yellowish; palpi, a very small spot back of humeri, halteres, fore coxæ, all femora, tibiæ and tibial spurs, yellow; all hairs and bristles, except those on tibiæ and tarsi white or pale yellow. Mesonotum with a little gray pollen, which leaves three broad black stripes, the middle one divided by a gray line; intermediate antennal joints 4½ times as long as wide. Hypopygium large, oval; forceps rather short, rounded in general outline, but divided on inner side into two nearly equal parts, with long hair on outer surface, which is bent so as to follow its curve. Last two joints of posterior tarsi slightly widened; anterior basitarsi eight-elevenths as long as their tibia.

Wings nearly hyaline; veins brown; subcostal vein yellow, ending opposite base of radial sector, its crossvein just before its middle; petiole of media and R-M crossvein of about equal length; cubitus forking opposite proximal end of R-M crossvein; costa extending more than a third of distance from tip of radial sector to anterior branch of media; anal vein reaching as far beyond fork of cubitus as length of R-M crossvein.

Female: Like the male, except that the abdominal segments have narrow yellowish hind margins and the thorax and abdomen are more shining.

Type: Male, No. 2501, and *allotype,* No. 2502, Mus. Calif. Acad. Sci., collected by J. August Kusche, May 15 and 12 respectively, at **Skagway, Alaska.** *Paratypes,* 10 specimens taken by Mr. Kusche at same place from May 6 to 18, 1923, and one taken by Dr. E. C. Van Dyke at Unalaska, July 4, 1907.

22. **Leia nigricornis** Van Duzee, new species

Female: Length 4 mm.; of wing the same. Head and antennæ black, the antennal scape sometimes yellowish; palpi yellow. Thorax and scutellum shining black; abdomen black, subshining; all hairs and bristles of thorax, abdomen and fore coxæ yellow, bristles on posterior edge of mesonotum and scutellum long. Coxæ, femora and tibiæ yellow; tips of posterior coxæ and femora and a line on lower edge of the femora at base black; tarsi brown; fore coxæ with long yellow hair; tibial spurs yellow; first four joints of fore tarsi as 51-28-22-9; joints of middle tarsi as 63-33-29-14-13; halteres yellow. Wings grayish; cubitus forking proximad of basal end of R-M crossvein; petiole of media as 35, R-M crossvein as 52; subcostal vein ending in the costa at middle of basal cell (cell R), its crossvein a little before its tip; base of radial sector short, crossvein-like, placed at right angles to radial sector and half length of R-M crossvein from tip of R_1; a preapical crossband at middle of radial sector, about half as wide at costa as length of apical part of radial sector, narrowing posteriorly and ending at tip of anterior branch of cubitus; with a slight cloud back of posterior branch of cubitus and sometimes one at fork of media.

Type: Female, No. 2503, Mus. Calif. Acad. Sci., taken by G. Dallas Hanna, September 10, 1920, at **Unalaska, Alaska.** One *paratype* was taken at the same time and place.

23. **Docosia defecta** Van Duzee, new species

Female: Length 2.5 mm. Thorax, head and abdomen dark brown; first two joints of antennæ, palpi, halteres, coxæ, femora and tibiæ dusky yellow; tips of femora and tibiæ, tibial spurs and tarsi brown; bristles of thorax small, black; minute hairs on thorax and abdomen pale. Joints of fore tarsi as 42-30-21-15-10; of middle ones as 45-26-17-10-8; those of posterior pair as 50-21-14-10-8. Wings grayish; costa extending fully half the distance from R_{4+5} to M_{1+2}; base of radial sector and petiole of media of equal length; R-M crossvein and forks of media and cubitus about equally distant from root of wing; subcostal vein wholly wanting.

Type: Female, in the author's collection, taken by him February 13, 1926, at **Mill Valley, Marin Co., California.**

24. **Docosia dialata** Van Duzee, new species

Male: Length 3 mm.; of wing 4 mm. Black; palpi and halteres yellow; fore coxæ, femora, tibiæ and their spurs yellowish with more or less infuscation, sometimes posterior legs wholly black; hair of antennæ, thorax, abdomen, legs, and hypopygium white, short and sparse on dorsum of abdomen, but longer on last segment; hypopygium, fore coxæ and venter of fourth segment with long erect, whitish hairs; bristles on sides of mesonotum and margin of scutellum black; hypopygial claspers yellowish; intermediate antennal joints longer than wide. Fore tibiæ as 36, their tarsal joints as 22-9-6-5-8, the joints beginning with second gradually widened, the fifth being 8 long to 6 wide, the last three joints short, petiolate. Wings grayish; posterior veins thin; subcostal vein ending in R_1, a little beyond middle of small cell R; R-M crossvein half as long as distance from base of radial sector to tip of R_1; petiole of media shorter than the R-M crossvein; cubitus forking under fork of media; anal vein represented by a slight fold in wing.

Female wholly black except petiole of halteres; sometimes the palpi and knobs of halteres a little brownish yellow; hairs on abdomen all short and quite abundant; posterior wing veins stronger; fore tarsi plain; fore tibiæ as 49, their tarsal joints as 36-17-15-9-9; otherwise as in the male.

Type: Male, No. 2504, and *allotype*, female, No. 2505, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, April 4, 1920, in **Moraga Valley, Contra Costa County, California.** *Paratypes,* one pair taken with the types and two females taken by the author at Mill Valley, Marin Co., California, March 13, 1926.

25. **Brachypeza brevitibia** Van Duzee, new species

Dark yellowish with three indistinct brown stripes on the mesonotum and more or less distinct saddles on the abdominal segments, apical segments mostly black; head and face black; antennæ wholly yellow, short, stout; basal two joints with black bristles, hairs on remainder white; scutellum black; hairs on the dorsum of thorax small, white, those on the sides and bristles of scutellum black; halteres yellow. Coxæ and femora yellow with minute pale hairs; tibiæ more brownish yellow; tarsi brown; fore femora one-fourth as wide as long; hind femora five times as long as wide; fore basitarsi 1.6, fore tibiæ 1.3 times as long as spur of fore tibia; posterior basitarsi 1.5 times as long as spur of their tibia. Wings grayish, unspotted; cubitus forking a little before the fork of the media; petiole of media half as long as its posterior branch, which does not reach the wing margin.

Type: Female, No. 2506, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 15, 1924, at **Mill Valley, Marin Co., California.**

26. **Rhymosia spinicauda** Van Duzee, new species

Male: Length 4 mm. Head and thorax black, but thickly covered with whitish pollen so as to conceal the ground color when viewed obliquely, this pollen coarse and its scales large; face, palpi, scape of antennæ, pleuræ and humeri yellow; lower edge of pleuræ, scutellum and metanotum blackish. Abdomen black; sides of segments with large yellow triangles posteriorly, which meet on the dorsum and form a narrow hind margin on upper surface of the segments; minute hairs on abdomen pale. Hypopygium (fig. 12) large, yellow, with a pair of rounded black appendages, which are covered with bristles. Coxæ and femora yellow, tibiæ brownish yellow, tarsi brownish black; setæ of posterior tibiæ about as long as diameter of tibia; basal seta of hind coxæ conspicuous; fore tibiæ as 63; joints of fore tarsi as 75-51-40-27-19; joints of middle ones as 82-45-33-21-17; those on posterior pair as 88-35-25-18-14; halteres pale yellow. Wings tinged with yellowish brown; cubitus forking at proximal end of R-M crossvein; subcosta short, ending free; petiole of media as 11, R-M crossvein as 15; first anal vein ending nearly opposite the fork of the cubitus, second anal vein of about same length and nearly parallel with wing margin; radial sector nearly straight, ending in tip of costa before apex of wing.

Type: Male, in the author's collection, taken by him, March 13, 1926, at **Mill Valley, Marin Co., California.**

This species can be recognized by its black thorax covered with coarse white pollen, and the black spiny claspers.

27. **Rhymosia parvicauda** Van Duzee, new species

Head, including face, yellowish brown; palpi and scape of antennæ yellow, remainder of antennæ mostly brown; antennæ 1½ times as long as thorax and head together; thorax including most of the pleuræ, scutellum and metanotum brown; the small hairs on thorax, abdomen and fore coxæ black, but those on abdomen appear more yellowish in certain lights. Abdomen black, second to fifth segments with a broad yellow band at base, which is of nearly equal width on both sides and dorsum of abdomen. Hypopygium (fig. 13) small, yellow; claspers small, black, furcate, there is also a pair of curved, spur-like appendages below; halteres, coxæ and femora yellow, tibiæ and tarsi brown; setæ of posterior tibiæ and basal seta of hind coxæ scarcely as long as diameter of tibia; fore tibiæ as 64; joints of fore tarsi as 67-47-39-28-20, of middle tarsi as 79-44-34-25-17, those of posterior pair as 85-36-24-17-11. Wings dark gray; fork of cubitus a little before the basal end of R-M crossvein; subcostal vein short, ending free; radial sector gently bent backward at tip, ending in tip of costa before apex of wing; first anal vein ending near basal third of posterior branch of the cubitus, second anal vein of nearly equal length; R-M crossvein as 17 and petiole of media as 10.

Female colored as in male and venation about same; fore tibiæ only a little shorter than the fore basitarsi.

Type: Male, No. 2507, Mus. Calif. Acad. Sci., taken by the author March 25, 1926, at **Mill Valley, Marin Co., California**; *allotype,* female, in the author's collection, taken February 21, 1926, at same place. One male *paratype* also was taken by the author, March 1, 1926, at the same location.

This form is easily separated from related species by the wide, yellow, basal bands on the abdominal segments being of equal width throughout, the furcate claspers and the wing characters.

28. **Rhymosia plumosa** Van Duzee, new species

Male: Length 4.5-5.5 mm. Head and thorax reddish yellow, sometimes almost yellow; posterior part of pleuræ with long black hair; small hairs on front, thorax, and fore coxæ black, those on the abdomen mostly pale; palpi yellow; first four joints of antennæ yellow, remainder brown. Abdomen yellow, first five segments with a black, triangular saddle above, which extends along apical margin and reaches beyond middle of segment on dorsal line; sixth segment black. Hypopygium (fig. 14) yellow with three large, yellow, thin appendages; these usually recumbent and not conspicuous as shown in the drawing; there is also a pair of long, slender, hairy appendages above these; below them is another pair of similar appendages (fig. 15) which have a small fork or blunt tooth on the enlarged basal portion, when seen from the side they appear as in figure 16, the fork being concealed. Coxæ and femora yellow, tibiæ and tarsi more brown; middle and hind coxæ with more or less conspicuous brown streaks; bristles of hind tibiæ minute; basal seta of posterior coxæ conspicuous; fore tibiæ as 101; joints of fore tarsi as 119-83-56-35-21; joints of middle ones as 128-70-49-30-22; of posterior pair as 122-52-28-20-15. Knobs of halteres dark brown, petiole whitish. Wings grayish; radial sector bent backward so as to meet tip of costa a little before apex of wing; first anal vein ending abruptly at about middle of posterior branch of cubitus; second anal vein slender, running nearly parallel with hind margin of wing and about ¾ as long as first anal vein; subcostal vein short, ending free; cubitus forking length of petiole of media before proximal end of R-M crossvein; petiole of media as 16, R-M crossvein as 15.

Female almost like the male in color and wing characters.

Type: Male, No. 2508, Mus. Calif. Acad. Sci., taken by the author, March 1, 1926, at **Mill Valley, Marin Co., California**; *allotype,* female, No. 2509, Mus. Calif. Acad. Sci., taken by the author, April 1, 1926, at the same location. Five *paratypes* were taken at same place, between February 20 and April 5, 1926.

29. **Allodia cincta** Van Duzee, new species

Female: Length 2 mm. Fuscus, scape of antennæ, palpi, part of venter, posterior margin of abdominal segments, halteres, coxæ and femora yellow; tibiæ, tibial spurs and tarsi brownish yellow. Scutellum with one pair of bristles; hind coxæ with one yellowish basal seta. Fore coxæ as 14, femora 15, tibiæ 15 and the joints of fore tarsi as 12-8-6-4-4. Wings grayish; cubitus forking slightly proximad of the basal end of the R-M crossvein.

Type in the author's collection, taken by him, May 22, 1915, at **San Francisco, California.**

This species would run to the unnamed species No. 11 in O. A. Johannsen's Fungus Flies of North America, part iii, p. 320 and it probably is that species, although it is much smaller than was his specimen.

30. **Allodia hirticauda** Van Duzee, new species

Male: Length 4-4.5 mm. Head black; face yellowish; palpi and scape of antennæ yellow, first four joints beyond scape yellow below. Dorsum of thorax brown, front edge, especially at humeri yellow; propleuræ yellow with four black bristles above each fore coxa; a yellow spot below wing; scutellum with four marginal bristles. Abdomen black, venter of first four segments, hind margins of first five segments, and most of genitalia yellow. Coxæ and femora yellow, middle and hind femora with a brown spot below at base and with their tips more or less brown; posterior coxæ with a black streak at tip; all trochanters with a black spot below; tarsi blackened almost to their base; fore coxæ as 25, femora 30, tibiæ 28 and the joints of fore tarsi as 30-23-18-13-7. Halteres yellow. Wings tinged with brown; petiole of media slightly longer than R-M crossvein; cubitus forking just before the fork of the media; subcostal vein short, straight, ending free. Lower claspers of hypopygium (fig. 17) hairy to their tips, where the hair is longest.

The female has the fore tibia as 26, joints of fore tarsi as 23-17-13-10-8; antennæ wholly brown, except the scape; basal joints of the flagellum much widened.

Type: Male, No. 2510, and *allotype,* female, No. 2511, Mus. Calif. Acad. Sci., taken by the author, March 6, 1926, at **Mill Valley, Marin Co., California.** The author also took one *paratype* at same place March 13 and one at Berkeley, Calif., May 28, 1915.

This is colored like *Allodia crassicornis* Stannius, but differs in having the lower claspers with long hair at their tips, in *crassicornis* these claspers are bare for a short distance at the tip.

31. **Phronia basalis** Van Duzee, new species

Male: Length 3 mm. Head and antennæ brown, antennal scape, face and palpi yellow; third antennal joint scarcely twice as long as wide. Thorax brown, humeri and prothorax yellow. Abdomen black, basal segments largely yellow on sides; last segment and hypopygium yellowish brown; all hairs of thorax, abdomen and fore coxæ yellow. Hypopygium (fig. 18) small, with small appendages; fore and middle coxæ and all femora and tibiæ yellow, posterior femora and tibiæ conspicuously blackened at tip; tarsi brown; posterior coxæ largely brown, without a basal seta; bristles of hind tibiæ not as long as diameter of tibia; fore tibiæ as 52; joints of fore tarsi as 49-30-18-13-9; those of middle ones as 44-21-15-11-9; first two joints of posterior tarsi as 50-17. Halteres pale yellow. Wings grayish; costa produced but little beyond tip of radial sector; R-M crossvein placed at an angle with radial sector; cubitus forking a little more than half length of its posterior branch beyond fork of media; petiole of cubitus as 70, its anterior branch as 53, and posterior branch as 35; R-M crossvein as 10, petiole of media as 12.

Female: Abdomen black with narrow yellow hind margins to the segments; hind coxæ, tips of middle coxæ and tips of hind femora and tibiæ more blackened than in male.

Type: Male, No. 2512, and *allotype,* female, No. 2513, Mus. Calif. Acad. Sci., taken by the author, March 13, 1926, at **Mill Valley, Marin Co., California.** Three *paratypes,* females, were taken at same time and place as type, and one pair was taken at same place on February 20, 1926.

32. **Phronia flabellata** Van Duzee, new species

Male: Length 3 mm. Head and antennæ brown; scape of antennæ, face and palpi yellow; third joint of antennæ twice as long as wide (measured over the dense hairs). Thorax dark brown, humeri yellow. Abdomen wholly black, somewhat shining; all hairs and bristles of thorax, abdomen and fore coxæ yellow. Hypopygium (fig. 19) black, somewhat globular, its claspers large, black, curved, with long black hair, which gives them a fan-like appearance, and a small protuberance on inner edge. Coxæ, femora and tibiæ yellow; hind coxæ without a basal seta; bristles of hind tibiæ very small; fore tibiæ as 49; joints of fore tarsi as 52-29-21-15-10; those of middle ones as 57-26-18-13-10; joints of posterior pair as 65-22-15-12-9. Halteres pale yellow. Wings grayish; costa scarcely produced beyond tip of radial sector; R-M crossvein placed at an angle with radial sector; hairs on radius and radial sector very small; cubitus forking distinctly less than length of its posterior branch beyond fork of media; petiole of cubitus as 88, its anterior branch as 55 and its posterior branch as 37; petiole of media as 12, crossvein as 9.

Female colored as in the male, except that the extreme tips of posterior femora and tibiæ are brownish; abdomen black with extreme tip yellow; venation about as in the male.

Type: Male, No. 2514, and *allotype*, female, No. 2515, Mus. Calif. Acad. Sci., taken by the author, March 13, 1926, at **Mill Valley, Marin Co., California.** Two *paratypes*, males, were taken at same time and place.

This is very much like the western species described by Dr. Johannsen as *venusta*, but it differs from his figure in having the hair on the claspers much longer, nor does his figure show the projection on the side that is found in this form; the fore basitarsus in that species is also shorter than its tibia, while in this species it is longer than the tibia. *P. fusciventris* n. sp., described here, is also very much like these in color, having the abdomen wholly black, but that species differs very much in the form of the claspers, and has the tips of both hind femora and tibiæ conspicuously black and hind coxæ partly black.

33. **Phronia fusciventris** Van Duzee, new species

Male: Length 3 mm. Head, thorax and abdomen black or blackish; antennæ brown, antennal scape, face and palpi yellowish brown; all hairs on thorax, abdomen and fore coxæ yellow, humeri yellow. Hypopygium (fig. 20) black, its appendages yellowish brown, upper pair long, curved, and fringed on outer surface with long curved hairs. Coxæ yellow; hind pair infuscated on the posterior disc, middle ones slightly infuscated at tip; femora and tibiæ yellow; posterior femora and tibiæ considerably blackened; hind coxæ without a basal seta; bristles of posterior tibiæ not as long as diameter of tibia; fore tibiæ as 49; joints of fore tarsi as 42-22-16-10-11; those of middle ones as 43-19-15-11-8; joints of posterior pair as 56-17-13-9-9. Halteres pale yellow. Wings dark grayish; R-M crossvein placed at a small angle with the radial sector, not in the same line; radius and radial sector long, haired nearly to their tips; cubitus forking a little more than length of its posterior branch beyond fork of media; petiole of cubitus as 80, its anterior branch as 43, and its posterior branch as 28; R-M crossvein as 10, petiole of media the same; costa projecting only a little beyond tip of radial sector.

Female like the male except that the petiole of the cubitus seems shorter. Abdomen wholly black, even its tip being black; middle and hind coxæ largely black and bristles on the scutellum black. Described from a single pair.

Type: Male, and *allotype*, female, taken by the author, March 13, 1926, at **Mill Valley, Marin Co., California,** in author's collection.

This form will be readily recognized by its wholly black, somewhat shining, abdomen and the long slender curved claspers.

34. **Exechia unicolor** Van Duzee, new species

Male: Length 3.7 mm. Black with yellowish brown legs, brown tarsi and yellow halteres. Hairs on the head, eyes and thorax black, those on abdomen long and yellow. Claspers yellow, longer than hypopygial segment, with a rather long thumb-like fork near base; their hairs mostly black, but those at tip yellow; head, thorax, and scutellum with brown pollen; fore coxæ with long black hairs on outer surface; setæ of posterior tibiæ short, hair-like; fore tibiæ as 47, tarsal joints as 45-27-26-15-13. Wings very slightly tinged with brown, veins dark brown; basal section of the radial sector very short, not much longer than broad; media forking near the middle of the R-M crossvein; petiole of cubitus about twice as long as its anterior branch.

Type: Male, No. 2516, Mus. Calif. Acad. Sci., collected by Mr. A. Christoferson in July, 1923, on **St. Paul Island, Alaska.** *Paratype,* one male, same data.

35. **Exechia borealis** Van Duzee, new species

Male: Length 3 mm.; of wing 2.3 mm. Head, face, scutellum, black; mesonotum and pleuræ largely black; humeri, lateral edges of mesonotum, venter of first four abdominal segments, a triangular spot on sides of second to fourth segments at posterior margin, hypopygium, halteres, first three antennal joints, palpi, coxæ, femora and tibiæ, yellow; tarsi yellowish brown; antennæ, except three basal joints, brown, their intermediate joints one-third longer than wide; fore basitarsi to tibiæ as 26 to 31. Wings grayish; Media forking opposite distal third of R-M crossvein; cubitus forking proximad of basal end of R-M crossvein; hairs of thorax, abdomen and fore coxæ white or pale yellow, those of legs black. Described from two males.

Type: Male, No. 2517, Mus. Calif. Acad. Sci., taken by J. A. Kusche, May 15, 1923, at **Skagway, Alaska.** One *paratype* taken at the same place and time.

36. Exechia æqualis Van Duzee, new species

Male: Length 3 mm. Head, face and antennæ brown, scape of antennæ yellow; palpi yellowish brown. Thorax, pleuræ and abdomen brown, a small spot at the humeri yellow; minute hairs on thorax and abdomen yellow. Hypopygium (fig. 21) brown, appendages mostly yellow, armed with a pair of long hairy appendages which have a smooth blunt tip, and with one or two pairs of smooth, short, curved inner appendages. Halteres, coxæ and femora yellow. Tibiæ more or less brown, lower surface of fore and hind pairs yellow; tarsi brown; fore coxæ with very minute yellow hairs on anterior surface and black hairs on outer edge; bristles on posterior tibiæ scarcely as long as diameter of tibia; fore tibia as 49; joints of fore tarsi as 50-34-24-16-10; of middle ones as 55-31-22-16-12; joints of posterior pair as 58-27-19-13-10. Wings grayish; sections of radius as 49 to 73; radial sector only a little bent back at tip; petiole of media 8, R-M crossvein 17; petiole of cubitus 75, anterior branch of cubitus 56 and posterior branch 40 fiftieths of a millimeter long; cubitus forking far beyond base of R-M crossvein.

A female that seems to belong here has the palpi yellow and the petiole of the media and R-M crossvein nearly equal in length, otherwise it is about as in the male.

Type: Male, and *allotype,* female, in the author's collection, taken by him at **Mill Valley, Marin Co., California**; the type February 21, the allotype March 20, 1926.

This is a small brown species with very long claspers, the fore tibia and basitarsus of nearly equal length, and the cubitus forking considerably beyond the distal end of R-M crossvein.

37. Exechia noctivagus Van Duzee, new species

Male: Length 4 mm. Head, face and antennæ brown, scape of antennæ, and palpi yellow. Thorax, including most of pleuræ, brown; humeri yellow; small hairs of thorax and abdomen yellow. Abdomen black with yellow triangles on sides of segments at posterior margin; those on second and third segments largest; those on apical segments reduced to narrow line. Hypopygium (fig. 22) brownish, with two pairs of long, blunt appendages, of nearly equal size. Halteres, coxæ and femora yellow, tips of middle and hind femora brownish; tibiæ and tarsi brown; bristles of posterior tibiæ scarcely as long as their diameter; fore tibia as 55; joints of fore tarsi as 75-43-31-22-16, of middle ones as 72-41-31-21-12, those of posterior pair as 79-34-22-16-11. Wings grayish, costal cell tinged with brown; sections of radius as 50 to 75; petiole of media 7, R-M crossvein 13, petiole of cubitus 65, anterior branch of cubitus 65 and posterior branch 45, fiftieths of a millimeter long; cubitus forking a little beyond distal end of R-M crossvein.

Type: Male, No. 2518, Mus. Calif. Acad. Sci., taken by the author, February 13, 1926, at **Mill Valley, Marin Co., California.** Two male *paratypes* also were taken at same place on April 3 and 8, 1926.

38. **Exechia brevipetiolata** Van Duzee, new species

Male: Length 3.2 mm. Head brown, face yellowish brown; scape of antennæ and palpi yellow. Thorax brown, humeri yellow, pleuræ mostly yellowish; outer corners of scutellum a little yellowish. Abdomen black, base of first five segments yellow; small hairs on abdomen pale. Hypopygium (fig. 23) yellow, its forked appendages blackish. Halteres, coxæ and femora yellow, extreme tips of coxæ and femora brownish; tibiæ and tarsi brown; bristles of posterior tibiæ not as long as diameter of tibia; hairs and bristles of fore coxæ black; fore tibiæ as 62; joints of fore tarsi as 63-45-37-27-18; of middle ones as 76-42-30-21-16; those of posterior pair as 83-32-21-15-11. Wings grayish; sections of radius as 69 to 78; radial sector considerably bent back at tip; petiole of media 8, R-M crossvein 20, petiole of cubitus 39, anterior branch of cubitus 100, and posterior branch 78, fiftieths of a millimeter long; fork of the cubitus opposite the proximal end of R-M crossvein.

Type: A unique male, in the author's collection, taken by him February 20, 1926, at **Mill Valley, Marin Co., California.**

The pair of forked hypopygial appendages, nearly equal fore tibia and basitarsus, and the cubitus forking nearly opposite the R-M crossvein, distinguish this species from those related to it.

39. **Exechia cincinnata** Johannsen

I found this species abundant at Mill Valley, Marin Co., California, from February to May, 1926. The specimens were more distinctly black and yellow than those I had taken in the east and the measurements of the tarsal joints are perhaps slightly different; still I feel no doubt of the determination. The hypopygium (fig. 24) and its appendages is the same as in eastern specimens; the fore tibia of the California specimens are as 55, joints of their tarsi as 54-38-33-24-14; those of middle ones as 60-36-30-21-13, and of posterior pair as 68-29-23-16-10; petiole of cubitus as 74, its anterior branch as 67, posterior branch as 38; petiole of media as 7, R-M crossvein as 15.

40. **Exechia angustata** Van Duzee, new species

Male: Length 5 mm. Head and face brown; palpi and first three antennal joints yellow, remaining joints of antennæ brown or brownish yellow. Thorax brown or yellowish brown, pleuræ more yellow; small hairs on thorax and abdomen yellow, bristles black. Abdomen black or brown, posterior margin of first five segments yellow, the yellow widest on fourth segment. Hypopygium (fig. 25) large, yellow, its appendages mostly blackish; lower appendages slender, the tip, which is a little enlarged, with small bristles or spines on inner surface, and long hairs nearly to their tips; knobs of halteres a little brownish. Coxæ, femora and tibiæ yellow, posterior tibiæ more brownish towards their tips, their setæ not as long as the diameter of tibia; basal seta of hind coxæ black; fore coxæ with pale hair, the long bristly hairs on outer edge of apical half appear black in certain lights, but yellow when seen against a dark background; tarsi brown, slender; fore tibia as 64; joints of fore tarsi as 87-66-38-25-15; those of middle ones as 85-48-32-22-15; joints of posterior pair as 78-36-22-14-9; fore basitarsus nearly 1¼ times as long as its tibia. Wings slightly grayish, veins yellowish brown; costal cell slightly tinged with brown; sections of radius as 61 to 86; R-M crossvein 15, petiole of media 9, petiole of cubitus 73, posterior branch of cubitus 55, fiftieths of a millimeter long; fork of the cubitus a little beyond the proximal end of the R-M crossvein; radial sector considerably bent so as to approach the anterior branch of the media at tip, being most widely separated from media at tip of the radius.

Female like the male in color and wing characters; last abdominal segment yellow, the minute lamellæ at tip brown with long black hair; all segments of abdomen with yellow hind margins.

Type: Male, No. 2519, Mus. Calif. Acad. Sci., taken by the author February 20, 1926, at **Mill Valley, Marin Co., California**; *allotype*, female, No. 2520, Mus. Calif. Acad. Sci., taken March 13, 1926, at same place. Three male *paratypes* also were taken by the author at the same place, February 20 and 25, and March 1, 1926.

This is something like *nugax* Johannsen, but differs in having the lower appendages of the hypopygium hairy and the inner appendages very much shorter; the fore basitarsi are also longer in proportion to their tibiæ.

41. **Exechia umbrosa** Van Duzee, new species

Male: Length 4 mm. Head and face brown; palpi more yellow; antennæ brown with the scape yellow. Thorax brown, humeri yellow; pleuræ more yellowish brown. Abdomen dark brown, its hairs pale; posterior margin of some or all of the segments yellow on the sides, in the type the abdomen is almost wholly brown; hypopygium (fig. 26) brown. Halteres and coxæ yellow, the latter with extreme tip brown; anterior coxæ with black hair; posterior pair with a black basal seta; femora yellowish, more or less brown at base and tip; posterior tibiæ yellowish, their bristles about half as long as diameter of tibia; fore and middle tibiæ brown; fore basitarsus 1.34 times as long as its tibia, the fore tibiæ being as 65; joints of fore tarsi as 86-53-38-25-11; joints of middle ones as 86-48-30-20-14; and of posterior ones as 99-35-23-15-11. Wings gray, costal cell tinged with brown; apical two-thirds of wing dark gray, their color beginning at fork of media and cubitus, and including a paler spot in front of basal portion of media; sections of radius as 60 to 100; petiole of media 9, R-M crossvein 15, petiole of cubitus 75, anterior branch of cubitus 77, and posterior branch 55, fiftieths of a millimeter long; cubitus forking a little beyond distal end of the R-M crossvein; the radial sector considerably bent backward at tip.

Type: Male, No. 2521, Mus. Calif. Acad. Sci., taken by the author, February 7, 1926, at **Mill Valley, Marin Co., California.** One male *paratype* also was taken at same place, March 13, 1926.

42. **Exechia unicincta** Van Duzee, new species

Male: Length 3.4 mm. Head, face and antennæ brown, first three antennal joints and palpi yellow. Thorax brown; pleuræ mostly brown; humeri yellow. Abdomen black; a small spot in lower edge of first segment, and second segment, except the hind margin and a narrow line on middle of dorsum, yellow; small hairs on thorax and abdomen pale. Hypopygium (fig. 27) and its long rounded appendages yellow; venter of first two segments yellow. Halteres, coxæ and femora pale yellow; tibiæ brownish; tarsi brown; hairs on fore coxæ small, yellow, a few on outer edge of apical half black; fore tibia as 61; joints of fore tarsi as 74-44-34-25-14; of middle ones as 76-44-27-21-15; those of posterior pair as 76-30-26-16-10; seta on hind tibiæ fully as long as diameter of tibia. Wings grayish; sections of radius of equal length (72 to 72); petiole of media 10, R-M crossvein 18, petiole of cubitus 85, anterior branch of cubitus 50, and posterior branch 35, fiftieths of a millimeter long; fork of cubitus more than half length of its posterior branch beyond distal end of R-M crossvein; radial sector nearly straight.

Type: Male, in the author's collection, taken by him, February 20, 1926, at **Mill Valley, Marin Co., California.**

This species will be readily recognized by the narrowly broken, yellow band on second abdominal segment, the large, rounded lobes at tip of hypopygium, the equal sections of the radius, and the cubitus forking far beyond the distal end of the R-M crossvein.

43. **Mycetophila bispina** Van Duzee, new species

Male: Length 3-3.5 mm. Head brown; face, palpi and first three joints of antennæ yellow. Thorax brown; large spots on the humeri, a minute one before the scutellum, median stripe and posterior edge of scutellum, yellow; abdomen blackish brown, somewhat shining, narrow hind margin of segments and a median line on first yellow; hairs of thorax and abdomen yellow. Hypopygium (fig. 28) yellow; claspers each with a long and a short bent bristle on inner surface. Coxæ, femora and tibiæ yellow; tips of posterior femora black, sometimes those of middle ones narrowly so; tarsi brown; fore coxæ with pale hair on anterior surface and black hair on outer side; hind femora with long hairs on lower anterior edge, some of which are black; middle tibiæ with two long bristles below; posterior tibiæ with two ranges of large bristles above; joints of fore tarsi as 40-22-18-11-11; those of posterior pair as 62-24-19-12-11. Wings grayish, more yellowish in front; central spot large, dark brown, ending in front at radius; preapical fascia beginning on costa a little beyond tip of R_1 and extending to tip of radial sector, somewhat crescent-shaped, reaching beyond posterior branch of media, but faint and often broken in cell M_1; subcostal vein ending free at one-third length of basal cell; cubitus forking opposite fork of media.

Female like the male, in color and wing characters, with two long bristles on lower surface of middle tibiæ. Described from twelve males and eight females.

Type: Male, No. 2522, Mus. Calif. Acad. Sci., taken February 25, 1926, at **Mill Valley, Marin Co., California;** ***allotype,*** No. 2523, Mus. Calif. Acad. Sci., taken May 5, 1926, at same place, as were the *paratypes;* all were taken by the author, the paratypes between March 4 and May 8, 1926.

44. **Mycetophila clavata** Van Duzee, new species

Length 3.5 mm. Head, thorax and abdomen brown, the latter dark and subshining, with hind margin of segments narrowly and obscurely yellow; humeri and a narrow median line on scutellum yellow; palpi yellowish brown; antennæ wholly brown; hairs on thorax and abdomen pale. Hypopygium (fig. 29) yellow, upper claspers tipped with a black spine, lower claspers clavate at tip. Coxæ, femora and tibiæ yellow, the latter a little darker in color; tarsi brown; fore coxæ with black hair and bristles; middle and hind femora a little blackened at tip; middle tibiæ with two large bristles below and a very small one nearer base; posterior tibiæ with two ranges of large bristles above; joints of fore tarsi as 50-27-17-13-11, those of middle ones as 51-31-24-15-9, of posterior pair as 70-25-19-14-10. Wings dark grayish, the central spot large, dark brown, ending in front at the radius, but the whole costal cell tinged a little with brown; the preapical fascia beginning at the costa just beyond the tip of R_1, extending to tip of radial sector and obliquely back to middle of cell Rs, where it turns again towards apex of wing back to M_1, back of this it is very narrow and faint to M_2; subcostal vein ending free about one-third length of basal cell; cubitus forking about opposite fork of media.

Female like the male in color and wing characters, and in having two large and a small bristle below on middle tibiæ.

Type: Male, No. 2524, Mus. Calif. Acad. Sci., taken by the author, March 5, 1926, at **Mill Valley, Marin Co., California**; *allotype,* female, in the author's collection, taken by him February 7, at same place.

45. **Mycetophila parvimaculata** Van Duzee, new species

Male: Length 3 mm. Head brown, face more yellowish brown; scape of antennæ and palpi yellow. Thorax, including the pleuræ, brown; prothorax, extreme edges of mesonotum, a median stripe extending from front of thorax to tip of scutellum and extreme lateral angles of scutellum yellow; hairs on thorax pale with many stiffer black ones among them; scutellum with two pairs of large marginal bristles. Abdomen subshining, black with yellow hind margins to the segments and with pale hairs. Hypopygium as in figure 30; claspers elongate. Coxæ, femora and tibiæ yellow, tips of middle and hind femora and tibiæ blackish, tarsi brown; middle tibiæ without bristles below; hind tibiæ with two ranges of long bristles above and a row of stout hairs on apical third of lower inner edge, which are longest near the tip; joints of fore tarsi as 44-22-16-12-12; of middle ones as 53-30-22-15-12; those of posterior pair as 50-28-20-15-15. Wings grayish, tinged with brown in front of radial sector; central spot large, dark brown, not extending in front of vein R_1; preapical fascia paler brown, extending backward from R_1 but not reaching M_1; it is wholly proximad of tip of R_1; there is also a faint cloud at tip of anterior branch of media; subcostal vein ending free and a little more than one-third as long as basal cell; cubitus forking slightly proximad of the basal end of the R-M crossvein.

Type: Male, in author's collection, taken by him, March 13, 1926, at **Mill Valley, Marin Co., California.**

46. **Mycetophila ovata** Van Duzee, new species

Male: Length 3 mm. Head brown; face, palpi and first four joints of antennæ pale yellow. Thorax brown with the humeri broadly yellow, scutellum with a median yellow stripe and with a yellow spot above it on posterior slope of thorax; sometimes the brown of the thorax is more in the form of three subconfluent stripes, covering most of upper surface. Abdomen dark brown, somewhat shining; hind margins of segments scarcely, if at all, bordered with yellow. Hypopygium (fig. 31) small with small somewhat oval claspers, which have only a few hairs and no spines; hairs on thorax pale, but a few on its fore part black. Coxæ, femora and tibiæ yellow, tarsi brown, tips of middle and hind femora narrowly black; middle tibiæ with three long, nearly equal bristles below; posterior tibiæ with two ranges of long bristles above; joints of fore tarsi as 23-19-16-10-9; of posterior ones as 59-23-17-12-10. Wings tinged with yellowish gray; central spot large and dark brown, but not reaching forward to R_1; preapical fascia beginning on costa at one-third the distance from the tip of R_1 to tip of the radial sector, extending to the tip of radial sector and backward beyond posterior branch of media, but it is much fainter beyond middle of cell Rs; subcostal vein ending free about one-third distance to base of radial sector; cubitus forking opposite fork of media.

The female is about like the male in color and wing characters; the middle tibiæ also have the three large bristles below. Described from four males and seventeen females.

Type: Male, No. 2525, and *allotype*, female, No. 2526, Mus. Calif. Acad. Sci., taken by the author, April 1 and February 25, 1926, respectively, at **Mill Valley, Marin Co., California**; *paratypes* were taken by the author at the same place from February 13 to May 4, 1926.

47. **Mycetophila fusca** Van Duzee, new species

Male: Length 3 mm. Head, including mouth parts, brown; thorax and abdomen blackish brown, subshining, with pale hairs; scutellum lighter brown; humeri yellow. Hypopygium as in figure 32; halteres, coxæ, femora and tibiæ yellow; fore coxæ with pale hairs on anterior surface and longer black hair on outer side; tips of middle and hind tibiæ dark brown; posterior femora with a few long hairs below near the tip, their tibiæ with two ranges of large bristles on upper surface; middle tibiæ without a large bristle below, but sometimes with two small bristles or stiff hairs there; tarsi brownish; joints of fore tarsi as 34-20-14-10-8; middle tibia as 56, joints of middle tarsi as 40-22-17-13-10; hind tibiæ as 73, joints of their tarsi as 56-18-14-12-9. Wings grayish with two brown spots and two spots which are more hyaline, one of these between the brown spots, the other beyond preapical spot; central brown spot small, not extending forward beyond R_1; preapical spot, or fascia, extending along costa from tip of R_1 towards base of wing, not reaching media, forming a rounded spot, which is about as long as wide and is rather faint; subcostal vein ending free, reaching more than one-third length of basal cell; R-M crossvein and petiole of media of equal length; cubitus forking just beyond fork of media.

Female like the male in color and wing characters and in having no bristles on lower surfaces of middle tibiæ, or with the two small ones.

Type: Male, No. 2527, and *allotype*, female, No. 2528, Mus. Calif. Acad. Sci., taken by the author, March 20, 1926, at **Mill Valley, Marin Co., California**; one male and seven female *paratypes* were taken by the author at same place, between February 28 and April 8, 1926.

In the type the basal half of both branches of the media are wanting in the right wing, but the other wing is normal.

48. **Mycetophila spiniger** Van Duzee, new species

Male: Length 3.2-3.7 mm. Head brown; face and palpi yellow; scape of antennæ more yellowish brown. Thorax dusky yellow with three brown vittæ which are more or less confluent; scutellum with a median yellow stripe which extends onto posterior part of thorax; pleuræ mostly black. Abdomen shining blackish brown, posterior margin of segments yellow. Hypopygium as in figures 33 & 34. Halteres, coxæ, femora and tibiæ yellow; tips of posterior femora and tibiæ, the tibial spurs and all tarsi brown; middle tibiæ with two bristles below; posterior with two ranges of long bristles above; fore tibiæ as 52; joints of fore tarsi as 50-28-22-14-12; joints of posterior pair as 69-27-21-15-11. Hairs of fore coxæ black, those of thorax and abdomen pale. Wings grayish, costal cell tinged with yellow; a brown spot covering the crossveins; preapical fascia reaching from costa to hind margin of wing at tip of C_2, on costa beginning just beyond the tip of R_1, extending to tip of radial sector, and becoming wider and fainter beyond second branch of media; cubitus forking a little beyond fork of media; subcostal vein nearly a third as long as basal cell.

Female colored as in male and wings about same as described above; fore tibiæ and basitarsus of about same proportion as in male; middle tibiæ with two large bristles below.

Type: Male, No. 2529, and *allotype*, female, No. 2530, Mus. Calif. Acad. Sci., taken by the author May 16, 1926, at **Mill Valley, Marin Co., California**; 34 *paratypes* taken at same place in March, April and May.

This is much like *extenta* Johannsen, which also has a spine at tip of claspers, but in that species the claspers are longer and more slender, the bristle at tip longer and the preapical fascia reaching only a little beyond M_2. In this species there is sometimes a faint cloud at apex of wing.

49. **Mycetophila pectoralis** Van Duzee, new species

Male and female: Length 4.2 mm.; of wing the same. Head brown; face black; palpi and antennal scape yellow, flagellum brown, its intermediate joints twice as long as wide; mesonotum dull brown, its sides broadly yellow; middle third of scutellum and halteres yellow; propleuræ yellow with black setæ; mesopleuræ black, subshining, sternopleuræ more brown; abdomen shining black with very narrow hind margin of segments yellow; small hairs on head, thorax and abdomen yellow, their setæ black; head with a row of black setæ just above the antennæ and along the orbits. Hypopygium and claspers yellow; claspers short, rounded posteriorly with a black, spine-like appendage on inner side; which is straight to near its end where it is abruptly bent.

Coxæ wholly, femora, tibiæ and base of tarsi yellow, tarsi brown at tip; fore coxæ with minute yellow hairs on anterior surface and a row of black setæ at tip; hind femora narrowly black at apex, with four long black subapical hairs; hind tibiæ with two rows of strong bristles; middle tibiæ with three strong bristles on lower surface; tibial spurs yellowish brown.

Wings slightly tinged with yellow; a dark brown spot on the cross-veins reaching R_1; an indistinct shade opposite this back of the cubitus; cubitus forking just beyond fork of media, its petiole about as long as its anterior branch; petiole of media very short, half as long as basal section of radial sector; a preapical fascia extending from tip of R_1 along costa to tip of Rs and back to Cu_2 becoming faint beyond M_1.

Fore basitarsus almost as long as its tibia; posterior basitarsus just equal to the remaining four joints taken together.

Type: Male, No. 2531, Mus. Calif. Acad. Sci., collected by E. P. Van Duzee, June 1, 1919, at **Santa Cruz, California.** *Paratype,* one male, same data.

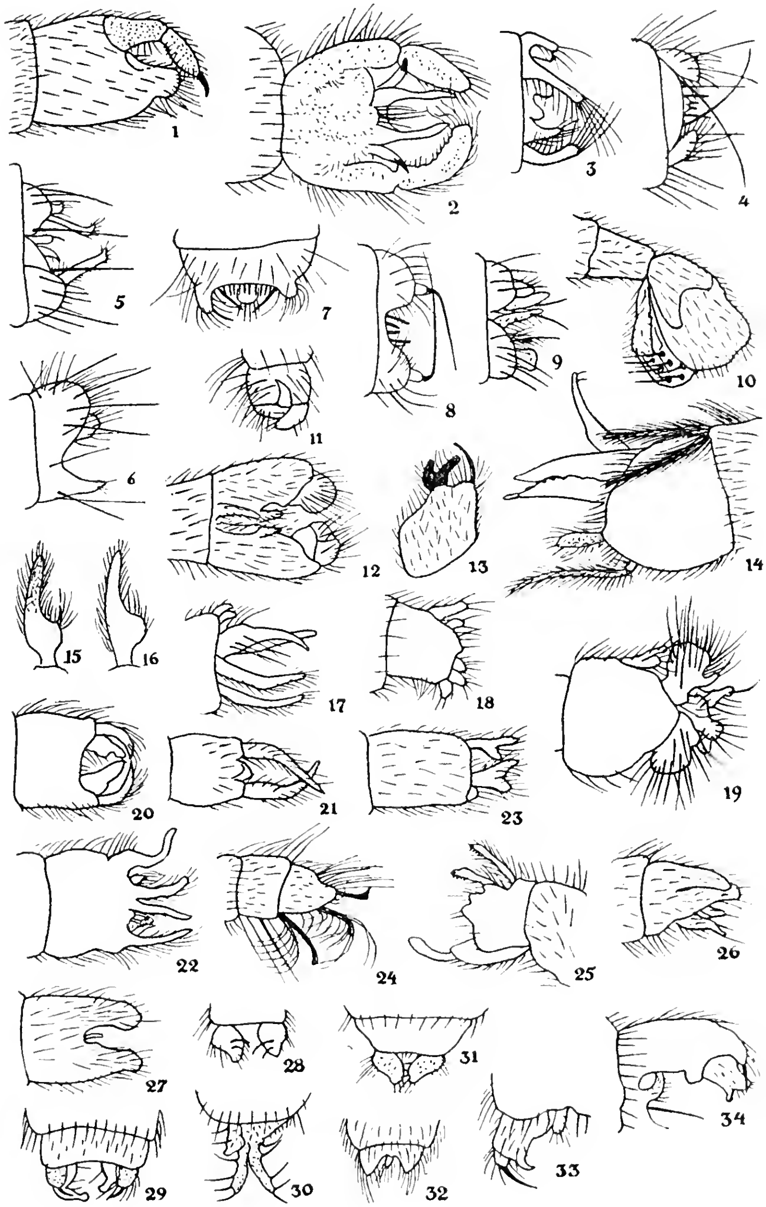
50. **Mycetophila singularis** Van Duzee, new species

Male: Length 3.5 mm.; of wing 4.2 mm. Head reddish brown, face dark yellow; palpi yellow; antennae brown, scape yellow; first joint of flagellum very narrow at base, normal size at tip; joints 3-6 apparently have their ends enlarged, when viewed from above, from the side they are of equal width, the antenna being flattened, the intermediate joints longer than wide. Thorax reddish yellow with faint brownish stripes, its hairs yellow, bristles black; pleuræ more brownish; scutellum yellowish. Abdomen subshining black, posterior margins of segments narrowly, and the venter, yellowish, its hairs short, yellow; hypopygium yellow, claspers oval with a curved black spine on inner side which nearly reaches their tips. Coxæ, femora, and posterior tibiæ yellow; fore and middle tibiæ and all tarsi brownish; tibial spurs dark brown; tips of posterior femora black; fore tarsi slender, each joint a little narrowed at base, second joint widest; fore tibia as 40, their tarsal joints as 30-13-12-10-8; hind femora with two or three long hairs near lower edge of apical third on anterior surface; fore coxæ with pale hairs and several black setæ on outer edge; posterior tibiæ with two ranges of bristles. Wings slightly tinged with yellow; a large brown spot over the crossveins, sometimes reaching the costa; a preapical fascia reaching from the costa to posterior margin of wing at tip of Cu_1 and along costa to tip of R_{4+5}, the cubitus forking distinctly beyond the fork of the media, its petiole being longer than its anterior branch; subcostal vein ending free, about one-third as long as first basal cell.

Type: Male, No. 2532, Mus. Calif. Acad. Sci., taken by E. P. Van Duzee, June 1, 1919, at **Santa Cruz, California.**

Explanation

Figure 1, Platyura angustata V. D.; Fig. 2, Tetragoneura longicauda V. D.; Fig. 3, Mycomya hirticauda V. D.; Fig. 4, Mycomya fulvitibia V. D.; Fig. 5, Mycomya nigrihirta V. D.; Fig. 6, Mycomya californica V. D.; Fig. 7, Mycomya fuscipalpis V. D.; Fig. 8, Mycomya longispina V. D.; Fig. 9, Mycomya abbreviata V. D.; Fig. 10, Trichonta fusciventris V. D.; Fig. 11, Neuratelia flexa V. D.; Fig. 12, Rhymosia spinicauda V. D.; Fig. 13, Rhymosia parvicauda V. D.; Fig. 14, Rhymosia plumosa V. D.; Fig. 15, clasper of same; Fig. 16, side view of clasper of same; Fig. 17, Allodia hirticauda V. D.; Fig. 18, Phronia basalis V. D.; Fig. 19, Phronia flabellata V. D.; Fig. 20, Phronia fusciventris V. D.; Fig. 21, Exechia æqualis V. D.; Fig. 22, Exechia noctivagus V. D.; Fig. 23, Exechia brevipetiolata V. D.; Fig. 24, Exechia cincinnata Johannsen; Fig. 25, Exechia angustata V. D.; Fig. 26, Exechia umbrosa V. D.; Fig. 27, Exechia unicincta V. D.; Fig. 28, Mycetophila bispina V. D.; Fig. 29, Mycetophila clavata V. D.; Fig. 30, Mycetophila parvimaculata V. D.; Fig. 31, Mycetophila ovata V. D.; Fig. 32, Mycetophila fusca V. D.; Fig. 33, Mycetophila spiniger V. D.; Fig. 34, another view of same.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVII, No. 3, pp. 67-87 June 22, 1928

III

A KEY TO THE SPECIES OF EUCALYPTUS GROWN IN CALIFORNIA

BY

ERIC WALTHER

Introduction

Of California's cultivated trees the most striking are easily the several species of Eucalyptus. Their towering, serried ranks dominate the landscape and lend it an unique, exotic flavor totally lacking in other parts of the United States. While about the only kind generally seen and planted today is the ubiquitous Blue Gum, **Eucalyptus globulus**, a great many other species were tried during the perhaps over-optimistic boom of some years ago. That not more of the latter were successful may well have been due to a choice of unsuitable species, resulting from a failure to properly appreciate the diversity of Australia's climate, which is by no means all dry, but in parts fairly moist, particularly in the regions producing the more important timber-eucalypts. It would seem reasonable to suppose, though, that in a genus spread throughout Australia, and now recognized to contain over 350 species, some might be found suited to almost any of the climatic, soil and moisture conditions existing in California. Before doing any further planting, or proceeding to the introduction of other species, it is desirable to know just what species are to be found here now, and what is their relative status. To make this exact knowledge possible it is necessary to determine correctly the species, preferably in the field. This has been rather difficult with the available keys, which last are often unsatisfactory, either because they do not include all the forms grown here, or through not being in accord with the latest works on the genus, or through the use of obscure characters. The need of an easily workable key is what this short paper attempts to meet. In choosing characters for the primary division of the genus, obviousness has been considered as more important than constancy. The resulting inevitable repetition is a necessary weakness of all artificial keys and need occasion no surprise in view of the extreme variability of the genus.

The species and forms treated here are those actually growing in California today, and more particularly in Golden Gate Park, San Francisco, on the University Campus at Berkeley, and at the former Experiment Station at Santa Monica. Special consideration has been given the material contained in the collections of the California Academy of Sciences, the University of California, and that of Prof. W. Metcalf. Some species are represented in these collections by single specimens, from a single locality, often of fragmentary material, and since their treatment here would have complicated the key unnecessarily, without serving any useful purpose, the writer has used his own judgment as to whether to include them or not. The test adopted governing the inclusion of a species is, as a rule, the continued existence of at least one tree that has borne flowers and fruit. While additional species are reported, and new ones are continually being introduced, their exact identity must remain doubtful until they flower and fruit; in the meantime it is best to disregard them.[1]

In the present paper the writer has followed as closely as possible the comprehensive work, "A Critical Revision of the Genus Eucalyptus," by the late J. H. Maiden. For a list of other works consulted the appended bibliography is referred to.

---

[1]See list on page 26.

It is too much to expect these lines to be entirely free of errors. Any criticism will be welcome, as will also any doubtful or new material. The writer will gladly determine any specimens that may be sent to him at the California Academy of Sciences, San Francisco. Material sent should consist, if possible, of buds, flowers, fruits, leaves and bark.

The writer wishes to express his appreciation of the kind help given by many friends, particularly Miss Alice Eastwood, without whose encouragement and help the work would scarcely have been possible.

EUCALYPTUS L'Heritier

(Myrtaceæ—Leptospermeæ—Eucalyptinæ)

Generic Description: For the present purpose it will be sufficient briefly to describe the genus as follows:

Evergreen trees and shrubs, with *bark* deciduous, or persistent, and then mostly fibrous; *leaves* simple, usually entire, commonly aromatic and glandular-punctate, with prominent intramarginal vein, mostly alternate and stalked, only in a few species persistently opposite and sessile; *flowers* in terminal corymbs or panicles, but more commonly axillary or lateral, and then mostly in umbels, rarely solitary; *ovary* inferior, several-celled, with axile placentation and numerous ovules; *stamens* numerous, usually inflected in bud; *anthers* opening either by parallel slits, or by terminal pores, or kidney-shaped; *petals,* and often also the *sepals,* apparently lacking and considered to be connate into the lid or *operculum* covering the stamens before anthesis.

Fruit a dry capsule with several cells that open at maturity by as many apical valves; *seeds* often few, but chaff usually plentiful.

Their nearest relation is **Angophora**, with distinct, free petals.

Directions for Using the Key

While the key here given is really fairly simple and should be found very easy to use, it differs somewhat in form from those used in most botanical works, and a word of caution may not be out of place. The key is strictly dichotomous, with two alternatives given under each numbered question, each of which should be read carefully to the end. Only then can a safe decision be made as to which alternative fits the plant in question.

An example may be given to illustrate how the key should be used and the name of one rather common species arrived at. Beginning with question number 1 in the left-hand column, we are asked whether the flowers of our plant are borne in terminal clusters or not. Answering this question in the affirmative we note the number given to the right of this alternative, in this case number 8. Finding this number in the left-hand column, we are asked about the size of the fruit and the venation of the leaves. Our species clearly fitting the description given under No. 8a., we now look for number 9 in the left-hand column. Since the capsules of our species are over 1 inch long, we proceed to number 10. A short, but careful consideration of this will show us that we have been dealing with the showy-flowered Scarlet Gum, **E. ficifolia.**

It may take a little longer to find the names of some of the other species, but no trouble should be experienced in the use of the key if the precautions given above are observed.

Key to the Species

(Nos. 1 to 7 to the primary groups.)

1a. Fls.[2] mostly *terminal*, in *panicles* or *corymbs*.................... *8*
—b. Fls. *axillary* or *lateral*, mostly in *umbels*, or *solitary*............ 2
2a. Lvs. mostly *opposite*, even on the flowering branches........... *51*
—b. Lvs. *alternate*, except occasionally on the young shoots.......... 3
3a. Lvs. distinctly *paler beneath*; or veins transverse and close, usually both.. *19*
—b. Lvs. about the *same color* on *both sides*; veins either obscure, or remote, or oblique, or longitudinal......................... 4
4a. *Lid* of *mature* buds *longer* than *calyx-tube*; valves often exserted.. *29*
—b. *Lid never exceeding calyx-tube* in length......................... 5
5a. *Peduncles conspicuously flattened*, or very short, or none; buds and capsules sessile and angled, the last often to over ⅓″ diam.... *44*
—b. *Peduncles not flattened*, but angled or terete and distinct; buds and capsules neither sessile nor angled.......................... 6

[2]Abbreviations used in the key:

′ :: foot.	E. :: Eucalyptus.	lvs. :: leaves.
″ :: inch.	fls. :: flowers.	occ. :: occasionally.
caps. :: capsule.	fr. :: fruit.	us. :: usually.
diam. :: diameter.	H. :: height.	var. :: variety.

6a.	*Valves deeply sunk;* lid about as long as calyx; pedicels often long and slender; rim mostly thin.	*58*
—b.	*Valves exserted* or near rim; lid or pedicels often short	7
7a.	*Lid of mature buds* very *short,* mostly not more than half as long as calyx-tube; caps. mostly globose or pear-shaped, with valves rarely protruding	*69*
—b.	*Lid of mature buds* about *as long as calyx-tube;* capsule mostly more or less conoid or cylindrical; valves often protruding	*83*
8a.	(1) Fls. and *caps. large,* the latter ¾–1½″ long; lvs. mostly paler beneath, with veins transverse and close	9
—b.	Fls. and *caps. smaller;* caps. rarely over ½″ long; lvs. evenly green on both sides, or if paler beneath, then veins oblique and remote.	*12*
9a.	*Capsule* over *1″ long;* fls. often with reddish stamens	10
—b.	*Capsule less than 1″ long;* stamens white or yellowish	*11*
10a.	*Seeds winged,* brown or red; stamens usually reddish or orange; capsule rarely urnshaped; small, commonly cultivated tree	**E. ficifolia**
—b.	*Seeds not winged,* black; fls. white, rarely pinkish; caps. often urnshaped; medium-sized tree, rarely grown	**E. calophylla**
	A. Fls. with pinkish stamens	**var. rosea**
11a.	(9) *Lvs. paler beneath;* pedicels to over ½″ long	**E. corymbosa**
—b.	*Lvs. not paler beneath;* pedicels ¼″ long or less	**E. eximia**
12a.	(8) *Bark smooth,* annually *deciduous;* lvs. often lemon-scented; lid hemispherical; anthers open by parallel slits	13
—b.	*Bark rough, persistent;* lvs. not lemon-scented; lid pointed; anthers open by terminal pores	*14*
13a.	*Lvs.* strongly *lemon-scented;* narrow, to 12-times as long as wide; capsule ⅜″ long or less	**E. citriodora**
—b.	*Lvs. not lemon-scented,* broader; caps. to ½″ long	**E. maculata**
14a.	(12) *Lvs.* distinctly *paler beneath*	**E. paniculata**
—b.	*Lvs. evenly green* on both sides	15
15a.	*Lid longer than calyx;* valves slightly protruding	**E. siderophloia**
—b.	*Lid not exceeding calyx;* valves scarcely protruding	16
16a.	Capsule *over* ¼″ long	17
—b.	Capsule *scarcely over* 3/16″ long	*18*
17a.	*Pedicels short and stout;* buds and caps. often angled; fl.-clusters mostly lateral	*65*
—b.	*Pedicels long and slender;* neither buds nor caps. angled; bark hard, red	*62*
18a.	(16) *Lvs. mostly broad,* very rarely wholly narrow, glaucous; caps. widest at rim; bark gray, soft	**E. polyanthemos**
—b.	*Lvs. always narrow;* caps. narrowed at mouth; bark hard, brownish	**E. crebra**
19a.	(3) *Peduncle* distinctly *flattened;* buds and caps. often sessile, or angled, or both	*22*
—b.	*Peduncle scarcely flattened;* buds and caps. otherwise	20
20a.	*Lid exceeding calyx-tube,* long-pointed; bark fibrous, persistent	**E. marginata**
—b.	*Lid not exceeding calyx,* more or less obtuse; bark deciduous	21

21a. *Lid very short, slightly broader than calyx;* caps. streaked lengthwise; valves sunk . . . . **E. corynocalyx**
—b. *Lid as long and wide as calyx;* caps. not streaked; valves often near rim . . . . **E. diversicolor**
22a. (19) *Bark of trunk persistent,* usually fibrous *25*
—b. *Bark of trunk deciduous,* smooth or nearly so 23
23a. *Lvs. densely gland-dotted;* lid usually short, as long as thick; caps. short, no longer than thick, with thick rim and 3 or 4 broadly triangular, wholly external valves . . . . **E. punctata**
A. Fls. and caps. large, the last to over 1/3" diam . . . . **E. punctata var. grandiflora**
—b. Lvs. *inconspicuously* gland-dotted; lid narrow; rim thin; valves usually 5, narrow, commonly sunk or partly protruding 24
24a. *Caps. glaucous,* shortly *pear-shaped;* valves protruding . . **E. grandis**
—b. *Caps. not glaucous,* mostly more or less *cylindroid;* valves included . . . . **E. saligna**
25a. (22) *Lid broader than calyx, obtuse;* lvs. only slightly paler beneath than above . . . . **E. gomphocephala**
—b. *Lid* either *pointed, or* if obtuse, then no *broader* than calyx 26
26a. Buds and caps. usually *stalked,* rarely sessile and angled; lid mostly long and pointed 27
—b. Buds and caps. shortly or *not stalked,* usually *angled;* lid short, scarcely pointed . . . . **E. botryoides**
27a. Lvs. with *veins oblique* and *remote;* caps. globose, narrowed to mouth, no longer than thick; valves rarely protruding . **E. pilularis**
—b. Lvs. with *veins transverse* and *close;* caps. hemispheric or cylindrical, either longer than thick, or widest at mouth 28
28a. Lvs. to *2" wide or more;* caps. cylindrical; rim thin; valves little or not protruding . . . . **E. robusta**
—b. *Lvs. narrower;* caps. hemispheric; rim broad; valves exserted . . . . **E. resinifera**
29a. (4) *Lid* of mature buds *1" long or more;* valves permanently connate at apex 30
—b. *Lid shorter,* rarely over 1/2" long; valves free at maturity *31*
30a. *Caps. connate,* to 3/4" diam.; valve-tips short; lvs. short, obtuse; shrub or small tree . . . . **E. lehmanni**
—b. *Caps. free,* less than 1/2" diam.; valve-tips long and slender; lvs. narrow, pointed; tall tree with hard, dark bark . . . . **E. cornuta**
31a. (29) *Peduncle flattened,* or very short or none; buds and caps. often sessile and angled 32
—b. Peduncles scarcely flattened, but distinct; buds and caps. stalked, rarely angled *36*
32a. *Caps.* about *1/4" long* and as much in diam., top-shaped; valves with awl-shaped tips . . . . **E. decipiens**
—b. *Caps.* to *1/3" long* or more, mostly cylindrical, rarely globose 33
33a. *Caps. globose,* narrowed to rim; peduncle not over 1/8" wide . . . . **E. pilularis**
—b. *Caps.* mostly *cylindrical* or urn-shaped; peduncle to 1/2" wide or more 34

34a. *Lvs. broad*, occ. *obcordate;* buds and caps. angled, quite sessile.... .... **E. platypus**

—b. *Lvs. narrow, pointed;* buds and caps. distinctly, if shortly stalked, never angled.. 35

35a. *Peduncle* often only *slightly flattened;* pedicels slender; caps. more or less urn-shaped; juvenile lvs. broad..........**E. occidentalis**

—b. *Peduncles* always *broad*, pedicels short and stout; caps. short-cylindric; juvenile lvs. narrow......................**E. eremophila**

36a. (31) *Caps.* to $\frac{1}{3}''$ *diam.* or more; buds often correspondingly large; bark occ. persistent, often fibrous.......................... *42*

—b. *Caps. scarcely over* $\frac{1}{4}''$ *diam.;* bark mostly smooth and deciduous. 37

37a. Caps. *cylindrical;* valves protruding, *with* narrow, *awl-shaped tips* 38

—b. Caps. *hemispheric* or *top-shaped;* valves *broadly* triangular, fully exserted.. *39*

38a. (37 & *91*) Lvs. *yellowish green; bark smooth;* lid little longer than calyx; caps. usually less than $\frac{1}{4}''$ diam., with thick rim........ ....**E. salmonophloia**

—b. *Lvs.* often *glaucous; bark* occ. *rough;* lid to twice as long as calyx or more; caps. to over $\frac{1}{4}''$ diam.; rim often thin[3].......**E. oleosa**

39a. (37) *Lid* to *twice as long as calyx*, or acuminate; *caps.* $\frac{1}{4}''$ *diam.;* rim broad and convex, bearing valves at apex................ 40

—b. *Lid* shorter, *never acuminate; caps. larger;* rim narrow; valves not quite at apex; bark persistent......................**E. rudis**

40a. *Pedicels slender*, to 3 times as long as caps. or more; *lid* little longer than calyx, *acuminate;* small tree with spreading branches.... ....**E. rostrata**

—b. *Pedicels shorter; lid* 2 to 3 times as long as calyx, *not acuminate;* tall, erect trees.. 41

41a. *Buds short*, crowded, *almost sessile;* caps. less than $\frac{1}{4}''$ diam.; lvs. *often broad*, especially on seedlings and suckers.....**E. amplifolia**

—b. *Buds narrow, long-stalked;* caps. to over $\frac{1}{4}''$ diam.; *lvs. usually narrow*, even on seedlings and suckers........**E. tereticornis**

42a. (36) *Caps. to over* $\frac{1}{3}''$ *long; pedicels to over* $\frac{1}{3}''$ *long;* umbels often only 3-flowered.. *85*

—b. *Caps.*, or *pedicels*, or both, *shorter;* umbels always with more than 3 flowers.. 43

43a. *Rim* very *prominent and convex*, often as broad as the rest of calyx-tube is long; lid beaked; bark fibrous; branches often long-pendulous; lvs. narrow; anthers with kidney-shaped pores........ ....**E. macrorrhyncha**

—b. *Rim narrow or sharp;* lid not beaked; lvs. often broad; bark brittle; branches at most slightly drooping; anthers open by parallel slits....................................**E. rudis**

44a. (5) *Caps.* $\frac{1}{2}''$ *diam. or more;* buds to $\frac{1}{3}''$ diam. or more.......... *46*

—b. *Caps not over* $\frac{1}{3}''$ *diam.;* buds scarcely over $\frac{1}{4}''$ diam............ 45

[3]**E. longicornis** and **E. transcontinentalis** are segregates from this species and may be distinguished by their long lid, which is beaked in **E. transcontinentalis**, this species also having glaucous leaves and buds.

45a. *Lid* of mature buds *not over half length of calyx-tube*; caps. usually more or less globose or hemispheric. *69*
—b. *Lid longer*, about *as long as calyx-tube;* caps. usually conoid or cylindrical. *83*
46a. (44) Shrub, less than 10′ tall; *lvs. broad, obtuse;* peduncles none; fls. in sessile clusters; buds warty, not glaucous. . . . . **E. alpina**
—b. Large or small trees; *lvs. narrow, pointed;* peduncles usually distinct, even if short; buds warty and glaucous, or smooth and green. . . 47
47a. *Buds and caps.* usually *warty and glaucous;* peduncles rarely over ⅓″ long, slightly flattened or angled. 48
—b. *Buds and caps. neither warty nor glaucous;* peduncles often longer, mostly very broad. *49*
48a. (47 & 55.) *Our most common species;* buds and caps. warty, mostly solitary, rarely in three's; *caps. ½–1″ diam.*, sharply angled; rim to over ¼″ wide. . . . . **E. globulus**
A. Habit compact; branches all ascending from apex of short trunk; fls. all in three's, small. . . . . **var. compacta**
—b. *Rare;* buds slightly warty; *caps.* pitted, mostly in three's, slightly angled, ⅓ *to* ½″ *diam.;* rim narrower, light brown. . . **E. maideni**
49a. (47) *Lid much broader than calyx*, obtuse; umbels many-flowered; caps. longer than thick. **E. gomphocephala**
—b. *Lid* pointed, *scarcely any wider than calyx;* umbels 3-flowered; caps. often broader than long. 50
50a. *Peduncle* over ½″ long, *much flattened;* caps. to 1″ diam. or more . . . . **E. megacarpa**
—b. *Peduncle* shorter, *slightly flattened;* caps. not over ½″ diam. . . . . **E. mortoniana**
51a. (2) *Lvs. sessile*, with base stem-clasping and cordate. 52
—b. *Lvs. distinctly* stalked, rounded or tapering at base. *56*
52a. *Trees;* with *bark* of trunk *persistent*, fibrous. *101*
—b. *Shrubs; or* trees *with deciduous bark*. *53*
53a. *Umbels many-flowered;* lid less than half the length of calyx-tube, not over ⅛″ long. . . . . **E. risdoni,** see No. 76
—b. *Umbels* usually *3-flowered, or flowers solitary;* lid longer. 54
54a. *Lvs.* with *margin* distinctly *crenulate;* caps. narrowed to rim; valves more or less sunk. . . . . **E. cordata**
—b. *Lvs. not crenulate;* caps. widest at apex; valves near rim. 55
55a. *Lvs.* about *as long as broad, obtuse;* young shoots terete or nearly so; caps. not over ⅓″ diam. . . . . **E. pulverulenta**
—b. *Lvs. longer than broad, acute;* young shoots quadrangular or even winged; caps. over ⅓″ diam. *48*
56a. (51) *Caps.* ¼–⅓″ *long*. *101*
—b. *Caps.* ⅜–½″ *long* or more. 57
57a. *Lvs. glaucous;* calyx angled, slightly 4-lobed; caps. with 4 ridges; stamens apparently in 4 groups. . . . . **E. tetragona**
—b. *Lvs. brownish green;* calyx, stamens and caps. otherwise. . . . . **E. preissiana**
58a. (6) *Pedicels long* and slender, over ¼″ long, mostly exceeding calyx 59
—b. *Pedicels short*, rarely exceeding calyx or capsule. *63*

59a. *Caps.* usually *over* ¼″ *diam.* 60
—b. *Caps.* usually *less than* ¼″ *diam.* 68
60a. Caps. with rim external, sharp; staminal ring not persistent; *lvs. to 12″ long, bright green;* bark persistent, fibrous; anthers open by parallel slits. . . . . **E. longifolia,** see No. 85a
—b. Caps. with rim terminal, narrow, not to be confused with the often persistent staminal ring; *lvs. shorter*, often *grayish;* bark deciduous or hard; anthers open by terminal pores. 61
61a. *Bark deciduous,* leaving trunk smooth. . . . . **E. leucoxylon**
A. Stamens purplish. . . . . **var. erythrostema**
AA. Stamens whitish. . . . .
B. Caps. not over ⅓″ diam. . . . . (type.)
BB. Caps. to ½″ diam. **var. macrocarpa**
—b. *Bark persistent,* rough. 62
62a. (17 & 61) *Lvs. broad,* mostly less than 3 times as long as wide, glaucous; *fls.* mostly *in panicles; caps.* longer than thick, much *narrowed at mouth*. . . . . **E. caleyi**
—b. *Lvs. narrower,* dull gray-green; fls. only rarely appearing panicled; *caps.* as long as thick, *scarcely contracted* at mouth; bark deeply furrowed, almost black. . . . . **E. sideroxylon**
A. Stamens pinkish. . . . . **var. rosea**
63a. (58) *Umbels* always *3-flowered;* peduncle often recurved; lid less than half length of calyx. . . . . **E. urnigera**
—b. *Umbels* mostly *many-flowered;* peduncle not recurved; lid mostly longer. 64
64a. *Lvs.* dark green, markedly *oblique at base;* bark thick, fibrous; *caps.* usually *narrowed to mouth;* rim often thick; anthers kidney-shaped. 80
—b. *Lvs.* dull-green, *not oblique at base,* but occasionally falcate; bark deciduous or thin; *caps. not narrowed to rim;* anthers open by pores. 65
65a. (17 & 64) *Caps.* ¼–⅓″ *long*. 66
—b. *Capsules scarcely over* ¼″ *long*. 67
66a. *Umbels solitary;* caps. to ⅓″ long; lvs. and buds glaucous. **E. albens**
—b. *Umbels* mostly *panicled,* even though lateral; caps. less than ⅓″ long; lvs. and buds not glaucous. . . . . **E. hemiphloia**
67a. (65) *Buds* often *short-stalked* and *angled;* caps. more or less cylindroid. . . . . **E. odorata**
—b. *Buds* mostly *long-stalked, not angled;* caps. hemispheric. 68
68a. (59 & 67) *Capsules* mostly *with 5–6 valves,* cylindroid, slightly angled, occ. appearing panicled; lvs. rigid; branches only slightly drooping; inner bark white. . . . . **E. bosistoana**
—b. *Caps.* mostly *4-celled,* hemispheric, not angled, nor panicled; lvs. short, soft; habit drooping; inner bark yellow. . . . . **E. melliodora**
69a. (7) *Fls. always in three's;* caps. cylindroid or urnshaped; valves sunk or even with rim; rim narrow; anthers open by parallel slits. . . . 90
—b. *Umbels with 5 or more fls.;* caps. hemispheric or pearshaped; rim occ. thick; valves near rim; anthers kidney-shaped. 70

70a.[4] *Bark* of trunk *persistent*, fibrous or rough *77*
—b. *Bark* cleanly *deciduous*, thin, trunk smooth 71
71a. *Buds wrinkled; lid depressed* at apex; lvs. less than 3″ long .... **E. coccifera**
—b. *Buds at most granular; lid not depressed* at apex 72
72a. *Lvs.* narrow-linear, mostly *less than ⅓″ wide*, veins obscure .... **E. amygdalina var. angustifolia,** see No. 78b
—b. *Lvs. broader*, to ½″ wide or more, veins usually distinct 73
73a. *Lvs. not over 3″ long*, rigid; peduncle markedly flattened; caps. thickest below middle, abruptly narrowed to pedicel .... **E. obtusiflora**
—b. *Lvs. 4″ long or more*, leathery; peduncle scarcely flattened; caps. pear-shaped, gradually tapering into pedicel 74
74a. *Lateral veins longitudinal*, paralleling midrib; lvs. to over 1″ wide .... **E. coriacea**
—b. *Lateral veins oblique*, at an angle to midrib; if appearing longitudinal, then lvs. glaucous and scarcely over ½″ wide 75
75a. *Lvs. to over 1″ wide*, very oblique at base; umbels often paired in the leaf-axils; bark persists at base of trunk . . **E. regnans,** see No. *81b*
—b. *Lvs. narrower*, scarcely oblique at base; umbels solitary; bark quite deciduous 76
76a. *Lvs.* often opposite even on the flowering branches, usually *glaucous*, as are the buds and caps.; rim mostly sharp .... **E. risdoni**
A. Lvs. opposite, broad; small tree .... (type)
AA. Lvs. mostly alternate and narrow; tall tree .... **var. elata**
—b. *Lvs.* always alternate on flowering branches, *scarcely glaucous;* rim broad, flat, often reddish .... **E. hæmastoma**
A. Caps. about ¼″ diam., long-stalked .... **var. micrantha**
AA. Caps. to ⅓″ diam., long or short-stalked ....
B. Caps. sessile or nearly so .... **var. capitata**
BB. Caps. long-stalked .... (type)
77a. (70) *Lid conic, pointed* *82*
—b. *Lid hemispheric, obtuse* or obscurely pointed 78
78a. *Caps. pear-shaped*, distinctly longer than thick, tapering gradually into pedicel 79
—b. *Caps. hemispheric*, about as long as thick, tapering rather abruptly into pedicel .... **E. amygdalina**
A. Bark deciduous, trunk smooth; lvs. always very narrow, ¼″ wide or less .... **var. angustifolia**
AA. Bark more or less persistent and fibrous; lvs. often broad
B. Umbels with 20 or more small flowers; caps. less than ¼″ diam.; lvs. narrow; habit pendulous .... **var. numerosa**
BB. Umbels with fewer, larger flowers; caps. usually ¼″ diam. or more ....

---

[4]The relative taxonomic value of the various species here following, and especially of the numerous forms of **E. amygdalina,** is very uncertain. The treatment adopted here does not mean to imply any opinion in the matter, its aim being merely to separate the more marked forms as consistently as possible.

C. Juvenile lvs. broad, glaucous, often even on old trees; buds often glaucous........................**var. dives**
CC. Juvenile lvs. broad or narrow, not glaucous; buds not glaucous..............................
D. Juvenile lvs. broad, green, adult lvs. thick and shining..........................**var. nitida**
DD. Juvenile lvs. narrow....................
E. Lid mucronate................**var. radiata**
EE. Lid obtuse......................(type)

79a. *Lvs. to over 1" wide*, very oblique at base and falcate; peduncle scarcely flattened; bark softly fibrous...................... *81*
—b. *Lvs. less than 1" wide*, falcate but hardly oblique at base; peduncle flattened; bark hard, not fibrous..............**E. sieberiana**
80a. (64) *Lid conical; caps. globose*, nearly sessile, densely crowded, narrow-mouthed; lvs. narrow, scarcely oblique at base, with veins transverse.. *82*
—b. *Lid hemispheric; caps. pear-shaped*, distinctly stalked, scarcely crowded, little narrowed at mouth; lvs. broad, very oblique at base, with veins longitudinal.............................. 81
81a. (75, 79, 80.) *Bark persistent; umbels* mostly *solitary;* rim thin; valves sunk; lvs. with oil-dots remote....................**E. obliqua**
—b. *Bark persists only rarely* at base of trunk; *umbels* mostly *paired* in the leaf-axils; rim thick, not depressed; valves scarcely sunk; lvs. with many crowded oil-dots..................**E. regnans**
82a. (77, 80, 99) *Lvs. peppermint-scented*, with rather oblique veins, *young growth smooth;* bark persists only on trunk and larger branches; caps. often small, usually narrowed to the mostly narrow rim; valves included......................**E. piperita**
—b. *Lvs. not peppermint-scented*, with veins more transverse than in last; *young growth rough or hairy;* bark persists even on the smaller branches; caps. to ⅓" diam.; rim usually thick, flat or convex; valves near rim............................**E. eugenioides**
83a. (7, 45) *Caps.* relatively large, *to ⅜" long*, their diam. as much or more... 84
—b. *Caps.* relatively smaller and *shorter*.......................... *87*
84a. *Pedicels long* and slender; caps. scarcely angled................. 85
—b. *Pedicels short* and stout; caps. slightly angled......**E. mortoniana**
85a. (42 & 84) Lid acuminate; *lvs. to 12" long* or more; tall tree with fibrous bark; stamens yellowish; rim external; valves scarcely protruding..................................**E. longifolia**
A. Umbels with many flowers...................**var. multiflora**
—b. Lid obtuse or nearly so; *lvs. rarely over 3" long*; shrub or small tree.. 86
86a. *Stamens reddish; buds elongated;* caps. conoid, flat-topped; rim narrow; valves scarcely protruding..............**E. erythronema**
—b. *Stamens not colored; buds* and caps. *globose* or nearly so, the latter with prominent, convex rim and exserted valves..**E. drummondi**
87a. (83) *Bark* mostly *persistent*................................ *95*
—b. *Bark* mostly *deciduous*.................................... 88

88a. *Lvs.* to over *2" wide, obtuse,* long-stalked................**E. alba**
—b. *Lvs. narrow, pointed*.. 89
89a. *Lvs.* mostly *3" long* or less; *lid* markedly *shorter than calyx*-tube; umbels always 3-flowered................................ 90
—b. *Lvs.* mostly *4" long or more; lid* about *as long as calyx*-tube; umbels more often many-flowered (except in the common **E. viminalis**).. *91*
90a. (69 & 89) Plant scarcely glaucous; *caps.* often *urn-shaped;* valves sunk; lid less than half length of calyx-tube; pedicels to ¼" long; *peduncles* often *recurved*........................**E. urnigera**
—b. Plant usually glaucous; *caps. hemispheric;* valves near rim; lid relatively longer; pedicels shorter.......................**E. gunni**
91a. (89) *Style* persistent in fruit, *forming awl-shaped tips to the valves*.... *38*
—b. Style not prominently persistent; *valves without needle-like tips*.... 92
92a. *Caps.* obconic or *top-shaped,* narrower than the rim, tapering very gradually to pedicel..............................**E. ovata**
—b. *Caps.* otherwise, more or less *hemispheric,* abruptly tapering to pedicel... 93
93a. *Lvs.* often glaucous, *of* seedlings and *suckers broad*; buds many in the umbels, often glaucous; caps. occ. somewhat urn-shaped; rarely cultivated...............................**E. rubida**
—b. *Lvs.* not glaucous, *narrow even in the juvenile stage;* umbels often 3-flowered; buds and caps. not glaucous, the latter hemispheric.. 94
94a. *Rarely cultivated;* umbels mostly many-flowered; *lid hemispheric,* obtuse; rim usually narrow; valves often only partly protruding ....**E. maculosa**
—b. *Commonly grown;* umbels mostly 3-flowered; *lid conic,* short-pointed; rim mostly broad and convex; valves mostly fully exserted...**E. viminalis**
95a. (87) Mature *buds and caps.* very small, scarcely over ⅛" long; buds shining brown; bark brown, fibrous.............**E. macarthuri**
—b. *Buds and caps.* larger, to ¼" *long or more,* usually green or glaucous 96
96a. *Pedicels long* and slender, even in fruit....................... 97
—b. *Pedicels none,* or very short and stout, at least in fruit.......... *99*
97a. *Valves widely exserted;* rim broad............................ 98
—b. *Valves included;* rim narrow, but staminal ring often persistent.... ....**E. melliodora**
98a. Lid shorter than calyx-tube; *caps. less than ¼" diam.;* anthers kidney-shaped; rarely cultivated...................**E. smithi**
—b. Lid as long or longer than calyx-tube; *caps. to over ¼" diam.;* anthers open by parallel slits; common in cultivation..**E. rudis**
99a. (96) *Lid* narrow, *acuminate; caps. globose;* valves scarcely protruding; anthers kidney-shaped........................... *82*
—b. *Lid* broad, *obtuse* or acutish; *caps. conoid, hemispheric* or *cylindrical;* valves often exserted; anthers open by parallel slits........... 100
100a. Buds and *caps.* mostly *quite sessile* and often more or less glaucous 101
—b. Buds and *caps.* usually distinctly, even if shortly, *stalked,* scarcely glaucous; bark only rarely persistent............**E. viminalis**

101a. (52, 56, 100) Lvs., buds and fruits usually glaucous; buds and *caps. scarcely angled; peduncle not* conspicuously *flattened;* valves often somewhat protruding; bark reddish-brown . . . . **E. cinerea**
A. Umbels with 5 or more flowers; lvs. often opposite. **var. multiflora**
—b. Lvs., buds and fruits grayish-green, only rarely glaucous; buds and *caps. angled*, strictly *sessile on the* much *flattened peduncle;* valves usually not protruding; bark grayish-brown . . . . . . **E. elæophora**

ALPHABETICAL LIST OF SPECIES IN KEY

Accepted specific names in bold face type; *synonyms* in italics; author of specific or varietal name, common name, range and maximum height in California in roman type.

In giving the range the following abbreviations are used: N.A., :: North Australia; N.S.W., :: New South Wales; Qu., :: Queensland; S.A., :: South Australia; Tas., :: Tasmania; W.A., :: West Australia.

Height in feet, to convert into meters, divide by three.

× :: growing in Golden Gate Park, San Francisco.

acervula Hooker, :: **E. ovata** Labillardiere.
alba Reinwardt, (*E. platyphylla* F. v. Mueller.) "Poplar Gum." Qu., Java, Timor, Papua . . . . H. 25
×**albens** Miquel, (*E. hemiphloia var. albens* F. v. Mueller.) "White Box." V., N. S. W., Qu. . . . . H. 20
×**alpina** Lindley. V. . . . . H. 12
×**amplifolia** Naudin, (*E. tereticornis var. amplifolia* ?) "Cabbage Gum." N. S. W., Qu. . . . . H. 40
amygdalina Labillardiere.
× — **var. angustifolia** F. v. Mueller, (*E. linearis* Dehnhardt.) "White Gum." Tas. . . . . H. 30
— **var. dives** F. v. Mueller, (*E. dives* Schauer.) "Blue Peppermint." V., N. S. W.
— **var. nitida** Bentham, (*E. nitida* Hooker.) N. S. W., Tas.
× — **var. numerosa** Maiden, (*E. numerosa* Maiden, *E. andreana* Naudin.) "Peppermint Gum." V., N. S. W. . . . . H. 40
— **var. radiata** Bentham, (*E. radiata* Sieber.) "Peppermint." V., N. S. W.
— *var. regnans* F. v. Mueller, :: **E. regnans** F. v. Mueller.
andreana Naudin, :: **E. amygdalina var. numerosa** Maiden.
angustifolia Auct., :: **E. amygdalina var. angustifolia** F. v. Mueller.
bosistoana F. v. Mueller. "Bosisto's Box." V., N. S. W. . . . . H. 25
×**botryoides** Smith. "Bastard Mahogany." V., N. S. W., Qu. . . . . H. 60
cajuputea Miquel, :: **E. odorata** Behr & Schlechtendal.
caleyi Maiden, (*E. sideroxylon var. pallens* Bentham.) "Broad-leaved Iron-bark." N. S. W. . . . . H. 15

calophylla R. Brown. "Red Gum." W. A. .... H. 40
— **var. rosea** Hort.
cambagei Deane & Maiden, :: **E. elæophora** F. v. Mueller
×**cinerea** F. v. Mueller, (*E. pulverulenta* F. v. Mueller, non Sims; *E. pulverulenta var. lanceolata* Howitt; *E. stuartiana* Auct. Hort. Calif.); "Blue-leaved Apple." N. S. W., Qu. .... H. 40
× — **var. multiflora** Maiden, (*E. pulverulenta* F. v. Mueller, in part; *E. stuartiana* F. v. Mueller, in part).
citriodora Hooker, (*E. maculata var. citriodora* F. v. Mueller.) "Lemon-scented Gum." Qu. .... H. 40
cladocalyx F. v. Mueller, :: **E. corynocalyx** F. v. Mueller.
×**coccifera** Hooker. Tas. .... H. 25
collossea F. v. Mueller, :: **E. diversicolor** F. v. Mueller.
conoidea Bentham, :: **E. erythronema** Turczaninow.
×**cordata** Labillardiere. Tas. .... H. 25
×**coriacea** A. Cunningham (*E. pauciflora* Sieber.) "Tumble-down Gum." V., S. A., N. S. W. .... H. 30
×**cornuta** Labillardiere. "Yate." W. A. .... H. 50
— *var. lehmanni* Auct. (?), :: **E. lehmanni** Preiss.
— *var. symphiocarpa* Auct., :: **E. lehmanni** Preiss.
corymbosa Smith "Bloodwood." N. S. W., Qu. .... H. 20
×**corynocalyx** F. v. Mueller, (*E. cladocalyx* F. v. Mueller.) "Sugar Gum." S. A., V. .... H. 40
crebra F. v. Mueller. "Narrow-leaved Iron-bark." N. S. W., N. A., Qu. .... H. 50
decipiens Endlicher. "Swamp Gum." W. A. .... H. 20
×**diversicolor** F. v. Mueller, (*E. collossea* F. v. Mueller.) "Karri." W. A. .... H. 60
dives Schauer, :: **E. amygdalina var. dives** F. v. Mueller.
drummondi Bentham, (*E. oldfieldi var. drummondi* Maiden) W. A. H.10
×**elæophora** F. v. Mueller, (*E. cambagei* Deane & Maiden, *E. goniocalyx* Auct.) "Bastard Box." S. A., V., N. S. W. .... H. 40
eremophila Maiden, (*E. occidentalis var. eremophila* Diels.) "Mallee." W. A. .... H. 12
×**erythronema** Turczaninow. (*E. conoidea* Bentham.) W. A. .... H. 15
×**eugenioides** Sieber. "Stringy Bark." V., N. S. W., Qu. .... H. 40
eximia Schauer. "Yellow Bloodwood." N. S. W. .... H. 30
fastigiata Deane & Maiden, :: **E. regnans** F. v. Mueller, in part ?)
×**ficifolia** F. v. Mueller. "Scarlet-flowering Eucalypt." W. A. ...... H. 25
fissilis F. v. Mueller, :: **E. obliqua** L'Heritier.
floribunda Huegel, :: **E. marginata** Smith.
gigantea Hooker, :: **E. obliqua** L'Heritier, in part only.
×**globulus** Labillardiere. "Blue Gum." Tas., V., N. S. W. .... H. 120
× — **var. compacta** Hort. Calif. "Compact Blue Gum." .... H. 60
gomphocephala A. P. DeCandolle. "Tooart." W. A. .... H. 30
goniocalyx Hort. Calif. & Auct., :: **E. elæophora** F. v. Mueller.
gracilipes Naudin, :: **E. leucoxylon** F. v. Mueller.
grandis (Hill.) Maiden, (*E. saligna var. pallidivalvis* Baker & Smith.) "Flooded Gum." N. S. W., Qu. .... H. 70

gunni Hooker. "Cider Gum." ?.............................. H. 20
gunni Hort. Calif. & Auct., :: **E. ovata** Labillardiere.
— *var. acervula* Deane & Maiden, :: **E. ovata** Labillardiere.
— *var. undulata* Luehm. & Auct., :: *E. ovata* Labillardiere, (??)
hæmastoma Smith "White Gum." Qu., N. S. W., Tas......... H. 20
× — **var. capitata** Maiden.
× — **var. micrantha** Bentham, (*E. micrantha* DeCandolle.) N. S. W., Qu.. H. 20
hemiphloia F. v. Mueller. "Black Box." N. S. W., Qu......... H. 30
— *var. albens* F. v. Mueller, :: **E. albens** Miquel.
×**lehmanni** Preiss. (*E. cornuta var. lehmanni* Auct., *E. macrocera* Turczaninow, *E. cornuta var. symphiocarpa* Auct.) "Bushy Yate." W. A.............................. H. 20
×**leucoxylon** F. v. Mueller. (*E. gracilipes* Naudin; *E. sideroxylon* F. v. Mueller, in part.) "White Gum." S. A., V., N. S. W.... H. 30
× — **var. erythrostema** F. v. Mueller. (*E. leucoxylon var. purpurea* Hort.)
— *var. purpurea* and *var. rosea* Hort, see preceding variety.
linearis Dehnhardt, :: **E. amygdalina var. angustifolia** F. v. Mueller.
longicornis F. v. Mueller, see **E. oleosa** F. v. Mueller.
×**longifolia** Link & Otto. "Woolly Butt." N. S. W., V........... H. 50
— **var. multiflora** Maiden.
×**macarthuri** Deane & Maiden. "Camden Woolly Butt." N. S. W. H. 40
macrocera Turczaninow, :: **E. lehmanni** Preiss.
×**macrorrhyncha** F. v. Mueller. "Red Stringy Bark." V., S. A., N. S. W., Qu.................................... H. 30
maculata Hooker. "Spotted Gum." N. S. W., Qu............. H. 30
— *var. citriodora* F. v. Mueller, :: **E. citriodora** Hooker.
maculosa R. T. Baker. "Spotted Gum." N. S. W., V.......... H.
maideni F. v. Mueller. "Blue Gum." V., N. S. W............. H. 30
marginata Smith. (*E. floribunda* Huegel.) "Jarrah." W. A..... H. 30
×**megacarpa** F. v. Mueller. W. A............................ H. 25
×**melliodora** A. Cunningham. "Yellow Box." V., N. S. W., Qu... H. 30
micrantha DeCandolle, :: **E. hæmastoma var. micrantha** Bentham.
×**mortoniana** A. Kinney. (*E. maideni* Auct., doubtful if F. v. Mueller's; *E. ovata var. grandiflora* Maiden, ?) [*see appendix, page* 84]................................ H. 60
montana Auct., :: **E. gunni** Hooker. (?)
nitida Hooker, :: **E. amygdalina var. nitida** Bentham.
numerosa Maiden, :: **E. amygdalina var. numerosa** Maiden.
obcordata Turczaninow, :: **E. platypus** Hooker.
×**obliqua** L'Heritier, (*E. fissilis* F. v. Mueller, *E. gigantea* Hooker, in part.) "Mess-mate," "Stringy Bark." S. A., V., N. S. W., Tas.................................... H. 50
obtusiflora DeCandolle, (*E. virgata var. obtusiflora* Maiden.) N. S. W... H. 15
×**occidentalis** Endlicher, "Flat-topped Yate." W. A............ H. 10
— *var. eremophila* Diels, :: **E. eremophila** Maiden.
odorata Behr & Schlechtendal. "Peppermint." S. A., N. S. W., V. H. 15

oldfieldi var. drummondi Maiden, :: **E. drummondi** Bentham.
oleosa F. v. Mueller. "Mallee." W. A., S. A., V., N. S. W...... H. 10
×**ovata** Labillardiere, (*E. acervula* Hook., *E. gunni* Auct.) "Swamp Gum." V., S. A., N. S. W., Tas..................... H. 60
— *var. grandiflora* Hort. Calif., :: **E. mortoniana** A. Kinney.
×**paniculata** Smith. "Iron Bark." V., N. S. W., Qu............. H. 40
pauciflora Sieber, :: **E. coriacea** A. Cunningham.
pilularis Smith. "Black Butt." V., N. S. W., Qu.............. H.
piperita Smith. "Peppermint." N. S. W...................... H. 20
platypus Hooker, (*E. obcordata* Turczaninow.) W. A............ H.
×**polyanthemos** Schauer. "Red Box." S. A., V., N. S. W......... H. 50
preissiana Schauer. W. A.................................. H. 8
×**pulverulenta** Sims. (*E. cinerea* F. v. Mueller and Hort. Calif., in part.) "Argyle Apple." N. S. W.................... H. 15
×**punctata** DeCandolle. "Gray Gum." N. S. W................. H. 60
— **var. grandiflora** Deane & Maiden.
radiata Sieber, :: **E. amygdalina var. radiata** Bentham.
×**regnans** F. v. Mueller, (*amygdalina var. regnans* F. v. Mueller, *E. fastigiata* Deane & Maiden, in part. ?) "Giant Gum." V., N. S. W., Tas................................. H. 50
×**resinifera** Smith. "Red Mahogany." N. S. W., Qu........... H. 30
risdoni Hooker. Tas...................................... H. 40
— **var. elata** Bentham.
×**robusta** Smith. "Swamp Mahogany." N. S. W., Qu........... H. 40
×**rostrata** Schlechtendal. "Red Gum." W. A., S. A., N. A., N. S. W., V., Qu.. H. 75
×**rubida** Deane & Maiden, (*E. gunni* Auct. & Hort.) "Manna Gum." S. A., V., N. S. W., Qu., Tas......................... H. 40
×**rudis** Endlicher. "Swamp Gum." W. A..................... H. 40
×**saligna** Smith. "Blue Gum." N. S. W., Qu.................. H. 40
— *var. pallidivalvis* Baker & Smith, :: **E. grandis** (Hill) Maiden.
salmonophloia F. v. Mueller. "Salmon-bark Gum." W. A...... H. 25
siderophloia Bentham. "Broad-leaved Iron-bark." N. S. W., Qu. H.
×**sideroxylon** A. Cunningham, (*E. leucoxylon var. sideroxylon* Auct.) "Red Iron-bark." V., N. S. W., Qu................. H. 30
— *var. pallens* Bentham, :: **E. caleyi** Maiden.
— **var. rosea** Hort.
×**sieberiana** F. v. Mueller. "Mountain Ash." V., N. S. W., Tas... H. 20
smithi R. T. Baker, (*E. viminalis var. pedicellaris* F. v. Mueller.)
stuartiana Auct. & Hort. Calif., :: **E. cinerea** F. v. Mueller.
tereticornis Smith. "Forest Red Gum." V., N. S. W., Qu., Papua H. 40
tetragona F. v. Mueller. W. A............................. H. 15
transcontinentalis Maiden; see note under **E. oleosa** F. v. Mueller.
undulata Luehm., :: **E. ovata** Labillardiere ?.
×**urnigera** Hooker. Tas.................................... H. 30
×**viminalis** Labillardiere. "White Gum." S. A., V., N. S. W., Qu. H. 70
— *var. pedicellaris* F. v. Mueller, :: **E. smithi** R. T. Baker.
virgata var. obtusiflora Maiden, :: **E. obtusiflora** Maiden.

Additional Species Reported as in California

The following either have been reported at various times as grown in California, or seed has been offered. No opinion can be expressed as to the correctness of these names until sufficient material for their determination becomes available.

abergiana
acaciæformis
acacioides
accedens
×acmenioides
×affinis
×algeriensis
angulosa
astringens
baileyana
×baueriana
bicolor
×blaxlandi
buprestium
cæsia
camphora
canaliculata
×capitellata
×consideniana
corrugata
cosmophylla
×crucis
dealbata
doratoxylon
drepanophylla
erythrocorys
×fastigiata
fœcunda
forrestiana
×gigantea
×goniocalyx
guilfoylei
howittiana
incrassata
jacksoni
jugalis
×kirtoniana
×lævopinea
leptophleba
leptopoda
le souefi
longicornis
macrocarpa
melanophloia
microcorys
microtheca
miniata
×muelleriana
nutans
oldfieldi
×patens
patentinervis
pellita
planchoniana
populifolia
propinqua
×pyriformis
quadrangulata
×rariflora
raveretiana
redunca
salubris
santalifolia
sepulcralis
×stellulata
stowardi
stricklandi
stricta
stuartiana (true)
tessellaris
×tetraptera
todtiana
torquata
trabuti
transcontinentalis
umbra
virgata

APPENDIX

Note on an interesting form of *Eucalyptus* grown in California.

While preparing this key to the species of *Eucalyptus* cultivated in California, some difficulty was experienced in differentiating clearly a tree variously known as **E. mortoniana, E. maideni** and **E. ovata var. grandiflora.** This multiplicity of names seems to indicate some doubt as to its correct determination, and without presuming to express any definite opinion as to its ultimate systematic position, the writer considers it advisable to here briefly discuss and describe it.

Eucalyptus sp. (?)

Medium-sized to large tree, to 20 meters tall or more. *Branches* ascending and spreading, drooping at their extremities; *bark* deciduous annually in thin strips except at base of trunk where it persists and becomes more or less thick, rough and fibrous; *juvenile leaves* opposite on quadrangular- or even winged stems, very shortly stalked, ovate, acute, cordate at base, green or rarely very slightly glaucous, 35-45 mm. long by 25-35 mm. broad, thinnish; *adult leaves* alternate, long-stalked, lanceolate, falcate, flat, rather thick, evenly green on both sides, 10-30 cm. long by 2-3.5 cm. wide, with the lateral veins remote and spreading from the midrib at an angle of about 40-45 degrees, intramarginal vein distant from the slightly thickened edge; *umbels* solitary in the leaf-axils, as far as known always three-flowered; *peduncle* flattened, 0.8-1 cm. long; *buds* shining green, smooth or nearly so; *calyx-tube* obconic or funnel-form, widest at juncture with lid and tapering gradually and uniformly to the indistinct, short and thick pedicel; *operculum* often seen to be double, varying from hemispheric to conic, obtuse or more often obtusely acuminate; *flowers* 0.8-1.1 cm. diameter; *stamens* whitish, inflected in bud; *anthers* opening by parallel slits; *capsule* shortly pedicelled, dark shining green, changing to brown when dry, very indistinctly glandular-roughened, cylindro-conic, 1-1.2 cm. in diameter, slightly longer; *rim* double, 0.2 cm. wide or less, usually flat, but often concave, or at times even slightly convex; *valves* usually 4, scarcely protruding, their broad base sunk and their narrow tips about even with the rim; *seeds* not winged, fertile black, angular, sterile light brown, narrow; *seedlings* uniform, very vigorous.

This description is based on fresh material from a tree growing in Golden Gate Park, San Francisco, California, on the Main Drive near the Tennis Courts. The material from Santa Monica is practically identical with this except for the perhaps more acuminate lid of the smooth buds and the slightly more convex rim. Both these trees may well have been grown from the same lot of imported seed. The tree in Golden Gate Park appears to be about 45 years old, and specimens of both **E. globulus** and **E. ovata** of about the same age and height are growing in its vicinity. In general appearance it resembles **E. globulus** rather than **E. ovata.** From seed of this tree a large number of seedlings have been raised and its wider dissemination may be hoped for. It is not improbable that this form is represented in California by other individuals, and the writer would welcome any information in the matter.

This species or form may first be compared with **E. mortoniana** A. Kinney, described in *"Eucalyptus,"* 1895, p. 193, illustration in back of volume. The writer has not seen any material named by Kinney, but his plate seems to show a form identical with the tree in Golden Gate Park, as well as with specimens from Santa Monica in the herbarium of the California Academy of Sciences. Kinney's description also fits fairly well, but might apply even better to a tree, apparently typical **E. maideni,** growing in Balboa Park, San Diego. Especially the comparison of the capsule to a kettle of some thick fluid boiling over, as suggested by the thick, brown rim of the fruit of the San Diego tree, is very apt. Comparison with a large series of **E. maideni** collected in its natural range may show this to be sufficiently variable to permit our material to be included in it; and the writer would be so inclined but for Maiden's reference of the local tree to **E. ovata var. grandiflora.**

Maiden in his "Revision," page 256, refers the form here discussed to *E. maideni* F. v. Mueller, basing his opinion on sheet No. 237,908 of the U. S. National Museum, not seen by the present writer. Figure 8, plate 80 of the *Revision* resembles our form only slightly and may well have been typical **E. maideni.**

Material from the tree in Golden Gate Park sent to J. H. Maiden by Miss Alice Eastwood was determined by him as *E. ovata grandiflora* Maiden.

This uncertainty is certainly very suggestive.

Von Mueller's description of **E. maideni** may well be taken to cover the trees in question, but that species seems to differ from the California trees as follows:

Juvenile leaves very glaucous, sessile or nearly so; *buds* mostly more or less warty, glaucous, strongly angled; *capsules* hemispheric; *rim* broad, usually convex, brown; *valves* usually broadly triangular, often exserted.

E. ovata var. grandiflora Maiden, resembles our material only slightly, and mainly in the buds and fruits; it differs as follows:

Juvenile leaves soon alternate and stalked, rotund, obtuse, scarcely glaucous, on terete stems; *mature leaves* ovate to ovate-lanceolate, undulate, thin; *umbels* usually many-flowered; *pedicels* as a rule long and slender; *buds* not angled; *capsules* conoid or goblet-shaped, with *rim* markedly larger than calyx-tube, and *valves* rather narrow.

Figure 2, plate 113 of Maiden's "*Revision*" nevertheless suggests our material, even if faintly. As at least the general range of **E. ovata** coincides in part with that of **E. maideni** and **E. globulus,** the hint of hybridism may perhaps be permitted. The specimens from Santa Monica have quite smooth buds with sharply pointed lids.

E. globulus Labillardiere, as grown in California, usually differs much more in its *juvenile leaves* being very glaucous, its *umbels* only rarely 3-flowered or peduncled, the *buds* very warty and glaucous and very strongly angled; *capsules* very large, with wide rim and broad valves.

To judge from the juvenile foliage alone, the tree in question appears to be much more closely related to **E. maideni** or **E. globulus** than to **E. ovata,** the resemblance to the latter being confined to the buds and fruits. As the Californian trees were most likely grown from Australian seed, actual field-observations in the native home of the various species are needed to show whether the hybrid theory is at all tenable.

An interesting sidelight is cast on the subject by Kinney's report of some test-distillations made by S. M. Woodbridge, who obtained from 1000 lbs. of green leaves of **E. globulus** 134.8 oz. of oil as against 10.9 oz. in the case of **E. mortoniana.**

In conclusion, the writer offers the suggestion that the name **E. mortoniana** Kinney may well be restored for the local form, as it seems to differ more from **E. maideni** F. v. Mueller than does that from **E. globulus** Labillardiere. It would seem that if **E. maideni** is really so variable as to include the California form here discussed, it should itself be merged with **E. globulus.** Until further observations throw new light on the matter that may well rest here for the time being, and if these lines should stimulate enough interest to lead to further investigations they will have served their purpose.

A Selected Bibliography

Baker, R. T.—Proceedings of the Linn. Soc. of New South Wales.
Bentham & Mueller—Flora Australiensis, 1866, Vol. 3.
Deane & Maiden—Proc. Linn. Soc. of New South Wales, 1895-1902.
DeCandolle, A. P.—Prodromus Systematis.
Don, G.—Mostly a translation of the preceding.
Hall, H. M.—Bailey's Cycl. of Hort., Vol. 2, 1914.
Hooker, J. D. & W. J.—In "Curtis, Botanical Magazine."
Hooker, J. D. & W. J.—Icones Plantarum.
Ingham, N. D.—Univ. Calif. Agr. Exp. Stat. Bull. 196 (Cultivation.)
Kinney, A.—Eucalyptus, 1895.
Lindley, J.—Botanical Register.
Loddiges—Botanical Cabinet.
Luehmann, J. G.—Australasian Society for the Advancement of Science, 1898.
Maiden, J. H.—Critical Revision of the Genus Eucalyptus;
Forest Flora of New South Wales;
Native Useful Plants of Australia;
Proc. of the Linn Soc. of New South Wales.
McClatchie, A. J.—Eucalypts cult. in the U. S.—U. S. Forest. Bull. 35, 1902.
Metcalf, W.—Growth of Euc. in Calif. Plant., U. C. Agr. Ex. Stat. Bull. 380.
Mueller, Ferdinand von—Eucalyptographia;
Fragmenta Phytographiæ Australiæ;
Proc. Linn. Soc. of New South Wales.
Niedenzu, F.—Myrtaceæ, in Engler & Prantl's "Natürlichen Pflanzenfam."

More extended Bibliographies can be found in several of above works.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 4, pp. 89-139, plates 2-7, 5 text figs. JUNE 22, 1928

IV

TERTIARY AND PLEISTOCENE MOLLUSCA FROM THE GALAPAGOS ISLANDS

BY

WILLIAM HEALEY DALL

AND

WASHINGTON HENRY OCHSNER

EDITOR'S NOTE

During 1905 and 1906 an expedition from the California Academy of Sciences spent 18 months in the exploration of the Galapagos Islands. Very large collections were made in several branches of natural history and the present report contains descriptions of the fossil Mollusca. Geology, paleontology and conchology were in charge of Mr. Ochsner and the material he assembled far exceeded in quantity and importance that secured in these branches by any previous or subsequent expedition. A preliminary notice giving a brief summary of the geological and paleontological results was published in 1924 by Dr. Dall.[1]

Previous reports on the Expedition of 1905-1906 have been published as: Proceedings of the California Academy of Sciences, 4th Ser., Vol. I, Vol. II, Pts. 1, 2, Nos. 1–18.

Various circumstances have contributed to delay the publication of the final reports on the fossils and land shells until this time although the manuscript has been almost complete for several years. In the meantime both authors have died[2]. The final preparation of the manuscript for the printer has been undertaken by Dr. G. Dallas Hanna and his part has been made possible through hearty cooperation of all interested persons; especially should be men-

---

[1] (Note on fossiliferous strata on the Galapagos Islands explored by W. H. Ochsner of the Expedition of the California Academy of Sciences in 1905-6. <Geol. Mag., Vol. 61, No. 723, 1924, pp. 428-9.)

[2] Dr. Dall in Washington, D. C., March 27, 1927, and Mr. Ochsner in Portland, Oregon, April 11, 1927.

tioned the following, to all of whom the Academy is very grateful: Mrs. Hilda Carling Ochsner; Mr. Charles H. Shaw; Mr. Randolph V. Whiting and Mr. Henry F. Wrigley.

The actual descriptions of the fossils were drawn by Dr. Dall. Except for the necessary changing of four new specific names and the addition of fuller locality data from Mr. Ochsner's notes, this portion of the paper remains as submitted. All locality data and general notes were supplied by Mr. Oehsner. Most of this material is taken almost verbatim from his note books, written in the field. The sketch maps and sections are tracings from originals found in these note books, now deposited in the Academy. The original base map was the U. S. Hydrographic Office sailing chart of the Galapagos Islands.

It was the expressed wish of both Dr. Dall and Mr. Ochsner that the report on the fossils should appear under joint authorship.

The plates of fossils have been made from photographs taken by Dr. Hanna.

—*Editor*

Introduction

The fauna of the Galapagos Islands has been the subject of much discussion. The islands have been held by some to have been a part of the American continent, separated by subsidence of a connecting area; others have considered them to be a permanently isolated group formed by volcanic action and built from the depths of the ocean by volcanic ejections. Still another hypothesis is that they form the remnants of an outlying archipelago of a former Pacific continent now submerged below the sea.

A discussion of the recent fauna by eminent specialists has led to the conclusion that in large part it is of American derivation, modified by long isolation. This is especially true of the land animals, while the marine invertebrates, although predominantly of American affinities, also include a small proportion of forms now more characteristic of the Pacific islands to the westward and southward. However, the marine invertebrate fauna of Clarion Island, one of the nearest to the Galapagos, so far as yet explored, is of a strictly Indo-Pacific type and presents a strong contrast to the fauna of the Galapagos.

One of the most interesting and important of the discoveries made by the Academy's Expedition of 1905-1906 was the discovery of fossil Mollusca in several places.

Formerly it was supposed that the islands were wholly of volcanic origin, or at least destitute of fossil-bearing sedimentary rocks. The discovery of these not only affords a clue to the minimum age of the Galapagos group, but also an indication of the sources from which its fauna has been derived.

It is known that about the end of the Oligocene period, or in the early Miocene, a movement in elevation of the earth's crust in the Panamic region resulted in the union of the continents of North and South America and the closing of the gap between them through which the Eocene marine fauna of the north and west shores of South America had previously extended.

It seems a reasonable hypothesis that, during the widespread volcanic activity of the Miocene, the Galapagos group, or its preexisting nucleus, underwent enlargement and elevation, a process which the discoveries made by the Academy's expedition show continued, perhaps intermittently, into Pleistocene time.[3]

The characteristics of the fossils collected are, with hardly an exception, typically American. The faunas are tropical, as might be expected, but there is nothing of a typical Indo-Pacific nature, although some of the species belong to groups widely distributed in tropical seas, both of America and elsewhere.

While most of the species belong to groups now represented in the Panamic fauna there are a few which recall forms now existing only on the Antillean side, and quite a number which belong rather to the subdivision of the Panamic fauna now existing in the Gulf of California, than to the warmer waters of the Gulf of Panama. The inference might be drawn from this that at the time the Galapagos fossil forms were living, the temperature of the local seas was somewhat cooler than at present.[4]

Collecting Stations

Albemarle Island.—About 1¼ miles northeast of the settlement of Vilamil, Albemarle Island, Locs. 802, 803 (C.A.S.). The locality is reached from the settlement by

---

[3] Mr. Joseph R. Slevin of the department of herpetology of the Academy and who was a member of the 1905-1906 expedition, visited the islands again in December, 1927, and reports violent volcanic activity on Narborough Island on December 13.—*Editor.*

[4] It is suggested from the present study that the fossils from Albemarle Island are Pleistocene in age while those from Indefatigable and Seymour are Pliocene.

crossing an almost level, barren, lava flow. The fossil-bearing sediments are covered with green bushes that stand out in sharp contrast with the surroundings. This vegetated area is a gently undulating plain, the soil of which is composed of a white shell-sand such as forms the beaches of the islands in

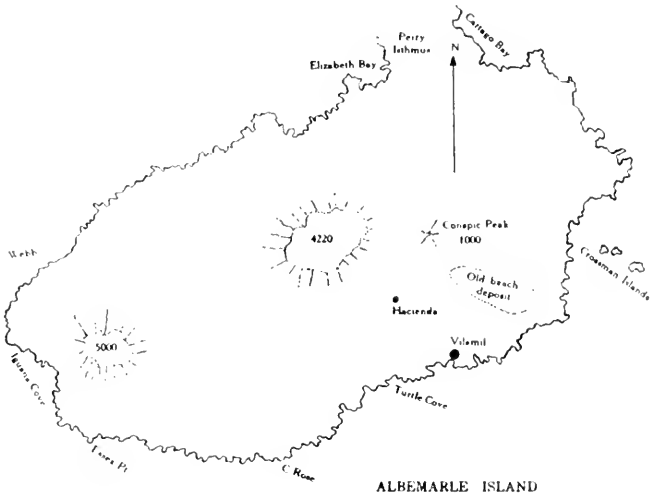


Fig. 1. Sketch map of lower part of Albemarle Island showing location of old beach deposit; this deposit is 40 feet above sea level and contains many marine fossils believed to be Pleistocene in age.

most places at the present time. The fossils are found in considerable abundance on the surface, the easily eroding, sandy matrix having broken down readily even in this dry zone. The entire area is an old weathered beach, about 40 feet above the sea, and it is believed that the fossils collected prove the age of the deposit to be younger than either that found on Indefatigable or on Seymour Island.

Indefatigable Island.—The northeast side of this large island appears from the sea to be an unbroken line of cliffs 50 to 150 feet high. The expedition's vessel, the *"Academy,"* anchored opposite a short narrow beach of basaltic pebbles, a short distance south of Gordon Rocks; here a landing was made. [See map.] The cliffs at this point are distinctly stratified and a large collection of fossils was secured from the various layers. Four zones were differentiated and numbered *A, B, C* and *D*. [Zones *A, B* and *D* bear locality numbers 807, 808, and 809, respectively, in the Academy's series. G. D. H.] The relative position and thickness of the zones is shown in the accompanying section. [The fossils of zones

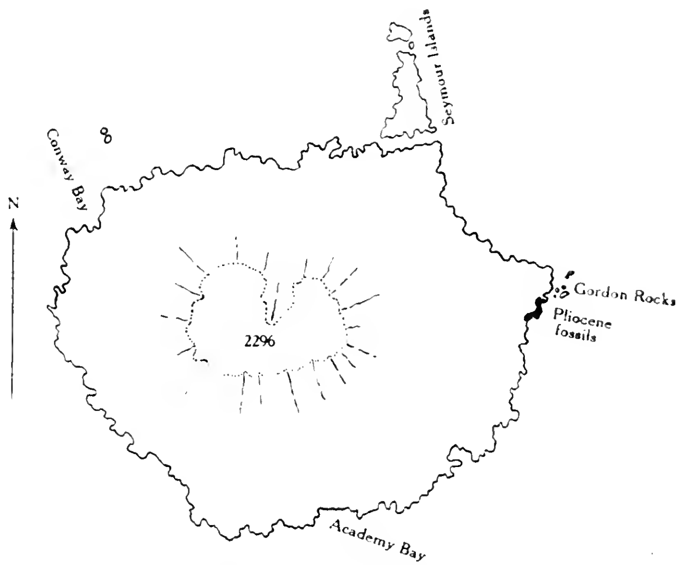


Fig. 2. Sketch map of Indefatigable Island showing location of fossil-deposit just south of Gordon Rocks. This deposit contains many marine fossils believed to be Pliocene in age.

B and *D* were not segregated in the check-list shown below. G. D. H.]

Zone *A*, the lower-most bed, is a hard, compact, light-colored, crystalline sandstone, evidently an old beach deposit. It can be traced along the cliffs for a considerable distance and is about 15 feet thick.

Zone *B* lies conformably on zone *A* but is a reddish, tufa-like sandstone which crumbles readily under the hammer. The rocks of zone *A* formed a natural shelf upon which fallen blocks of *B* and *D* rested and from these blocks many fossils were taken. Zone *B* is about 40 feet thick.

Zone *D* is a layer about four feet thick at the top of *B*, and contained many fossils; the assemblage seemed to differ somewhat from *B*.

Zone *C* is the lava capping to the sedimentary series and at the collecting point was about 70 feet thick.

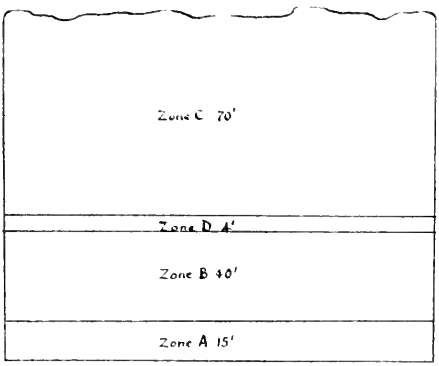


Fig. 3. Diagrammatic cross-section of beach-cliff exposure on Indefatigable Island, just south of Gordon Rocks.

Beneath zone *A* lava was found wherever the exposure could be seen.

This sedimentary series was observed to extend along the sea cliff of the northeast side of the island for many miles and undoubtedly would furnish additional fossils upon further search.

Seymour Island.—This island is actually a northern extension of Indefatigable, the present separation having been produced by recent faulting. The same or other earth movements produced a series of terraces and raised some old beaches above the sea. Fossils occur at several places as shown on the sketch map herewith but all seem to belong to the same period and are apparently not far from the same age as those found in the upper zone *(B* and *D)* of Indefatigable.

The usual landing on the island is about the center of the west side. Immediately to the southwest loose fragments of grayish rock are found scattered over the surface of reddish soil; these fragments contain fossils but most of them are so badly weathered they are of little value. The rocks are in place along some of the sea cliffs, particularly on the south-west escarpment. Here the lower edge of the fossiliferous stratum at its highest point lies about 45 feet above the sea and is capped with a dense crystalline lava 12 to 15 feet thick. The fossil bed dips rather uniformly to the south at about 8°;

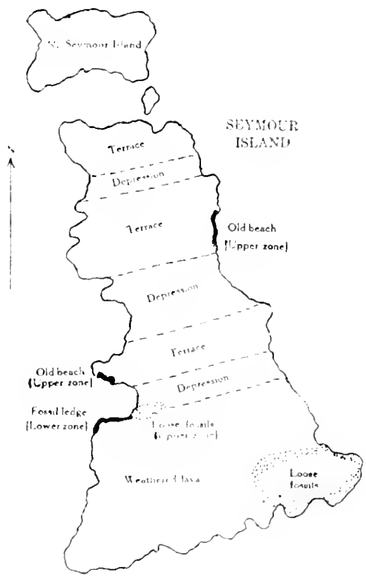


Fig. 4. Sketch map of Seymour Island showing location of various fossil-deposits believed to be Pliocene in age.

it gradually becomes thinner and is finally lost near sea level. Its greatest thickness is about eight feet. [This is referred to in the notes as the "fossil ledge." G. D. H.] The matrix is clear white, yellow and red beach sand. The upper 12 to 18 inches is very compact, almost crystalline from its contact with the lava flow. It was believed in the field that this stratum was somewhat older than that noted below and the fossils were kept separate. [Collections from this ledge are No. 806 of the Academy's paleontological series. G. D. H.]

Another fossiliferous locality is a small, old-beach area just to the west of the ledge mentioned and another is a small bight of the eastern shore. [See map.] The exposures are poor on account of the weathering of the sea cliffs but they appeared to be about five feet thick. The scattered fossil-bearing rocks were supposed to be part of this "old beach" material because of the general crystalline texture and the fossils found. The old-beach exposure on the western sea cliff is not over 300 feet long and it can be traced inland about 200

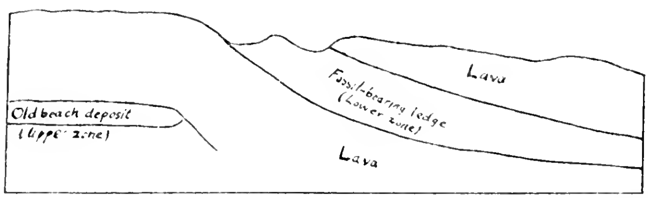


Fig. 5. Diagrammatic cross-section of beach-cliff exposure on the west side of Seymour Island.

feet. [The collections made from this deposit and the scattered masses are numbered 804 and 805 respectively in the Academy's series and are referred to as the upper or younger bed on Seymour. G. D. H.]

Check-lists of Fossils

Old Beach, Albemarle Island

Gastropoda

Acirsa albemarlensis, n. sp.
Alectrion versicolor, var. *nodocincta* C. B. Adams
Cancellaria emydis, n. sp.
Cantharus janellii Kiener
Colubraria pervaricosa, n. sp.
Conus academicus, n. sp.
Conus sp. aff. *fergusoni* Sowerby
Conus mahogani Reeve
Conus loomisi, n. sp.
Crepidula aculeata Gmelin
Crucibulum spinosum Sowerby
Cymatosyrinx zeteki, n. sp.
Cypræa albuginosa Mawe
Epitonium nesioticum, n. sp.
Fusinus dupetitthouarsi Kiener
Hipponix barbatus Gray
Malea ringens Sowerby
Mitra gausapata Reeve
Mitra lineata Swainson
Natica chemnitzii Pfeiffer
Oliva melchersi Philippi
Olivella inconspicua C. B. Adams
Phos cocosensis Dall
Phos sp. indet.
Polinices uber Valenciennes
Solarium granulatum Lamarck
Strombina recurva Sowerby
Terebra albemarlensis, n. sp.
Terebra galapagina, n. sp.
Terebra litorea, n. sp.
Trivia maugeriæ Gray
Trivia pacifica Gray
Trivia pulloidea, n. sp.
Vermicularia eburnea Reeve

Pelecypoda

Barbatia gradata Broderip	*Glycymeris gigantea* Reeve
Barbatia reeveana Hanley	*Ostrea megodon* Hanley
Barbatia solida Broderip & Sowerby	*Papyridea aspersa* Sowerby
Chama exogyra Conrad	*Pecten* sp. aff. *slevini*, n. sp.
Chama phonea, n. sp.	*Psammosolen galapaganus* Dall
Chione subrostrata Lamarck	*Pteria* sp. indet.
Divaricella lucasana, n. sp.	*Tellina* (*Macaliopsis*) *reclusa* Dall

Forty-eight species collected, of which three are indeterminable specifically, and 32 (or 66 per cent) are still living in the Panamic fauna.

B 2; upper zones, *B* and *D*, Indefatigable Island. C 2; upper zone (old beach and scattered fossils) on Seymour Island.

Gastropoda

Acteocina infrequens C. B. Adams	B 2	
Alectrion tropicalis, n. sp.	C 2	
Alectrion oldroydæ, n. sp.	B 2	
Argobuccinum argus Gmelin (*vexillum* Broderip)	B 2	
Bullaria adamsi Menke	B 2	C 2
Conus academicus, n. sp.	B 2	
Conus sp. aff. *fergusoni* Sowerby	C 2	
Conus gradatus Mawe	B 2	
Conus miliaris Broderip, var.	C 2	
Crepidula aff. *onyx* Sowerby	B 2	
Cymatium sp. aff. *tigrinus* Broderip	B 2	
Cypræa (young) aff. *cervinetta* Kiener	C 2	
Epitonium ennapleura, n. sp.	B 2	
Epitonium implicatum, n. sp.	B 2	
Epitonium innominatum, n. sp.	B 2	
Fusinus dupetitthouarsi Kiener	B 2	
Fusinus panamensis Dall	B 2	
Latirus galapaganus, n. sp.	B 2	
Latirus melvilli, n. sp.	B 2	
Murex (*Phyllonotus*) *princeps* Broderip	C 2	
Nerita oligopleura, n. sp.	C 2	
Neverita cf. *recluziana* Deshayes	C 2	
Neverita sp. ind.	B 2	
Oliva, sp. indet.	B 2	
Polinices cora Orbigny	B 2	
Polinices uber Valenciennes	B 2	
Solenosteira, sp. indet.	B 2	

Strombina angularis Sowerby	B 2	
Strombina liopleura, n. sp.	B 2	
Strombus propegracilior, n. sp.	B 2	
Surcula insulæ, n. sp.	B 2	
Tegula forbesi, n. sp.	B 2	C 2
Turbo agonistes, n. sp.	B 2	C 2
Turbo crenulatus Gmelin	B 2	
Turbo vermiculosus, n. sp.	B 2	C 2
Turritella goniostoma Valenciennes	C 2	
Vermicularis eburnea Reeve	B 2	

PELECYPODA

Anomia adamas Gray	C 2	
Anomia peruviana Orbigny	C 2	
Argina ? vespertina Morch	B 2	
Barbatia seymourensis, n. sp.	C 2	
Chama sp.	C 2	
Chione seymourensis, n. sp.	C 2	
Chione, sp. indet.	C 2	
Diplodonta, sp. indet.	B 2	
Dosinia ponderosa Gray	B 2	
Ervilia galapagana, n. sp.	B 2	
Jagonia galapagana Dall	C 2	
Jagonia mexicana Dall	B 2	
Lima ? nesiotes, n. sp.	C 2	
Lucina spherica, n. sp.	B 2	
Macoma (Psammotreta) aurora Hanley	C 2	
Macrocallista (cast) aff. *squalida* Sowerby	C 2	
Metis dombeyi Hanley	C 2	
Modiolus aff. *brasilianus* Lamarck	C 2	
Ostrea, sp. ind.	C 2	
Pecten circularis Sowerby	B 2	
Pecten insulus, n. sp.	B 2	
Pecten seymourensis, n. sp.	C 2	
Pecten slevini, n. sp.	C 2	
Pecten subnodosus Sowerby	C 2	
Pitaria callicomata ? Dall	B 2	
Pitaria, sp. indet.	B 2	C 2
Protothaca grata Say	C 2	
Protothaca sp. young aff. *thaca* Molina	C 2	
Pteria sp. ?	C 2	
Scapharca sp. aff. *labiata* Sowerby	C 2	
Scapharca multicostata Broderip	B 2	

Sixty-eight species of which 27 are still living, 23 are apparently new, and 18 are indeterminable.

B 1; lower, zone *A*, Indefatigable Island.
C 1; lower zone (fossil ledge) on Seymour Island.

GASTROPODA

Conus sp. aff. *fergusoni* Sowerby	C 1	
Conus indefatigabilis, n. sp.	B 1	
Fusinus dupetitthouarsi Kiener	B 1	
Sinum concavum Lamarck	B 1	C 1
Strombus, sp. indet.	B 1	

PELECYPODA

Codakia recta, n. sp.	C 1
Panope similaris, n. sp.	B 1
Pecten slevini, n. sp.	B 1
Pholadomya darwini, n. sp.	C 1

Nine species, of which two are still living, two are indeterminable, and five appear to be new.

DESCRIPTIONS OF NEW SPECIES

1. **Terebra albemarlensis** Dall & Ochsner, new species

Plate 2, figure 1

Shell acute, elongate, the apex defective, with about 18 remaining whorls; sculpture of the early whorls consisting of about 15 feeble axial riblets extending backward to the sutural band in front of which they expand into hemispherical bead-like nodules with less or subequal interspaces, forming a band in front of the sutural band; next the preceding suture is a broad obliquely nodulous spiral band; the whorl is distinctly constricted in the middle; this sculpture is gradually modified until on the later whorls we have a broad obliquely, axially wrinkled band in front of the very obscure suture separated by a deeply incised line from the anterior, nearly smooth part of the whorl which is contracted rather abruptly at the base; aperture defective, the outer lip thin, sharp, retractively arcuate in the middle as indicated by the lines of growth; body with a thin wash of callus, pillar short, rapidly attenuated, abruptly twisted, with a shallow sulcus inside the margin which in a perfect specimen may be keeled. Height (about four whorls lost), 85 mm; of last whorl, 23 mm.; maximum diameter, 15 mm.

Holotype: No. 2894; *paratypes:* Nos. 2895, 2896, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, 1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group. Probably Pleistocene.

In a fragment, probably of the same species, the nucleus is slightly oblique to the axis and comprises about three irregular, smooth, polished, inflated whorls, succeeded by about eight nearly smooth whorls with a plain sutural band set off from the whorl by an incised line; only after these does the sculpture above described begin. If the identification is correct, this would give the type specimen 24 whorls exclusive of the nucleus. The changes in the sculpture during growth are quite remarkable. This species is perhaps nearest to *T. variegata* Gray, now living in the Gulf of California.

2. **Terebra galapagina** Dall & Ochsner, new species

Plate 2, figure 2

Shell elongate, acute, slender, solid, with 14 whorls exclusive of the (lost) nucleus which from the fragment remaining was smooth and polished; sculpture strong, axially composed of (on the last whorl 16) strong, slightly sigmoid ribs, extending over the entire whorl, with narrower interspaces, conspicuously swollen just in front of the inconspicuous suture, the series giving the effect of a band of nodules; in front of these the whorl is somewhat constricted, most strongly on the earlier whorls; spiral sculpture of (on the last whorl 11, between the sutures five) incised lines with wider flattish interspaces cutting the ribs in front of the sutural band of nodules; at the posterior margin of the base the space between these lines inclines to be somewhat nodulose on the ribs; in front of these are two or three more similar lines, while the surface of the canal is marked only by incremental lines; aperture narrow, canaliculate at the posterior commissure; outer lip thickened when it coincides with a rib, internally smooth, not lirate; on the body and inner lip a moderate deposit of callus; canal short, wide, recurved, the pillar without a keel or sulcus, the siphonal fasciole inconspicuous. Height, 35 mm.; maximum diameter of last whorl, 7 mm.; height of last whorl, 13 mm.

Holotype: No. 2897; *paratypes:* Nos. 2898, 2899, 2900, 2901, 2902, 2903, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, 1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group. Probably Pleistocene.

This species is nearest to the recent *T. armillata* Hinds, which ranges from Magdalena Bay, Lower California (where it is also found as a post Pliocene fossil) to the Gulf of Panama.

3. **Terebra litorea** Dall & Ochsner, new species

Plate 2, figure 3

Shell elongate, acute, with 15 slightly constricted flat-sided whorls beside the (lost) nucleus; suture distinct, sculpture in general feeble; on the apical whorls the axial sculpture consists of (on the sixth whorl about 12) rounded straight ribs extending from suture to suture with a raised nodulous spiral band in front of the suture and five or six fine spiral threads on the rest of the whorls, evenly spaced and over riding the ribs; on the subsequent whorls the ribs become narrower, sharper, and more numerous, crossing the subsutural band, the nodules disappear, the spiral threads become wider and flattened with much narrower interspaces, the axial ribs flexuous (about 33 on the last whorl), and continuous over the whole whorl; the base is rounded, constricted toward the canal; the aperture subrectangular, narrower than high; the body with a thin coat of enamel; pillar strong, twisted, with two sharp spiral plaits of which the posterior is carried outside the aperture as a sharp keel behind the siphonal fasciole; canal rather long, narrow and recurved. Height of shell, 56 mm.; of last whorl, 21 mm.; maximum diameter, 13 mm.

Holotype: No. 2904, Mus. Calif. Acad. of Sci., collected by W. H. Ochsner, March 3, 1906, 1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group. Probably Pleistocene.

This species is nearest to the recent *T. specillata* Hinds, of the west coast of America from the Gulf of California to the Bay of Panama.

4. **Conus indefatigabilis** Dall & Ochsner, new species

Plate 2, figure 4

Shell rather large, of about 10 whorls, the nucleus lost, the suture excavated, without spiral sculpture, the shoulder in the early whorls with a cord-like keel which becomes sharper in the later ones; the anal sulcus deep, the suture appressed, and the whorl between the shoulder and the suture sculptured with concentric lines in harmony with the sulcus; anterior portion of the whorl straight-sided, rapidly attenuated, a slight convexity near the shoulder; surface smooth except a few spiral sulci near the anterior end. Height, 57 mm.+; height of last whorl, 50 mm.+; maximum diameter at the shoulder, 34 mm.

Holotype: No 2905; *paratype:* No. 2906, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from lowermost horizon (zone A) on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species is perhaps nearest to *Conus regularis* Sowerby living from the Gulf of California to Panama.

5. **Conus academicus** Dall & Ochsner, new species

Plate 2, figure 5

Shell of moderate size with an acute apex and slightly concave sides to the spire, with about eight whorls excluding the (lost) nucleus; suture distinct, not channelled or turrited; surface between the sutures axially sculptured with hardly curved, close-set incremental lines and very slightly excavated; shoulder rounded, surface in front of the shoulder two-thirds of the distance toward the anterior end smooth, slightly convex; the anterior third sculptured with distant grooves, the interspaces wider and smooth, the grooves becoming closer and more channelled anteriorly, about four on the body and six or seven more crowded on the region of the canal; aperture long and narrow, the inner lip smooth, the canal short, straight, and as wide as the aperture behind and hardly differentiated from it. Height of shell, 31 mm.; of aperture, 25 mm.; maximum diameter at the shoulder, 16 mm.

Holotype: No. 2907; *paratypes:* Nos. 2908, 2909, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

6. **Conus loomisi** Dall & Ochsner, new species

Plate 2, figure 6

Shell of moderate size, solid, with a slightly concave, acute spire, and about 12 whorls exclusive of the (lost) nucleus; suture distinct, whorls between the sutures excavated, marked only with concavely retractive inceremental lines, corresponding to a sulcus at the aperture; shoulder well marked but rounded; body in front of the shoulder with slightly convex sides, constricted somewhat behind the canal; sculpture of the posterior half of the body obsolete, consisting of very narrow incised lines with much wider flat interspaces; on the anterior half of the body these lines gradually become wider excavated channels, numbering about eight on the canal, which in the adult has a marked siphonal fasciole, there being three or four more grooves; aperture narrow, wider anteriorly; canal deep, wide, very slightly recurved. Height, 44 mm.; height of last whorl, 38 mm.; diameter at shoulder, 22 mm.

Holotype: No. 2910; *paratypes:* Nos. 2911, 2912, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906. 1¼ **miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

The recent shell which most nearly approaches this is *Conus lucidus* Mawe, which occupies the same region at present. This is a shorter and more stumpy shell with less conspicuous sculpture.

The species is named for Mr. Leverett Mills Loomis who was Director of the Museum of the California Academy of Sciences at the time the Galapagos Expedition was organized.

Several localities produced undeterminable cones, one large one especially which by its size and outline recalled *C. fergusoni* Sowerby, from the Gulf of Panama.

7. **Surcula insulæ** Dall & Ochsner, new species

Plate 6, figure 12

Shell acutely fusiform, with about three smooth inflated nuclear and seven subsequent sculptured whorls of which the last is longer than the spire; axial sculpture of (on the penultimate whorl about 10) obscure wide ribs, with subequal interspaces, the ribs stronger on the early whorls and obsolete on the last whorl, and chiefly conspicuous on account of the swelling at the intersections of the spiral sculpture; suture widely appressed, the band sculptured by the concave incremental lines of the anal sulcus; spiral sculpture on the early whorls of two strong cords swollen where they over ride the ribs, the posterior cord slightly stronger; between it and the sutural band two smaller threads; whorl constricted behind the shoulder; on the last turn the ribs are indicated only by keeled elongate nodules of the major spiral; in front of the shoulder are about 22 flattish threads extending to the canal, mostly with narrower interspaces, undulated by axial irregularities of growth which almost approach a minor variety of ribbing, and occasionally a little nodulous at the intersections; aperture long and narrow, outer lip simple, thin, only moderately produced; anal sulcus close to the suture, about semicircular; body and inner lip erased, smooth, canal rather wide, somewhat twisted, and anteriorly attenuated. Height of shell, 26 mm.; of last whorl, 17 mm.; of aperture and canal, 13 mm.; maximum diameter, 8 mm.

Holotype: No. 2913, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species belongs to the group of the recent *S. maculosa* Sowerby, which ranges from the Gulf of California to Peru.

8. **Cymatosyrinx zeteki** Dall & Ochsner, new species

Plate 6, figure 13

Shell small, rather acute, with a smooth blunt nucleus of about three turns and nine subsequent whorls; aperture about one-third of the total length; whorls slightly convex, constricted by the anal fasciole; sculpture of (on the penultimate whorl 10, on the last whorl 14) nearly straight axial, stout, rounded ribs, crossing the whorls, and crowded together with very narrow interspaces, obsolete on the canal; aperture semilunate; outer lip produced anteriorly; anal sulcus short, wide, with a flaring margin; inner lip with a rather thick smooth layer of enamel; canal short, wide, with an inconspicuous fasciole. Height of shell, 20 mm.; of last whorl, 11 mm.; of aperture, 8 mm.; maximum diameter, 7.5 mm.

This shell belongs to the smooth, prominently ribbed group of which the recent Antillean *C. æpynota* (Dall), is an example, and approaches the recent Galapagan species, *C. roseotincta* (Dall).

Holotype: No. 2914; *paratype:* No. 2915, Mus. Calif. Acad. Sci., collected by W. H Ochsner, March 5, 1906. **1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

The species is named for Mr. James Zetek, who has made extensive collections in the Panamanian region.

9. **Cancellaria emydis** Dall & Ochsner, new species

Plate 2, figure 7

Shell small for the genus, acute, plump, the aperture longer than the spire, with a small turbinate smooth nucleus of about 3½ whorls and 4½ subsequent whorls; axial sculpture of (on the penultimate whorl 13) sharp, narrow ribs crossing the entire whorl with a slight obliquity, separated by wider, excavated but not channelled interspaces, and crossed by (on the last whorl 12) narrow prominent cords, of which the two in front of the suture are more prominent and widely separated than the others; this reticulation extends over the whole shell, the cords being slightly swollen but not nodulous at the intersections; aperture oblique, sublunate, rather narrow, with nine or ten lirations within the thin, not expanded outer lip which is slightly crenulated in the specimen by the external sculpture; body with a subsutural callous ridge and shallow sulcus; pillar straight, callous, with three marked plaits, diminishing in size anteriorly behind the pillar; the inner lip has a thick smooth layer of enamel; siphonal fasciole strong; between it and the callosity of the pillar a narrow umbilical chink; canal inconspicuous but rather deep. Height of shell, 23 mm.; of last whorl, 17 mm.; of aperture, 14 mm.; maximum diameter, 15 mm.

Holotype: No. 2916; *paratype:* No. 2917, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, **1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

This belongs to the typical section of the genus, and the nearest recent representative on the Pacific coast is *C. ventricosa* Hinds, which does not approach it very closely; the Antillean species is more similar.

10. **Latirus melvilli** Dall & Ochsner, new species

Plate 6, figure 10

Shell small, of about nine whorls, including a minute smooth nucleus of about three whorls; sculpture succeeding the nucleus, minutely reticulated, developing later axially into (on the earlier whorls some 15, on the last whorl 10) rounded ribs, on the early whorls extending from suture to suture, later obsolete between the suture and the shoulder, and on the last whorl also on the base; these ribs are prominent, almost angular on the last two whorls at the shoulder, but not so on the earlier turns; the suture is distinct but not appressed; between it and the shoulder are three spiral cords with wider interspaces in which run much smaller threads; between the shoulder and the canal are about 14 similar or sharper spiral cords with three or four threads in each interspace; the canal is also spirally threaded; threads and cords except at the shoulder, not enlarged at the intersections with the ribs; aperture semilunate, not internally lirate and with no substantial callus in the specimens (which however may not be completely mature); pillar with two or more feeble plaits; canal short, wide, slightly recurved, with an inconspicuous siphonal fasciole. Height, 24 mm.; of last whorl, 16 mm.; maximum diameter, 11 mm.

Holotype: No. 2919; *paratype:* No. 2920, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D) on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

Named in honor of J. Cosmo Melvill, Esq., who has monographed the recent species of the genus.

11. **Latirus galapaganus** Dall & Oschner, new species

Plate 2, figure 8; plate 6, figure 9

Type specimen unique and rather imperfect, decollate but retaining four whorls separated by a distinct but not appressed suture; upper whorl sculptured by vertical, narrow, axial ribs about three-quarters of a millimeter apart, and reaching from suture to suture; these are crossed by six or seven obscure flattish spirals with subequal interspaces, not swollen at the intersections; two or three spirals near the preceding suture are stronger than the rest; this sculpture becomes more feeble in the succeeding whorls, and on the last whorl, behind an obscure shoulder, only two or three faint spirals are discernible; the ribs, though obscure, appear chiefly as feeble nodulosities near the shoulder of the last whorl; aperture semilunate, defective, a thin callus on the body; pillar with one major posterior and two minor anterior plaits; base slightly constricted behind the canal. Height of specimen, 27 mm.; of last whorl, 20 mm.; of aperture (approximately), 14 mm.

Holotype: No. 2918, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

Although the specimen is imperfect, it is clearly not referable to any of the recent species of the region.

12. **Colubraria pervaricosa** Dall & Ochsner, new species

Plate 6, figure 11

Shell small with a minute, turbinately coiled, smooth, polished nucleus of about three whorls; apex acute, whorls somewhat convex, the last more than half the length of the shell; axial sculpture of (on the penultimate whorl about 15) slightly retractively arcuate ribs, rounded, with subequal interspaces, and crossing the entire whorl; suture distinct, somewhat appressed; spiral sculpture of numerous rounded small threads, close-set and somewhat roughened by the incremental lines, subequal and covering the whole shell, not swollen where they pass over the ribs; aperture rather narrow, outer lip much thickened forming a swollen varix, not reflected, internally with five strong subequal lirations, a small deep subsutural sulcus; inner lip callous, the outer edge forming a raised lamina; base rounded, anteriorly constricted; canal short, deep, slightly recurved. Height of shell, 18 mm.; of last whorl, 10 mm.; maximum diameter 6.5 mm.

Holotype: No. 2921, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, 1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group. Probably Pleistocene.

This shell belongs to the group of which the type (by elimination) should carry the name of *Fusus* Helbling, not Lamarck. The adoption of this name, however, would involve such confusion that we hesitate to use it.

This species is not distantly related to the forms found in the Antilles, as well as many of other parts of the world, but less distantly to the characteristic Indo-Pacific larger forms of the group.

13. Strombina ? liopleura Dall & Ochsner, new species

Plate 6, figure 7

Shell small, strongly sculptured, with about five whorls, the nucleus short, smooth, depressed, of about a whorl and a half; axial sculpture of a variable number (12 to 19) of nearly straight rounded ribs, more or less swollen just in front of the suture in the later whorls, with a stout varix close behind the outer lip; on the base and canal these are crossed by more or less developed spiral threads not swollen at the intersections and which in some cases may be represented behind the periphery on the last whorl; the earlier whorls are usually quite smooth and the suture distinct but not channelled; aperture elongate-quadrate, outer lip sharp, (the throat obscured by matrix); inner lip with a relatively thick layer of enamel and produced and slightly twisted canal. Height of shell, 7 mm.+; of last whorl, 5 mm.+; maximum diameter, 3 mm.

Holotype: No. 2922; *paratypes:* No. 2923, 2924, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species is represented by more or less imperfect individuals and may perhaps be an elongate *Anachis,* but its general aspect recalls the sculptured Strombinas.

14. **Alectrion tropicalis** Dall & Ochsner, new species

Plate 2, figure 9

Shell large, with a very acute spire of about 10 whorls, of which two are included in a minute, smooth, compactly coiled, and polished nucleus; succeeding whorls evenly reticulated by six or eight narrow strap-like threads which over run low thread-like axial riblets; the spiral sculpture later becomes attenuated and on the last turn obsolete but still covering the entire whorl; suture distinct, appressed only on the last whorl which develops about 18 irregular slightly oblique, low ribs, prominent only at the angle of the shoulder which they feebly coronate; space between the suture and the shoulder slightly constricted; aperture wide, subquadrate, outer lip thin, body erased; pillar short with a keel at its edge; siphonal fasciole distinct, bounded behind by a sharp low keel; siphonal sulcus deep. Height of shell, 43 mm.; of last whorl, 30 mm.; of aperture, 22 mm.; maximum diameter, 23 mm.

Holotype: No. 2925, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from **upper horizon, Seymour Island, Galapagos Group.** Probably Pliocene.

This fine species belongs to the group so well represented in the California Pliocene and recent faunas and called by Conrad *Schizopyga.*

15. **Alectrion oldroydæ** Dall & Ochsner, new species

Plate 2, figure 10; plate 6, figure 8

Shell large, with 6½ whorls beside the (lost) nucleus; spire acute, whorls rapidly enlarging; suture distinct, not channelled or appressed; whorls evenly rounded; apical whorls evenly reticulated with spiral and axial small cords, the interspaces about equal; as the whorls increase the axial sculpture becomes fainter and on the last whorl obsolete; on the penultimate whorl the spirals behind the shoulder number about six and the same in front of it, the latter become wider and flatter with narrower channelled interspaces, the major spirals numbering about 12 with smaller and closer threads behind the shoulder and near the canal; aperture about half as long as the whole shell; outer lip thin, entire, slightly expanded; inner lip free from callosity; pillar slightly concave with a strong fold bordering the short and recurved canal; siphonal fasciole inconspicuous, bordered behind by a low keel but no deep sulcus; canal wide, rather deeply excavated. Height, 34 mm.; of aperture, 17 mm.; maximum diameter of last whorl, 18.5 mm.

Holotype: No. 2926, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species is allied to the recent group containing *A. perpinguis* Hinds, and *A. mendica* Gould, of the California coast, but so far as known there are no species analogous to it in the present fauna of the islands. It is named in honor of Mrs. Ida S. Oldroyd who has worked on the fossil species of the genus in California.

16. **Acirsa albemarlensis** Dall & Ochsner, new species

Plate 6, figure 4

Shell small, slender, acute, (the nucleus lost) with about eight rounded adherent whorls crossed by low blunt axial lamellæ (more than 30 on the last whorl) not continuous over the suture and slightly flexuous; spiral sculpture of numerous equal and equidistant fine raised threads not crossing the varical lamellæ but slightly crenulating them; base imperforate, rounded; aperture rounded. Height of shell, 10.5 mm.; of last whorl, 5.0 mm.; maximum diameter, 4.0 mm.

Holotype: No. 2927, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, **1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

This species like some of the others, recalls forms of the recent Antillean fauna rather than any yet reported from the Pacific coast.

17. **Epitonium nesioticum** Dall & Ochsner, new species

Plate 6, figures 5, 6

Shell small, acute, with a small polished smooth nucleus and seven or eight more rounded adherent whorls; axial sculpture of (on the last whorl 13) sharp lamellose varices, mostly subequal and equally spaced, but with an occasional thicker one, indicating a resting stage; the varices just in front of the suture have a small projecting angle; spiral sculpture of numerous fine sharp threads, equal and equidistant, with slightly wider interspaces, not crossing nor crenulating the varices; final varix thickened and slightly reflected; base rounded, centrally depressed but imperforate. Height of shell, 7.5 mm.; of last whorl, 3.5 mm.; of aperture, 2.2 mm.; maximum diameter, 3.3 mm.

Holotype: No. 2928; *paratypes:* No. 2929, 2930, 2931, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, **1¼ miles northwest of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

This species belongs to the recent group of the genus which is typified on the California coast by *E. bellastriatum.*

18. **Epitonium implicatum** Dall & Ochsner, new species

Plate 6, figure 1

Shell slender, with about 12 evenly rounded whorls, the suture deep but the whorls adherent and with no basal disk or cord; surface smooth, polished, crossed obliquely by 13 low, narrow, lamellose varices continuous over the whole spire and a little expanded at the suture; in the course of their length they make at least a half turn of the spire, the anterior end lagging; base rounded, imperforate; the aperture subcircular, oblique. Apex defective, length of seven whorls, 18 mm.; maximum diameter, 6 mm.

Holotype: No. 2932, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east side of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species belongs to the type of a group which is represented in the recent and Tertiary fauna of the West Indies, but which has not yet been reported from the Pacific coast of the Americas.

19. **Epitonium ennapleura** Dall & Ochsner, new species

Plate 6, figure 2

Shell small, acute, slender, smooth, with more than eight rounded, barely adherent whorls (the nucleus lost) crossed by nine thin and lamellose oblique continuous varices, slightly acuminate at the shoulder, and making about a third of a turn about the spire; suture very deep; aperture ovate; base rounded, imperforate, without a disk or encircling cord. Length of specimen, 10.3 mm.; maximum diameter, 3.2 mm.

Holotype: No. 2933, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This form of *Epitonium* is common to both coasts of tropical and warm temperate America.

20. **Epitonium innominatum** Dall & Ochsner, new species

Plate 6, figure 3

Shell small, slender, acute, the nucleus lost but retaining seven whorls with indications of one or two more; whorls moderately rounded, adherent, with a deep suture and no basal disk or cord; they are obliquely crossed by nine low narrow lamellose varices continuous over the spire and making about one third of a turn around it, with no noticeable expansion at the suture, the anterior end lagging; as the shell approaches maturity one or two of the varices are slightly expanded, thickened and concentrically striated on their anterior faces; these doubtless represent resting stages; base rounded, imperforate. Length of specimen, 9.5 mm.; maximum diameter, 3.3 mm.

Holotype: No. 2934, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species belongs to the same group in the genus as the preceding.

21. **Trivia pulloidea** Dall & Ochsner, new species

Plate 6, figures 16, 17

Shell small, solid, the dome of the back nearer the posterior end, giving the shell when viewed from above a pyriform outline; posterior end broadly rounded, anterior end attenuated, base moderately marginate above, crenulated by the ribs; beginning at the anterior end 17 cord-like ribs passing over the dome without interruption can be counted, but on the posterior slope the ribs are smaller and somewhat obscure in the specimen; base convex, depressed toward the aperture with about 12 strong cords continued into the aperture on the left side, the right lip is narrower and the cords less conspicuous; the siphonal sulcus is ample. Height, 5 mm.; length, 8 mm.

Holotype: No. 2935, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, **1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

This somewhat resembles *T. pulla* Gaskoin, of the recent Gulf of Panama and Galapagos fauna, but differs in details.

In the upper zone on Seymour Island an immature shell was collected which, if not the larger *Cypraea cervinetta* of Kiener, at least must have been extremely similar to it, and adds another very characteristic Middle American type to the Galapagos fauna.

22. **Strombus propegracilior** Dall & Ochsner, new species

Plate 2, figure 23

Shell solid, of more than seven whorls (apex defective) with a rather acute spire, the last two whorls comprising the bulk of the whole shell; surface smooth except that the whorls carry at the shoulder eight stout, short, radiating spines; suture appressed and undulated, the space between it and the shoulder in front slightly excavated; whorl in front rapidly attenuated, conic, with a strong siphonal fasciole; canal defective but evidently recurved; inner lip smooth, outer lip defective; body with a thin callus; the spines appear on the apical whorls chiefly as nodules. Height of shell, 80+ mm.; of last whorl 65+ mm.; of aperture, 55 mm.; maximum diameter, 45 mm., not including the spines.

Holotype: No. 2936, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species approaches the recent *Strombus gracilior,* which ranges from the Gulf of California to Panama Bay.

23. **Nerita oligopleura** Dall & Ochsner, new species

Plate 2, figure 11; plate 6, figure 15

Shell of moderate size, very solid and heavy, retaining traces of three wide blackish color bands on a lighter ground; apex flattened, the number of whorls obscured by erosion; sculpture of three or four wide, strong, low, spiral ridges with subequal interspaces, the basal one more distant and obscure; these are crossed by irregular sulci apparently due to inequalities of growth and possibly not specific; the general surface is more or less minutely pitted, a condition perhaps due to fossilization; aperture wide, semilunate, with a shallow sulcus at the upper commissure; inner lip broad, callous, apparently minutely granulose, the inner margin with three feeble denticulations near the middle; outer lip thick, showing no liration or denticulation in the specimen. Height, 14 mm.; maximum diameter, 18 mm.

Holotype: No. 2937, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from **upper horizon, Seymour Island, Galapagos Group.** Probably Pliocene.

No species at all like this is reported from the recent fauna of the region.

24. **Turbo vermiculosus** Dall & Ochsner, new species

Plate 2, figure 15

Shell small for the genus, unusually elevated, with more than four rounded whorls somewhat constricted in front of the sutural border; suture distinct, very narrowly channelled; spiral sculpture of (on the penultimate whorl three, on the last whorl six) strong broad low ridges with smaller intercalary threads and obscure minute intervening threads, the interspaces almost channelled and two ridges of the secondary size on the base; axial sculpture of incremental lines sometimes minutely, imbricately lamellose; in addition the entire surface is minutely vermiculately granulous and punctate; base rounded, imperforate with an irregular thickened ridge behind the inner lip; aperture subcircular with a strong subsutural ridge but no internal liræ; body with a thin layer of enamel. Height about, 34 mm.; of last whorl, 26 mm.; maximum diameter, 25 mm.

Holotype: No. 2938, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from **upper horizon, Seymour Island, Galapagos Group.** Probably Pliocene.

The curious surface sculpture separates this species from any of the recent forms of the region belonging to the genus *Turbo.* The absence of an operculum makes its reference to the proper subdivision of the genus impracticable.

25. **Turbo agonistes** Dall & Ochsner, new species

Plate 2, figures 12, 16

Shell small for the genus, heavy, solid, of about five rapidly enlarging whorls; nucleus defective but blunt and small; whorls flattened behind the shoulder, the suture distinct, undulated by the sculpture, usually with a row of small round nodules in front of it like a string of beads; the shoulder with from seven to nine short stout conspicuous spines, from these extend obscure ridges obliquely to the margin of the base where they rise into smaller stout pointed nodules, and again appear arching round the umbilical region as a row of still smaller, eroded and irregular nodules; the other axial sculpture is of oblique, rather rude, sometimes lamellose, incremental lines; spiral sculpture of three or four obscure threads between the two anterior rows of nodules, and obsolete traces of spiral sculpture on the other interspaces, more evident on the upper whorls, and which is some mutations of the species may be much more conspicuous; beside this there is a very minute granulation over the whole unworn surface, but only visible under magnification; aperture circular except where the outer lip is modified by the external sculpture; base imperforate, pillar lip arcuate, callous, with a small anterior projection as in most Turbos; aperture shorter than the spire. Height of spire, 25 to 31 mm.; of aperture, 10 to 16 mm.; maximum diameter, 23 to 28 mm.

Holotype: No. 2939; *paratype:* No. 2940, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This interesting species is not closely approached by any of the recent forms of the region.

26. **Tegula forbesi** Dall & Ochsner, new species

Plate 2, figure 13

Shell trochoid, solid, subconic, with about five hardly convex whorls, excluding the (lost) nucleus; suture distinct, narrow, channelled; spiral sculpture of strong, flattened, close-set ridges, seven above the basal margin and five on the base, the suture running at the basal margin; these are obliquely crossed by basally retractive rather strong incremental lines, tending occasionally to cut the spirals into obscure nodules, especially the one just in front of the suture; in general however the lines are crowded and the spiral interspaces sublamellose; the ridges sometimes carry a medial groove; basal margin bluntly rounded, base flattish, with a rather wide umbilical opening, margined by a rounded cord outside of which is a rather conspicuous sulcus with a smooth space between it and the spiral sculpture of the base; aperture oblique, the outer lip not thickened but crenulate in harmony with the external sculpture; body with a thin layer of enamel; pillar deeply excavated, short, evenly rounded to meet the basal lip; there are no internal lirations. Height of shell, 21.5 mm.; of last whorl, 16 mm.; maximum diameter, 23 mm.

Holotype: No. 2941; *paratype:* No. 2942, collected by W. H. Ochsner, November 21, 1905, from upper horizon on **Seymour Island, Galapagos Group.** Probably Pliocene.

This species is most nearly related to the recent *T. aureotincta* Forbes of California.

27. **Arca (Barbatia) seymourensis** Dall & Ochsner, new species

Plate 2, figure 18; plate 4, figure 5

Shell compressed, inequilateral, somewhat irregular, somewhat rounded and attenuated in front; beaks low near the anterior end; disk constricted widely below the beaks; posterior dorsal margin arcuate, expanded, compressed, posterior end subtruncate, with a ridge extending from each angle of the truncation to the beaks, the space between the ridges depressed; basal margin concavely arcuate at the vicinity of the constriction above referred to; sculpture of radial, flattish cords, with subsequent channelled interspaces, coarse toward the ends of the shell and on the posterior ridges more or less irregularly lamellate or subspinose; the radial sculpture crossed by more or less irregular, sometimes coarse, incremental lines; area above the hinge with two deep angular sulci; hinge with numerous minute teeth, a few at each end larger and more oblique; pallial line distinct, inner margin of the valve entire. Length of shell, 35 mm.; beaks behind the anterior end, 10 mm.; height at beaks, 18 mm.; maximum diameter, 14 mm.

Holotype: No. 2943; Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from upper horizon on **Seymour Island, Galapagos Group.** Probably Pliocene.

This is quite near *Arca reeveana* Hanley, but has the sculpture behind the beaks coarser and lamellose. It is of the type of a group common to the east and west coasts of Central America.

28. **Pecten (Pecten) slevini** Dall & Ochsner, new species

Plate 3, figure 9; plate 4, figure 4

Shell large, right valve inflated, left valve flattish, medially somewhat concave; hinge-line short, overhanging that of the left valve; posterior ear arched, with low concentric lamellation, and two or three feeble indications of radial ridges; anterior ear flatter with closely crowded lamellæ and four or five rather strong radial riblets; this ear is separated by a deep groove from the disk; the ctenolium, if any, is defective in the specimens; right valve with 17 prominent rounded ribs, with wider, not channelled, interspaces; the posterior submargin is narrow, with two or three feeble radial riblets; the whole surface is over run with undulate equal and equally spaced low fine concentric lamellæ with about equal interspaces; the left valve has 15 ribs with similar sculpture and similar posterior submargin; hinge-plate with a large deep resiliary pit and in the right valve three anterior and two (?) posterior, strongly cross-striated radial ridges of which the dorsal is the longer; basal margin defective, but internally grooved. Estimated height, 70 mm.; width, 80 mm.; maximum diameter, 26 mm.; length of hingeline, 39 mm.

Holotype: No. 2944; *paratype:* No. 2945, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), **on east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species is quite close to the Pliocene *P. hemphillii* Dall, from Pacific Beach near San Diego, California; but apparently not so near any of the typical Pectens of the Panama region.

The species is named for Mr. Joseph R. Slevin, a member of the expedition of 1905-1906.

29. **Pecten insulus** Dall & Ochsner, new species

Plate 2, figures 19, 20

Shell small, sharply sculptured, convex, with 16 flattish radial ribs separated by subequal interspaces; the ribs are depressed and rounded at the sides and the interspaces not channelled; submargins deeply impressed, concentrically striated, anterior ear with four or five rather strong radial ribs concentrically, prominently lamellose; concentric sculpture covering the whole disk of close-set rather thick, flattish threads not obsolete on top of the ribs and not tending to be sharp or lamellose; interior grooved in harmony with the ribbing; both valves (?) apparently similarly sculptured. Height. 17 mm.; width, 18 mm.; diameter about, 12 mm.

Holotype: No. 2946; *paratype:* No. 2947, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This species recalls some of the Oligocene Antillean species, but its sculpture is characteristic. Both the specimens were filled with matrix and the posterior ears wanting.

30. **Pecten seymourensis** Dall & Ochsner, new species

Plate 2, figure 22

Shell rather large, ovate, moderately inflated, solid; right valve with a rather short hinge-line and narrow submargin; anterior ear short (defective), posterior longer, radially sculptured with small threads, submargin with obsolete similar sculpture; hinge rather feeble with a moderately large shallow resiliary pit; external sculpture of 18 squarish, dorsally smooth and flat, radial ribs, with narrower channelled interspaces concentrically, finely lamellose; interior obscured by matrix, basal margin internally grooved in harmony with the external ribbing. Height, 57 mm.; breadth, 53 mm.; diameter of right valve, 12 mm.

Holotype: No. 2948; *paratype:* No. 2949, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from upper horizon, **Seymour Island, Galapagos Group.** Probably Pliocene.

This species belongs to the group of *P. purpuratus* Lam., but is sufficiently distinct. The left valve was not obtained.

31. ? **Lima nesiotes** Dall & Ochsner, new species

Plate 3, figures 2, 3

Shell large, subovate, radiately sculptured, solid; radial ribs 16, low broad, smooth on the back, separated by narrower interspaces which are crossed by low, close-set, minute imbrications; submargins as broad as two ribs and smooth; anterior ear narrow, smooth, the margin slightly concave for the gape of the valves; posterior ear shorter, narrow with three or four faint radial threads; hinge with a large resiliary pit of which the margins are prominent; interior grooved in harmony with the ribs near the base, the grooves narrow with wider slightly concave interspaces. Height, 48 mm.; width, 42 mm.; diameter of right valve, 7.5 mm.

Holotype: No. 2955; *paratypes:* Nos. 2950-2954, 2956, 2957, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from upper horizon, **Seymour Island, Galapagos Group.** Probably Pliocene.

This species seems to belong in the group of *L. halensis* Dall, from the Oligocene of southern Georgia, but has more ribs and a less elongate form. Both differ from the recent Limas in the absence of imbricating sculpture or spines on the back of the ribs. Both have an aspect somewhat inclining toward that of *Chlamys*, and the present species may possibly be an aberrant *Chlamys* though *L. halensis* certainly belongs to the genus *Lima*.

A specimen of *Pteria* was collected on Seymour Island (zone not stated on the label) which differs from any species known to us by its extreme inflation. It is not in a sufficiently good condition for description, but doubtless represents a new species.

32. **Codakia recta** Dall & Ochsner, new species

Plate 4, figure 1

Shell large, heavy, rounded, nearly equilateral, with inconspicuous beaks, over a very small rounded impressed lunule; anterior end evenly rounded from the beaks, posterior end convexly arcuate forming an obscure angle at its junction with the evenly rounded base; ligament sunken, escutcheon obsolete; sculpture of rather wide flattish radials, retractively arcuate, extending over the whole disk, separated by much narrower channelled interspaces, the radials with a median groove near the base; in the middle of the disk there are about six radials in the space of ten millimeters, but they are narrower and more crowded toward the posterior submargin; these are crossed by numerous regular close-set concentric threads, about three to a millimeter, and a few pronounced concentric sulci indicating resting stages. The interior of the shell is obstructed by matrix. Height, 83 mm.; length 86 mm.; diameter, 32 mm.

Holotype: No. 2958, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from lower horizon, **Seymour Island, Galapagos Group.** Probably Pliocene.

The nearest relation of this species is *Codakia distinguenda* Tryon, which ranges from the Gulf of California to Panama Bay. The latter has a much deeper and larger lunule and more evident escutcheon, while it is rounder behind and with the hinge line on each side of the beaks more horizontal.

33. **Lucina spherica** Dall & Ochsner, new species

Plate 3, figure 8; plate 4, figures 2, 7

Shell orbicular, moderately inflated, slightly inequilateral, thin, beaks low, small, prosocœlous over an extremely minute narrow lunule, not much impressed and having the portion of the lunule in the right valve longer and less deep than that in the left valve; anterior submargin compressed, arcuate, semilunate, posterior submargin more sharply defined, longer, narrower, and with the ligament deeply set in between the dorsal margins; sculpture of fine close-set low lamellæ, like exaggerated incremental lines, over the whole disk, near the base with more or less, hardly perceptible fine radial lineation; beaks slightly nearer the anterior end; interior more or less radially striate or granulose within the pallial line; anterior adductor scar smaller than the posterior, with a long narrow prolongation within the pallial line; hinge plate edentulous; basal margins simple, entire, sharp. Height, 50 mm.; length, 53 mm.; beaks behind the anterior end, 25 mm.; maximum diameter, 25 mm.

Holotype: No. 2959 A and B; *paratypes:* Nos. 2960-2965, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D) on **east shore of Indefatigable Island, Galapagos Group**. Probably Pliocene.

The species was also collected in the upper horizon on Seymour Island.

There are two recent species of this group in the Antilles and one in the Gulf of California, but none is so far reported from the Panamic or Peruvian region.

34. **Divaricella lucasana** Dall & Ochsner, new name

Plate 2, figures 17, 21, 24

Lucina eburnea Reeve, Conch. Icon., VII, *Lucina*, pl. VIII, fig. 49, 1850. Not *L. eburnea* Deshayes, Bull. Soc. Géol. de France, VI, 1835.

Holotype: No. 2966, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, **1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

This species ranges from Cape San Lucas south to Panama Bay. It was collected in abundance from the old beach deposit of probable Pleistocene age, 1¼ miles northeast of Vilamil, Albemarle Island.

35. **Chama phonea** Dall & Ochsner, new species

Plate 3, figures 4, 6

Valve more or less spiral, the apex being concealed, heavy, thick, solid, with obscure indications of two spiral shallow depressions and sculptured by rude concentric imbricated lamellæ, not spinose or crenulated and without radial sculpture; ligamentary border and sulcus nearly half as long as the circumference of the valve, below them and curving with them is a broad cornucopia-shaped ridge recalling the area in an oyster shell; from its abrupt posterior termination projects a narrow, short, granulose tooth with a wide, striated, shallow depression (to receive a tooth of the opposite valve) in front of it and below it; cavity of the disk extending under the hinge plate; adductor scars large, subequal, the disk between them excavated, margin of the valve not crenulated but minutely granulose; spirality dextral. Vertical measurement, 38 mm.; transverse, 45 mm.

Holotype: No. 2969, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906, **1¼ miles northeast of Vilamil, Albemarle Island, Galapagos Group.** Probably Pleistocene.

The specimen is an upper valve upon which are seated a Polyzoan, the lower valve of a specimen of *Chama exogyra* Conrad, and a coral resembling *Astrangia.*

No recent species of the western coast is like the present form. A different but undeterminable species of *Chama* was collected from the upper zone of Seymour Island.

36. **Chione seymourensis** Dall & Ochsner, new species

Plate 3, figures 1, 5

Shell small, inflated, with low, slightly prosocoelous beaks over a narrow lanceolate lunule; beaks nearer the anterior end, which is evenly rounded; posterior end more oblique, base evenly arcuate; radial sculpture of low flat riblets separated by much narrower grooved interspaces; the radials are cancellated by somewhat irregular, subequidistant, incised concentric lines coincident with the lines of growth; this sculpture covers the whole disk, and there is no escutcheon; internal margins of the valve smooth; pallial and muscular impressions hidden by matrix; right valve with three diverging cardinals, the anterior feeble, the median strongest; the ligament is sunken and rather long. Height, 22 mm.; length, 34 mm.; beak behind the anterior end, 10 mm.; diameter of right valve, 6 mm.

Holotype: No. 2970, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, November 21, 1905, from upper horizon, **Seymour Island, Galapagos Group.** Probably Pliocene.

This species is nearest the recent *C. pertincta* Dall, from the Gulf of Panama.

37. **Ervilia galapagana** Dall & Ochsner, new species

Plate 4, figure 6

Shell small, plump, elongate-ovate, anterior end slightly shorter; both ends evenly rounded, base arcuate, beaks inconspicuous; sculpture of regular and regularly spaced concentric impressed lines with wider interspaces, and occasional prominent concentric incremental ridges, indicating resting stages; margins entire, hinge apparently typical, but most of the interior obscured by matrix. Height, 4.0 mm.; total length, 6.5 mm.; beaks in front of the posterior end, 4.0 mm.

Holotype: No. 2971, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

No recent species of this genus has yet been reported from the tropical Pacific coast of America. The Antillean species is marked by much sharper and closer sculpture.

38. **Pholadomya darwini** Dall & Ochsner, new species

Plate 3, figure 7; plate 4, figure 3

Shell large, thin, inflated, very slightly inequivalve, the right valve being the smaller; beaks inflated, nearly touching each other; anterior end rather abrupt and much shorter than the posterior; ligamentary furrow short; posterior end defective but from the earlier incremental lines it is apparently short, rounded, and with a nearly cylindrical wide gape; the shell in a general way resembles *P. candida* of the West Indies but is proportionately shorter, more inflated and larger; the sculpture much resembles that of *P. candida,* being composed radially of (more than 13) low rounded arcuate ribs with the concavity posterior and separated by wider interspaces with rarely a smaller intercalary rib; the anterior end and a dorsal part of the valves behind the beaks has no radial sculpture; the concentric sculpture is stronger on the beaks and obsolete on the lower half of the shell, it comprises narrow rather regular ripples separated by subequal interspaces which obscurely nodulate the radials at the points where the ripples over ride the ribs; the margins are entire, the interior of the shell inaccessible. Height at the beaks, 55 mm.; diameter, 44 mm.; estimated length about, 75 mm.

Holotype: No. 2972, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from lower horizon (zone A), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This is another of the species which recalls the Antillean fauna in which *Pholadomya candida* still survives, the only living representative of its group except an aberrant species in Japan. The presence of this species in the Galapagos Pliocene emphasizes the American character of the Galapagos fauna.

The species is named for Charles Darwin, the first naturalist to visit the Galapagos Islands.

39. **Panope similaris** Dall & Ochsner, new species

Plate 5, figure 1

Shell large, white, inequilateral, the anterior end shorter beaks small, deeply incurved, slightly opisthocoelous, without lunule or escutcheon; anterior dorsal slope arching into the evenly rounded anterior margin; posterior dorsal slope descending, concavely arched to meet the obliquely truncate posterior end which gapes widely and has the lower angle produced; base slightly arcuate, ascending to meet the truncation, so that the posterior part of the shell appears distinctly attenuated; sculpture near the beaks of small concentric ripples with subequal interspaces, which become less regular and less emphatic toward the middle of the disk and obsolete beyond it; there also seems to have been, especially on the posterior part of the shell, a minute granulation; the interior is obstructed by hard matrix. Height, 87 mm.; length, 143 mm.; diameter, 48 mm.; beaks behind the anterior end, 55 mm.

Holotype: No. 2973, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone B), on **east shore of Indefatigable Island, Galapagos Group.** Probably Pliocene.

This is a narrower shell, more attenuated and more obliquely truncate behind than *P. generosa* Gould, of California.

PLATE 2

Fig. 1. *Terebra albemarlensis* Dall & Ochsner, new species. Holotype, No. 2894 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 85 mm.; p. 99.

Fig. 2. *Terebra galapagina* Dall & Ochsner, new species. Holotype, No. 2897 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 35 mm.; p. 100.

Fig. 3. *Terebra litorea* Dall & Ochsner, new species. Holotype, No. 2904 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 56 mm.; p. 101.

Fig. 4. *Conus indefatigabilis* Dall & Ochsner, new species. Holotype, No. 2905 (C. A. S. type coll.) from zone *A*, Indefatigable Island; Pliocene; height, 57 mm.; p. 102.

Fig. 5. *Conus academicus* Dall & Ochsner, new species. Holotype, No. 2907 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 31 mm.; p. 102.

Fig. 6. *Conus loomisi* Dall & Ochsner, new species. Holotype, No. 2910 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 44 mm.; p. 103.

Fig. 7. *Cancellaria emydis* Dall & Ochsner, new species. Holotype, No. 2916 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 23 mm.; p. 105.

Fig. 8. *Latirus galapaganus* Dall & Ochsner, new species. Holotype, No. 2918 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 24 mm.; p. 107.

Fig. 9. *Alectrion tropicalis* Dall & Ochsner, new species. Holotype, No. 2925 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 43 mm.; p. 109.

Fig. 10. *Alectrion oldroydæ* Dall & Ochsner, new species. Holotype, No. 2926 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 34 mm.; p. 110.

Fig. 11. *Nerita oligopleura* Dall & Ochsner, new species. Holotype, No. 2937 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 14 mm.; p. 114.

Fig. 12. *Turbo agonistes* Dall & Ochsner, new species. Holotype, No. 2939 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height 25 to 31 mm.; p. 115.

Fig. 13. *Tegula forbesi* Dall & Ochsner, new species. Holotype, No. 2941 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 21.5 mm.; p. 116.

Fig. 14. *Phos cocosensis* Dall. (See Proc. U. S. Nat. Mus., Vol. 18, 1895, p. 11) Plesiotype, No. 2974 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 36 mm.; p. 96.

Plate 2 continued on next page

Plate 2—*Continued from preceding page*

Fig. 15. *Turbo vermiculosus* Dall & Ochsner, new species. Holotype, No. 2938 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 34 mm.; p. 115.

Fig. 16. *Turbo agonistes* Dall & Ochsner, new species. Paratype, No. 2940 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 24 mm.; p. 115.

Fig. 17. *Divaricella lucasana* Dall & Ochsner, new name. Paratype, No. 2968 (C. A. S. type coll.) from Albemarle Island, Pleistocene; height, 20 mm.; p. 122.

Fig. 18. *Arca seymourensis* Dall & Ochsner, new species. Holotype, No. 2943 (C. A. S. type coll.) from Seymour Island, Pliocene; length, 35 mm.; p. 117.

Fig. 19. *Pecten insulus* Dall & Ochsner, new species. Holotype, No. 2946 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 17 mm.; p. 119.

Fig. 20. *Pecten insulus* Dall & Ochsner, new species. Paratype, No. 2947 (C. A. S. type coll.) from zone *D*, Indefatigable Island; height, 21 mm.; p. 119.

Fig. 21. *Divaricella lucasana* Dall & Ochsner, new name. Holotype, No. 2966 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 18.6 mm.; p. 122.

Fig. 22. *Pecten seymourensis* Dall & Ochsner, new species. Holotype, No. 2948 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 57 mm.; p. 119.

Fig. 23. *Strombus propegracilior* Dall & Ochsner, new species. Holotype, No. 2936 (C. A. S. type coll.) from zone *B*, Indefatigable Island; Pliocene; height, 80 mm.; p. 114.

Fig. 24. *Divaricella lucasana* Dall & Ochsner, new name. Paratype, No. 2968*B* (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 20 mm.; p. 122.

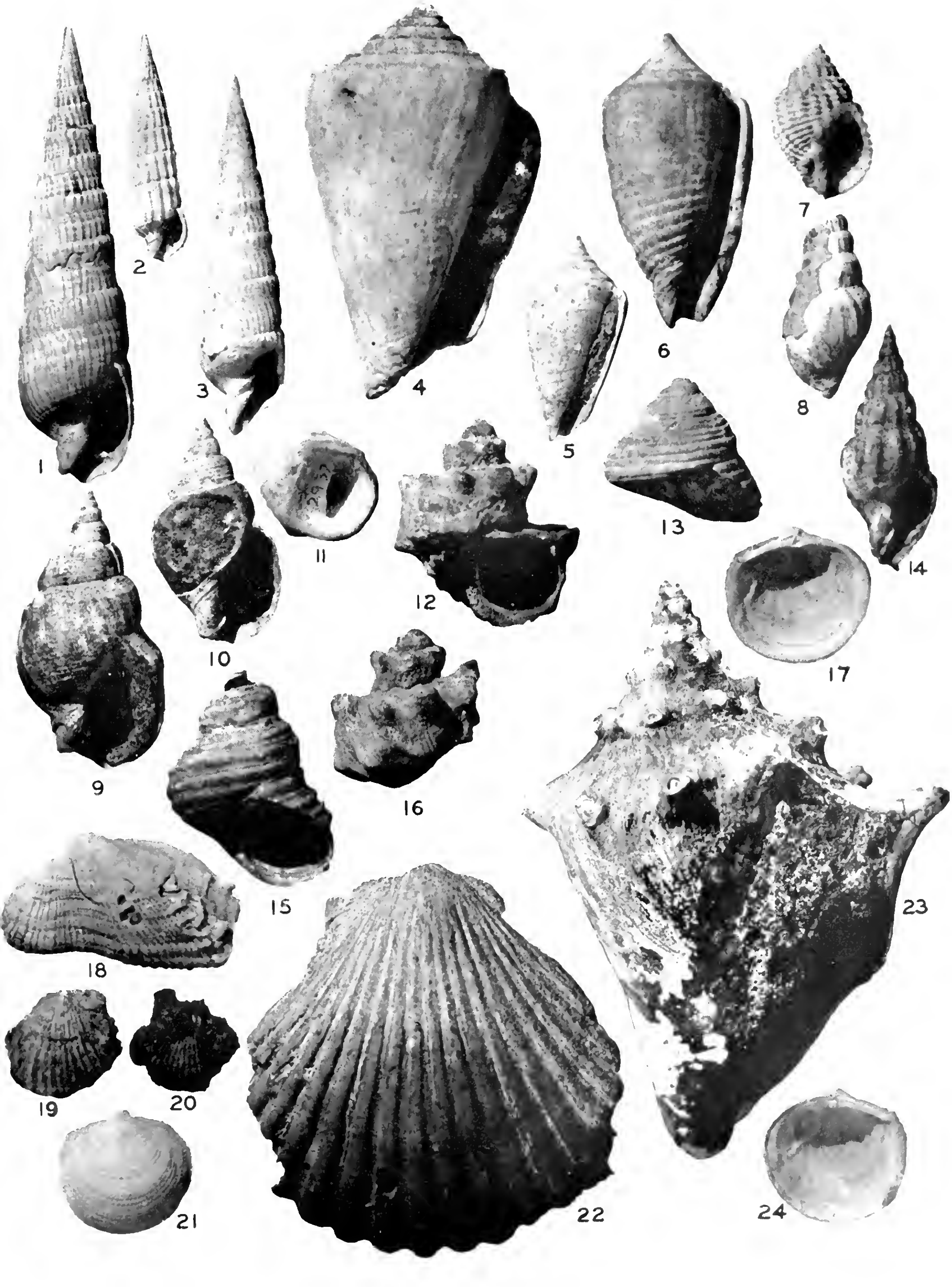

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24

Plate 3

Fig. 1. *Chione seymourensis* Dall & Ochsner, new species. Holotype, No. 2970 (C. A. S. type coll.) from Seymour Island; Pliocene; length, 34 mm.; p. 123.

Fig. 2. *?Lima nesiotes* Dall & Ochsner, new species. Holotype, No. 2955 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 48 mm.; p. 120.

Fig. 3. *?Lima nesiotes* Dall & Ochsner, new species. Paratype, No. 2957 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 44 mm.; p. 120.

Fig. 4. *Chama phonea* Dall & Ochsner, new species. Holotype, No. 2969 (C. A. S. type coll.) from Albemarle Island, Pleistocene; vertical measurement, 38 mm.; p. 122.

Fig. 5. *Chiore seymourensis* Dall & Ochsner, new species. Holotype, No. 2970 (C. A. S. type coll.); same specimen as fig. 1; p. 123.

Fig. 6. *Chama phonea* Dall & Ochsner, new species. Holotype, No. 2969 (C. A. S. type coll.); same specimen as fig. 4; p. 122.

Fig. 7. *Pholadomya darwini* Dall & Ochsner, new species. Holotype, No. 2972 (C. A. S. type coll.) from zone *A*, Indefatigable Island; Pliocene; diameter, 44 mm.; p. 124.

Fig. 8. *Lucina spherica* Dall & Ochsner, new species. Holotype, No. 2959.1 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 50 mm.; p. 121.

Fig. 9. *Pecten (Pecten) slevini* Dall & Ochsner, new species. Holotype, No. 2944 (C. A. S. type coll.) from zone *D*, Indefatigable Island, Pliocene; height, 70 mm.; p. 118.

Fig. 10. *Psammosolen galapaganus* Dall. Plesiotype, No. 2975 (C. A. S. type coll.) from Albemarle Island; Pleistocene; length, 55 mm.; p. 97.

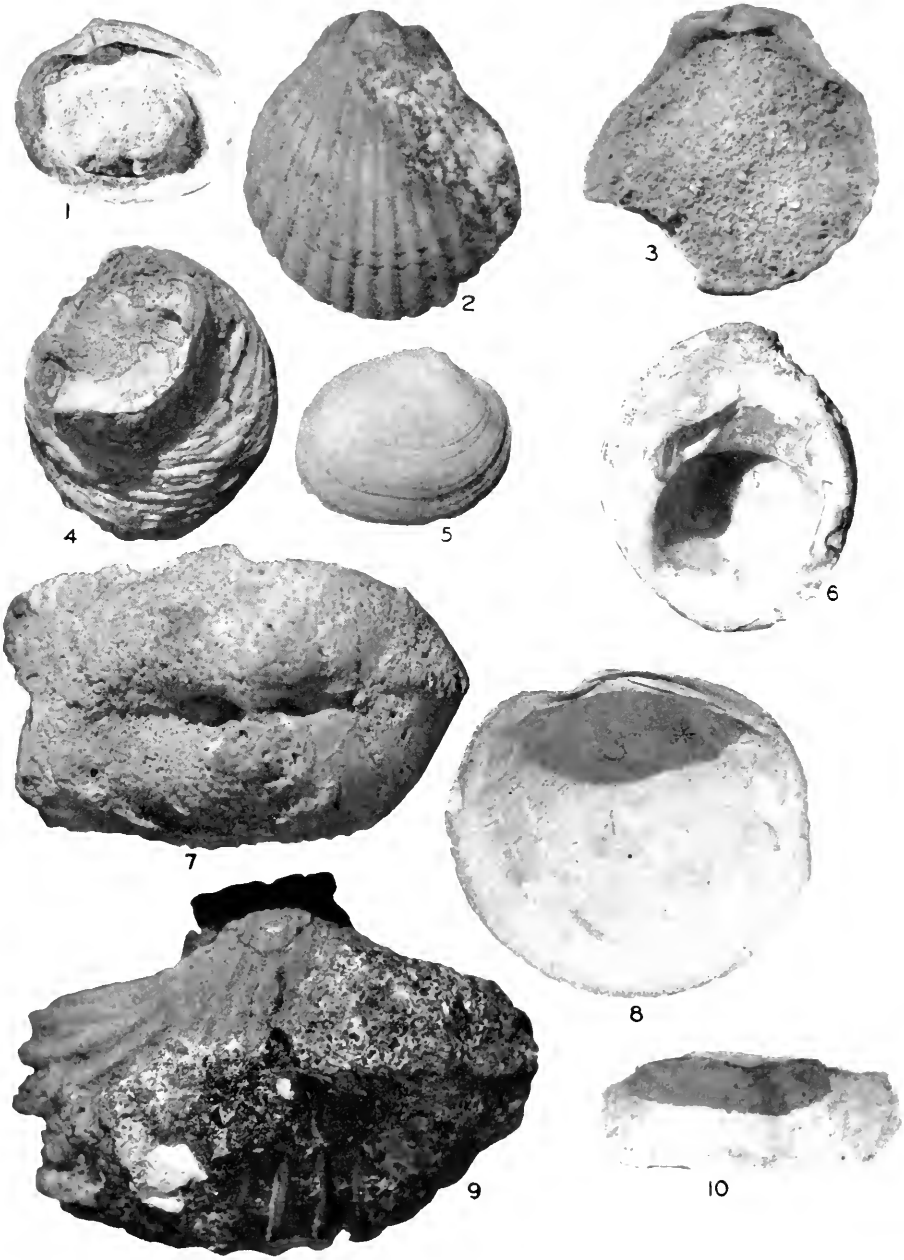

1
2
3
4
5
6
7
8
9
10

PLATE 4

Fig. 1. *Codakia recta* Dall & Ochsner, new species. Holotype, No. 2958 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 83 mm.; p. 121.

Fig. 2. *Lucina spherica* Dall & Ochsner, new species. Holotype, No. 2959*B* (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 50 mm.; p. 121.

Fig. 3. *Pholadomya darwini* Dall & Ochsner, new species. Holotype, No. 2972 (C. A. S. type coll.) from zone *A*, Indefatigable Island; Pliocene; height, 55 mm.; p. 124.

Fig. 4. *Pecten* (*Pecten*) *slevini* Dall & Ochsner, new species. Holotype, No. 2944 (C. A. S. type coll.) from zone *D*. Indefatigable Island; Pliocene; height, 70 mm.; p. 118.

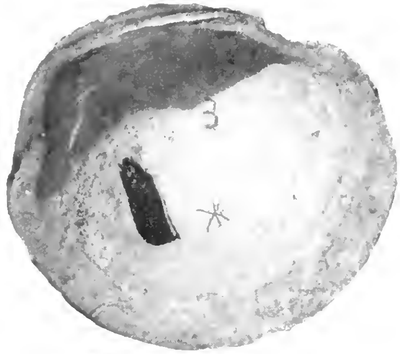
Fig. 5. *Arca seymourensis* Dall & Ochsner, new species. Holotype, No. 2943 (C. A. S. type coll.) from Seymour Island; Pliocene; length, 35 mm.; p. 117.

Fig. 6. *Ervilia galapagana* Dall & Ochsner, new species. Holotype, No. 2971 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 4 mm.; p. 124.

Fig. 7. *Lucina spherica* Dall & Ochsner, new species. Holotype, No. 2959*A* (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 50 mm.; p. 121.

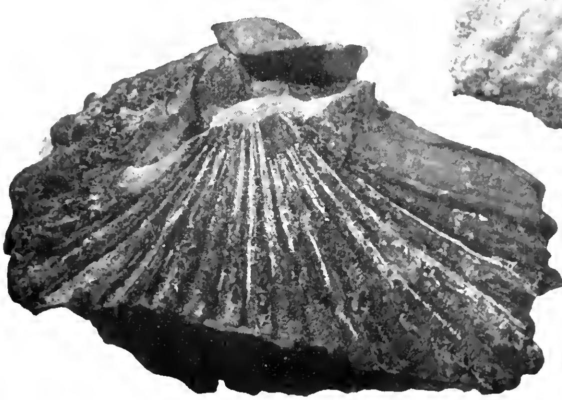
Fig. 8. *Psammosolen galapaganus* Dall. Plesiotype, No. 2975 (C. A. S. type coll.) from Albemarle Island; Pleistocene; length, 55 mm.; p. 97.

1



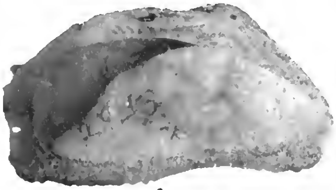
2

3

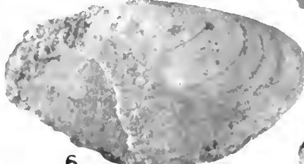


4

7



5



6

8

PLATE 5

Fig. 1. *Panope similaris* Dall & Ochsner, new species. Holotype, No. 2973 (C. A. S. type coll.) from zone *B*, Indefatigable Island; Pliocene; length, 143 mm.; p. 125.

Plate 6

Fig. 1. *Epitonium implicatum* Dall & Ochsner, new species. Holotype, No. 2932 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; length, 18 mm.; p. 111.

Fig. 2. *Epitonium ennapleura* Dall & Ochsner, new species. Holotype, No. 2933 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; length, 10.3 mm.; p. 112.

Fig. 3. *Epitonium innominatum* Dall & Ochsner, new species. Holotype, No. 2934 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; length, 9.5 mm.; p. 112.

Fig. 4. *Acirsa albemarlensis* Dall & Ochsner, new species. Holotype, No. 2927 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 10.5 mm.; p. 110.

Fig. 5. *Epitonium nesioticum* Dall & Ochsner, new species. Paratype, No. 2929 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 8 mm.; p. 111.

Fig. 6. *Epitonium nesioticum* Dall & Ochsner, new species. Holotype, No. 2928 (C. A. S. type coll.) from Albemarle Island, Pleistocene; height, 7.5 mm.; p. 111.

Fig. 7. *Strombina ? liopleura* Dall & Ochsner, new species. Holotype, No. 2922 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 7 mm.; p. 108.

Fig. 8. *Alectrion oldroydæ* Dall & Ochsner, new species. Holotype, No. 2926 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height 34 mm.; p. 110.

Fig. 9. *Latirus galapaganus* Dall & Ochsner, new species. Holotype, No. 2918 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 24 mm.; p. 107.

Fig. 10. *Latirus melvilli* Dall & Ochsner, new species. Holotype, No. 2919 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; height, 27 mm.; p. 106.

Fig. 11. *Colubraria pervaricosa* Dall & Ochsner, new species. Holotype, No. 2921 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 18 mm.; p. 107.

Fig. 12. *Surcula insulæ* Dall & Ochsner, new species. Holotype, No. 2913 (C. A. S. type coll.) from zone *D*, Indefatigable Island; Pliocene; 26 mm. p. 104.

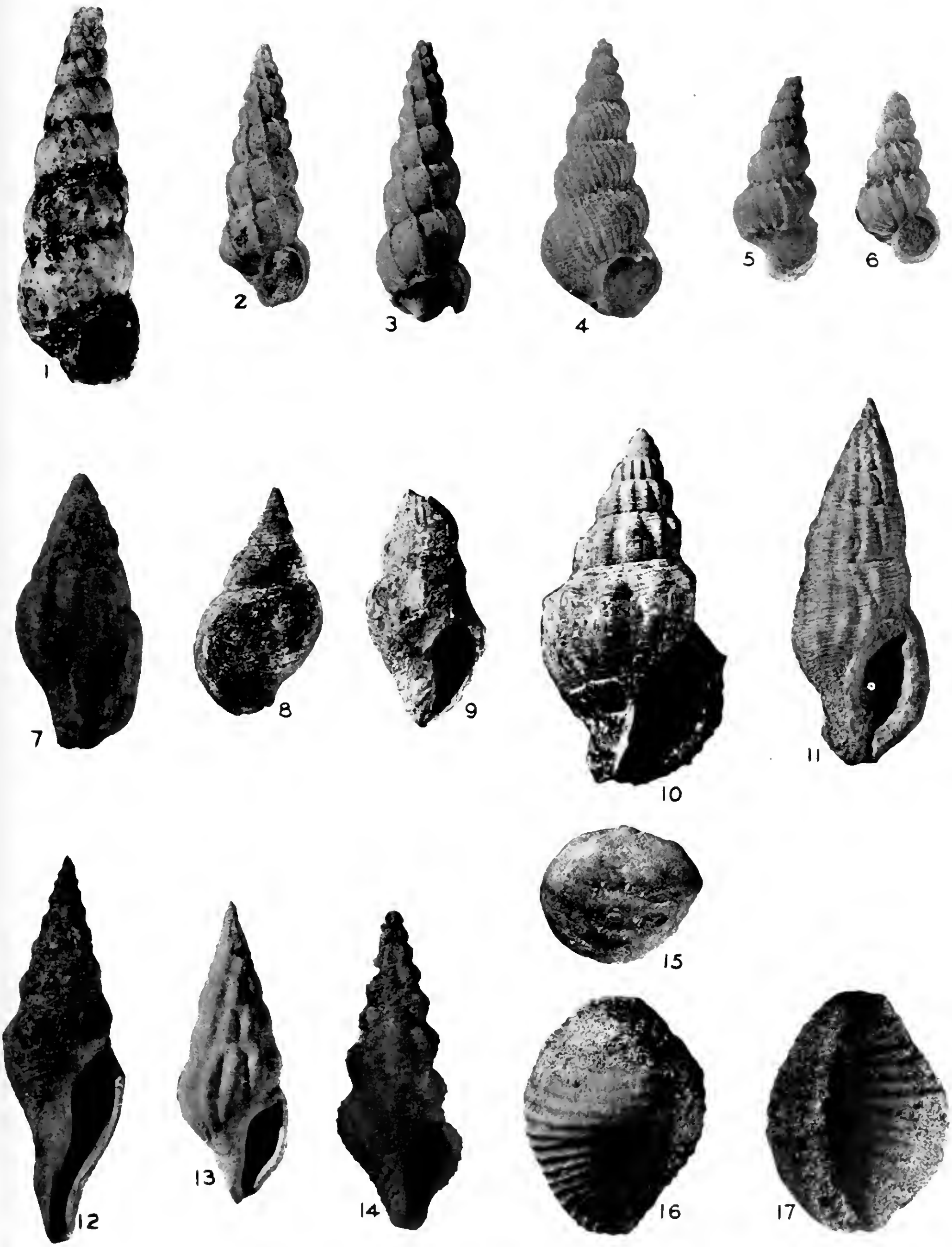
Fig. 13. *Cymatosyrinx zeteki* Dall & Ochsner, new species. Holotype, No. 2914 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 20 mm.; p. 104.

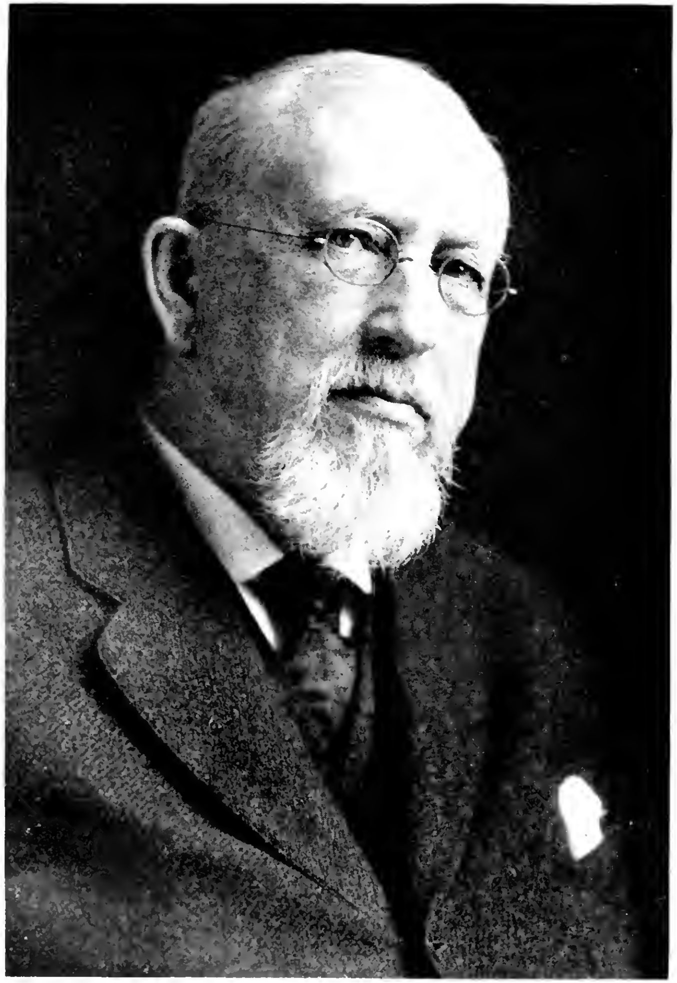
Fig. 14. *Fusinus* species. Plesiotype, No. 2976 from Albemarle Island; Pleistocene; height, 22 mm.

Fig. 15. *Nerita oligopleura* Dall & Ochsner, new species. Holotype, No. 2937 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 14 mm.; p. 114.

Fig. 16. *Trivia pulloidea* Dall & Ochsner, new species. Holotype, No. 2935 (C. A. S. type coll.) from Albemarle Island; Pleistocene; length, 8 mm.; p. 113.

Fig. 17 *Trivia pulloidea* Dall & Ochsner, new species. Holotype, No. 2935 (C. A. S. type coll.). Same specimen as Fig. 16.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17



Wm. H. Dall

August 21, 1845—March 27, 1927.

Washington Henry Oehsner

July 4, 1879—April 11, 1927.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 5, pp. 141-185, plates 8, 9 JUNE 22, 1928

V

LANDSHELLS OF THE GALAPAGOS ISLANDS[1]

BY

WILLIAM HEALEY DALL

AND

WASHINGTON HENRY OCHSNER[2]

INTRODUCTION

Numerous visitors have collected on the islands of the Galapagos Group and each expedition has added some species to the list of their molluscan fauna; but none other has had the advantage of such a prolonged opportunity as had the members of the 1905-1906 Expedition of the California Academy of Sciences, and none other has obtained so large a series of known species, or added so many undescribed forms to the list. It is a curious fact that no expedition has collected all the forms previously described. It is probable that numerous others still remain to be discovered by future explorers.

SUMMARY OF ENVIRONMENTAL CONDITIONS

A brief summary of the conditions under which the fauna and flora of the Galapagos Islands exist will make it easier for the reader to comprehend the data given in connection with

---

[1] Previous reports on the Expedition to the Galapagos Islands of 1905-1906 have been published as Proceedings of the California Academy of Sciences, 4th Ser., Vol. 1; Vol. 2, Pts. 1, 2, Nos. 1-18; and Vol. 17, No. 4.

[2] We are indebted to Mrs. Ida S. Oldroyd for assistance in preparing the collection for study and to Dr. V. Sterki and Dr. H. Pilsbry for advice in identifying some of the Pupillidæ.

the several species. The information utilized in this summary is chiefly derived from the field notes made while collecting the landshells; other sources are enumerated in the general discussion contained in the monograph of the fauna published in 1896[3] by the senior author.

The Galapagos Islands lie in the path of the southeast trade winds and of ocean currents from the east and southeast. The trade winds bring moisture and the distribution of the moisture precipitated as rain or dew governs the distribution of vegetation and indirectly that of the land Mollusca.

Since the winds come from the southeast and thus strike the southeastern islands of the group first, their southeastern slopes benefit by receiving a greater part of the conducted moisture than the northern and northwestern slopes. Variations are caused by the height of the islands, the highest peaks reaching cooler air and a greater amount of moisture, and by some of the leeward islands being more or less sheltered by those to windward. There is also a wet and a dry season, the period from December to June having less precipitation than the rest of the year. The conditions, therefore, are very complex and require for a permanent explanation the cooperation of meteorologist, zoologist and botanist. The arid zone, which on the southeastern shore of an island may extend from high water mark to a height above the sea level of 50 to 60 feet, on the northern side of the same island may ascend to a thousand. It is obvious then that the mere statement of the elevation can convey no information as to the surroundings of the specimen unless we also know, first, the exact locality and, second, the disposition of the zones of vegetation on the particular island and the meteorological conditions. These zones, summarized from the field notes taken on Indefatigable Island, may be characterized as follows:

1. The arid or dry zone, 0 to 100 feet elevation on the south side of the island. Rough fragments of lava with scanty dust of disintegration under and between them, forming a scanty soil and thin vegetation; scattered cactus, thorny

[3] Dall, W. H., Insular landshell faunas, especially as illustrated by the data obtained by Dr. G. Baur, in the Galapagos Islands, <Proc. Acad. Nat. Sci., Phila., August, 1896, pp. 395-459, pls. XV-XVII. Also supplementary data in the same periodical for 1900, pp. 88-96, pl. VIII.

bushes, and a prickly vine most in evidence; many of the shrubs with narrow leaves, at a distance resembling leafless branches or thorns; generally dry.

On Chatham Island this zone on the south side has a dusty soil, the lava being much disintegrated; it rises to 500 feet, but on the northwest side much higher. On Tower and Bindloe islands this may be said to be the only zone; on Barrington and Duncan, the upper zones are hardly indicated; on Abingdon the arid zone rises to 700 feet. Species of the type of *B. chemnitzioides* are characteristic of this zone, and the minute heliciform species and *Pupilla* are found here when there is no other landshell present.

II. The transition zone, on Indefatigable Island, southern exposure, reaches from 100 to 350 feet elevation. Here there is more soil though still scanty moisture; small ferns, long grass, some shrubs, and tall cacti appear.

III. Forest zone, or dense green zone; receiving not only its own rainfall but more or less drainage from above. Here are no cacti, but many trees, tall bushes, ferns and grass; umbrella trees and wild plantains abundant. There is much rain, disintegrating the lava into a rich soil which covers most of the rocks. Elevation 350 to 1500 feet.

IV. Grassy zone, elevation from 1500 feet to top. Open grassy country with few shrubs, absence of ferns, tall grasses and trees. This region prevalently misty with frequent rains, which, however, drain away quickly to the forested zone below, is probably really dryer than the latter.

These data refer especially to Indefatigable Island. On Narborough and some of the other islands, ferns and shrubs are noted as occurring on the very rim of the crater up to 4000 feet, in the grassy zone.

On Gardner Island more annual plants were noted on the east and southeast side and a greater number of perennials on the opposite or lee slope.

Chatham is one of the oldest islands of the group geologically. In the southern part the cones and craters have broken down into grassy hills with a well-watered, rich, red, volcanic soil, except near the shore. On this island the arid zone on the south side rises to 500 feet with the soil dry and dusty. There is then a transition zone of 150 to 200 feet, then grassy up to 2100 feet. On the northwest or lee side the arid zones reaches much higher, the transition zone to 1100 feet, above which it is grassy. On the northern side there are some more recent lava flows with scanty vegetation.

James Island, on the other hand, is one of the geologically newer islands. The soil, though fertile, is dusty.

On James Island December 23 to January 4, *Bulimulus darwini* was hibernating on the smooth bark of a Eucalyptus-like tree, and also on dry compositæ, always near the top of the herb and shaded by the plume of the top.

On Barrington the rainy season was setting in October 20. On Chatham, October 17 the soil was like dust. January 24 to 29 the wet season had set in, but at this time Hood Island was entirely dry! On Abingdon the beginning of the wet season was about September 19.

On Albemarle Island in the southern part, the arid zone reaches to 350 feet elevation; the transition zone from 350 to 400 feet, when the forest zone begins, reaches to 1000 feet and above this gradually merges into the grassy zone 1300 to 3100 feet elevation. During the wet season the slope at Iguana Cove, at the southwest corner of the island, is green from the water's edge upward.

On Albemarle the green zone is divided near Vilamil into two regions conchologically, the lower 480 to 700 feet with *B. tortuganus;* the upper 700 to 1300 feet with *B. simrothi*, the species being most abundant at about 1000 to 1300 feet, associated with *Pupilla, Helicina, Vitrea*, and *Tornatellina.*

Tower Island is a great lava field, relatively low; only *Pupilla* was found there. Bindloe is somewhat similar; only *Pupilla* was found although other collectors have reported a few Bulimuli.

On Abingdon Island the arid zone reaches to 700 feet, the next above from 700 to 1600 feet with herbage and bushes; the grassy zone follows from 1600 to 1950 feet.

Another factor influences the distribution of the vegetation on some of the islands, where on an old disintegrated surface new lava flows have been ejected. On the still solid surface of these new flows few plants find wherewithal to sustain existence. Yet between these flows wedge-shaped areas of the old soil extend upward bearing a vegetation more profuse, since drainage from the lava surface, if any, naturally flows into them. This is another case where the datum of elevation taken by itself is relatively meaningless.

Rainfall and Wet Periods

There seemed to be almost as much variation in respect to wet and dry periods on particular islands, as there was in regard to elevation of the floral zones. At Gardner it was noted that the southeast trade winds set in about July 1, with showers. October 2, on Champion Island all was dry and the landshells in hibernation. At Hood Island, January 31 to February 7, everything was still dry, and all shells hibernating. Showers began June 23 to July 3, and the hibernators were soon roused to activity especially in the wetter upper region. During hibernation the Bulimuli and other species often seek the most retired places under blocks of lava, more or less buried in the volcanic dust, or clustering in the cavities of rotten wood or in the dry crania of tortoises or cattle. Specimens thus collected must not therefore be supposed normally to inhabit such a situs. After the rains began the shells vanished from such places, so that no live individuals were seen where multitudes had hibernated. They attach themselves to their situs whether rock, twig, or bark of a tree, by a membranous and rather thick epiphragm, then retire a short distance and form another thinner epiphragm further within the shell, the two effectually preventing desiccation.

On Indefatigable Island October 23 the dry season was prevalent, no water in the pond; dead shells were plentiful, 200 to 600 feet; living ones in hibernation were noticeable at about 450 feet above the southeast anchorage. November 6, *Tornatellina* was resting under bark of dead trees, near Academy Bay. Bulimuli were attached to the smooth bark of a Eucalyptus-like tree at 450 feet but none was seen on other trees. They reached from 10 to 35 feet above the ground; at 550 feet elevation no more were seen.

On Chatham in July all species were hibernating. On Charles Island May 14 to 17 everything was dry, the mollusks hibernating.

Habits and Habitat of Landshells

On Hood Island at the east and southeast much driftwood was seen and a new patch of mangrove was evidently started by sea drift. On Albemarle the dark soil of mangrove swamps on the south coast is the haunt of *Auricula.* It was found on the ground at the edge of a fresh-water lagoon and all around it to a distance of four or five feet away from the water. It also occurred near salt lagoons and above the water, on the stems of mangroves growing there, and occasionally under dead logs in the vicinity.

On James Island *Bulimulus darwini* was seen active on the leaves of a small vine. The Succineas seemed to prefer the upper levels where they were taken from ferns growing on tree trunks, also under bark of dead trees and on grass blades.

It was noted that the larger specimens of *Succinea* were found at the higher levels, a fact probably correlated with the greater amount of moisture. The animal in some of the species is black and almost invisible when hibernating attached to blackish lava. A greenish species appears at the upper level, 2100 feet, probably *S. brevior,* and hibernates attached to twigs of shrubs, where they have somewhat the aspect of buds.

On Barrington the brownish, *Bulimulus eschariferus* was found hibernating mostly on brown twigs; the olivaceous *B. cucullinus* on grayish lava blocks.

On Albemarle near Tagus Cove the first living *Bulimulus* was found at 1500 feet elevation with *Pupilla. Pupilla munita* seemed to prefer the lower levels, the larger species the higher altitudes. Corrugated Bulimuli were found at 2400 feet; toward the rim of the crater they were larger and rougher, but at the rim a nearly smooth whitish species occurred. Brownish Bulimuli hide under cactus bark, the grayer kinds under dead leaves and on rocks. *Succinea bettii* is found sparingly at 1100 feet and upward, the larger specimens at the higher altitudes.

On Charles Island the same rule applied to the Succineas. *Bulimulus unifasciatus* was more abundant, hiding under rotten wood. One specimen was found in the lemon grove on a fungus. The Croton and Castella bushes at 675 feet altitude were clustered with hibernating shells May 14 to 17; they seemed in greatest abundance between 900 and 1100 feet. *Tornatellina* was found only near the "lower spring" under damp stones, at 1000 feet, active on May 25. The animal shines through the apex and early whorls of the translucent shell, almost black. They frequent only damp places and, as previously noted by Dr. Baur, are partial to ferns.

The following quotations are from the field notes, only slight emendations having been made.

"May 25, 1906. Some attention was given to the shells of the first two (dry) zones. The specimens were all found hibernating under loose lava blocks, higher up under and in old rotten logs. The real belt of distribution (***Bulimulus escharíferus*** and ***rugulosus***) seems about 200 to 450 feet. Shortly below 200 feet a few are in evidence, all under shrubs; at 450 feet only a few of them remain and most of them are in rotten wood. It seems marvelous, indeed, that within 50 feet of altitude these first (arid) zone shells should disappear and the upper (transition zone) forms have their beginning, at first sparsely and from 700 to the limit of 1000 feet wax profusely abundant.

"June 1, 1906. Just after the disappearance (of the arid zone forms up to 625 feet) the species of the upper (transition) zone come in (***Bulimulus nux***, ***B. asperatus*** Albers, ***Succinea bettii***). The lower forms lack the bright coloration of the higher shells.... Those shells reposing on the upper stalks of a bush were almost invariably of the lighter colored and rougher surface, while those species living at the base of the bush on the ground had a pretty brown color and some polish. At first the shells were noticed singly, then in pairs, and finally in small clusters, showing the rapid changes.

"At 500 feet, the lower limit and for 100 feet upward the shells were almost entirely confined to the small shrubby *Scoparia*. Higher up they also frequent taller bush, ***Leptochætea***.

"***Bulimulus nux*** was taken in large numbers from the great lemon groves, south and southeast from Spring Mountain and on the mountain slopes. They were (May 31, 1906) hibernating in the cavities of rotten wood and were most numerous in the deepest shade of the lemon groves at about 800 feet, though extending to 1650 feet; they usually keep well hidden under moss on rocks and about the bases of shrubs.

"June 2, 1906. Charles Island. A few Bulimuli were taken from the stems of ***Leptochætea***. At the upper limit of this vegetation, about 1600 feet, the grassy zone begins; here the ***B. nux*** nearly disappear, but ***B. unifasciatus*** are present and ***B. calvus*** becomes very numerous. This station is generally under the few loose lava blocks which dot the grassy top of the mountain; a few were found at the base of grass tufts. A few *Succinea bettii* were taken from under the moss and lichens hanging from a few Heliotropium bushes which reach the top on the inside of the crater. In the same situs were found *Pupilla munita, Helicina nesiotica* and *Succinea.*

"April 6, 1906. Narborough Island. Mr. Beck of the expedition succeeded in reaching the rim of the great crater from the east side, directly inland from Mangrove Point. He brought specimens which occurred from 2000 feet upwards. The first to be noticed were *Bulimulus unifasciatus*, in old cactus, later *B. calvus*. The vegetation of this island for about 3000 feet is scant. The first 1000 feet is completely barren recent lava. The next 2000 feet there are islands and long strips of green vegetation framed in the lava. The second region has been the last to be visited by lava streams, but in part has suffered disintegration sufficiently to nourish vegetation. This at first is thin, then as the level of the fog condensation is reached, more abundant. The last 1500 feet comprises a terrace-like country and the rim of the crater itself. This is covered with a dense growth of tall grass, ferns and bushes of which the thickest growth forms a narrow belt about and on the great rim. It was in this area that most of the shells were taken, the altitude being estimated at about 4500 feet.

"The north coast of the island was visited April 18 and 19. It presents a rough barren recent lava surface with scattered islands of vegetation, growing on disintegrated older lava and in ensemble approaching the intermediate green zone of the other islands. All the collecting here was confined to the arid zone which in the largest "vegetation island" extends a long distance inland. The specimens were all taken from under loose lava fragments, from the roots of small bushes and under the loose damp leaves of the compositæ which had gathered in depressions of the surface. From the latter situation active individuals were taken; most of the others were hibernating. They comprised *B. unifasciatus*, *B. calvus* and *Pupilla munita.*

"October 3. On Gardner Island near Charles, there was a profusion of dead landshells. After climbing about 250 feet live ones in a state of hibernation began to be encountered. They were glued to old cactus leaves or in the hollow stems of decayed cactus. The situs and environment of the shells was of extreme dryness. The whole surface of the island is volcanic. Little soil has formed and it is of a dry dusty nature. The dry dusty situs of the shells is reflected in their sculpture, it being rough and much corrugated. The whole surface of the island is strewn with dead shells which are also found in profusion in the 740 feet high crater. Champion Island is of a similar character. The crater has about 150 feet elevation, and all the living shells (*B. planospira*) were hibernating in crevices. A few large dead shells of *B. verrucosus* Pfeiffer, were picked up but no living were found. Near Academy Bay, Indefatigable Island, at about 400 feet, it was noticed that the species of *Bulimulus* which resorted to the smooth-barked tree for hibernation, harmonized very closely with their surroundings and were not easily detected.

"At Jervis Island at about 500 feet the first dead shells were seen, but no live ones until about 900 feet were ascended. Between this level and the 1000-foot summit all the live specimens were taken, hibernating on the lower surface of loose blocks of lava. The relation of the peculiar crenulation of these shells with their dark dusty color to the environment was an interesting feature.

"It should be noted that the lava blocks were reposing upon and sometimes imbedded in a loose volcanic dust resembling in color the shells themselves. At times the shells were hardly to be detected when the under side of the rock was dusty. The highest summit which is grassy with a few ferns and bushes is often decked with fog and a slight rain fell on the day of collecting, December 2.

"On James Island, directly back of the lagoon and parallel with the coast, is a rather steep ridge two miles long and rising about 1600 feet. On ascending this ridge many dead but no living Bulimuli were seen. At this date, December 22 to 26, the living forms were concealed in hibernation. Those near the coast were *B. calvus*, *cinerarius*, and *jacobi*, but at about 500 feet the elevated corrugated *B. sculpturatus* and *rugiferus* began to appear and continued up to about 1600 feet. *Succinea* came in at 900 to 1000 feet and up to the summit where a few live shells of *S. bettii* were taken from the leaves of the wild heliotrope and other shrubs and grass. They were the only living shells obtained December 28, notwithstanding there was plenty of green vegetation kept fresh by the condensing fogs; it seems that the hibernating instinct restrains the species until the rainy season arrives. Between the 1000 and 1600 foot levels a few Bulimuli were taken from the underside of small loose blocks of lava. The soil, though fertile, is dusty and the shells were not easily distinguished from their similarly colored background. James was thought to be one of the newer of the islands.

"The present position of a much crenulated shell in the wet zone, may be a vestigial character of the old rough conditions which certainly were present in the early time of the disintegration of the rocks. The eastern portion of the island is one great chaos of recent lava flows, and here the upper limit of shell life is probably about 600 feet. The floral zones on this island are more or less confused and indistinct.

"Duncan Island, December 2, was very rough and dry, with myriads of dead shells above 900 feet, but scarcely a living one to be found, especially of the Bulimuli. A few Succineas and *Guppya* were found among the roots of grass and small bushes at the summit, about 1275 feet elevation.

"On Chatham Island in the arid zone near shore, between 25 and 60 feet above the sea, the slender *Bulimulus chemnitzioides* and *B. habeli*, accompanied by a few dead *Succinea brevior*, were found under blocks of lava. In this zone the light reddish volcanic rock is weathered to form a dusty soil which fills the interstices between the basaltic blocks of lava and partly accounts for the half corrugated and half polished surface of some of the Bulimuli. Two specimens of *Succinea wolfi* were taken near Wreck Bay, January 29, from the stems of *Croton* about 250 feet above the sea, but no more live ones were collected. At Finger Rock, February 12, Bulimuli were found hibernating, head downward, under the loose bark of standing dead trees.

"On Charles Island *Bulimulus unifasciatus* Albers, was the predominating form at the summit, 1780 feet, slowly diminishing with the altitude."

Similar data could be multiplied almost indefinitely from the copious field notes.

In general it may be said that the habits of these species correspond with those with which we are familiar in more northern climes.

The minute heliciform species are found on the earth in the moister regions or where the shelter of a lava block retains moisture in the soil. For the most part, altitude has little significance for them.

The Auriculids frequent the shores near the sea or about the mangrove swamps, fresh or brackish. *Helicina* is often associated with them, or may be found on the rim of a high crater provided the place is moist.

The Succineas have their range indirectly governed by the moisture and its correlative vegetation. They are larger and more abundant in the upper or moister regions but may occur near the beach.

The Pupillidæ range, not only over the majority of the islands arid or otherwise, but also from near the sea beaches up to the rim of a 4000 foot crater cone.

The Bulimuli, the most prominent factors in the landshell fauna of the islands, as in other regions, may be grouped into ground-dwellers and tree lovers. The latter as usual are the most elegantly colored and usually smooth; the former dull-colored, often hairy, and seem to associate a dusty situs with peculiar corrugations in the growth of the shell. The forms which are prevalent on the moist, grassy region of the upper summits are usually smooth and thinner than the corrugated forms of the lower levels.

The great variety of forms, some of which have attained and others seem only on the way to specific equilibrium, may be regarded as due to long development from small and insignificant ancestors, absence of competition in the struggle for existence and isolation of small communities through meteorological or geological changes. No indication of any former land connection with the continent to the eastward, is afforded by the study of these shells. Analogous cases are the Achatellinidæ of the Hawaiian Islands and the Achatinoid and Buliminoid snails of St. Helena.

The whole problem has been discussed in the senior author's monograph of 1896, and to the principles there enunciated nothing in the present collection is opposed; in fact, the hypothesis of the connection between the corrugated Bulimuli and their dusty situs receives a certain amount of corroboration from the Academy expedition's observations.

That much remains to be done before we can discuss with any finality the question of inter-island distribution is evident, and it seems quite probable that the future will add largely to the present faunal list. Every successive expedition has made substantial additions to it, and it seems certain that abundant rewards await future exploration.

NAMES OF THE ISLANDS

The well known British names given by the first surveyors, nearly a century ago and familiar to navigators and explorers, have been changed by an Ecuadorian Congress as shown in the following list. It is regrettable if the new names are to be adopted that distinctive ones were not chosen, such names as Fernandina, Santa Cruz, San Salvador, Santa Fé, having been used many times for well known geographical features, to the great confusion of geographers. To conform to previous publications on the fauna and flora of the islands and to avoid the confusion which would result from any other course, the established names will continue to be used in this paper. It will be noticed on an inspection of the chart issued by the Hydrographic Office that there are two Gardner islands, one at Gardner Bay of Hood Island and the other southeast of Charles Island.

The names applied to the respective islands are as follows:

English	*Ecuadorian*
Abingdon	Pinta
Albemarle	Isabela
Barrington	Santa Fé
Bindloe	Marchena
Brattle	Tortuga
Charles	Santa Maria
Chatham	San Cristobal
Duncan	Pinzon
Hood	Espanola
Indefatigable	Santa Cruz
James	San Salvador
Jervis	Rabida
Narborough	Fernandina

GROUPS OR SECTIONS OF THE BULIMULI

The species of *Bulimulus*, subgenus *Næsiotus*, may be arranged in groups of species apparently more nearly related to one another than to those of the other groups, though hardly forming subgenera.[4]

Rhaphiellus Pfr. 1855
Group of *Bulimulus achatellinus* Forbes

The Academy collection contains none of this arboricolous species, which no collector seems to have found abundant. Quite probably, if attention is especially directed to the trees, other members of this group will be found. The axis in this species is quite simple and tubular.

Næsiotus Albers, 1850
Group of *Bulimulus nux*

Bulimulus nux Brod. type
Bulimulus var. perchloris Dall & Ochsner
Bulimulus var. monotænius Dall & Ochsner
Bulimulus var. nuciformis Petit
Bulimulus var. verrucosus Pfeiffer
Bulimulus var. basiplicatus Dall & Ochsner
Bulimulus asperatus Albers, not Reibisch
Bulimulus bauri Dall

Granucis Dall & Ochsner, new section
Group of *Bulimulus planospira*

Bulimulus planospira Ancey, type
Bulimulus rugulosus Sowerby
Bulimulus invalidus Reibisch
Bulimulus approximatus Dall

Nuciscus Dall & Ochsner, new section
Group of *Bulimulus ustulatus*

Bulimulus ustulatus Sby. type
Bulimulus var. venustus Reib.
Bulimulus var. phlegonis Dall & Ochsner
Bulimulus var. pallescens Dall & Ochsner
Bulimulus calvus Sby.
Bulimulus var. caryonis Dall & Ochsner
Bulimulus elæodes Dall.
Bulimulus hemærodes Dall
Bulimulus pallidus Reibisch
Bulimulus rugatinus Dall (*acutus* R.)
Bulimulus cinerarius Dall (*cinereus* R.)
Bulimulus jacobi Sby.
Bulimulus tanneri Dall
Bulimulus perrus Dall

[4] The several groups have been designated as sections following Pfeiffer and Albers, in order to maintain uniformity, the species after which the group is named being in all cases the type of that section.

Group of *Bulimulus hoodensis*

Bulimulus hoodensis Dall

This species seems an intruder into the fauna of the Galapagos, having none of the insular characteristics but rather those of the continental Bulimuli.

Reclasta Dall & Ochsner, new section
Group of ***Bulimulus unifasciatus***

Bulimulus unifasciatus Sowerby, not Reibisch, type
Bulimulus olla Dall
Bulimulus var. jacobinus Dall

Adenodia Dall & Ochsner, new section
Group of ***Bulimulus eschariferus*** Sowerby

Bulimulus eschariferus Sowerby, type
Bulimulus var. ventrosus Reibisch
Bulimulus var. subconoidalis Ancey
Bulimulus perspectivus Pfeiffer

Stemmodiscus Dall & Ochsner, new section
Group of ***Bulimulus snodgrassi***

Bulimulus snodgrassi Dall, type
Bulimulus cucullinus Dall
Bulimulus galapaganus Pfeiffer

Olinodia Dall & Ochsner, new section
Group of ***Bulimulus amastroides***

Bulimulus amastroides Ancey, type
Bulimulus nucula Pfeiffer
Bulimulus trogonius Dall

Særonia Dall & Ochsner, new section
Group of ***Bulimulus simrothi***

Bulimulus simrothi Reibisch, type
Bulimulus tortuganus Dall
Bulimulus albemarlensis Dall

Ochsneria Dall, new section
Group of ***Bulimulus wolfi***

Bulimulus akamatus Dall
Bulimulus adelphus Dall
Bulimulus wolfi Reibisch, type
Bulimulus lycodus Dall
Bulimulus alethorhytidus Dall
Bulimulus cymatias Dall
Bulimulus ochsneri Dall
Bulimulus særonius Dall

Granitza Dall & Ochsner, new section
Group of ***Bulimulus duncanus***

Bulimulus duncanus Dall, type
Bulimulus jervisensis Dall
Bulimulus darwini Pfeiffer

Granella Dall & Ochsner, new section
Group of ***Bulimulus sculpturatus***

Bulimulus sculpturatus Pfeiffer, type
Bulimulus rabidensis Dall
Bulimulus rugiferus Sowerby
Bulimulus nesioticus Dall
Bulimulus reibischi Dall
Bulimulus nudus Reibisch

Pleuropyrgus von Martens

Group of *Bulimulus chemnitzioides*

Bulimulus chemnitzioides Forbes, type
Bulimulus habeli Stearns
Bulimulus (habeli var.?) terebra Reibisch
Bulimulus indefatigabilis Dall

Pelecostoma Reibisch

Group of *Bulimulus canaliferus*

Bulimulus canaliferus Reibisch, type

Check List and Distribution of Galapagos Landshells

Auricula stagnalis—Indefatigable, Albemarle, and Bindloe islands.
Bulimulus achatellinus—Chatham and Hood islands.
Bulimulus adelphus—Indefatigable Island.
Bulimulus akamatus—Indefatigable Island.
Bulimulus albemarlensis—Albemarle Island.
Bulimulus alethorhytidus—Indefatigable Island.
Bulimulus amastroides—Chatham Island.
Bulimulus approximatus—Hood Island.
Bulimulus asperatus—Charles Island.
Bulimulus bauri—Chatham Island.
Bulimulus calvus—Chatham, Charles, and James islands.
Bulimulus canaliferus—Chatham Island.
Bulimulus chemnitzioides—Chatham Island.
Bulimulus cinerarius—Albemarle and James islands.
Bulimulus cucullinus—Hood, Charles and Barrington islands.
Bulimulus cymatias—Indefatigable Island.
Bulimulus darwini—Jervis Island and, possibly, Bindloe.
Bulimulus duncanus—Duncan Island.
Bulimulus elæodes—Albemarle Island.
Bulimulus eschariferus—Chatham, Charles and Barrington islands.
Bulimulus galapaganus—Charles Island.
Bulimulus habeli—Chatham Island.
Bulimulus hemærodes—Albemarle and Narborough islands.
Bulimulus hoodensis—Hood Island.
Bulimulus indefatigabilis—Indefatigable and James islands.
Bulimulus invalidus—Charles Island.
Bulimulus jacobi—Albemarle, Narborough, James and Abingdon islands.
Bulimulus jervisensis—Jervis Island.
Bulimulus lycodus—Indefatigable Island.
Bulimulus nesioticus—Indefatigable and James islands.
Bulimulus nucula—Chatham and Charles islands.
Bulimulus nudus—Charles Island.
Bulimulus nux—Chatham, Gardner, Charles and Champion islands.

Bulimulus ochsneri—Indefatigable Island.
Bulimulus olla—Barrington, Indefatigable and Duncan islands.
Bulimulus pallidus—Albemarle and Abingdon islands.
Bulimulus perrus—Narborough Island.
Bulimulus perspectivus—Chatham and Charles islands.
Bulimulus planospira—Gardner, Charles and Champion islands.
Bulimulus rabidensis—Jervis Island.
Bulimulus reibischi—Indefatigable Island.
Bulimulus rugatinus—Chatham and Albemarle islands.
Bulimulus rugiferus—James Island.
Bulimulus rugulosus—Charles and, possibly, Chatham islands.
Bulimulus sacronius—Indefatigable Island.
Bulimulus sculpturatus—James Island.
Bulimulus simrothi—Albemarle Island.
Bulimulus snodgrassi—Hood, Gardner and Charles islands.
Bulimulus tanneri—Indefatigable, Albemarle and Daphne islands.
Bulimulus terebra—Chatham Island.
Bulimulus tortuganus—Tortuga and Albemarle islands.
Bulimulus trogonius—Albemarle Island.
Bulimulus unifasciatus—Chatham, Charles and James islands.
Bulimulus ustulatus—Charles Island.
Bulimulus wolfi—Indefatigable Island.
Endodonta helleri—Albemarle, Narborough, and James islands.
Euconulus galapaganus—Chatham, James and Abingdon islands.
Guppya bauri—Hood, Duncan, Albemarle and Abingdon islands.
Helicina nesiotica—Chatham, Charles and Albemarle islands.
Helicina ochsneri—Chatham and Albemarle islands.
Melampus trilineatus—Hood Island.
Onchidella steindachneri—Charles and Albemarle islands.
Onchidium lesliei—Charles and Albemarle islands.
Pedipes angulatus—Bindloe Island.
Pupilla clausa—Albemarle Island.
Pupilla munita—Charles, Duncan, Albemarle, Narborough and Tower islands.
Pupilla reibischi—Albemarle Island.
Siphonaria gigas—Charles Island.
Succinea bettii—Chatham, Charles, Indefatigable, Duncan, Albemarle, James and Abingdon islands.
Succinea brevior—Chatham and Charles islands.
Succinea corbis—Charles, Albemarle, Narborough islands.
Succinea producta—Chatham, Charles, Duncan, Albemarle, Narborough and James islands.
Succinea wolfi—Charles and Albemarle islands.
Tornatellina chathamensis—Chatham, Charles and Albemarle islands.
Tralia panamensis—Hood Island.
Vitrea actinophora—Chatham and James islands.
Vitrea chathamensis—Chatham, Albemarle, James and Abingdon islands.
Williamia galapagana—Chatham, Hood and Charles islands.

DESCRIPTIONS OF SPECIES

In the following descriptions the reference "Dall, 1896" is intended to refer to the senior author's monograph of that year; "Dall, 1900", to the supplementary report; "Reibisch, 1892", to the publication by that author of 1892. It is intended to give a reference to the original place of publication of a given name and if possible to a good figure. For full synonymy the reader must refer to the monograph of 1896, since it would serve no good purpose to republish the data. If changes are made, due to the receipt of more information, these will be duly noted. The complete fauna will be found in the foregoing check-list. Species not collected by the Academy's Expedition will be referred to among the descriptions only when new data require it. A full bibliography will be found in the 1896 monograph; it only lacks the supplementary paper of 1900, and the preliminary descriptive paper based on the present collection.[5]

Group of *Bulimulus nux*

1. **Bulimulus (Næsiotus) nux** Broderip

Plate 9, figures 1–10

Bulimulus nux BROD. P. Z. S. Lond. 1832, p. 125 (Charles Island) Sowerby, Conch. Ill., p. 6, figs. 37, 37*, 1833; DALL, 1896, pl. XVI, fig. 6 (genitalia) pl. XVII, fig. 10 (dentition), 1900.

This species which seems to occur in great numbers where found at all, is confined, with its varieties to the islands Charles and Chatham, with two islets, Champion and Gardner, near Charles. The Academy collection consists of a remarkable series of several thousands which enables us to fix the range of variation and to reestablish as a distinct species *B. asperatus* Albers (not of Reibisch). The typical form is dark brown when fresh, and was collected on bushes at Charles Island at altitudes between 800 and 1000 feet. It was associated with the pale, streaky, straw-colored variety *(perchloris* Dall & Ochsner, new subspecies, Figs. 1 and 2), and the

[5] Dall, W. H. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906 XI. Preliminary descriptions of new species of Pulmonata of the Galapagos Islands. Proc. Calif. Acad. Sci., 4th ser. Vol. 2, pt. 1, No. 11, 1917, pp. 375-382.

banded form (*unifasciatus* Reibisch not Sowerby,=*monotænius* Dall & Ochsner, new name, Figs. 3, 4, 5, 6, 7, 8). There were also specimens of the variety *nuciformis* Petit, brown with whitish axial wrinkles and yellow streaks, in the same area and in a lemon grove at the same elevation. The full grown examples of *B. verrucosus* Pfeiffer which we have seen are larger than the *B. nux* but are all dead. Their sculpture is the same as that of *B. nuciformis* and they were mistaken for *B. asperatus* Albers by Reibisch. At present we feel inclined to regard them merely as a large variety of *B. nux*. They were found in the lemon grove on Charles Island above referred to. A curious variation with a strong plication on the pillar (*basiplicatus* Dall & Ochsner, new subspecies, Figs. 9 and 10), was found sparsely on the grassy zone of Chatham Island, at 1900 to 2500 feet elevation. It does not differ otherwise from *nuciformis*.

The axis in *B. nuciformis* is shown by a section to be simple, slender and hardly twisted. That portion of it contained in the last whorl is pervious but not greatly enlarged. The part in the earlier whorls appears solid.

2. **Bulimulus (Næsiotus) asperatus** Albers

Bulimulus asperatus Albers, Mal. Blatt., IV, p. 98, 1857; Nov. Conch. IV, p. 145, pl. 133, figs. 8, 9; (not of Reibisch).

Bulimulus incrassatus var. *sulcatus* Reibisch, 1892, figs. 4*b*, 4*c*.

The fine series collected during the Academy's work enables us to positively separate this form specifically from *B. nux*. The specimens are extremely uniform in color and sculpture, destitute of the rugosities found in *B. nux* and characteristically, spirally sulcate anteriorly. The color is chestnut brown, axially, closely streaked with a lighter shade in fine lines, giving a somewhat violaceous tint in paler specimens, or very rarely pure chestnut.

The axis is like that of *B. nux* except that the tubular part in the last whorl is larger in diameter.

The area occupied by this species is wider than that of *B. nux* according to the field notes. It is found on bushes at Charles Island, between altitudes of 500 to 1000 feet.

June 22, 1928

3. **Bulimulus (Næsiotus) bauri** Dall

Bulimulus (Næsiotus) bauri DALL, Nautilus, VII, p. 54, September, 1893; Proc. Acad. Nat. Sci. Phila. for 1896, p. 441, pl. XV, fig. 12; pl. XVII, figs. 9, 15 (dentition).

Chatham Island, at 1600 feet, on the under side of leaves of plants, Dr. Baur. This was not collected by the Academy's expedition. A section shows the axis tubular and stout in the last whorl; above it is slender, solid, and markedly twisted.

Group of *Bulimulus planospira*

4. **Bulimulus (Næsiotus) planospira** Ancey

Bulimulus rugulosus var. *planospira* ANCEY, Bull. Soc. Mal. de France, IV, p. 294, 1887; DALL, 1896, p. 432, pl. XVI, fig. 3.

This species was collected at the northwest end of Charles Island, at about 200 feet, by Dr. Baur, and by the Academy party at about 150 feet, hibernating under blocks of lava on Champion and Gardner islands near Charles. Its station is in the arid zone near the sea. The axis is shown by a section to have in the last whorl a tubular form and in the upper whorls a considerable twist.

5. **Bulimulus (Næsiotus) rugulosus** Sowerby

Bulimulus rugulosus SOWERBY, Conch. III, pt. 142, fig. 37*a–b*, 1839; DALL, 1896, pl. XVII, fig. 1 (jaw).

This species was collected on the northwest side of Charles Island, by Dr. Baur, under stones near the shore. The Academy collectors found it on the north side of the same island at between 200 and 500 feet elevation under stones and rotten wood; also at 700 feet on Abingdon Island. An original specimen obtained from Sowerby by Dr. Isaac Lea, shows the entire surface to be covered with almost microscopic, beaded, close-set, spiral lines. Most of the specimens obtained are bleached, but fresh ones are of a dark brown color, sometimes with a paler peripheral band. Fresh young individuals have short hairs seated on the beads.

This species is also reported from Chatham Island by Darwin, Kellett and Cuming, but, owing to the very slight discrimination among the closely allied species shown by the earlier describers, we do not feel confident of the identity. We have seen no specimen from Chatham, though the species might be expected to occur there.

6. **Bulimulus (Næsiotus) invalidus** Reibisch

Bulimulus invalidus Reibisch, 1892, p. 5, pl. 1, fig. 6.

This form is of somewhat doubtful status. It differs from *rugulosus* by the absence, or almost complete absence of the beaded sculpture, by its usually larger size, and by the extension of the axial wrinkling over the greater part of the shell. A few spiral incised lines sometimes appear on it. Fresh specimens are brownish; a variety exists in which the shells appear of an ashy yellow, but this may be due to bleaching.

This has about the same distribution on Charles Island as *B. rugulosus,* in the arid zone. Reibisch's figure seems to resemble a slender form of *B. nux* but specimens received under his name from Dr. Wolf are as above described. The axis is like that of *nuciformis.*

Bulimulus approximatus Dall, 1900, by form and habit seems to belong to this group, but has a smooth and polished surface and olivaceous tint. It inhabits Hood Island but was not among the shells collected by the Academy.

Group of *Bulimulus ustulatus*

7. **Bulimulus (Næsiotus) ustulatus** Sowerby

Plate 9, figures 11–17

Bulimulus ustulatus Sowerby, P. Z. S. Lond. 1833, p. 72; Conch. Ill., *Bulinus*, p. 6, fig. 42, 1833.

This is a Charles Island species. The typical form, from some of the original lot, is a nearly smooth shell, with a very distinct suture and feeble, axial wrinkles; yellowish with peripheral pale band and usually a darker brown band on each side of the pale one; the coloration is variable. The typical form has not appeared in any of the later collections. A large series of varieties was collected by the Academy expedition.

The most conspicuous and attractive variety is that described by Reibisch under the name *venustus*. This when fresh is bright yellow, peripherally banded with two blackish spirals, and with narrow, blackish or dark brown, axial, streaks between narrow, yellow, axial wrinkles. The yellow fades to straw-color in the cabinet. These were found under stones at 1500 to 1750 feet elevation. Another variety (*phlegonis* Dall & Ochsner, new subspecies, Figs. 11, 12, 15, 16, 17), is somewhat larger and heavier, burnt sienna, dark brown, not banded, but with axial, lighter threads between dark interspaces. This was found in the lemon grove, on bushes at 1650 ft. elevation together with the next variety.

The latter is ashy white, slightly larger, with livid, flesh color or light brownish, axial streaks or nebulous bands, but rarely distinct peripheral banding. This merges into the largest and most rudely wrinkled variety (*pallescens* Dall & Ochsner, new subspecies, Figs. 13, 14), of a light brown or straw-color, a peripheral band sometimes indicated by two narrow brown spiral lines, but usually wanting. This was collected in an open pasture land near a stream southwest of Spring Mountain. This has an axis like that of *B. nux*.

8. **Bulimulus (Næsiotus) calvus** Sowerby

Bulinus calvus Sby., P. Z. S. Lond. 1833, p. 72; Conch. Ill., *Bulinus*, p. 6, fig. 41, 1833.

James Island, Cuming; Chatham Island, Kellett; Charles Island, under stones at 750 ft. elevation, Ochsner; also Cuming and Wolf. Dark brown with paler streaks and peripheral band, surface polished. A variety (*caryonis* Dall & Ochsner, new subspecies), from the same station is pale pinkish brown, the shell longer and with more distinct sutures, peripheral band absent or obsolete, surface of the shell not polished, with rather rude axial wrinkles but no granulation visible with an ordinary lens.

Length about thirteen millimeters. This with a larger amount of material may prove distinct. It is more or less intermediate between *calvus* and *nucula*. The axis in both these forms is like that of *asperatus* Albers.

9. **Bulimulus (Næsiotus) elæodes** Dall

Plate 8, figures 1, 2

Bulimulus (*Næsiotus*) *elæodes* Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 376.

"Albemarle Island, on leaves, hibernating, at 1500 to 2300 feet elevation, near Banks Bay." (W. H. O.)

The specimens vary a good deal in height, the one selected as type being of about the greatest length while some others are much shorter. The axis is similar to that of *planospira.*

10. **Bulimulus (Næsiotus) hemærodes** Dall

Plate 8, figure 3

Bulimulus (*Næsiotus*) *hemærodes* Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 376.

Hibernating under dead wood on Cowley Mountain, Albemarle Island, between 2100 and 2300 feet elevation, in the grassy zone; and hibernating on the grassy rim of the crater of Narborough up to 4500 feet. (W. H. O.)

This species, except for its apertural characters, might serve as a weak imitation of *B. simrothi.* It illustrates remarkably well the vicissitudes due to the action of alkaline volcanic dust upon the delicate shell-forming margin of the mantle, thus indirectly inducing rugosities, as suggested in the monograph of 1896. By breeding one of these species in a vivarium from rugose ancestors it would be quite possible in a few generations to test this hypothesis and incidentally the hypothesis of the non-inheritance of acquired characters. The association of rugose and distorted species with the presence of such dust, was often noted in the field.

11. **Bulimulus (Næsiotus) pallidus** Reibisch

Bulimulus pallidus Reibisch, 1892, p. 6, pl. 1, fig. 9.

Albemarle Island, on bushes and stones, 200 to 800 feet altitude, Wolf; on rim of crater in grassy zone, near Tagus Cove, at 4000 feet elevation; also on Abingdon Island in the verdant area at 700 feet under stones. (W. H. O.)

The axis in this species is tubular and simple as in the last species. The range in altitude of station is notable. We have thought it best to recognize this form as a species although some individuals range very close to the following species.

12. **Bulimulus (Næsiotus) rugatinus** Dall

Bulimulus acutus Reibisch, 1892, p. 8, pl 1, fig. 13; not of Leach, Zool. Misc. 1815.

Bulimulus rugatinus Dall, Proc. Biol. Soc. Wash., XXX, p. 10, January, 1917.

Chatham Island, Wolf; Albemarle Island, near Tagus Cove, 3000-4000 feet elevation in grassy zone; also hibernating under stones at 1600 feet, Ochsner and Snodgrass.

The axis is simple, slender, tubular and hardly twisted.

13. **Bulimulus (Næsiotus) cinerarius** Dall

Bulimulus jacobi var. *cinereus* Reibisch, 1892, p. 7, pl. 1, fig. 10; not *B. cinereus* of Reeve, 1848.

Bulimulus jacobi, var. *vermiculatus* Dall, Nautilus, VII, p. 53, September, 1893; not *B. vermiculatus* Beck, 1838; Dall, 1896, p. 439, pl. XVI, fig. 14.

Bulimulus cinerarius Dall, Proc. Biol. Soc. Wash., XXX, p. 10, January, 1917.

James Island, Wolf. Albemarle Island, near Iguana Cove, hibernating under tortoise bones at 200 to 250 feet, and also at 600 to 700 feet. (W. H. O.)

The axis of this species is like that of *B. asperatus* Albers.

14. **Bulimulus (Næsiotus) tanneri** Dall

Bulimulus tanneri Dall, Nautilus, VIII, p. 127, March, 1895, and index, p. iii; Proc. Acad. Nat. Sci. Phila. for 1896, p. 438, pl. XVI, fig. 5.

Indefatigable Island, Tanner. Albemarle Island near Tagus Cove; at rim of crater in grassy area, at 4000 feet altitude; and inside the crater of Daphne Island, at 250 feet, verdant area. (W. H. O.)

The axis of this species is like that of *B. cinerarius*.

15. **Bulimulus (Næsiotus) perrus** Dall

Plate 8, figure 4

Bulimulus (Næsiotus) perrus Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 376.

Narborough Island, in the grassy area at the rim of the crater, 2000 to 4500 feet elevation. (W. H. O.)

Group of *Bulimulus unifasciatus*

16. **Bulimulus (Næsiotus) unifasciatus** Sowerby

Bulinus unifasciatus Sby., P. Z. S. Lond. 1833, p. 37; Conch. Ill., *Bulinus*, fig. 55, 1833; Dall, 1896, pl. XVII, figs. 6, 11 (dentition and jaw). Not *Bulimulus unifasciatus* Reib., 1892, p. 20, pl. 1, fig. 1, (= *B. nux* var. *monotænius*).

James and Charles islands; Cuming. Chatham Island; Kellett and Baur. Charles Island, on *Croton* bushes, 500 to 1650 feet, also in lemon grove on bushes, 800 to 1200 feet elevation; (W. H. O.)

By its thin shell and general aspect this species is readily distinguished from any other of the Galapagos species. The variations are chiefly from the purplish brown of fine fresh specimens to a more or less dingy olive, and the absence or presence of the pale peripheral band. The axis is simple and tubular. The species was collected abundantly on Charles Island but it was not found elsewhere. We do not feel confident that the following species is closely allied to *unifasciatus.*

17. **Bulimulus (Næsiotus) olla** Dall

Bulimulus jacobi Reeve, Conch. Icon. Vol. V, Bulimus, pl. XXI, fig. 135, 1848; not of Sowerby, 1833.

Bulimulus olla Dall, Nautilus VII, September, 1893, p. 53; Dall, 1896, p. 427, pl. XVI, fig. 2.

Duncan Island, 600 feet, under stones, mostly dead; (W. H. O.) James Island; Cuming. Duncan, Barrington and Indefatigable islands; Baur. Variety *jacobinus,* James Island, 200 to 1800 feet, under stones, mostly dead; (W. H. O.)

The variety differs only in size but there are practically no intermediate sizes, as follows:

B. olla	Length 15.5; diameter 9.0 mm.
var. *jacobinus*	Length 13.0; diameter 7.5 mm.
var. *jacobinus*	Length 14.5; diameter 7.5 mm.

In neither form is the peripheral band noticeable when fresh, but most of the specimens are dead.

Group of *Bulimulus eschariferus*

18. **Bulimulus (Næsiotus) eschariferus** Sowerby

Bulinus eschariferus Sby., Conch. Ill., *Bulinus*, figs. 85*a*, 85*b*, 1833; Dall, 1896, p. 434.

Chatham Island, Darwin, Kellett, Baur, and Snodgrass. Charles Island; H. M. S. Peterel. Barrington and Chatham Islands; (W. H. O.)

The typical form, brown with pale peripheral band, was obtained by the Academy expedition on Barrington Island, hibernating under blocks of lava at 200 to 500 feet elevation. The variety *ventrosus* Reibisch, differs only by its olivaceous tint without peripheral band; it was obtained on Chatham Island under stones of the dry zone from near shore to 300 feet elevation; also at the "north middle" of the island in similar situations at 450 to 500 feet. A completely very dark brown variety, with no peripheral band was also collected at the "north middle" of the island. Ancey noted a form which has developed a plication on the pillar, similarly to *B. nux* var. *basiplicatus*, which he called *subconoidalis*, but we have not found any such among the Academy's specimens. He rightly remarked that it is not a character of great importance. The axis of this species is simple and tubular, rather more widely so than in most of the perforate species.

19. **Bulimulus (Næsiotus) perspectivus** Pfeiffer

Bulimulus perspectivus Pfr., P. Z. S. Lond. 1846, p. 43; Reeve, Conch. Icon. *Bulimus*, pl. 63, fig. 435, 1849.

Chatham Island, 300 to 600 feet; Wolf. Typical form, dark brown without band, found hibernating under blocks of lava in the arid zone on Charles Island, 50 to 300 feet above the sea; a pale variety without peripheral band on Chatham Island, hibernating at 350 feet; and a banded, dark brown variety on Charles near Flamingo lagoon, at 75 feet, and at Muck Bay, 25 to 60 feet elevation. It is thus a consistent inhabitant of the arid zone like many of the granulose species. The axis is simple, slender, and hardly twisted.

Group of *Bulimulus snodgrassi*

20. **Bulimulus (Næsiotus) snodgrassi** Dall

Bulimulus snodgrassi DALL, 1900, p. 90, pl. VIII, fig. 2.

Hood Island; Snodgrass and Heller. Hood Island, under stones, 180 to 600 feet elevation, including an albino specimen; also on Charles Island near the lagoon; and on Gardner Island at 150 feet in similar situations; (W. H. O.) A species of the arid zone.

A character remarkably distinguishing this and the following species from any other of the known Galapagos forms except *B. canaliferus,* is furnished by the modification of the axis. This in the upper whorls of the shell is simple and tubular as in many of the Galapagos species, but in the first half of the last whorl, and invisible from the aperture, a semicircular, disk-like flange projects at right angles to the axis into the lumen of the whorl and about half-way toward the outer wall of the whorl. This dwindles in front and behind into a short plait-like ridge on the axis which does not enter the penultimate whorl or become visible from the aperture. This arrangement recalls the lamina in *Phenacotaxus umbilicatellus* Pilsbry, of Peru, except that it is confined to the first half of the last whorl, while in the Peruvian shell the lamina occupies part of three whorls and has its major expansion in the penultimate whorl.[6]

This species passes through the usual series of color variations, lighter or darker color, presence or absence (in melanitic specimens) of the peripheral spiral bands, etc., but in other respects preserves a general uniformity.

[6] See Smithsonian Misc. Coll., Vol. 59, No. 14, 1912, p. 9, figs. 1, 2.

21. **Bulimulus (Næsiotus) cucullinus** Dall

Plate 8, figures 5, 6

Bulimulus (Næsiotus) cucullinus DALL, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 377.

Found hibernating on Hood Island under stones between 200 and 600 feet elevation; a variety with faint indications of a peripheral band, with the others; also on Charles Island in the moist area under moss and grass at 1650 feet; and on Barrington Island under stones in hibernation at 200 feet; lastly a paler variety on Hood Island at 380 feet elevation.

The axial flange in this species is shorter, rounder, and less prominent than in *B. snodgrassi,* but occupies the same position in the shell. In the associated *B. galapaganus* Pfeiffer, the projection is thick and rounded.

Group of *Bulimulus amastroides*

22. **Bulimulus amastroides** Ancey

Bulimulus amastroides ANCEY, Bull. Soc. Mal. de France, IV, July, 1887, p. 293; DALL, 1900. p. 441, pl. XV, fig. 2.

Chatham Island from 1500 to 2500 feet elevation, California Academy of Sciences; also the U. S. Bureau of Fisheries.

The axis in this species is simple, slender and twisted.

23. **Bulimulus (Næsiotus) trogonius** Dall

Bulimulus trogonius DALL, Proc. Biol. Soc. Wash., XXX, p. 10, January, 1917.

Collected by the U. S. Bureau of Fisheries on Albemarle Island. The shell is very small, and the axis unusually thickened in the last whorl, but simple.

Group of *Bulimulus simrothi*

24. **Bulimulus (Næsiotus) simrothi** Reibisch

Bulimulus simrothi REIB., 1892, p. 11, pl. II, fig. 1.

Found by the Academy expedition on Albemarle Island near Vilamil under leaves, at 500 to 1200 feet elevation; and by Baur at 1000 to 1200 feet.

The axis in this species is thickened by a continuation of the tubercle over the pillar in a spiral manner in the last whorl; the portion of the axis in the upper whorls is thin, slender and twisted. There is a purple stain on the pillar in the last whorl, not visible from the aperture.

25. **Bulimulus (Næsiotus) tortuganus** Dall

Bulimulus tortuganus Dall, Nautilus, VII, p. 54, 1893; Dall, 1900, p. 440, pl. XVI, figs. 11, 12, 13; pl. XVII, fig. 2 (jaw); as of *B. simrothi* in error.

La Tortuga, off southeast Albemarle, in the grassy zone; Dr. Baur. Albemarle Island on bushes near Vilamil at 486 to 700 feet; (W. H. O.)

On the evidence of a photograph of *B. simrothi* in 1900 this form was referred to it as a synonym. By means of the full series collected by the Academy expedition we are able to establish it specifically. It is extremely similar to *B. simrothi* in general characters but is uniformly larger, with a more elevated spire and much rougher on the surface of the last whorl. In the adult *B. simrothi* the tubercles on the pillar and outer lip are relatively more prominent, the general tint is light brown, white *tortuganus* is whitish on the last whorl and with distinctly pink apical whorls. In many of the specimens of *tortuganus* the tubercles of the aperture are hardly noticeable. The axis is more slender and hardly twisted in the upper whorls, while in the last whorl there is no continuation of the pillar tubercles on the axis, though the dark stain of color is there.

The figures supposed to be of *B. simrothi* in the monograph of 1900, are really all taken from specimens of *B. tortuganus.*

These forms initiate the series of species with apertural armature, which render the group of *Næsiotus* so peculiar.

26. **Bulimulus (Næsiotus) albemarlensis** Dall

Plate 8, figures 7, 8

Bulimulus (Næsiotus) albemarlensis Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 377.

On bushes and grass near Vilamil at 2300 to 3300 feet elevation; (W. H. O.) The pillar tubercle is not prolonged around the axis which is slender, tubular, and simple.

Measurements of average specimens of the preceding species are as follows in millimeters.

B. simrothi	Length 10; last whorl 7; diameter 6.
B. tortuganus	Length 13; last whorl 9; diameter 7.
B. albemarlensis	Length 15; last whorl 12; diameter 9.

There is the usual amount of variation among individuals. The three species above noted form a group peculiar to Albemarle Island and its associated islets, as far as yet known.

27. **Bulimulus (Næsiotus) akamatus** Dall

Plate 8, figure 9

Bulimulus (*Næsiotus*) *akamatus* DALL, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 378.

Found by the Academy expedition on Indefatigable Island, under blocks of lava, at 200 to 650 feet elevation, in the arid zone.

This is a very characteristic and well defined species, but apparently not abundant. It has no indication of a peripheral band.

28. **Bulimulus (Næsiotus) adelphus** Dall

Plate 8, figure 10

Bulimulus (*Næsiotus*) *adelphus* DALL, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 379.

Found with the preceding species by the Academy expedition in the arid zone.

29. **Bulimulus (Næsiotus) lycodus** Dall

Plate 8, figures 11, 15, 16

Bulimulus (*Næsiotus*) *lycodus* DALL, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 379.

Found by the Academy Expedition on Indefatigable Island on tree trunks at 450 to 550 feet elevation.

At first this was suspected to be a variety of *B. wolfi* Reibisch, which belongs to the same section, but a comparison with a specimen of *wolfi* received from Wolf himself, showed that the latter is a larger and more slender shell with less emphasized sculpture and a more prominent tubercle inside the outer lip.

30. **Bulimulus (Næsiotus) alethorhytidus** Dall

Plate 8, figures 17, 18

Bulimulus (*Næsiotus*) *alethorhytidus* Dall, Proc. Calif. Acad. Sci., 4th Ser. Vol. 2, pt. 2, No. 11, 1917. p. 379.

Indefatigable Island, in the moist area on the south side at 350 to 400 feet, and at all attitudes in the interior; (W. H. O.)

This almost comically small and wrinkled species is one of the most interesting finds of the Academy expedition. It is usually pink tipped, with white corrugations and the indentations more or less darkened by volcanic dust.

31. **Bulimulus (Næsiotus) cymatias** Dall

Plate 8, figure 19

Bulimulus (*Næsiotus*) *cymatias* Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 380.

Indefatigable Island, under lava blocks in a moist area between 400 and 650 feet elevation; (W. H. O.)

A very well marked species with a unique axial armature.

32. **Bulimulus (Næsiotus) ochsneri** Dall

Plate 8, figures 20, 21

Bulimulus (*Næsiotus*) *ochsneri* Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 380.

Indefatigable Island, under lava blocks at 200 to 650 feet altitude; (W. H. O.)

This fine species might easily be taken for a dark variety of *B. cymatias* if one considered only the external appearance, but the interior armature is totally different. With *B. særonius* it completes the peculiar group of dentate species from Indefatigable Island, to which the Academy expedition has added so many.

33. **Bulimulus (Næsiotus) særonius** Dall

Bulimulus (Næsiotus) særonius DALL, Proc. Biol. Soc. Wash., XXX, p. 9, January, 1917.

Indefatigable Island, U. S. S. Albatross.

Group of *Bulimulus duncanus*

34. **Bulimulus (Næsiotus) duncanus** Dall

Bulimulus duncanus DALL, Nautilus, VII, p. 52, September, 1893; DALL, 1900, p. 438, pl. XVI, fig. 7.

Duncan Island, dead, at 600 feet altitude; (W. H. O.)

This species appears to be extinct; at any rate no collector has obtained it living. It is notable for its nearly smooth surface devoid of spiral sculpture, thin shell and solitary parietal tubercle.

35. **Bulimulus (Næsiotus) jervisensis** Dall

Plate 8, figure 22

Bulimulus (Næsiotus) jervisensis DALL, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 381.

A few dead specimens were collected on Jervis Island at an elevation of 900 to 1000 feet.

One or two of these were fresh enough to admit of the hope that living specimens may be secured by some future collector.

36. **Bulimulus (Næsiotus) darwini** Pfeiffer

Bulimus darwini PFR., P. Z. S. Lond. 1846, p. 29; REEVE, Conch. Icon. *Bulimus*, pl. XXI, fig. 136, 1848; DALL, 1900, p. 43.

Bindloe Island, *fide* Wimmer (?) James Island, on bushes and grass at 1800 to 2200 feet; (W. H. O.).

Some little doubt attaches to Wimmer's locality or his identification. Darwin has left no printed record of a landing on Bindloe Island though he collected this species; Dr. Habel's shells which were examined by the senior author before they were put into Wimmer's hands, were in a state of considerable confusion where labels might easily have been mixed.

At any rate, the Academy locality can not reasonably be questioned, and it is doubted if the species is found on more than one island, on account of its extreme specialization. The armature of the aperture is like that of *B. jervisensis* and very feebly developed, indeed absent in some (immature?) individuals. The upper part of the axis is slender and somewhat twisted.

Group of *Bulimulus sculpturatus*

37. **Bulimulus (Næsiotus) sculpturatus** Pfeiffer

Bulimus sculpturatus Pfeiffer, P. Z. S. Lond. 1846, p. 29; Reeve, Conch. Icon., *Bulimus*, pl. XX, fig. 125, 1848.

Bulimulus (Næsiotus) sculpturatus Dall, 1900, p. 443.

Found by the Academy expedition in the forest region of James Island, at an elevation of 1000 to 1800 feet.

The somewhat spare and undulated axial ribs crossed by sharp, coarse spiral striæ, and simple tubular hardly twisted axis, are characteristic of this species whose location was unknown until fixed by the Academy's collection.

38. **Bulimulus (Næsiotus) rabidensis** Dall

Plate 8, figures 23, 24

Bulimulus (Næsiotus) rabidensis Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 381.

Obtained by the Academy in "a fairly dry" region on Jervis (or Rabida) Island, at an altitude of 900 to 1000 feet.

This form is markedly separated from *sculpturatus* by its ovoid instead of conical profile, and by the fact that the spiral sculpture is the most conspicuous, while the axial rugosities are as in the other species.

39. **Bulimulus (Næsiotus) rugiferus** Sowerby

Bulinus rugiferus Sby., P. Z. S. Lond. 1833, p. 36; Conch. Ill., *Bulinus*, fig. 40, 1833.

Bulimulus (Næsiotus) rugiferus Dall, 1900, p. 443.

James Island; Cuming.

In this and the two following species the axis is slender, unarmed and more or less twisted.

40. **Bulimulus (Næsiotus) næsioticus** Dall

Bulimulus (Næsiotus) næsioticus DALL, 1900, p. 443, pl. XVI, fig. 1.

James Island; U. S. Bureau of Fisheries. Indefatigable Island, at 350 to 1100 feet altitude; (W. H. O.)

41. **Bulimulus (Næsiotus) reibischi** Dall

Bulimulus (Næsiotus) reibischi DALL, Nautilus, VII, p. 126, March, 1895; DALL, 1900, p. 444, pl. XVI, fig. 4.

Indefatigable Island, U. S. Bureau of Fisheries. This species is not contained in the Academy collection.

Group of *Bulimulus chemnitzioides*

42. **Bulimulus (Næsiotus) chemnitzioides** Forbes

Bulimus chemnitzioides FORBES, P. Z. S. Lond. 1850, p. 55, pl. IX, fig. 6.

Bulimulus (Pleuropyrgus) lima REIBISCH, 1892, p. 12, pl. II, fig. 4.

Bulimulus (Næsiotus) chemnitzioides DALL, 1900, p. 445, pl. XVII, fig. 4 (dentition).

Chatham Island; Wolf and Baur. Found by the Academy expedition under stones at Wreck Bay, Chatham Island, in the arid zone, at 25 to 60 feet above the sea.

The axis is solid, slender, and distinctly twisted. There is a broad brown peripheral color band.

43. **Bulimulus (Næsiotus) habeli** Stearns

Bulimulus (Pleuropyrgus) habeli (STEARNS MS.) DALL, Nautilus, V, January, 1892, p. 99; STEARNS, Proc. U. S. Nat. Mus., XVI. No. 942, 1893, p. 382, pl. 51, fig. 1.

Chatham Island; Habel, Cooper and Baur. Found by the Academy expedition in the dry zone, 0 to 300 feet above the sea, on Chatham Island.

Earlier specimens were more or less bleached, but the Academy's fresh ones are about the color of the preceding species, with a broad brown band just behind the suture, the upper half of the upper whorls and the base of the last whorl paler. The axis resembles that of the last species. The variety *terebra* Reibisch, hardly differs except that the whole shell is reddish brown instead of banded. *Bulimulus indefatigabilis* Dall, of this section was not found by the Academy collectors.

Group of *Bulimulus canaliferus*

44. **Bulimulus (Næsiotus) canaliferus** Reibisch

Bulimulus (Pelecostoma) canaliferus Reibisch, 1892, p. 13, pl. II, fig. 6.
Bulimulus (Næsiotus) canaliferus Dall, 1900, p. 442, pl. XV, fig. 14.

Chatham Island; in moss and on ferns, 900 to 2000 feet; Wolf. The Academy expedition collected it on Chatham Island in the dry zone, from near the beach to 450 feet elevation.

The numerous, flat-sided, short whorls, the basal attenuation, the large funnel-shaped umbilical pit, and the prominent flange on the pillar, give a peculiar aspect to this species. On sectioning the shell the flange is seen to continue as a strong concave plate surrounding the axis and continuing into the second whorl, gradually growing less prominent.

Reibisch's second species of *Pelecostoma* is *Tornatellina chathamensis*.

Genus *Pupilla* Leach

Subgenus *Gastrocopta* Wollaston, 1878

45. **Pupilla (Gastrocopta) munita** Reibisch

Pupa (Leucochila) munita Reibisch, 1892, p. 15, pl. II, fig. 9.

Albemarle Island near the sea, on bushes; Wolf. Albemarle near Tagus Cove in rotten wood at 250 to 300 feet elevation and near Iguana Cove, 15 to 60 feet; Narborough at 50 feet, under stones; Charles, under dead wood and bones, at 750 feet; and Tower Island under wood at from 0 to 200 ft. above the sea; (W. H. O.).

This is the most common and widely distributed *Pupilla* of the islands. According to Dr. Pilsbry it is not the same as

P. wolfi Miller, from Guayaquil, as Reibisch suspected. *P. clausa* Reibisch, is a smaller shell and is regarded by Dr. Pilsbry as distinct. The latter did not occur among the Academy specimens but was found on Indefatigable Island near the sea on bushes, by Wolf and in similar situations on Abingdon Island by Snodgrass. It is highly probable that these and other small species of landshells, if carefully searched for, would be found on nearly all the islands. While hibernating attached to dead leaves, their distribution by high winds is easy.

46. **Pupilla (Gastrocopta) reibischi** Dall

Pupilla reibischi DALL, Proc. Biol. Soc. Wash., XXX, p. 10, January, 1917.

Shell subcylindric, blunt, five-whorled, of a dark brown color, whorls moderately inflated, suture distinct; aperture with a wide reflected margin which in well developed individuals is often of a reddish color; pillar lip reflected over a well marked umbilical chink; teeth after Sterki's dental formula but substituting figures for dots after his numeration:[7] A B 3 D 4 5. The parietal tooth (A) when fully developed is bifid anteriorly and somewhat produced behind into the whorl; the other teeth appear short, and none of them are white. Length of shell 2.5 mm.; diameter 1.0 mm.

Found on Albemarle Island, near Tagus Cove, under rotten wood at a height of 250 to 300 feet, mixed with *P. munita;* (W. H. O.).

This species is easily distinguished from both *P. munita* and *P. clausa* by its darker color. It is more slender and cylindrical than the former and larger than the latter. It has been submitted to Dr. Sterki who pronounces it distinct from *munita*. The accessory lamellæ are rather deeply ensconsed in the aperture. The species seems to be considerably rarer than *P. munita*. *P. clausa*, by the results of collections made, is rare.

---

[7] Proc. U. S. Nat. Mus. for 1888, pl. XLII, fig. 5.

Genus *Guppya* Mörch

47. **Guppya bauri** Dall

Zonites (*Hyalinia*) *bauri* DALL, Nautilus, V, January, 1892, p. 98.
? *Trochomorpha bauri* DALL, 1896, p. 447, pl. XV, figs. 8, 9.

South Albemarle Island, on tortoise bones; Baur. Hood Island at 300 feet in rock crevices; and under old bones, at 350 feet; also Duncan and Abingdon; (W. H. O.).

Genus *Euconulus* Reinhardt

48. **Euconulus galapaganus** Dall

Conulus galapaganus DALL, Nautilus, VII, September 1893, p. 55; DALL, 1896, p. 448, pl. XV, fig. 11.

Southwest end of Chatham Island, under leaves at 1600 feet; Baur. James Island in the forest zone at 1000 to 1800 feet, and under stones at 750 feet; (W. H. O.).

This species appears to be rare.

Genus *Vitrea* Fitzinger

49. **Vitrea actinophora** Dall

Vitrea actinophora DALL, 1900, p. 93, pl. VIII, figs. 11, 16, 17

Top of mountain near Tagus Cove, Albemarle Island; Snodgrass and Heller. Near Vilamil, Albemarle Island, under leaves at 500 to 1800 feet, and in similar situations on James Island at 2000 to 2750 feet; (W. H. O.).

50. **Vitrea chathamensis** Dall

Vitrea chathamensis DALL, 1896, p. 448, pl. XV, figs. 3, 10; DALL, 1900, p. 93.

Chatham Island, 1600 feet; Baur. Abingdon Island, 1700 feet; Snodgrass. James Island in the forest zone at 1000 to 1800 feet; near Iguana Cove, Albemarle Island, 200 to 700 feet; and near Tagus Cove, under cactus leaves, at 1600 feet; (W. H. O.).

June 22, 1928

Genus *Endodonta* Albers

51. **Endodonta helleri** Dall

Endodonta helleri Dall, 1900, p. 93, pl. VIII, figs. 7, 8, 9

Near Iguana Cove, Albemarle Island, at 2000 feet; Snodgrass and Heller. Albemarle Island near Cowley Mountain on moist ground at 350 to 500 feet; on Narborough in grass and bushes at the rim of the crater at 4000 feet; and on James Island, in moist grass and bushes at 1800 to 2000 feet; (W. H. O.).

Genus *Succinea* Draparnaud

52. **Succinea bettii** E. A. Smith

Succinea bettii E. A. Smith, P. Z. S. Lond. 1877, p. 72, pl. XI, fig. 8; Dall, 1896, p. 448, pl. XV, fig. 6.

Succinea wolfi Reibisch, 1892, p. 16, pl. 2, fig. 12*a–b*.

Charles, James, Chatham and South Albemarle islands; various collectors, Charles Island on leaves and stems of grass and shrubs in the misty area, at 1200 to 1500 feet; also on leaves in the lemon grove on Spring Mountain, in the moist region, at 1600 feet; Indefatigable Island, rainy area, 450 to 650 feet, on leaves of *Ipomœa;* Albemarle Island near Vilamil under leaves, 500 to 1800 feet, also in the grassy zone on leaves and stems, at 2000 to 3100 feet; (W. H. O.).

Attention is called to the protective color of the animal's mantle, seen through the translucent shell; in one case the creature appeared nearly black on a blackish lava background, though the shell itself is translucent yellow. The attractive appearance of some of the specimens when clinging like buds to slender stems of plants in the grassy zone was also noted. The variety (?) *wolfi* of Reibisch was found on leaves at Charles Island, elevation 1000 feet, and near the shore at Iguana Cove, Albemarle Island, under stones, at 15 to 60 feet above the sea.

53. **Succinea brevior** E. A. Smith

Succinea bettii, var. *brevior* Smith, P. Z. S. Lond. 1877, p. 77.

Succinea brevior Dall, Nautilus, VII, September, 1893, p. 56; Dall, 1896, p. 449, pl. XV, fig. 4, pl. XVI, fig. 8 (jaw); pl. XVII, fig. 9 (dentition); Dall, 1900, p. 94.

Charles Island; Baur and Snodgrass. Charles Island, on leaves near rim of crater in the grassy zone at 1700 feet; and at roots of grass and shrubs at the top of Chatham Island in the moist area at 1900 to 2500 feet; (W. H. O.).

54. **Succinea producta** Reibisch

Succinea (*Tapada*) *wolfi* var. *producta* Reibisch, 1892, p. 16, pl. 2, fig. 12 cz.

Succinea producta Dall, 1896, p. 449, pl. XV, fig. 7; pl. XVI, fig. 10 (jaw); pl. XVII, fig. 5 (dentition); Dall, 1900, p. 95.

Chatham and Narborough islands; on lichen covered rocks, 900 to 2000 feet elevation; Wolf, Baur, and Snodgrass. James Island at roots of grass and shrubs and on leaves of *Ipomœa,* in the moist, grassy zone at 2200 feet; Albemarle Island near Banks Bay, hibernating under stones in the dry zone, at 400 feet; and near the rim of the crater in the grassy zone on the leaves of shrubs, at 4000 feet; (W. H. O.).

Succinea corbis was not found among the Academy collections, and an examination of the original types after 20 years showed that the original lattice-like corrugation of the periostracum has entirely disappeared, probably due to contraction under the influence of desiccation.

Genus *Tornatellina* Beck

55. **Tornatellina chathamensis** Dall

Leptinaria chathamensis Dall, Nautilus, V, January, 1892, p. 98; Dall, 1896, p. 451, pl. XVI, fig. 9, pl. XVII, fig. 16 (dentition).

Bulimulus (*Pelecostoma*) *cymatoferus* Reibisch, October, 1892, pt. 3, p. 14, pl. II, fig. 7.

Tornatellina chathamensis Dall, 1900, p. 95.

Chatham Island, on ferns, 1600 to 2000 feet above the sea; Baur. Albemarle Island, near Iguana Cove, hibernating under dead leaves at 200 to 250 feet; and near Tagus Cove, under cactus leaves at 1600 feet; (W. H. O.).

This species, according to Dr. Baur, is especially likely to be found on the fronds of ferns.

Genus *Helicina* Lamarck

56. **Helicina (Idesa) nesiotica** Dall

Helicina (*Idesa*) *nesiotica* DALL, Nautilus, V, p. 97, January, 1892.

Helicina wolfi REIBISCH, 1892 (October), p. 17, pl. II, fig. 13.

Helicina (*Idesa*) *nesiotica* DALL, 1896, p. 451, pl. XV, figs. 1, 2; pl. XVII, fig. 12 (dentition); DALL, 1900, p. 96.

Chatham Island at 1600 feet, on leaves; Baur. Albemarle Island, near Iguana Cove, under stones, 15 to 60 feet above the sea; under dead leaves at 200 to 250 feet; under moss at 600 to 700 feet; Charles Island, under moss at 1700 to 1750 feet; (W. H. O.).

57. **Helicina (Idesa) ochsneri** Dall

Plate 8, figures 12, 13, 14

Helicina (*Idesa*) *ochsneri* DALL, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 382.

Albemarle Island, eight miles west of Turtle Cove, near salt lagoon; and at Cowley Mountain on moist ground, 350 to 500 feet above the sea; (W. H. O.).

The dimensions of the average *H. nesiotica* as given by Reibisch are: height 2.6 and diameter 3.5 mm., although some individuals measure slightly more.

Genus *Auricula* Lamarck

58. **Auricula stagnalis** Orbigny

Auricula stagnalis ORB. Mag. de Zool. 1835, p. 23; Voy. Am. Mer. Moll. 1835, p. 325, pl. 42, figs. 7, 8.

Obtained by the Academy expedition on Indefatigable Island near the salt lagoon, inland from Academy Bay; and on Albemarle Island. Turtle Cove, near the first salt lagoon, and also at the second lagoon; also 12 miles west of Turtle

Cove at another salt lagoon; and in a fresh water mangrove swamp 12 miles west of Vilamil. Habel collected it on Bindloe Island and it is reported from the continental coast at Panama and Guayaquil by Orbigny and C. B. Adams.

This is a species native to brackish and salt lagoons and swamps. As it can stand long immersion in salt water without injury, and generally adheres to logs or mangrove stocks, its dispersion is easy, and it undoubtedly came to the islands on floating timber or uprooted trees much as the mangrove has.

The individuals vary largely among themselves; Orbigny's figured type was rather small and slender. Specimens can be found with short blunt spire and inflated body whorl or elevated spire and slender body. The color varies from pale straw to lead color, and in ferruginous waters it takes a tinge of reddish. However, it is perfectly obvious that none of these differences is specific.

This was the only Auriculid in the Academy collection. The others, together with the local species of *Siphonaria*, *Williamia*, and Onchidiidæ will be found enumerated in the distributional list.

59. **Williamia galapagana** Dall

Williamia galapagana Dall, Proc. Calif. Acad. Sci., 4th Ser., Vol. 2, pt. 2, No. 11, 1917, p. 382.

The genus *Williamia* Monterosato, is represented in the Galapagos Islands by a species which was identified by Wimmer with *Nacella subspiralis* Carpenter, and later, too hastily, from defective material, by the senior author as *Siphonaria peltoides* Carpenter, both California forms. The Galapagan form was later named *W. galapagana*, but without a description; this was supplied in 1917 as cited above.

Station; on floating seaweed at the Galapagos Islands; specimens collected on the beach at Hood and Chatham islands.

The species is less elevated and with a less produced and incurved apex than in *subspiralis*, of which *peltoides* is probably merely a mutation, and very much smaller than the Californian *W. vernalis*. It was not obtained by the Academy expedition.

It may be added that *Opeas juncea* Gould, has been collected on Hood Island and another species of *Opeas* on Charles Island; both having been introduced recently by man, they are not considered part of the fauna in this paper.

Plate 8

Fig. 1. *Bulimulus (Næsiotus) elæodes* Dall. Syntype No. 1650 (C. A. S. type coll.) from Albemarle Island, Galapagos group; length 12.5 mm.; p. 161.

Fig. 2. *Bulimulus (Næsiotus) elæodes* Dall. Syntype No. 1651 (C. A. S. type coll.) from Albemarle Island, Galapagos group; length 11 mm.; p. 161.

Fig. 3. *Bulimulus (Næsiotus) hemærodes* Dall. Holotype No. 1652 (C. A. S. type coll.) from Albemarle Island, Galapagos group; length 13.4 mm.; p. 161.

Fig. 4. *Bulimulus (Næsiotus) perrus* Dall. Holotype No. 1653 (C. A. S. type coll.) from Narborough Island, Galapagos group; length 10.5 mm.; p. 163.

Fig. 5. *Bulimulus (Næsiotus) cucullinus* Dall. Syntype No. 1654 (C. A. S. type coll.) from Hood Island, Galapagos group; length 18.9 mm.; p. 166.

Fig. 6. *Bulimulus (Næsiotus) cucullinus* Dall. Syntype No. 1655 (C. A. S. type coll.) from Hood Island, Galapagos group; length 18.2 mm.; p. 166.

Fig. 7. *Bulimulus (Næsiotus) albemarlensis* Dall. Syntype No. 1658 (C. A. S. type coll.) from Albemarle Island, Galapagos group; length 15 mm.; p. 167.

Fig. 8. *Bulimulus (Næsiotus) albemarlensis* Dall. Syntype No. 1659 (C. A. S. type coll.) from Albemarle Island, Galapagos group; length 13.5 mm.; p. 167.

Fig. 9. *Bulimulus (Næsiotus) akamatus* Dall. Holotype No. 1660 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 14.5 mm.; p. 168.

Fig. 10. *Bulimulus (Næsiotus) adelphus* Dall. Holotype No. 1661 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 15 mm.; p. 168.

Fig. 11. *Bulimulus (Næsiotus) lycodus* Dall. Syntype No. 1662 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 11.4 mm.; p. 168.

Fig. 12. *Helicina ochsneri* Dall. Holotype No. 1674 (C. A. S. type coll.) from Albemarle Island, Galapagos group; maximum diameter of shell 3.8 mm.; height, 2.5 mm.; p. 178.

Fig. 13. Same as fig. 12. Basal view.

Fig. 14. Same as fig. 12.

Fig. 15. *Bulimulus (Næsiotus) lycodus* Dall. Syntype No. 1663 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 10.9 mm.; p. 168.

Plate 8 continued on next page

PLATE 8—*Continued from preceding page*

Fig. 16. *Bulimulus* (*Næsiotus*) *lycodus* Dall. Syntype No. 1664 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 11.5 mm.; p. 168.

Fig. 17. *Bulimulus* (*Næsiotus*) *alethorhytidus* Dall. Syntype No. 1665 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 13 mm.; p. 169.

Fig. 18. *Bulimulus* (*Næsiotis*) *alethorhytidus* Dall. Syntype No. 1666 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 12.9 mm.; p. 169.

Fig. 19. *Bulimulus* (*Næsiotis*) *cymatias* Dall. Holotype No. 1667 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 13 mm.; p. 169.

Fig. 20. *Bulimulus* (*Næsiotis*) *ochsneri* Dall. Holotype No. 1668 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 12.4 mm.; p. 169.

Fig. 21. *Bulimulus* (*Næsiotis*) *ochsneri* Dall. Syntype No. 1669 (C. A. S. type coll.) from Indefatigable Island, Galapagos group; length 16.6 mm.; p. 169.

Fig. 22. *Bulimulus* (*Næsiotis*) *jervisensis* Dall. Holotype No. 1671 (C. A. S. type coll.) from Jervis Island, Galapagos group; length 16.1 mm.; p. 170.

Fig. 23. *Bulimulus* (*Næsiotis*) *rabidensis* Dall. Syntype No. 1672 (C. A. S. type coll.) from Jervis Island, Galapagos group; length 14 mm.; p. 171.

Fig. 24. *Bulimulus* (*Næsiotis*) *rabidensis* Dall. Syntype No. 1673 (C. A. S. type coll.) from Jervis Island, Galapagos group; length 15 mm.; p. 171.

Fig. 25. *Bulimulus* (*Næsiotis*) *calvus caryonis* Dall. Holotype No. 1686 (C. A. S. type coll.) from Charles Island, Galapagos group; length 10.6 mm.; p. 160.

Note. The measurements given in this explanation were obtained from the type specimens by L. G. Hertlein. (Editor.)

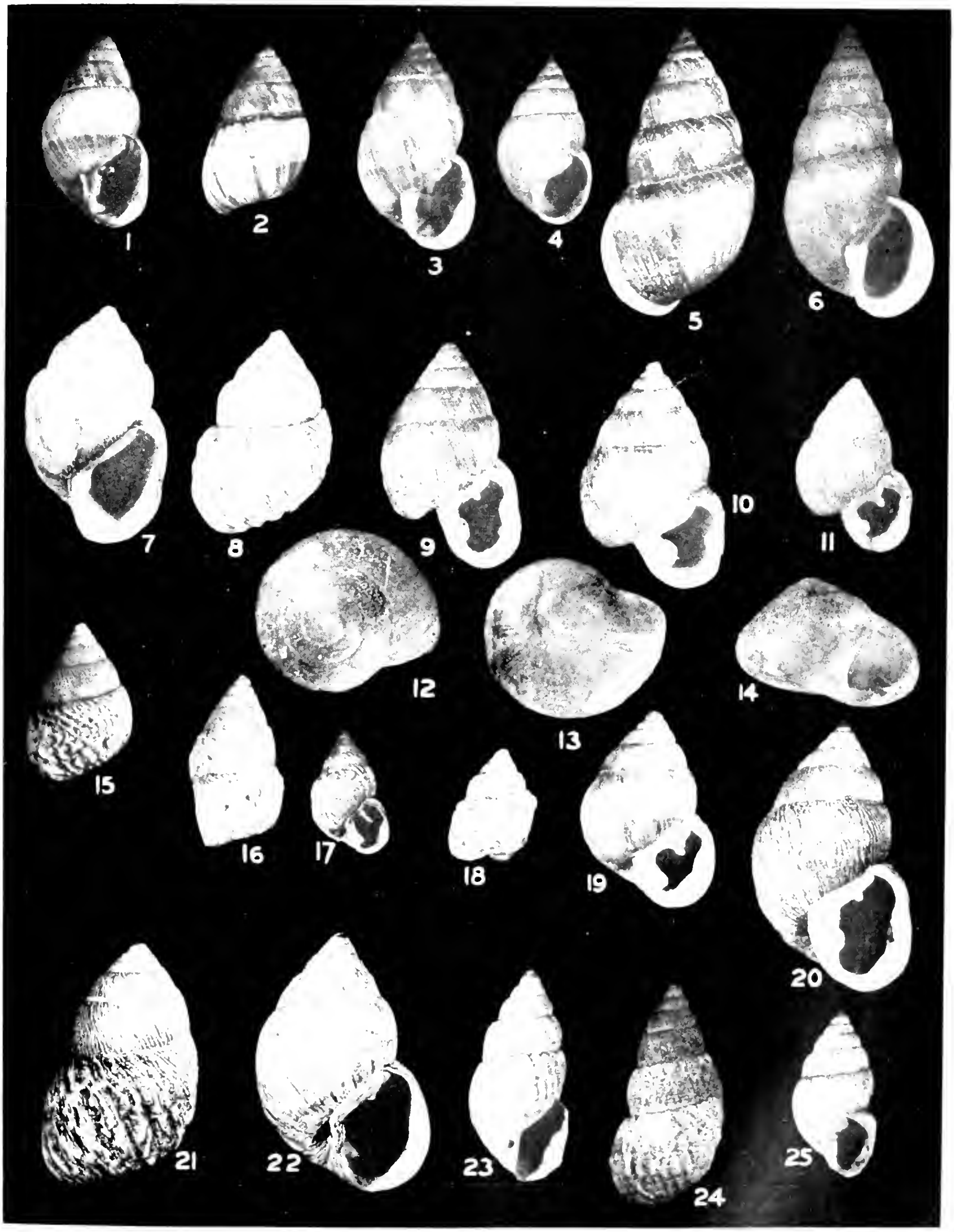

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Plate 9

Fig. 1. *Bulimulus (Næsiotis) nux perchloris* Dall & Ochsner. Syntype No. 1675 (C. A. S. type coll.) from Charles Island, Galapagos group; length 16.5 mm.; p. 156.

Fig. 2. *Bulimulus (Næsiotis) nux perchloris* Dall & Ochsner. Syntype No. 1676 (C. A. S. type coll.) from Charles Island, Galapagos group; length 18.5 mm.; p. 156.

Fig. 3. *Bulimulus (Næsiotis) nux monotænius* Dall & Ochsner. Syntype No. 1677 (C. A. S. type coll.) from Charles Island, Galapagos group; length 19.5 mm.; p. 157.

Fig. 4. *Bulimulus (Næsiotis) nux monotænius* Dall & Ochsner. Syntype No. 1678 (C. A. S. type coll.) from Charles Island, Galapagos group; length 18.9 mm.; p. 157.

Fig. 5. *Bulimulus (Næsiotis) nux monotænius* Dall & Ochsner. Syntype No. 1679 (C. A. S. type coll.) from Charles Island, Galapagos group, length 19.9 mm.; p. 157.

Fig. 6. *Bulimulus (Næsiotis) nux monotænius* Dall & Ochsner. Syntype No' 1680 (C. A. S. type coll.) from Charles Island, Galapagos group; length 16.9 mm.; p. 157.

Fig. 7. *Bulimulus (Næsiotis) nux monotænius* Dall & Ochsner. Syntype No. 1681 (C. A. S. type coll.) from Charles Island, Galapagos group; length 15.9 mm.; p. 157.

Fig. 8. *Bulimulus (Næsiotis) nux monotænius* Dall & Ochsner. Syntype No. 1682 (C. A. S. type coll.) from Charles Island, Galapagos group; length 15.2 mm.; p. 157.

Fig. 9. *Bulimulus (Næsiotis) nux basiplicatus* Dall & Ochsner. Syntype No. 1683 (C. A. S. type coll.) from Chatham Island, Galapagos group; length 19.8 mm.; p. 157.

Fig. 10. *Bulimulus (Næsiotis) nux basiplicatus* Dall & Ochsner. Syntype No. 1684 (C. A. S. type coll.) from Chatham Island, Galapagos group; length 17.6 mm.; p. 157.

Fig. 11. *Bulimulus (Næsiotis) ustulatus phlegonis* Dall & Ochsner. Syntype No. 1687 (C. A. S. type coll.) from Charles Island, Galapagos group; length 13.6 mm.; p. 160.

Fig. 12. *Bulimulus (Næsiotis) ustulatus phlegonis* Dall & Ochsner. Syntype No. 1688 (C. A. S. type coll.) from Charles Island, Galapagos group; length 12.5 mm.; p. 160.

Fig. 13. *Bulimulus (Næsiotis) ustulatus pallescens* Dall & Ochsner. Syntype No. 1692 (C. A. S. type coll.) from Charles Island, Galapagos group; length 15.9 mm.; p. 160.

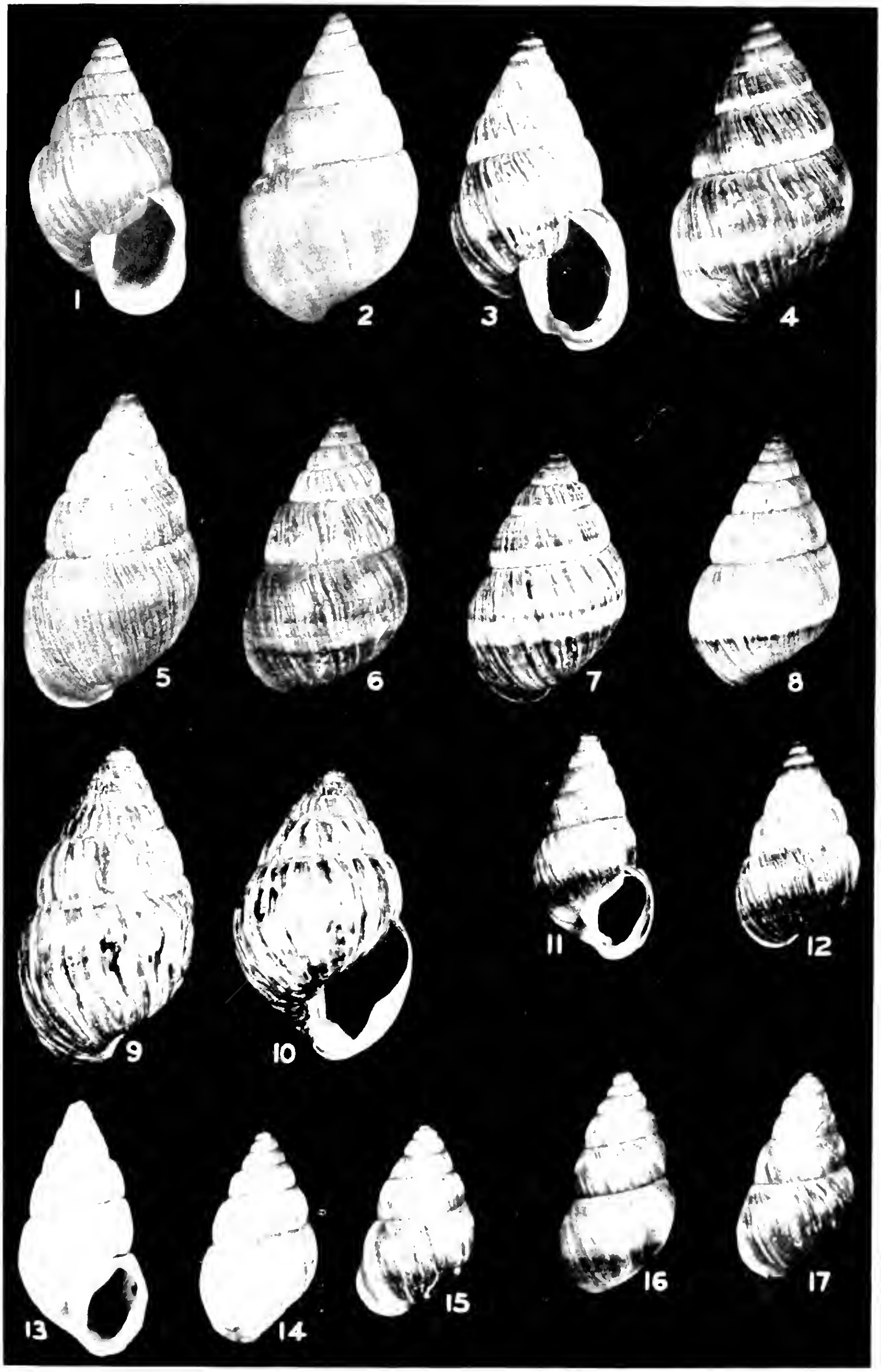
Fig. 14. *Bulimulus (Næsiotis) ustulatus pallescens* Dall & Ochsner. Syntype No. 1693 (C. A. S. type coll.) from Charles Island, Galapagos group; length 13.1 mm.; p. 160.

Fig. 15. *Bulimulus (Næsiotis) ustulatus phlegonis* Dall & Ochsner, Syntype No. 1689 (C. A. S. type coll.) from Charles Island, Galapagos group; length, 12.1 mm.; p. 160.

Fig. 16. *Bulimulus (Næsiotis) ustulatus phlegonis* Dall & Ochsner. Syntype No. 1690 (C. A. S. type coll.) from Charles Island, Galapagos group; length 14 mm.; p. 160.

Fig. 17. *Bulimulus (Næsiotis) ustulatus phlegonis* Dall & Ochsner. Syntype No. 1691 (C. A. S. type coll.) from Charles Island, Galapagos group; length 13 mm.; p. 160.

Note. The measurements given in this explanation were obtained from the type specimens by L. G. Hertlein. (Editor.)


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVII, No. 6, pp. 187-203, plate 10 June 22, 1928

VI

WEST AMERICAN MOLLUSCA OF THE GENUS PHASIANELLA

BY

A. M. STRONG

The expedition of the California Academy of Sciences in 1925 to the Revillagigedo and Tres Marias Islands, visited Cape San Lucas. A few hours intensive collecting by G. Dallas Hanna and Eric Knight Jordan resulted in the securing of a large amount of valuable material, including good series of specimens from the type locality of four species of *Phasianella*. These specimens and the large number from other western localities which have accumulated in the various collections in California, make possible a fairly complete review of the various species in the genus found on the west coast of America. Existing data on the group are scattered through a number of publications and there has been a good deal of confusion and uncertainty in regard to the identity of the different species.

The first species to be described was *Littorina umbilicata* d'Orbigny, 1840,[1] from "Arica" and "Cobija," "Bolivia" and "Peru." *Phasianella perforata* Philippi, 1848,[2] from Peru

---

[1] Voyage Amer. Mérid., Vol. 5, 1840, p. 394, pl. 76, figs. 1-3.

[2] Zeitschr. für Mal., 1848, p. 164.

came next. This was followed by *Turbo phasianella* C. B. Adams, 1852,[3] from Panama, and *Phasianella compta* Gould, 1855,[4] from San Diego. In his "Mazatlan Catalogue," Carpenter, 1857,[5] described under the name *P. perforata* Phil., 12 specimens from that locality, and *P. compta* Gould is listed on the strength of "one very dead shell and some fragments." In the same connection Carpenter also described *P.* var. *striulata*, based on two dead shells, "one very slender, the other of ordinary form," but later he stated[6] that these were *Turbo phasianella* C. B. Adams. Reeve[7] also described a shell from Mazatlan as *P. perforata* Phil., but Dall[8] has pointed out that the true *P. perforata* Phil. is a South American shell and not the *P. perforata* of Carpenter and Reeve.

Mr. John Xantus de Vessey collected extensively at Cape San Lucas in 1860 and 1861, and the first series, mainly beach worn shells, was presented to the Smithsonian Institution. Carpenter described about 50 new species from this material in 1864[9], including under the subgenus *Eucosmia* four species of *Phasianella*, as follows: *P. variegata*, "rare, dead"; *P. substriata*, "very rare"; *P. punctata*, "one specimen"; and *P. cyclostoma*, "one specimen." Dall in 1908[10] stated that *P. punctata* Cpr. (not Risso) may take the name *P. carpenteri*, and *P. variegata* Cpr. (not Lamarck) may take the name *P. typica*.

Carpenter in 1865 published a "Diagonsis of New Forms of Mollusca from the West Coast of North America first collected by Col. E. Jewett."[11] In this he made the following statement in regard to *Phasianella*; "*P. compta*, with a large

---

[3] Panama Shells, 1852, No. 282.

[4] U. S. House of Representatives Doc. 129, 33d Congress, 1st Sess., 1855 p. 25; Pacific R. R. Repts., Vol. 5, pl. 11, figs. 25, 26.

[5] Catalogue of Mazatlan Shells Collected by Frederick Reigen, 1857, p. 224.

[6] Ann. Mag. Nat. Hist., Vol. 13, 1864, p. 475.

[7] Conch. Icon., pl. 6, fig. 17.

[8] Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 255; Proc. U. S. Nat. Mus., Vol. 37, 1909, p. 238

[9] Ann Mag. Nat. Hist., Vol. 13, 1864, p. 475.

[10] Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 255.

[11] Ann. Mag. Nat. Hist., Vol. 13, 1865, p. 180.

proportion of the small shells of the genus, is included under *P. pullus* in Mr. Reeve's monograph. In so difficult a tribe, it is judged better to name the distinct forms, and those from separate localities, until more is known." He then described three species from southern California as follows: *P.* (? *compta* var.) *pulloides, P.* (? *compta* var.) *punctulata,* and *P.* (? *compta* var.) *elatior.*

Tryon's Manual of Conchology treats *P. compta* Gould as a variable species for which a general description is given. Four figures are included and the descriptions of Carpenter's three California species are quoted as varieties. Dall in 1908[12] gave the name *P. compta* var. *producta* to the first form figured by Tryon[13] and added a few words of description. Packard in his "Molluscan Fauna from San Francisco Bay," 1918,[14] listed *P. pulloides* Cpr. as the only species from that locality but quoted Tryon's description of *P. compta* Gould for it. For the various forms from Lower California and the Gulf, Tryon's Manual of Conchology quoted Carpenter's descriptions without figures or notes.

Dall in 1897[15] added another species to the list, *P. (Eulithidium) lurida* Dall from Vancouver Island. Finally in his "Summary of the Marine Shell-bearing Mollusks of the Northwest Coast of America"[16] he listed the following; *P. (Tricola) compta* Gould, ranging from Monterey to the Gulf of California, with varieties *punctulata* Carpenter and *producta* Dall; *P. (Tricola) pulloides* Carpenter, ranging from Monterey to Lower California, with variety *elatior* Carpenter; *P. (Eulithidium) typica* Dall, ranging from San Luis Obispo, California, to Cape San Lucas; *P. (Eulithidium) substriata* Carpenter, ranging from Catalina Island to Panama; and *P. (Eulithidium) lurida* Dall, ranging from Vancouver Island to Mendocino County, California.

---

[12] Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 256.
[13] Tryon's Man. of Conch., Vol. 10, pl. 39, fig. 69.
[14] University of California Publications in Zoology, Vol. 14, No. 2, 1918, p. 310.
[15] Bull. Nat. Hist. Soc. Brit. Col., No. 2, 1897, p. 15.
[16] U. S. Nat. Mus. Bulletin 112, 1921, p. 171.

During the preparation of this review, in addition to examining the material belonging to the Academy, the writer has examined the specimens in the collection at Leland Stanford Junior University under the charge of Mrs. Ida S. Oldroyd, and those in the collections of Dr. Fred Baker of San Diego and Dr. S. Stillman Berry of Redlands. These, together with the large number of specimens from southern California in the collection of the writer, made several thousand in all, including specimens from a large number of localities from Puget Sound to the Gulf of California. It was found in several cases that more than one name was being applied to the same species and vice versa. A comparison of the original description and figure with material from the type locality has made it possible to redefine most of the species, resulting in a number of changes in nomenclature and geographic range. One undescribed species was found, represented by specimens in all the collections.

The specific characters are not marked, the principal differences being in size, shape, presence or absence of spiral striations, and shape of inner lip and umbilicus. The opercula also show some slight differences. Each of the species has a color combination and pattern which, with slight variations, is distinctive for a majority of the specimens. However, in nearly all cases, occasional specimens will depart so far from this pattern that it is of little value in separating or defining the species. Full descriptions have been prepared for all the species represented in the various collections. Representative specimens have been figured on the accompanying plate and the specimens themselves deposited in the collection of type material of the California Academy of Sciences, where they bear the numbers indicated.

In addition to the collectors whose names have been mentioned the writer wishes to acknowledge his indebtedness to Dr. G. Dallas Hanna, Curator of Paleontology in the California Academy of Sciences, for advice and assistance in the

preparation of the manuscript and for the photographs used in the preparation of the plates.[17] In Tryon's Manual of Conchology the genus is divided into subgenera, based on the character of the radula. No attempt has been made in the present study to determine the characters of this organ, and the species are grouped in two subgenera as in the papers to which reference has been made. The species of *Phasianella* recognized from the west coast follow.

1. **Phasianella (Tricola) compta** Gould

Plate 10, figure 1

Phasianella compta Gould, H. Rep. Doc. 129, Prelim. Rep., 1855, p. 25; Pacific R. R. Reps., Vol. 5, 1857, pl. 11, figs. 25, 26. Tryon Man. Conch., Vol. 10, 1888, p. 173 (part), pl. 39, fig. 69. Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci. Vol. 2, 1927, pt. 3, p. 161.

Phasianella compta producta Dall, Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 256; U. S. Nat. Mus., Bull. 112, 1921, p. 172.

Shell ovate-conic, rather solid, smooth and polished; whorls five, moderately rounded, oblique, separated by a distinct suture; surface with many fine, close-spaced, oblique spiral color lines of alternating ashy white and olive green which are lightened and darkened so as to form wide-spaced irregular longitudinal bands, sometimes with a row of ill-defined alternate light and dark spots on the periphery of the body whorl; aperture nearly circular, outer lip thin, with a narrow band at the edge, colored as on the surface of the shell, interior bluish white; inner lip enameled, white, the enamel spreading nearly or quite over the umbilical region and extending over the parietal wall to the posterior angle of the aperture. Operculum calcareous; outer surface convex, white, darkening toward the edges; central portion smooth, edges microscopically wrinkled.

The specimen figured came from Mugu Bay, Ventura Co., California, and measures, height 9.2, diameter 5.8 mm. This

---

[17] The photographs were made with emulsions sensitive to all colors; proper filters were used so that the prints represent the true black and white values of the colors of the objects. (G. D. H.)

is the largest and the most uniformly olivaceous of the west coast species. It is found living in colonies on the marsh grass of the tidal flats. The species is represented only in the collections from Mugu, San Pedro, Anaheim, Newport, and San Diego bays in southern California.

2. **Phasianella (Tricola) pulloides** Carpenter

Plate 10, figures 5, 6, 7

Phasianella (? *compta* var.) *pulloides* CARPENTER, Ann. Mag. Nat. Hist., Vol. 15, 1865, p. 180. OLDROYD, Stanford Univ. Publ. Univ. Ser. Geol. Sci. Vol. 2, pt. 3, 1927, p. 162.

Phasianella (? *compta* var.) *punctulata* CARPENTER, Ann. Mag. Nat. Hist., Vol. 15, 1865, p. 180.

Phasianella (? *compta* var.) *elatior* CARPENTER, Ann. Mag. Nat. Hist., Vol 15, 1865, p. 180.

Eucosmia punctata CARPENTER (not RISSO) Ann. Mag. Nat. Hist., Vol. 13, 1864, p. 475; Suppl. Rep. Brit. Assoc., 1864, p. 618.

Phasianella compta GOULD, TRYON Man. Conch., Vol. 10, 1888, p. 173 (part), pl. 39, figs. 70, 71, 72.

Phasianella carpenteri DALL, Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 255.

Phasianella pulloides CARPENTER, PACKARD, Univ. of Cal. Publ. in Zool., Vol. 14, No. 2, 1918, p. 310.

Tricola pulloidea CARPENTER, DALL, U. S. Nat. Mus., Bull. 112, 1921, p. 172.

Shell ovate-conical, quite solid, smooth and very highly polished, with a porcelaneous surface; whorls five, moderately rounded, oblique, separated by a distinct suture; color and color-pattern very variable, usually clouded longitudinally with white, yellow, pink, purple or drab in varying combinations, sometimes almost unicolor or more or less distinctly spotted, often showing faintly the oblique spiral lines as in *P. compta* Gould but uniformly smaller and more porcelaneous; aperture somewhat oval, outer lip thin, inside showing colors of outer surface; inner lip white, enameled, the enamel spreading nearly or quite over umbilical region and extending over parietal wall to posterior angle of aperture. Operculum calcareous, outer surface convex, white, sometimes slightly darkened near outer edge, which is very finely subspirally ridged.

The specimen figured from Point Fermin, near San Pedro, California, measures, height 6.0, diameter 3.3 mm. and is an adult shell. The specimen figured from Cape San Lucas measures, height 4.5, diameter 2.8 mm. and the specimen figured from Point Dume, California, measures height 2.3, diameter 1.8 mm. Due to the tendency in the older shells for the body whorl to grow increasingly obliquely downward they appear more elongate than the younger. In a limited number of specimens several distinct forms could be picked out but in the thousand or more examined no points of constant difference could be found. Carpenter's *punctulata* seems to have been a large spotted specimen and his *elatior* a small maculated one. *P. carpenteri* Dall *(Eucosmia punctata* Cpr.) belongs here. It was described as follows: "Much larger, more elongate and narrower than *E. variegata* and more like a *Phasianella,* the greater part densely punctate with brown, umbilicus small." The specimens in the Academy's Cape San Lucas material answering this description can not be distinguished from the California shells. The description of *P. compta* Gould in Tryon's Manual of Conchology is more in accord with this species than with Gould's original description or figure.

The range of the species as shown by the specimens examined is from Puget Sound to Cape San Lucas. Young shells are sometimes found in large numbers on sea lettuce and the smaller sea weeds of the tide pools along the southern California coast. The adults seem to stay in deeper water and are more rarely found.

3. **Phasianella (Tricola) perforata** Philippi

Plate 10, figure 14

Phasianella perforata Philippi, Zeit. f. Mal., 1848, p. 164; Tryon, Man. Conch. Vol. 10, 1888, p. 172 (part) pl. 39*a*, fig. 12.

Phasianella (Tricola) perforata Philippi, Dall, Proc. U. S. Nat. Mus., Vol. 37, 1909, p. 238.

This species was described by Philippi as follows:[18]

"Oblongconoid, perforate, white, subtessellated with oblique, purplish lines; suture and periphery ornamented with large maculations of white and purple; whorls deeply convex, the last subangulated; aperture oblong-ovate, equal to the spire."

[18] Translation from Tryon, Man. Conch. Vol. 10, 1888, p. 172.

Considering the variations found in other species in the genus there is little in this description or in the figure given by Tryon by means of which the shell could be placed. Dall gives the type locality as Paita, Peru, which seems to be the only locality from which it has been reported.

4. Phasianella (Eulithidium) typica (Dall)

Plate 10, figures 12, 13

Eulithidium typicum DALL, Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 255.

Eucosmia variegata CARPENTER (not LAMARCK), Ann. Mag. Nat. Hist., Vol. 13, 1864, p. 474; Suppl. Rep. Brit. Assoc., 1864, p. 618.

Phasianella substriata CARPENTER, TRYON, Man. Conch., Vol. 10, 1888, p. 177.

Eulithidium typicum DALL, (part), U. S. Nat. Mus., Bull. 112, 1921, p. 172.

Phasianella typica DALL, OLDROYD, Stanford Univ. Publ. Univ. Ser. Geol. Sci., Vol. 2, pt. 3, 1927, p. 162; (text, not pl. 91, fig. 9; see *P. rubrilineata*).

Shell turbinate, rather thin, of five well rounded, moderately elevated whorls, separated by a distinct suture; surface smooth except for microscopic curved lines of growth, very bright and highly polished, variously spotted, maculated and striped with rose, brown and white; aperture nearly circular, slightly produced anteriorly, outer lip thin, interior showing colors of outer surface more or less distinctly; inner lip white, thin and sharp, more or less reflected over the deep umbilical groove, beyond which a thin layer of callus extends to posterior angle of aperture. Operculum calcareous, outer surface convex, bluish white, inner half smooth, outer half with sharp subspiral grooves.

The specimen figured from Cape San Lucas is the single one out of 81, all young, in the Academy's material from that locality which contained the operculum. It measures, height 2.1, diameter 1.7 mm. The adult figured was one of 25 dead shells from Magdalena Bay in the Baker collection. It measures, height 5.5, diameter 3.6 mm. This shell differs from all forms of *P. pulloides* Carpenter, with which it is most apt to be confused, in the more turbinate shape, sharper inner lip, and more distinct umbilical groove. In a number of cases the name has been applied to California shells belonging to other species. It was found only in the collections from the two localities noted.

5. **Phasianella (Eulithidium) substriata** (Carpenter)

Plate 10, figure 11

Eucosmia substriata Carpenter, Ann. Mag. Nat. Hist., Vol. 13, 1864, p. 474; Suppl. Rep. Brit. Assoc., 1864, p. 618.

Phasianella substriata Carpenter, Tryon, Man. Conch., Vol. 10, 1888, p. 177 (part). Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci., Vol. 2, pt. 3, 1927, p. 163.

Eulithidium substriatum Carpenter, Dall, U. S. Nat. Mus., Bull 112, 1921, p. 172.

Shell turbinate, thin, of four well-rounded, moderately elevated whorls, separated by a distinct suture; surface rather dull, with irregular microscopic lines of growth and a variable number of more or less prominent, rather wide-spaced spiral striations over the entire surface; color generally whitish or yellowish, with rather sparse spots and maculations of white, yellow, brown or red, which sometimes spread out covering much or all of the surface; aperture nearly circular, outer lip thin, interior showing colors of outer surface; inner lip thin, sharp, erect, extending as a thin layer of callus to the posterior angle of the aperture; umbilicus wide and deep. Operculum calcareous, the outer surface convex, bluish white, sometimes darkening toward edge, with fine, sharp, subspiral ridges over outer two-thirds.

The specimen figured was dredged in 10 fms. off Reef Point, Orange County, California, and measures, height 2.7, diameter 2.3 mm. The Academy's material from Cape San Lucas contained 477 specimens which are referred to this species, of which only two small ones contained the operculum. As stated by Carpenter, this species and the young of *P. typica* Dall, are very similar in shape; however, the presence of the spiral striations, smaller size in the adult, generally lighter colors and larger umbilicus, make them easily separable.

Living shells have been dredged in considerable numbers just outside the kelp line off Reef Point and Point Vincent in southern California. Additional specimens from San Diego and San Jose Island, Gulf of California, were examined.

6. **Phasianella (Eulithidium) cyclostoma** (Carpenter)

Plate 10, figures 2, 3, 4

Eucosmia cyclostoma CARPENTER, Ann. Mag. Nat. Hist., Vol. 13, 1864, p. 474; Suppl. Rep. Brit. Assoc., 1864, p. 618.

Phasianella cyclostoma CARPENTER, TRYON, Man. Conch., Vol. 10, 1888, p. 177.

Eulithidium cyclostoma CARPENTER, DALL, Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 255.

The following is a translation of Carpenter's description of this species:

"Shell small, very obtuse, wide, regular, valvatoid, outline of spire scarcely convex; pale cinerous, densely punctate or maculate with brownish olive, apex pale, mammillated; whorls normally 3, very convex, with deep sutures; aperture scarcely indented parietally; umbilicus large, subspiral. Long. .05, long. spir. .025, lat. .05 poll., div. 90°. Curiously like a small depressed *Valvata obtusa,* but with the texture of *Phasianella.*"

In the Academy's material from Cape San Lucas there were a number of young shells answering this description and others evidently the same in adult form. In all, 39 specimens were found which are referred to this species. These shells look in many ways like small pathologic specimens of *P. typica* Dall, the last whorl in some of the larger shells showing a strong tendency to separate from the upper whorls. However, the expanded shouldered whorl seems to be a constant character. No similar shells were found in the collections from other localities. The following is a description of the species based on these specimens:

Shell minute, turbinate, thin, smooth and bright; whorls four, apex flattened, the succeeding whorls becoming rapidly larger and more elevated with a distinct rounded shoulder. periphery of body whorl slightly angulated, suture deep; apex white or dull colored, the succeeding whorls variously spotted and maculated with white, rose and varying shades of brown, the pattern and color combination often entirely different on the later and earlier whorls; aperture nearly circular, outer lip thin, somewhat expanded in the younger shells, the interior showing the colors of the outer surface; inner lip thin, sharp, erect; umbilicus large. The character of the operculum is unknown.

The adult figured came from Cape San Lucas and measures, height 3.1, diameter 2.5 mm. The young measures, height 1.2, diameter 1.0 mm.

7. **Phasianella (Eulithidium) rubrilineata** Strong, new species

Plate 10, figures 8, 9, 10

Phasianella typica Dall, Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci. Vol. 2, pt. 3, 1927, pl. 91, fig. 9; (not text, p. 162; see *P. typica*).[19]

Shell minute, depressed turbinate, smooth, except for microscopic lines of growth; whorls four, apex flattened, the succeeding whorls rapidly enlarging and well rounded; body whorl somewhat oblique; first two whorls whitish, third whorl clouded with white and brown or rose, often showing a few more or less distinct spiral lines of color, body whorl with alternating oblique spiral lines of rose and white which grow narrower and closer spaced from the suture to the base, upper portion of the whorl often with large white blotches; aperture large, nearly circular, outer lip thin, somewhat flaring, the inner surface showing the color lines very distinctly; inner lip slightly flattened, umbilical groove broad, longitudinally striated. Operculum calcareous, outer surface convex, white, darkening toward the outer edge, which is microscopically subspirally striated. Height 2.1, diameter 1.9 mm.

Holotype: No. 2741, Mus. Calif. Acad. Sci., collected by A. M. Strong, from **Point Loma, San Diego County, California,** *paratype:* No. 2742, from Todos Santos Bay, Lower California, Henry Hemphill collection; *paratype:* No. 2743, from Point Fermin, San Pedro, California.

Specimens of this species were found in all the collections examined. Three specimens, No. 3310 in the Hemphill collection at the Academy, from Todos Santos Bay, Lower California, were marked "*Phasianella rubrilineata* Cpr. Types."

[19] Carpenter's name of *Eucosmia variegata* from Cape San Lucas was preoccupied and Dall renamed the species *P. typica*, but the type remains as established by Carpenter. Carpenter stated that the Cape San Lucas shells were dead and that the operculum was unknown. The shell figured by Mrs. Oldroyd as the type of *P. typica* Dall is a living shell containing the operculum, quite different from anything in the Academy's material from Cape San Lucas and does not fit Carpenter's description of *E. variegata*. It is the same as the shell in the Henry Hemphill collection from Todos Santos Bay labeled "*P. rubrilineata* Cpr. Types."

As all three were dead shells a living specimen is picked for the type but the name, which does not seem to have been published, is retained. In the older collections the specimens of this species are usually labeled *P. cyclostoma* Carpenter, but they have more recently been identified as *P. typica* Dall. They differ from those species in the Cape San Lucas material in being smaller, more depressed, with a proportionately larger aperture and a distinctly different color pattern. They are easily distinguished from the young of *P. pulloides* Carpenter of the same size by the more prominent umbilicus, larger aperture and different color pattern.

Living specimens have been collected along the southern California coast from the smaller sea weeds in the tide pools, and dead shells are quite plentiful in the dredgings outside the kelp line. Additional localities from which specimens have been examined are Catalina Island, San Clemente Island, Point Vincent and Point Fermin in southern California and South Coronado and San Martin islands in Lower California.

8. **Phasianella (Eulithidium) mazatlanica** Strong, new name

Plate 10, figure 15

Phasianella perforata Philippi of Carpenter, Mazatlan Catalogue, 1857, p. 224, No. 283.—REEVE, Conch. Icon., Vol. 13, pl. 6, fig. 17. Not *Phasianella perforata* PHILIPPI, Zeit. f. Malak., 1848, p. 164.

Carpenter described this species as follows:

"This beautiful shell closely resembles the W. Indian species. Like many of its congeners, it has parallel diagonal lines of colour; and is also variously and most beautifully stained with red and brown. The first whorl of the five is discoidal. It is characterized by extremely minute wrinkling over the whole surface, only discernible under the microscope, when quite fresh. The umbilicus is very large when young, and sharply keeled; when adult, it is often nearly filled up by the callous labrum. Operculum radiately wrinkled over a large part of the outer surface; within, spire produced, sharply keeled. The largest specimen measures long. .13, lat. .12 in., div. 70°. The smallest sp. long. .032, lat. .037, div. 90°."

Dall[20] in pointing out that the Mazatlan shell was not *P. perforata* Philippi did not suggest a name for the species. No specimens answering this description were found in the collec-

[20] Proc. U. S. Nat. Mus., Vol. 34, 1908, p. 255; Proc. U. S. Nat. Mus., Vol. 37, 1909, p. 238.

tions. The microscopic wrinkling over the entire surface and the partly filled umbilicus in the adult should serve as distinguishing characteristics. The figure reproduced herewith is copied from Tryon[21] which in turn was taken from Reeve.

9. **Phasianella (Eulithidium) lurida Dall**

Phasianella lurida Dall, Bull. Nat. Hist. Soc. Brit. Col., No. 2, 1897, p. 15, pl. 1, fig. 11.—Oldroyd, Publ. Puget Sound Biol. Station, Vol. 4, 1924, p. 168, pl. 44, fig. 11.—Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci., Vol. 2, pt. 3, 1927, p. 163.

Dall's description of this species is as follows:

"Shell small, solid, turbinate, of 4 whorls, of a lurid purple color, slightly paler on the base and apex; whorls rounded, sculptured only by feeble lines of growth, polished; sutures distinct; base rounded with feeble spiral striations; aperture rounded; peritreme sharp-edged, smooth within, the lips united over the body by a wash of callus; umbilical region imperforate. Most of the specimens are marked with whitish dots, which I believe to be due to sessile Polyzoa, which are apt to leave such marks when removed. Height 3.75, diamter 3 mm."

A few specimens in the collection at Stanford University from Crescent City, California, and from Puget Sound are referred to this species but they do not furnish sufficient material for a more comprehensive description. None of them shows the white dots which are very prominent in the figure of the type and some of them show distinct but rather faint maculations of rose. The largest specimen from Puget Sound is fully twice the size of the type and has one more whorl. In several of the specimens the operculum is clouded with rose.

10. **Phasianella (Eulithidium) phasianella** (C. B. Adams)

Plate 10, figures 18, 19

Turbo phasianella C. B. Adams, Panama Shells, 1852, No. 282.

Phasianella ? perforata var. *striulata* Carpenter, Mazatlan Catalogue, 1857, p. 225, No. 283*b*; Ann. Mag. Nat. Hist., Vol. 13, 1864, p. 474.

Phasianella phasianella C. B. Adams, Tryon, Man. Conch., Vol. 10, 1888, p. 178.

Adams described this species as follows:

[21] Man. Conch., Vol. 10, 1888, pl. 38, fig. 62.

"Shell ovate-conoid, color various, mostly red or brown, sometimes uniform, frequently in dark flamules on a light ground, sometimes with spiral, darker stripes or series of spots; surface covered with spiral striæ; apex subacute; spire conoid, with the outline moderately curvilinear, whorls 5, convex, with a distinct suture; aperture broad, ovate, sub-effuse, labrum thin; umbilicus very small. Mean divergence about 64°, alt. .16, diam. .11 inches."

Among specimens of *Phasianella* collected at Santa Elena, Ecuador, by John Mark Reed, are some which answer in every way to this description but in the entire lot there is much variation. Color and color-pattern are fully as variable as in *P. pulloides* Carpenter, and the larger shells show the same tendency to appear more elongate than the smaller. In many of the specimens the spaces between the deep, close-set spiral striæ appear granulated by the intersection with strong growth lines. Others are smooth with fine spiral striæ which in a few cases only appear on the base and close to the suture. In some of the older shells the small umbilicus is entirely covered by enamel. In all the operculum is lustrous, clouded with varying shades of brown, sometimes almost black, the central smooth portion considerably elevated, the edge with close set radial ridges. In spite of the variations the entire lot would appear to belong to a single species.

The larger of the two specimens figured from Santa Elena, Ecuador, measures, length 6.4 mm., diameter 4 mm., and the smaller, length 4 mm., diameter 3.1 mm. They differ from *P. substriata* Carpenter, the striated species from the California and Lower California coast, in the larger size, generally brighter colors, smaller umbilicus, and darker operculum. Carpenter's record from Mazatlan needs verification.

11. **Phasianella (Eulithidium) umbilicata** (d'Orbigny)

Plate 10, figures 16, 17

Littorina umbilicata D'ORBIGNY, Voyage, Amer. Mérid., Vol. 5, pt. 3, 1840, p. 394, pl. 76, figs. 1–3.

Phasianella minima PHILIPPI, Reise durch die Wueste Atacama, 1860, p. 186; Isla Blanca.—TRYON, Man. Conch., Vol. 10, 1888, p. 178; Vol. 9, pl. 46, fig. 24.—DALL, Proc. U. S. Nat. Mus., Vol. 37, 1909, p. 238.

Not *Phasianella umbilicata* D'ORBIGNY, in Moll. Cuba, Vol. 2, 1842, p. 77, pl. 19, figs. 32, 34.

d'Orbigny described this as a new species, very common on the coast of "Arica" and "Cobija," "Bolivia" and "Peru." The following is a translation of his French description:

"Ovate, globose, thin, glossy, marked only by oblique, inconspicuous striæ; umbilicus a chink, continuous on the columella; spire very short, obtuse, composed of three slightly convex whorls, the last being very large in proportion to the others; aperture oval with thin lip; columella heavy; color black or blue black. Length 1.5 mm.; diameter 1.3 mm."

The species is apparently not represented in any western collection; therefore, d'Orbigny's original figures 1 and 2 are copied herewith; his figure 3 was merely a natural size drawing, showing no specific characters. His drawings are colored purple and not black or blue black as given in his description.

d'Orbigny used the name *umbilicata* for two species of *Phasianella* as shown above; one came from the west coast of South America and the other from the West Indies. Much uncertainty has attended the dates of publication of the two works in which the names appeared. Philippi, considering that the Cuban report appeared first, renamed the South American shell *minima* and his name was accepted by Tryon and Dall. Through the researches of Sherborn & Woodward,[22] however, it is learned that that part of the Voyage, Amer. Mérid. containing this species (pp. 377-408) was issued in 1840. Troschel[23] referred to the Littorinidæ portion of the work in 1841. Woodward[24] has given the date of issue of that portion of de la Sagra's work containing d'Orbigny's Mollusca as 1842.[25] From this data it appears that the West Indian shell bears a homonymous name.

---

[22] Sherborn & Woodward, Ann. & Mag. Nat. Hist., Ser. 7, Vol. 7, 1901, p. 389.
[23] Troschel in Wiegmann's Archiv f. Naturgeschichte, 1841, p. 261.
[24] Woodward, Cat. Library, Brit. Mus., Vol. 4, 1913, p. 1780.
[25] See also Archiv f. Naturg., 1843, p. 116, where a reference to the work appears.

PLATE 10

Fig. 1. *Phasianella (Tricola) compta* GOULD. Plesiotype, No. 2734 (C. A. S.), from Mugu Bay, Ventura County, California; height 9.2; diameter, 5.8 mm.; p. 191.

Figs. 2, 3, 4. *Phasianella (Eulithidium) cyclostoma* (Carpenter). Plesiotypes, Nos. 2735-2737 (C. A. S.), from Cape San Lucas, Lower California; height, 2.8 mm.; diameter, 2.6 mm.; height, 1.2 mm.; diameter, 1.0 mm.; and height, 3.1 mm.; diameter, 2.5 mm., respectively.; p. 196.

Fig. 5. *Phasianella (Tricola) pulloides* (Carpenter). Plesiotype, No. 2738 (C. A. S.) from Cape San Lucas, Lower California; height, 4.5 mm.; diameter, 2.8 mm.; p. 192.

Fig. 6. *Phasianella (Tricola) pulloides* (Carpenter). Plesiotype, No. 2739, (C. A. S.) from Point Fermin, San Pedro, California; height, 6.0 mm.; diameter, 3.3 mm.; p. 192.

Fig. 7. *Phasianella (Tricola) pulloides* (Carpenter). Plesiotype, No. 2740, (C. A. S.) from Point Dume, California; height, 2.3 mm.; diameter, 1.8 mm.; p. 192.

Fig. 8. *Phasianella (Eulithidium) rubrilineata* STRONG, n. sp. Holotype, No. 2741 (C. A. S.) from Point Loma, San Diego County, California; height, 2.1 mm.; diameter, 1.9 mm.; p. 197.

Fig. 9. *Phasianella (Eulithidium) rubrilineata* STRONG, n. sp. Paratype, No. 2742, (C. A. S.) from Todos Santos Bay, Lower California; one of Hemphill's original specimens studied by Carpenter; height, 2.3 mm.; diameter, 2.1 mm.; p. 197.

Fig. 10. *Phasianella (Eulithidium) rubrilineata* STRONG, n. sp. Paratype, No. 2743 (C. A. S.) from Point Fermin, San Pedro, California; height, 2.1 mm.; diameter, 2.0 mm.; p. 197.

Fig. 11. *Phasianella (Eulithidium) substriata* (Carpenter). Plesiotype, No. 2744 (C. A. S.) from Reef Point, Orange County, California; 10 fathoms; height, 2.7 mm.; diameter, 2.3 mm.; p. 195.

Fig. 12. *Phasianella (Eulithidium) typica* (Dall). Plesiotype, No. 2745 (C. A. S.) from Magdalena Bay, Lower California; height, 5.5 mm.; diameter, 3.6 mm.; p. 194.

Fig. 13. *Phasianella (Eulithidium) typica* (Dall). Plesiotype, No. 2746 (C. A. S.) from Cape San Lucas, Lower California; height, 2.1 mm.; diameter, 1.7 mm.; p. 194.

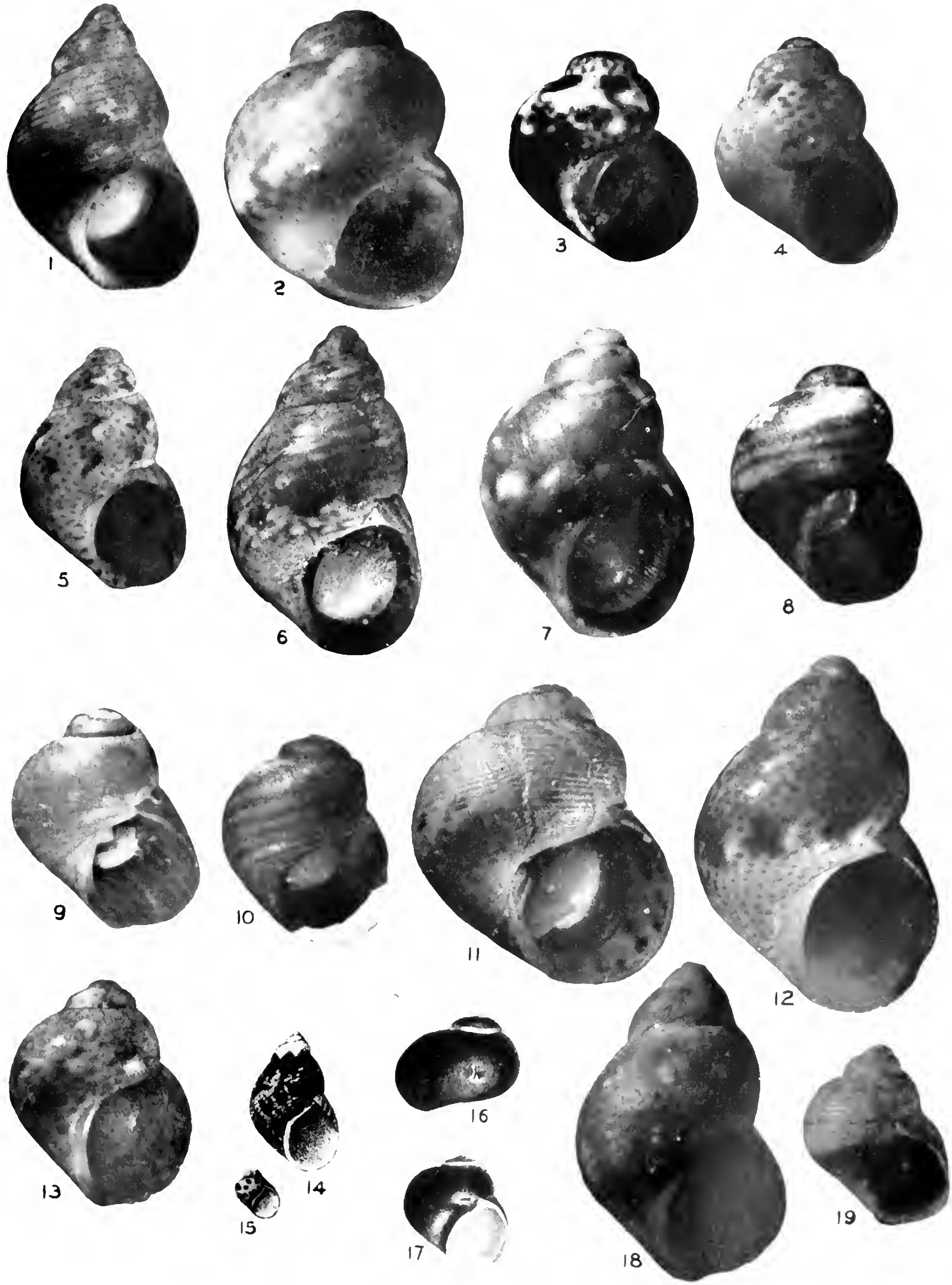
Fig. 14. *Phasianella (Tricola) perforata* PHILIPPI. After Tryon, Man. Conch. Vol. 10, 1888, pl. 39*a*, fig. 12; p. 193.

Fig. 15. *Phasianella (Eulithidium) mazatlanica* STRONG, new name. After Tryon, Man. Conch. Vol. 10, 1888, pl. 38, fig. 62; Tryon's figure was copied from Reeve, Conch. Icon., Vol. 13, pl. 6, fig. 17.; p. 198.

Figs. 16, 17. *Phasianella (Eulithidium) umbilicata* (d'Orbigny). After d'Orbigny, Voy. Amer. Merid. Vol. 5, pt. 3, 1840, pl. 76, figs. 1, 2. d'Orbigny's fig. 3 was a drawing of the shell, natural size, and showed no specific characters; p. 200.

Fig. 18. *Phasianella (Eulithidium) phasianella* (C. B. Adams). Plesiotype, No. 2892, (C. A. S.) from Santa Elena, Ecuador; height, 6.4 mm.; diameter, 4 mm.; p. 199.

Fig. 19. *Phasianella (Eulithidium) phasianella* (C. B. Adams). Plesiotype, No. 2893, (C. A. S.) from Santa Elena Ecuador; height, 4 mm.; diameter, 3.1 mm.; p. 199.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 7, pp. 205-246, plates 11, 12 JUNE 29, 1928

VII

SOME PYRAMIDELLIDÆ FROM THE GULF OF CALIFORNIA[1]

BY

FRED BAKER

G. DALLAS HANNA

AND

A. M. STRONG

In the spring and summer of 1921, the California Academy of Sciences sent an expedition to the Gulf of California for the purpose of making general collections in natural history. The complete itinerary with a map was published in 1923.[2] Many technical reports have resulted from a study of the specimens collected. Three of these have treated of various groups of living marine mollusca.[3] The expedition was accompanied by one of the present writers (Dr. Baker) for the purpose of making collections in this group. There was opportunity at times to dredge in shallow water but the total results in this

---

[1] In this paper there have been assembled the results of the Academy's Expedition to the Gulf of California in 1921; the Expedition to the Revillagigedo Islands in 1925 (Cape San Lucas portion only); and some miscellaneous collections in so far as they relate to this group of mollusks. For this reason the paper has not been given a number in any one of the Expedition Series of reports. *(Editor.)*

[2] Slevin, Joseph R. Expedition of the California Academy of Sciences to the Gulf of California in 1921. General Account.<Proc. Calif. Acad. Sci., 4th Ser., Vol. 12, No. 6, 1923, pp. 55-72.

[3] No. 37. MacFarland, F. M. Opisthobranchiate Mollusca.<Op. cit., Vol. 13, No. 25, pp. 389-420, pls. 10-12.

No. 34. Baker, Fred. Mollusca of the family Triphoridæ.<Op. cit., Vol. 15, No. 6, pp. 223-239, pl. 24.

No. 35. Baker & Hanna. Marine Mollusca of the order Opisthobranchiata.<Op. cit., Vol. 16, No. 5, pp. 123-135, pl. 14.

June 29, 1928

endeavor were hardly satisfactory; the weather sometimes interfered with such work from a small boat and often the bottom was so completely overgrown with algæ that the dredge could not be made to "dig in."

Nevertheless, some small but very rich samples were obtained at a few favorable localities. In most of these, minute mollusca were abundant and those belonging to the family Pyramidellidæ form the basis of the present contribution.

In addition, two other collections have been incorporated in order to make the paper more complete. One of these was made by Captain George D. Porter during his visit to the Gulf. He was in the employ of Miss Jeanette M. Cooke of San Diego, California, and became an excellent collector. Conchology suffered a real loss when he was killed in 1896.[4] His dredgings have only lately been sorted. Unfortunately they often bear no more definite locality label than "Gulf of California" but since he obtained several very striking species it seems best to describe them.

The other collection incorporated herein was obtained in 1925 at Cape San Lucas, Lower California, by G. Dallas Hanna and Eric Knight Jordan while returning from the Revillagigedo Islands. The fauna of this locality is similar in many ways to that of the Gulf and the two undoubtedly belong to the same zoo-geographic province. Cape San Lucas is a classical locality in marine conchology because of the collections which have been made there in the past; it is the type locality of many species. The Academy's 1925 party collected by dredging in water up to 10 fathoms in depth close to the shore of the little bay and 100 to 200 yards to the east of the granite promontory which forms the cape. Some very rich collections were made also at the wash of the tide, little windrows of various débris having been thrown up. A very strong current sets around the cape and into the bay, so that the shells found in shallow water or even on shore may have lived in greater depths than the collecting apparatus used was able to reach.

The work of identifying west American species in this family of mollusca is made possible through the excellent monograph prepared some years ago by Dr. William H. Dall and

---

[4] For details of Captain Porter's death, see p. 218.

Dr. Paul Bartsch[5]; without this report our task would have been very nearly impossible.

The photography for the present paper has been made the subject of protracted research. One of us has lately pointed out[6] that such small objects present almost insurmountable difficulties with the present development of photographic optics. Through the use of a varied selection of superb lenses it is believed that illustrations thoroughly reliable for identification purposes have been obtained without recourse to the usual amount of retouching. We are under obligations to Dr. Barton Warren Evermann, Director of the Academy, for approving the purchase of the optical equipment used.

1. **Pyramidella (Voluspa) auricoma** Dall

Pyramidella auricoma DALL, Blake Report, Gastropoda, 1889, p. 332.

Pyramidella (*Voluspa*) *auricoma* DALL, DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 20, pl. 1, fig. 3.

Specimens apparently of this species, were taken at La Paz and San Evaristo Bay, Lower California; at San Gabriel Bay and Isthmus Bay, Espiritu Santo Island; and at West Anchorage and Amortajada Bay, San Jose Island, Gulf of California. The best preserved of these are light horn-colored, variously mottled with darker shades, suggesting that the "yellowish-white" type specimen may have been faded.

2. **Pyramidella (Longchæus) adamsii** (Carpenter)

Obeliscus adamsii CARPENTER, Rept. Moll. West Coast N. Amer. <Brit. A. A. S. 1863 (1864), pp. 546, 547. = *Obeiliscus ? conicus*, jun. CARPENTER, Cat. Maz. Shells, 1856, pp. 409, 410.

Pyramidella (*Longchæus*) *adamsi* (CARPENTER), DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, pp. 21, 22, pl. 1, figs. 6, 6*a*.

Specimens of this species were taken at La Paz, Puerto Escondido and Coyote Bay, Concepcion Bay, Lower California; in four fathoms off the Salt Works, San Jose Island and at San Gabriel Bay and Isthmus Bay, Espiritu Santo Island, Gulf of California.

---

[5] Dall, Wm. H. & Bartsch, Paul. Bull. 68, U. S. Nat. Mus., 1909.

[6] Hanna, G. Dallas. The photography of small objects.<Trans. Am. Micr. Soc., Vol. 46, No. 1, January, 1927, pp. 15-25.

3. **Pyramidella (Longchæus) bicolor** Menke

Plate 11, figure 1

Pyramidella bicolor MENKE, Malak. Blätt., Vol. 1, 1854, p. 28.

Pyramidella (Longchæus) bicolor MENKE, DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, pp. 22, 23, pl. 1, fig. 2.

Specimens agreeing well with the description and figure given by Dall & Bartsch were taken at Puerto Escondido, San Luis Gonzaga Bay and Coyote Bay, Concepcion Bay, Lower California. The pinkish coloration is present but indistinct. The figured specimen retains the nuclear whorls which have not heretofore been described or figured. These are relatively small, placed almost vertically and about half immersed in the succeeding whorl.

4. **Pyramidella (Longchæus) mazatlanica** Dall & Bartsch

Pyramidella (Longchæus) mazatlanica DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 24, pl. 1, figs. 7, *7a*.

A single immature individual of this species was taken at Cape San Lucas, Lower California.

5. **Turbonilla (Turbonilla) centrota** Dall & Bartsch

Turbonilla (Turbonilla) centrota DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 30, pl. 2, figs. 6, *6a*; new name for *Chemnitzia acuminata* C. B. ADAMS, Ann. Lyc. Nat. Hist. of N. Y., 1853, p. 388; not *Turbonilla acuminata* (GOLDFUSS), 1852, which belongs to *Turritella*.

Five specimens of this species were taken at Cape San Lucas.

6. **Turbonilla (Turbonilla) lucana** Dall & Bartsch

Turbonilla (Turbonilla) lucana DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 32, pl. 2, fig. 3.

Seven specimens of this species were taken at Cape San Lucas.

7. **Turbonilla (Chemnitzia) amortajadensis** Baker, Hanna & Strong, new species

Plate 11, figure 2

Shell small, thin, slender, elongate-conic, translucent, shining, milk-white; nuclear whorls 2¾, forming a rather high helicoid spire, which is nearly vertical and immersed about one-fourth in the succeeding whorl; postnuclear whorls 7¼, well rounded, the curve being rather greater above than below, scarcely shouldered above, rather high between the sutures, marked by moderate and moderately protractive axial ribs, of which 12 appear on the first and 14 on the remaining whorls; interspaces slightly wider than the axial ribs, terminating slightly posterior to the sutures and very abruptly below the periphery of the last whorl; sutures moderately impressed; base well rounded, rather long, showing microscopic growth lines but no other sculpture; aperture broadly, irregularly subovate; posterior angle obtuse; outer and basal lips thin, regularly, increasingly rounded to a subangular junction with the columella; columella very slightly concave, scarcely reflected, joining the parietal wall at an obtuse angle and with no fold apparent at its insertion; parietal wall nearly straight and scarcely calloused. Length, 2.8 mm.; diameter, .75 mm.

Holotype: No. 4001, Mus. Calif. Acad. Sci., collected by Fred Baker in 1921, from **Amortajada Bay, San Jose Island, Gulf of California,** in two to three fathoms.

The shell somewhat resembles *T. aculeus* C. B. Adams[7], but is smaller, with more rounded whorls, fewer axial ribs and intercostal spaces terminating above the sutures. In this last respect the species agrees with *T. paramœa* Dall & Bartsch[8], but again the Amortajada Bay shell has far fewer ribs. In the key to the subgenus *Chemnitzia*[9], this species could be placed immediately after *T. paramœa.*

[7] Ann. Lyc. Nat. Hist. N. Y., Vol. 5, 1852, p. 388.
[8] Bull. 68, U. S. Nat. Mus., 1909, p. 37, pl. 2, figs. 4, 4*a*.
[9] Bull. 68, U. S. Nat. Mus., pp. 33, 34.

8. **Turbonilla (Chemnitzia) muricata** (Carpenter)

Plate 11, figure 3

Chemnitzia muricata CARPENTER, Cat. Maz. Shells, 1856, p. 428.
Turbonilla (Chemnitzia) muricata (CARPENTER), DALL & BARTSCH, Bull. 68, U. S. Nat. Mus. 1909, p. 36, pl. 2, fig. 9.

Two specimens agreeing well with the description and figure given by Dall & Bartsch were taken at Northeast Anchorage, Monserrate Island, Gulf of California.

9. **Turbonilla (Chemnitzia) kelseyi** Dall & Bartsch

Turbonilla (Chemnitzia) kelseyi DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 39, pl. 2, figs. 16, 16*a*.

Specimens of this species were taken at San Francisquito Bay, in three to four fathoms, San Luis Gonzaga Bay, Coyote Bay, Concepcion Bay, and Cape San Lucas, Lower California; at Amortajada Bay, San Jose Island, Gulf of California. The most southerly locality heretofore reported for this species is San Ignacio Lagoon, Lower California.

10. **Turbonilla (Strioturbonilla) buttoni** Dall & Bartsch

Turbonilla (Strioturbonilla) buttoni DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 43, pl. 3, figs. 4, 4*a*.

Specimens of this species were taken at San Luis Gonzaga Bay, and in about four fathoms at La Paz, Lower California; also at Monserrate Island and the West Anchorage, San Jose Island, Gulf of California. The most southerly locality heretofore reported for this species is Abreojos Point, Lower California.

11. **Turbonilla (Strioturbonilla) mexicana** Dall & Bartsch

Turbonilla (Strioturbonilla) mexicana DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 45, pl. 3, figs. 5, 5*a*.

Single specimens of this species were taken at West Anchorage and at Amortajada Bay, San Jose Island, Gulf of California.

12. **Turbonilla (Strioturbonilla) schmitti** Bartsch

Plate 11, figure 4

Turbonilla (*Strioturbonilla*) *schmitti* BARTSCH, Proc. U. S. Nat. Mus., Vol. 52, 1917, p. 644, pl. 43, fig. 8.

Specimens of this species were taken at San Francisquito Bay and Cape San Lucas, Lower California. They agree in most particulars with Bartsch's description and figure, but the axial ribs show some extension over the base and a tendency of their upper extremities to spread across the intercostal spaces in a manner not noted by him.

13. **Turbonilla (Strioturbonilla) c-b-adamsii** (Carpenter)

Chemnitzia C-B-Adamsii CARPENTER, Cat. Maz. Shells, 1856, p. 427.

Turbonilla (*Strioturbonilla*) *c-b-adamsii* (CARPENTER), DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 52, pl. 3, fig. 3.

A single specimen of this species in the Baker collection was taken by George D. Porter in the "Gulf of California."

14. **Turbonilla (Strioturbonilla) phanea** Dall & Bartsch

Turbonilla (*Strioturbonilla*) *phanea* DALL & BARTSCH, Bull. 68, U. S. Nat. Mus. 1909, p. 56, pl. 4, figs. 4, 4*a*.

The species was taken in beach drift by George D. Porter on Espiritu Santo Island, Gulf of California; specimens have been deposited in the collections of Strong, Baker and the Academy.

15. **Turbonilla (Strioturbonilla) nahuana** Baker, Hanna & Strong, new species

Plate 11, figure 5

Shell very small, regularly elongate-conic, with no spiral sculpture except occasional patches of minute spiral striations; slightly shining, milk-white; nuclear whorls small, decidedly exserted, smooth, not quite vertically placed, about one-fourth immersed in the succeeding whorl; postnuclear whorls 7¼, narrowly, horizontally shouldered above, rather evenly and strongly rounded, marked by quite broad, sinuous axial ribs extending to the umbilical region, nearly vertical on the first turn but becoming strongly protractive on the lower whorls, about 12 appearing on the first turn, 14 on the second to the fifth, and 20 on the last; intercostal spaces shallow, generally narrower than the ribs; sutures well impressed, rendered sinuous by the ends of the axial ribs; periphery not defined; base evenly rounded, marked by strong extensions of the axial ribs; aperture irregularly subovate, effuse near the base of the columella; outer lip thin, showing the external sculpture plainly within, rather strongly curved from the beginning; basal lip rather less curved, reflected below to reinforce the columella; columella slightly concave, nearly vertical, not revolute, rather broadly reflected and free throughout its whole length. Length, 2.5 mm.; diameter, 0.8 mm.

Holotype: No. 4004, Mus. Calif. Acad. Sci., and one paratype in the Baker collection, taken by George D. Porter in the **"Gulf of California."**

The species has somewhat the appearance of a *Salassiella* of the genus *Odostomia* falling between *O. laxa* Dall & Bartsch and *O. richi* Dall & Bartsch,[10] but we are unable to find evidence of a varix, possibly because the two specimens may be immature. We have therefore referred it, with some doubt, to *Turbonilla (Strioturbonilla)*. It seems to have no close affinity with any west coast *Strioturbonilla*.

16. **Turbonilla (Strioturbonilla) chalcana** Baker, Hanna & Strong, new species

Plate 11, figure 6

Shell small, elongate-conic, marked by extremely fine spiral sculpture which crosses the axial ribs at some points; translucent, shining, milk-white; nuclear whorls 1¾, somewhat exserted, not quite vertically placed and about one-fourth immersed in the succeeding turn; postnuclear whorls 8¼, the lower three or four high between the sutures, narrowly, tabulately shouldered above, very slightly appressed below the sutures, this being more marked in the interspaces than on the axial ribs, whorls well rounded, especially on the lower one

[10] Bull. 68, U. S. Nat. Mus., 1909, p. 133.

fourth, marked by narrow, rounded, very sinuous and irregular and irregularly placed, slightly protractive axial ribs, about 12 appearing on the first three whorls and 24 on the succeeding turns; intercostal spaces shallow, a little wider than the axial ribs, ending a little above the sutures on the lower whorls and at the periphery on the last whorl; sutures well impressed periphery defined by the ends of the intercostal spaces; base well rounded, covered by distinct lines of growth and marked by feeble extensions of the axial ribs which reach the umbilical region but with no defined intercostal spaces; aperture rather small, subpyriform; outer and basal lips thin, showing the external sculpture plainly within, the outer following the tabulate shoulder, then bending sharply down in a moderate curve to join the basal lip; basal lip more curved, effuse near its junction with the columella; columella nearly straight and vertical, broadly reflected, adnate only at its upper fifth; parietal wall narrowly and thinly calloused. Length, 3.6 mm.; diameter, 1.1 mm.

Holotype: No. 4005, Mus. Calif. Acad. Sci., and three paratypes in the Baker collection, taken by George D. Porter, in the **"Gulf of California."**

In the key to the subgenus *Strioturbonilla*[11] this species falls with *T. calvini* Dall & Bartsch,[12] from La Paz, Lower California, a species which it closely resembles in size and shape, but from which it differs radically in having wider axial ribs and narrower interspaces and more of them on the lower turns.

17. **Turbonilla (Pyrgolampros) gonzagensis** Baker, Hanna & Strong, new species

Plate 11, figure 7

Shell of medium size, elongate-conic, light horn-colored; nuclear whorls about two, smooth, opalescent, inclined nearly at a right angle to the succeeding whorl, in which they are scarcely immersed; postnuclear whorls nearly 11, moderately high between the sutures, slopingly shouldered above, very slightly exserted, moderately rounded, with a slight flattening

[11] Bull. 68, U. S. Nat. Mus., 1909, p. 40.
[12] Op. Cit., p. 48, pl. 4, figs. 1, 1*a*.

in the middle, marked by prominent, rounded, increasingly retractive axial ribs, of which on the type 14 appear on the earlier whorls, increasing gradually to 18 on the latest; axial ribs extending strongly over the periphery without a perceptible break and gradually decreasing to the umbilical region; interspaces moderate, distinctly broader than the ribs; shell everywhere covered by numerous, distinct, wavy spiral incised lines, crowded towards the summits of the whorls, very distinct in the interspaces, less marked over the ribs, and most distinct on the base; sutures impressed but not channeled, in places rendered crenulate by the extremities of the axial ribs; base well rounded, rather short; aperture suboval; posterior angle acute; outer lip thin, beginning rather straight, the curve increasing to a juncture with the basal lip, which sweeps in a full curve into the concave columella; columella scarcely reflected, with a moderate fold at its insertion; parietal wall very thinly calloused. Length, 6.4 mm.; diameter, 1.4 mm.

Holotype: No. 4006, *paratypes:* Nos. 4007-4010, Mus. Calif. Acad. Sci., from **San Luis Gonzaga Bay, Lower California,** in three fathoms. In addition, specimens were taken at Puerto Escondido in three fathoms and in four fathoms at La Paz, Lower California; also in three to four fathoms, at West Anchorage, San Jose Island, Gulf of California; all were collected by Fred Baker, in 1921.

The species can be differentiated from all others of the subgenus *Pyrgolampros* described from this coast by the small number of narrow, retractive axial ribs on all the whorls. In the key to the subgenus *Pyrgolampros*[13] this species could be placed immediately after *T. halibrecta*.

18. **Turbonilla (Pyrgolampros) pazensis** Baker, Hanna & Strong, new species

Plate 11, figure 8

Shell small, elongate-conic, with a narrow, light chestnut band showing low down on all but the first two whorls, the rest of the shell being light yellowish-white; nuclear whorls

[13] Bull. 68, U. S. Nat. Mus., 1909, p. 60.

nearly three, helicoid, nearly vertical and about one-third immersed in the succeeding whorls; postnuclear whorls 8½, well rounded, the first three or four most markedly, scarcely shouldered, marked by rather narrow, slightly retractive, irregular and irregularly spaced, sinuous, axial ribs extending over the base to the umbilical region, of which on the type, 16 appear on the first, 18 on the fourth, and 22 on the last whorl; intercostal spaces distinctly wider than the axial ribs, rather shallow, crossed by irregular and irregularly spaced, wavy, microscopic, incised spiral lines, not fewer than 20 in number, which rise on the sides of, but do not cross, the axial ribs; base well rounded, showing no sign of angulation, marked by about 20 rather broad, wavy, incised spiral lines, much stronger than those in the intercostal spaces, continuous over the feeble extensions of the axial ribs and becoming narrower and more closely spaced towards the umbilical region; sutures rather shallow and not well defined; aperture subpyriform; outer lip very thin, showing the external sculpture and color band very distinctly within, nearly straight and vertical to the color band, thence increasing its curvature regularly through the basal lip to a subangular junction with the columella; basal lip very slightly effuse near the columellar junction; columella slightly concave, scarcely revolute or reflected, slightly thickened but scarcely folded at its insertion; parietal wall not calloused and showing the spiral basal lines distinctly. Length, 4.5 mm.; diameter, 1.4 mm.

Holotype: No. 4011, Mus. Calif. Acad. Sci., taken by Fred Baker in 1921, near the main wharf at **La Paz, Lower California,** in three to four fathoms.

The species shows some resemblance in coloration to *T. newcombei* Dall & Bartsch[14] but it is proportionately narrower, with flatter whorls, less defined sutures and more axial ribs, which are slightly retractive. In the key to the subgenus *Pyrgolampros*[15] it could be placed between *T. valdezi* and *T. newcombei.*

---

[14] Proc. U. S. Nat. Mus., Vol. 33, 1907, p. 503, pl. 45, fig. 6.
[15] Bull. 68, U. S. Nat. Mus., 1909, p. 60.

19. **Turbonilla (Pyrgolampros) francisquitana** Baker, Hanna & Strong, new species

Plate 11, figure 9

Shell small, rather stout, elongate-conic, light brown; nuclear whorls nearly vertical, not sharply differentiated from the succeeding turn, in which they are less than half immersed; postnuclear whorls 7½, the upper ones strongly roundly shouldered, the later ones more squarely and less distinctly, marked by narrow, rounded sinuous, irregular and irregularly spaced, strongly protractive axial ribs which reach the umbilical region, 14 appearing on the earlier turns on the type and 18 on the later ones; intercostal spaces shallow, much broader than the axial ribs, everywhere marked by numerous very fine and indistinct incised spiral lines which sometimes cross the axial ribs and by a smaller number of much larger and irregularly spaced incised spiral lines which do not cross the axial ribs and which show most distinctly on the lower whorls and base; sutures deeply impressed but rendered ill-defined by the extensions of the axial ribs; base rounded, rather short; aperture roundly subquadrate, posterior angle rendered obtuse by the shoulder; outer lip following the narrow shoulder, then nearly vertical and flattened, curving sharply into the more rounded basal lip which is slightly effuse at its junction with the columella; columella nearly straight and vertical, moderately reflected and showing only a slight thickening at its insertion; parietal wall with very little callus. Length, 3.7 mm.; diameter, 1 mm.

Holotype: No. 4012, Mus. Calif. Acad. Sci., collected by Fred Baker in 1921, from **San Francisquito Bay, Lower California.**

The species differs in important characters from all other species of *Pyrgolampros* described from this coast, the most striking difference being the extreme protractivity of the axial ribs. In the key to the subgenus *Pyrgolampros* it could be placed between *T. gibbosa* and *T. ridgwayi.*

20. **Turbonilla (Pyrgiscus) macbridei** Dall & Bartsch

Turbonilla (Pyrgiscus) macbridei Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 90, pl. 8, figs. 13, 13*a*.

The species was taken in beach drift on Espiritu Santo Island, Gulf of California, by George D. Porter; specimens have been deposited in the collections of the California Academy of Sciences and those of Messrs. Baker and Strong.

21. **Turbonilla (Pyrgiscus) porteri** Baker, Hanna & Strong, new species

Plate 11, figure 10

Shell of medium size, slender elongate-conic, light chestnut brown with a darker band at the summit and base of each whorl; nuclear whorls large and prominent, vertically placed and scarcely immersed in the succeeding whorl; postnuclear whorls 9½, moderately high between the sutures, the earlier turns well rounded, the later ones flattened in the middle, the last very slightly inflated at the periphery, marked by numerous narrow, low, rounded, slightly protractive axial ribs which extend with little diminution to the umbilical region, about 16 appearing on the first postnuclear whorl, 18 on the fourth, and 22 on the penultimate; interspaces shallow, rather broader than the ribs, marked by nearly equal and equally spaced, squarish incised pits, not crossing the axial ribs, about 11 appearing on the lower whorls; sutures moderately impressed, crenulated by the ends of the axial ribs; base short, well rounded, with sculpturing only slightly less defined than that of the preceding whorl; aperture subpyriform, the posterior angle very acute; outer and basal lips sharp, the latter joining the columella at a rounded obtuse angle; columella nearly straight, oblique, slightly calloused and reflected but not twisted, with a low thickening at its insertion; parietal wall scarcely calloused, and slightly convex. Length, 5.2 mm.; diameter, 1.25 mm.

Holotype: No. 4013, Mus. Calif. Acad. Sci., collected by George D. Porter in the **"Gulf of California."**

The species suggests *T. (Pyrgiscus) cortezi* Bartsch[16] but is smaller for the same number of whorls, has fewer and protractive axial ribs and more incised spiral series of pits. The apex is like *T. azteca* of this paper, but the shells differ in many particulars.

The species is named for Captain George D. Porter, who, with his companion, John Johnson, was ambushed and killed in 1896 on Tiburon Island in the Gulf of California, by the Seri Indians. Their boat, which was owned by the late Miss J. M. Cooke of San Diego, was looted and burned. It was on this ill-fated expedition that Capt. Porter collected the various shells credited to him in this paper.

22. **Turbonilla (Pyrgiscus) johnsoni** Baker, Hanna & Strong, new species

Plate 11, figure 11

Shell slender, regularly elongate-conic, milk-white; nuclear and, probably, one or two postnuclear whorls decollated; remaining postnuclear whorls nearly 10, high between the sutures, very narrowly, squarely shouldered above, slightly rounded on the posterior two-thirds, more strongly on the anterior third, marked by narrow, unevenly spaced, generally straight and nearly vertical axial ribs becoming slightly retractive on the lower turns and tending to become double and indistinct on the last whorl, about 14 appearing on the first remaining turn, 18 on the fourth, and 32 on the penultimate; intercostal spaces shallow, nearly twice as wide as the axial ribs, crossed by rather narrow, irregular and irregularly spaced incised spiral lines or pits which are close above and more widely separated below, about 10 appearing on the upper whorls and 12 on the lower, dividing the intercostal spaces into irregular, squarish sections; sutures fairly impressed but rendered indistinct by the axial sculpturing; base moderate, well rounded, marked by obsolescent sculpture similar to that on the last whorl; aperture subrhomboidal, somewhat effuse at the junction of the basal lip and columella; outer and basal lips thin within, showing the external sculpture plainly, some-

[16] Proc. U. S. Nat. Mus., Vol. 52, 1917, p. 656, pl. 42, fig. 7; pl. 45, fig. 12.

what fractured and thickened on the edges in repairing; columella nearly vertical, roundly calloused and reflected, scarcely revolute, reinforced by a strong fold at its insertion; parietal wall thinly calloused. Length of remaining whorls, 6.35 mm.; diameter, 1.3 mm.

Holotype: No. 4014, Mus. Calif. Acad. Sci., collected by George D. Porter in the "**Gulf of California.**"

In the key to the subgenus *Pyrgiscus*[17] this species would take a place after *T. (Pyrgiscus) wickhami* Dall & Bartsch[18] through certain resemblances, but differs from that species in even more particulars.

This species is named for Mr. John Johnson who was killed with Capt. Porter by the Seri Indians while collecting on Tiburon Island in 1896.

23. **Turbonilla (Pyrgiscus) mayana** Baker, Hanna & Strong, new species

Plate 11, figure 12

Shell rather small, elongate-conic, translucent, shining, light horn-colored; nuclear whorls of moderate size, prominent, inclined at an angle of about 60° and about one-fourth immersed in the succeeding turn; postnuclear whorls 7¾, narrowly, horizontally shouldered above, and somewhat coronated by the axial ribs, very moderately rounded, most decidedly on the lower quarter, marked by strong, narrow, irregular and irregularly placed, nearly vertical axial ribs extending faintly beyond the periphery, about 12 appearing on the first postnuclear whorl, 20 on the second to the fifth, and 22 on the last; intercostal spaces nearly twice as wide as the ribs, marked by from eight to 14 irregular and irregularly spaced, shallow, quadrangular pits on the various whorls, separated by low, laminate, wavy spiral cords which cross the axial ribs almost without change; sutures rendered indistinct by the ends of the axial ribs, not deeply impressed; periphery not distinctly defined; base moderate, very evenly rounded, marked by about 13 spiral cords, the first three or four laminate,

[17] Bull. 68, U. S. Nat. Mus., 1909, p. 74.

[18] Op. cit., p. 106, pl. 10, fig. 9.

wavy, rather widely separated, the interspaces crossed by well marked growth lines, the anterior cords lower and broader and more closely crowded as they approach the umbilical region; aperture subpyriform, effuse near the base of the columella; outer and basal lips thin, showing the external sculpture very plainly within, the outer nearly straight and vertical at first, the curve increasing regularly to a point where the basal lip reinforces the columella; columella slightly concave and oblique, broadly reflected and free below, more narrowly calloused and adnate above; parietal wall with a rather heavy but narrow callus uniting the outer lip and the insertion of the columella. Length, 4.9 mm.; diameter, 1.4 mm.

Holotype: No. 4015, Mus. Calif. Acad. Sci., collected by George D. Porter in the **"Gulf of California."**

The species is probably as near *T. (Pyrgiscus) canfieldi* Dall & Bartsch[19] from Monterey, California, as any west coast species, but is a little stouter, with fewer and narrower axial ribs and proportionately broader interspaces, and seems to stand alone among the members of this genus on this coast in the particular form of the laminate cords crossing the axial ribs and intercostal spaces with little variation in size. It does not fit into the key to the subgenus *Pyrgiscus*[20] as now arranged but could be placed after *T. canfieldi.*

24. **Turbonilla (Pyrgiscus) tolteca** Baker, Hanna & Strong, new species

Plate 11, figure 13

Shell rather stout, elongate-conic, milk-white with a shading above and below the sutures suggestive of two faded color bands; nuclear and, probably, two postnuclear whorls decollated; remaining postnuclear whorls eight, rather high between the sutures, narrowly, slopingly shouldered above, flattened in the middle, slightly appressed below, marked by

[19] Bull. 68, U. S. Nat. Mus., 1909, p. 95, pl. 9, figs. 3, 3*a*.
[20] Op. cit., p. 74.

irregular and irregularly spaced, low, indistinct, rounded, slightly protractive axial ribs which cross the periphery but scarcely reach the umbilical region, about 16 appearing on the first five remaining whorls and 20 on the penultimate; intercostal spaces shallow, wider than the axial ribs, rather flat at the bottom, crossed by irregularly spaced, narrow incised spiral lines which generally cross the axial ribs, rendering them irregularly tuberculate, the numbers varying on different whorls and at different places on the same whorl from 10 to 20; sutures rather distinctly defined by a narrow and very shallow channel; this channel continuing a little above the posterior angle of the aperture but soon disappearing; base rather short, well rounded, marked by the feeble continuations of the axial ribs and by very indistinct extensions of the incised spiral lines of the preceding whorls; aperture rather small, subrhomboidal; outer and basal lips thin, showing the external sculpture plainly within, each only moderately curved, and forming a subangulate junction; basal lip subtruncate; columella rather heavily calloused and broadly, flatly reflected, hiding a distinct umbilical depression; parietal wall with a narrow callus uniting the columella and the outer lip, thus forming an entire peritreme. Length of the remaining whorls, 6.25 mm.; diameter, 1.5 mm.

Holotype: No. 4016, Mus. Calif. Acad. Sci., collected by George D. Porter in the "**Gulf of California.**"

The description of this species at several points follows almost the same wording as that of *T. (Pyrgiscus) johnsoni* of this paper, but the latter is a smaller, more slender shell with a larger number of whorls for the same measurements, a larger number of axial ribs which tend to become retractive on the lower whorls, and on each whorl, a smaller number of incised spiral lines which do not cross the axial ribs. The present species falls in another section of the key to the subgenus *Pyrgiscus*[21] and could probably be placed after *Turbonilla macbridei* Dall & Bartsch.[22]

---

[21] Bull. 68, U. S. Nat. Mus., 1909, p. 74.
[22] Op. cit., p. 90, pl. 8, figs. 13, 13*a*.

25. **Turbonilla (Pyrgiscus) azteca** Baker, Hanna & Strong, new species

Plate 11, figure 14

Shell of medium size, rather slender, elongate-conic, white except at one point on the base which is light horn-colored; nuclear whorls large, prominent, opalescent, placed nearly vertically, scarcely immersed in the succeeding turn; postnuclear whorls 8½, high between the sutures, the upper ones exserted, convex, the lower narrowly, distinctly shouldered and flattened in the middle; marked by strong, moderately rounded, generally straight and regularly spaced, strongly retractive axial ribs, which are indistinct on the first two postnuclear whorls but extend with little decrease in size to the umbilical region; of these on the type, 22 appear on the third to the fifth and 24 on the remaining whorls; interspaces well defined, about as wide as the axial ribs, marked on the holotype by six series of deep, irregularly rounded pits with a seventh marking the sutures, the axial ribs being rendered slightly tubercular in places by extensions from these pits; sutures deep, but rendered irregular by these pits and the extensions of the axial ribs; base well rounded, rather short, showing no change in sculpture from that of the last whorl, with about six spiral series of pits, the last two tending to become pitted sulci; aperture subrhomboidal; posterior angle acute, outer lip nearly straight, crenulated by the external sculpture; basal lip closely rounded, slightly effuse near the columellar junction; columella reflected, nearly straight and vertical, angulated and scarcely thickened at its insertion; parietal wall thinly calloused. Length, 6.35 mm.; diameter, 1.5 mm.

Holotype: No. 4017; *Paratypes:* Nos. 4018-4020, Mus. Calif. Acad. Sci., collected by Fred Baker from **San Luis Gonzaga Bay, Lower California,** in about four fathoms. Three additional specimens came from Coyote Bay, Concepcion Bay, Lower California, in about two fathoms, also collected by Fred Baker in 1921. A small spot on the holotype and one paratype is light horn-color, suggesting the probability that the holotype is faded. All specimens examined follow the holotype very closely except that the number of spiral series of pits varies up to 10 in one specimen.

The species is related to *Turbonilla (Pyrgiscus) ceralva* Dall & Bartsch[23] but is much larger and has far fewer axial ribs. In the key to the subgenus *Pyrgiscus*[24] it could be placed before *T. ceralva.*

26. **Turbonilla (Pyrgiscus) lara** Dall & Bartsch

Plate 11, figure 15

Turbonilla (Pyrgiscus) lara Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 107, pl. 10, figs. 6, 6*a*, 6*b*.

A single specimen dredged near the main wharf at La Paz, Lower California, in about four fathoms, varies but little from the description and figure above cited.

27. **Turbonilla (Pyrgiscus) larunda** Dall & Bartsch

Plate 11, figure 16

Turbonilla (Pyrgiscus) larunda Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 109, pl. 10, fig. 4, 4*a*, 4*b*.

Two shells dredged in about two fathoms in Coyote Bay, Concepcion Bay, Lower California, seem to be this species. The best preserved one, not quite mature, has the spiral striation slightly different from that described in the above citation, but not enough to warrant its separation as a subspecies.

28. **Turbonilla (Mormula) coyotensis** Baker, Hanna & Strong, new species

Plate 11, figure 17

Shell of medium size for the subgenus, imperforate, slender, shining, nearly everywhere marked by fine growth lines and minute spiral striæ; light horn-colored; nuclear whorls not distinctively colored, nearly vertical, very slightly immersed in the

[23] Bull. 68, U. S. Nat. Mus., 1909, p. 104, pl. 10, figs. 5, 5*a*.
[24] Op. cit., pp. 74-76.

succeeding turn; postnuclear whorls 13½, moderately rounded, slightly more prominent on the lower third, marked by strong, rounded, frequently sinuous, slightly protractive axial ribs of which 16 occur on the first eight whorls, 18 on the next three, and 20 on the succeeding turns; moderate and ill-defined external varices appearing on the seventh, twelfth and thirteenth whorls; intercostal spaces more than twice as broad as the axial ribs, marked by deep, spiral incised lines, rather evenly spaced, of which there are usually eight on each whorl, but occasionally nine or ten; periphery marked by a broad, flat, indistinctly defined spiral band followed by about eight narrow cords also indistinctly defined by wavy, irregularly spaced incised spiral lines which are crossed by the obsolescent extensions of the axial ribs; base well rounded; aperture subrhomboidal, showing the external sculpture plainly within and very faint signs of color bands; outer and basal lips quite evenly rounded to a subangular junction with the columella, the basal lip being slightly effuse; columella nearly straight and vertical, rather slender, very slightly revolute, scarcely reflected, lightly calloused and showing no fold at its insertion; parietal wall thinly calloused. Length, 9.9 mm.; diameter, 2.4 mm.

Holotype: No. 4023; *paratype* No. 4024, Mus. Calif. Acad. Sci., collected by Fred Baker in **Coyote Bay, Concepcion Bay, Lower California,** in about two fathoms; *paratype:* No. 4025, from San Luis Gonzaga Bay, Lower California, in three or four fathoms, also collected by Fred Baker in 1921.

This species seems to be new, holding a position between *T. (Mormula) ambusta* Dall & Bartsch[25] from the California coast and *T. (Mormula) major* (C. B. Adams)[26] from Panama, differing from each in certain criteria about as much as they differ from each other. In the key to the subgenus *Mormula*[27] it could be placed between these two species.

[25] Bull. 68, U. S. Nat. Mus., 1909, p. 115, pl. 11, fig. 13.

[26] *Chemnitzia major* C. B. Adams, Ann. Lyc. Nat. Hist., N. Y., Vol. 5, 1852, p. 391.

[27] Bull. 68, U. S. Nat. Mus., 1909, p. 110.

29. **Turbonilla (Bartschella) excolpa** Dall & Bartsch

Plate 11, figure 18

Turbonilla (Dunkeria) excolpa Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 123, pl. 12, figs. 4, 4*a*.

One shell dredged in shallow water at La Paz, Lower California, does not differ from the above, described from "Gulf of California," except in size; it is smaller but has fewer whorls and otherwise appears immature.

30. **Turbonilla (Bartschella) subangulata** (Carpenter)

Plate 11, figure 19

Dunkeria subangulata Carpenter, Cat. Maz. Shells, 1856, p. 434.

Turbonilla (Dunkeria) subangulata (Carpenter), Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 124, pl. 12, fig. 11.

A single shell dredged in shallow water in Coyote Bay, Concepcion Bay, and three from La Paz, Lower California, agree well with the description and figure of this species.

31. **Turbonilla (Pyrgisculus) monilifera** Dall & Bartsch

Plate 12, figure 1

Turbonilla (Pyrgisculus) monilifera Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 126, pl. 12, fig. 15.

Two specimens dredged in about four fathoms at La Paz, Lower California, agree with the description of this species. As the nuclear whorls are missing from the type, the better specimen is figured.

32. **Turbonilla (Cingulina) urdeneta** Bartsch

Turbonilla (Cingulina) urdeneta Bartsch, Proc. U. S. Nat. Mus., Vol. 52, 1917, p. 660, pl. 45, fig. 1.

A single specimen in the Baker collection was taken in beach drift on Espiritu Santo Island, Gulf of California, by George D. Porter.

33. **Turbonilla (Careliopsis) stenogyra** Dall & Bartsch

Plate 12, figure 2

Turbonilla (Careliopsis) stenogyra Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 130, pl. 12, figs. 1, 1*a*.

A broken shell dredged in three to four fathoms in Puerto Escondido, Lower California, seems to belong here. This extends the range from the type locality, San Hypolito Point, to the gulf side of the Peninsula.

34. **Turbonilla (Cingulina) evermanni** Baker, Hanna & Strong, new species

Plate 12, figures 3, 4

Shell small, very thin, slender, elongate-conic, everywhere marked by very minute protractive growth lines but showing no signs of axial ribs; translucent, white; nuclear whorls very small, slightly exserted, inclined at an angle of about 45°, about one-fourth immersed in the succeeding whorl; postnuclear whorls eight, broadly, slopingly shouldered above, the flattened shoulder being nearly smooth and comprising about one-fourth of each whorl; all postnuclear whorls marked below the shoulder by nearly equal and equally spaced incised spiral lines, separated by low, rounded cords of about the same width as the incised lines, of which from five to nine appear on the several whorls; base well rounded, marked by incised spiral lines and cords exactly as in the lower portion of the preceding whorls; aperture suborbicular, posterior angle very obtuse; lips thin, showing the external sculpture from within; columella slightly concave, nearly vertical, slightly reflected, showing no fold at its insertion. Length, 2.50 mm.; diameter, 0.75 mm.

Holotype: No. 4029, Mus. Calif. Acad. Sci., dredged by Fred Baker in about four fathoms at **West Anchorage, San Jose Island, Gulf of California.** Another specimen is from Amortajada Bay on the same island from shallow water, also collected by Fred Baker in 1921.

The species is the second of the subgenus *Cingulina* described from this coast. It differs so radically from *Turbonilla*

(Cingulina) urdeneta Bartsch[28] that confusion of the species is hardly possible.

35. **Odostomia (Salassiella) laxa** Dall & Bartsch

Odostomia (Salassiella) laxa DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 133, pl. 13, figs. 8, 8*a*.

Several specimens of this species were taken at Cape San Lucas, an extension southward from the type locality, Scammon Lagoon.

36. **Odostomia (Salassia) scalariformis** (Carpenter)

Plate 12, figure 5

Parthenia scalariformis CARPENTER, Cat. Maz. Shells, 1856, p. 413.

Odostomia (Salassia) scalariformis (CARPENTER), DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 135, pl. 13, fig. 1.

Five specimens from Cape San Lucas seem to agree with the description of Dall & Bartsch except for length of shell, "5 mm.", which probably is a misprint; the figure shows the diameter contained less than 2½ times in the length, the proportion being about the same as in our illustration. The best preserved of our five specimens shows fine, close, incised spiral lines over most of the shell, a character not mentioned in the description. Additional specimens were taken at San Francisquito Bay, Lower California, Monserrate Island and Isthmus Bay, Espiritu Santo Island, Gulf of California.

37. **Odostomia (Salassia) gabrielensis** Baker, Hanna & Strong, new species

Plate 12, figure 6

Shell small, slender, pupiform, everywhere covered with rather distinct growth lines; translucent white; nuclear whorls somewhat exserted, small, smooth, inclined at an angle of about 45°, not sharply differentiated from the succeeding turn, in which they are partially immersed; postnuclear

[28] Proc. U. S. Nat. Mus., Vol. 52, 1917, pp. 660, 661, pl. 45, fig. 1.

whorls 5¼, broadly, roundly, horizontally tabulated above and coronated by the upper ends of the axial ribs; nearly vertical and flat on the upper three-fourths, then contracting in a rather wide curve to a deeply impressed suture; axial ribs vertical, prominent, rounded, irregularly placed, with much wider interspaces, reaching the umbilical region, but becoming much weaker on the base, 10 on each whorl on the type; aperture oval, peristome continuous; outer and basal lips thin, the basal lip slightly effuse and narrowly curved into the columella; columella slender, concave, distinctly reflected producing a rather broad and deep groove behind it, with a prominent, deeply entering fold at its center, the reflection continuing over the parietal wall to a junction with the outer lip. Length, 3 mm.; diameter, 1 mm.; length of aperture, 0.75 mm.

Holotype: No. 4032; *paratype:* No. 4033; Mus. Calif. Acad. Sci., collected by Fred Baker from **San Gabriel Bay, Espiritu Santo Island, Gulf of California.** Other specimens were taken at Isthmus Bay, Espiritu Santo Island, Monserrate Island, and San Jose Island, Gulf of California, and from La Paz, Lower California; all collected by Fred Baker in 1921.

The species differs from *O. scalariformis* in being smaller, with a smaller number of axial ribs and these are almost vertical instead of retractive. All specimens taken at rather widely separated points agree almost absolutely in these characters.

38. **Odostomia (Besla) convexa** (Carpenter)

Chrysallida convexa CARPENTER, Cat. Maz. Shells, 1856, p. 424.

Odostomia (*Besla*) *convexa* (CARPENTER), DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 135, pl. 13, fig. 4.

A single specimen of this species was taken at San Luis Gonzaga Bay, Lower California. The specimen has seven postnuclear whorls, making it longer and more slender than the specimen described and figured by Dall & Bartsch.

39. **Odostomia (Chrysallida) vizcainoana** Baker, Hanna & Strong, new species

Plate 12, figure 10

Shell of medium size, elongate-conic, white; nuclear whorls decollated; postnuclear whorls seven, rather high between the sutures, nearly straight, narrowly, nearly tabulately shouldered above, marked by rather narrow, prominent, somewhat irregular and irregularly-spaced, but generally nearly vertical axial ribs extending over the peripheral cord and much less distinctly to the umbilical region, their upper extremities distinctly enlarged, giving the whorls a coronated appearance; 16 appearing on the later whorls in the type; intercostal spaces wider than the axial ribs, crossed by almost laminate spiral cords rising about half as high as the axial ribs, enclosing rather large, squarish pits tending to be elongate spirally and widest at their upper parts, the intersections being more or less tuberculate; three spiral cords appear on the first postnuclear whorl, four on the middle and five on the later turns; sutures channeled but rendered uneven by the extensions of the axial ribs and the peripheral cord; base well rounded, rather long, with a tuberculate peripheral cord extending into the sutures as a thin roughened thread for one or more turns, and about 10 narrow basal cords becoming obsolete as they approach the umbilical region; aperture quite regularly elongate-pyriform but somewhat flattened on the columellar side; outer lip sharp, basal lip effuse; columella concave, not revolute, rather broadly and adnately reflected below, narrowly above, and armed with a heavy fold at its insertion; parietal wall lightly calloused. Length, 3.6 mm.; diameter, 1.2 mm.

Holotype: No. 4034; *paratypes:* Nos. 4035-4037, Mus. Calif. Acad. Sci., taken by Fred Baker in about four fathoms off the main wharf at **La Paz, Lower California.** Other specimens were taken at Puerto Escondido and Agua Verde Bay, Lower California and at two points on San Jose Island. There is a specimen in the Baker collection taken by George D. Porter in beach drift on Espiritu Santo Island.

The species is quite variable, especially in the degree of shouldering of the upper ends of the whorls and in the direction of the axial ribs, some specimens having both protractive and retractive ribs, the latter generally on the last whorl. The specimens retaining the nuclear whorls show them very small, not quite vertically placed and very deeply immersed in the succeeding whorl, from which they are not sharply differentiated. In the key to the subgenus *Chrysallida*[29] it could be placed between *O. acrybia* and *O. communis,* since it has about the same number of basal cords, but both these species have more axial ribs and fewer spiral cords.

The species is named for the explorer, Sebastian Vizcaino, who visited Lower California in the sixteenth century.

40. **Odostomia (Chrysallida) audax** Baker, Hanna & Strong, new species

Plate 12, figure 7

Shell small, ovate-conic, everywhere marked by minute growth lines, white; nuclear whorls small, opalescent, not quite vertical, about two-fifths immersed in the succeeding turn; postnuclear whorls 4½, moderately, evenly rounded, narrowly, almost tabulately shouldered above, angled and narrowly contracted below, marked by broad, low, rounded, irregular, slightly retractive axial ribs, with about 12 to 20 appearing on the various whorls; intercostal spaces narrow, marked by low, narrow spiral cords, of which five appear on all but the first whorl, tending to divide on the last whorl, thus showing five ill-defined pairs; axial ribs flatly tuberculate, terminating on the last spiral cord; sutures deeply channeled, somewhat crenulated by the ends of the axial ribs; base evenly rounded, rather long, showing no distinct peripheral cord but marked by a small fasciole and seven scarcely tuberculate basal cords which gradually decrease in size towards the umbilical region and are separated by sulci which are deeper and better defined than the pits between the spiral cords of the rest of the shell; aperture quite evenly pyriform; lips thin, peristome nearly continuous, the narrow callus of the columella being scarcely separable except by the slight thickening of the columella at its insertion. Length, 2.5 mm.; diameter, 0.95 mm.

[29] Bull. 68, U. S. Nat. Mus., 1909, pp. 137, 138.

Holotype: No. 4038; *paratype:* No. 4039, Mus. Calif. Acad. Sci., collected by G. D. Hanna and E. K. Jordan at **Cape San Lucas, Lower California.** A paratype is deposited in each of the collections of Baker and Strong. A worn specimen from La Paz seems to be the same species.

The species is similar to *O. (Chrysallida) tyleri* Dall & Bartsch[30] but differs in the strongly channeled sutures, the earlier occurrence of five spiral cords on each whorl and in the breaking up of these cords on the last whorl, a character shown also by the paratype. In the key to the subgenus *Chrysallida*[31] it must be separated from *O. tyleri* on account of the channeled sutures and could be placed after *O. telescopium.*

41. **Odostomia (Chrysallida) contrerasi** Baker, Hanna & Strong, new species

Plate 12, figure 13

Shell of medium size, elongate-conic, quite generally marked by distinct and very retractive growth lines, covered by a thin, fugaceous, light straw-colored epidermis, denuded spots showing white; nuclear whorls rather prominent, widely exserted, placed at an angle of about 30° from the horizontal, scarcely immersed in the succeeding turn; postnuclear whorls five, indistinctly differentiated from the last nuclear whorl by the faint beginning of the postnuclear sculpture, very narrowly, almost tabulately shouldered at the summit, moderately, rather evenly rounded, marked by four, low, rounded spiral cords on all but the last whorl, the upper two of which are rather narrow and nearly equal, the other two broader and more widely spaced, all tending to become equal on the last whorl, where a fifth narrow cord appears on the periphery; axial ribs feeble, best developed on the upper whorls where the intersections with the spiral cords form weak nodules, most distinct on the upper two cords and only indicated on the last whorl by indistinct punctations in the incised lines delimiting the spiral cords; sutures well impressed, but rendered indis-

[30] Bull. 68, U. S. Nat. Mus., 1909, p. 157, pl. 16, fig 5

[31] Bull. 68, U. S. Nat. Mus., 1909, pp. 137, 138.

tinct by the extension of the peripheral cord which, in places, is not entirely covered by the preceding whorl; base well rounded, marked by very strong lines of growth and six gradually diminishing spiral cords with several minute spiral cords intercalated between them; aperture oblique, rather narrowly pyriform, effuse near the columellar base; outer and basal lips thin, crenulated by the external sculpture which shows plainly within; columella concave, with a distinct tooth at its insertion and a flattened, reflected callus; parietal wall thinly and narrowly calloused. Length, 3.75 mm.; diameter, 1.80 mm.

Holotype: No. 4040, Mus. Calif. Acad. Sci., and two paratypes in the collections of Strong and Baker, collected by George D. Porter in the "**Gulf of California.**"

This species somewhat resembles *Odostomia (Chrysallida) sanctorum* Dall & Bartsch[32] from Todos Santos Bay near the boundary between California and Lower California and, in a less degree, *O. (Chrysallida) deceptrix* Dall & Bartsch[33] from Abreojos Point on the west side of the peninsula of Lower California. It differs radically from both in the distinct tuberculation of the upper two spiral cords. In the key to the subgenus *Chrysallida*[34] it could be placed before *O. deceptrix* with the added legend: "Spiral cords moderate."

The species is named for Professor Francisco Contreras, Director of the National Museum of Natural History of Mexico, an authority on conchology, who was a member of the Academy's Expedition to the Gulf of California in 1921.

42. **Odostomia (Chrysallida) ovata** (Carpenter)

Chrysallida ovata Carpenter, Cat. Maz. Shells, 1856, p. 417.

Odostomia (*Chrysallida*) *ovata* (Carpenter), Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 152, pl. 15, figs. 7, 7*a*.

Several shells from Cape San Lucas, Lower California, agree well with the description and figure of this species.

[32] Bull. 68, U. S. Nat. Mus., 1909, p. 167, pl. 18, fig. 1.
[33] Op. cit., p. 169, pl. 17, fig. 1.
[34] Op. cit., p. 137.

43. **Odostomia (Chrysallida) lapazana** Dall & Bartsch

Odostomia (Chrysallida) lapazana Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 156, pl. 16, figs. 9, 9*a*.

A single shell from Cape San Lucas, Lower California, agrees with the description and figure of this species.

44. **Odostomia (Chrysallida) fasciata** (Carpenter)

Chrysallida fasciata Carpenter, Cat. Maz. Shells, 1856, p. 423.

Odostomia (Chrysallida) fasciata (Carpenter), Dall & Bartsch, Bull., 68, U. S. Nat. Mus., 1909, p. 165, pl. 17, fig. 2.

Two shells from Cape San Lucas, Lower California agree with the description and figure of this species.

45. **Odostomia (Pyrgulina) herreræ** Baker, Hanna & Strong, new species

Plate 12, figure 9

Shell of medium size, elongate-conic, shining, milk-white; nuclear whorls rather large, opalescent, somewhat exserted, nearly vertically placed and about one-third immersed in the succeeding turn; postnuclear whorls 5¾, slopingly shouldered above for about one fifth of the whorl, with a close, narrow, appressed line in this shoulder below the sutures, moderately rounded below the shoulder, high between the sutures, marked by narrow, rounded, nearly vertical axial ribs, more distinct on the appressed portion of each whorl and reaching the umbilical region with little diminution; about 16 appearing on the first three and 20 on the remaining whorls; intercostal spaces unequal, three to four times as wide as the axial ribs, crossed by very numerous fine, wavy, incised spiral lines which rise on the sides of the axial ribs but cross them very irregularly, between 30 and 40, appearing on the penultimate whorl; sutures deep but not well defined; base long, well rounded at the periphery but flattened or slightly concave below, marked by the same sculpture as the preceding whorl; aperture oblique, quite regularly pyriform with an obtuse posterior angle; peritreme completed by a very narrow parietal callus, the outer and basal lip, columella and parietal wall not being distinctly definable. Length, 3.4 mm.; diameter, 1.12 mm.

Holotype: No. 4041, Mus. Calif. Acad. Sci., collected by George D. Porter in the **"Gulf of California."**

This species is easily distinguished from *Odostomia (Pyrgulina) marginata* (C. B. Adams),[35] the only other species of the subgenus *Pyrgulina* described from this coast so far as we are able to determine. It is longer and more slender, has more axial ribs and many more incised spiral lines in the interspaces.

The species is dedicated to Professor A. L. Herrera, Director of the Mexican Biological Survey.

46. **Odostomia (Ividella) mendozæ** Baker, Hanna & Strong, new species

Plate 12, figure 11

Shell small, thin, minutely perforate, subdiaphanous, white; nuclear whorls small, exserted, inclined at an angle of about 45°, not deeply immersed in the succeeding turn; postnuclear whorls 4½, broadly, tabulately shouldered above and coronated by the ends of the axial ribs, nearly flat below the shoulder strongly contracted on the anterior third, marked by laminate, irregular and irregularly spaced, nearly vertical axial ribs, 14 appearing on the first and second whorls in the type, 18 on the third, 20 on the last, and becoming obsolete below the peripheral cord; crossed by three rather less prominent, laminated spiral keels, forming minute, rounded tubercles at the intersections, nearly equally spaced, one at the edge of the shoulder, the other two dividing the rest of the whorl into three spaces of which the posterior is slightly wider, with a fourth cord beginning in the suture and continuing as a peripheral keel; base rounded, rather long, marked by two roughened but not tubercular spiral keels which are less laminate than those on the body whorls, separated from each other by a widening sulcus broader than that between the peripheral

[35] *Chemnitzia marginata* C. B. ADAMS, Ann. Lyc. Nat. Hist. N. Y., Vol. 5, 1852, pp. 391, 392,=*Odostomia (Pyrgulina) marginata* (C. B. ADAMS), DALL & BARTSCH, Bull. 68, U. S. Nat. Mus., 1909, p. 169, pl. 18, figs. 5, 5*a*.

and first basal keels, these sulci being crossed by rather strong growth lines replacing the axial ribs; sutures widely and indistinctly channeled; aperture broadly subovate; outer and basal lips thin, showing the external sculpture very plainly within, irregularly crenulated by the external sculpture; columella very concave, narrowly calloused, slightly reflected, scarcely thickened at its insertion; parietal wall not calloused, crossed by the basal keels. Length, 2.0 mm.; diameter, 0.95 mm.

Holotype: No. 4042; *paratypes:* Nos. 4043-4045, Mus. Calif. Acad. Sci., collected by G. D Hanna and E. K. Jordan in 1925 at **Cape San Lucas, Lower California.** Additional paratypes are in the collections of Baker and Strong.

The species resembles *Odostomia (Ividella) navisa* Dall & Bartsch[36] and its subspecies *delmontensis,* but differs in the presence of a third spiral keel, well marked on all the post-nuclear whorls except the first. In the key to the subgenus *Ividella* it could be placed after the subspecies *delmontensis*[37].

The species is named for Bezerra de Mendoza who, with Grijalva, discovered Lower California in 1534.

47. **Odostomia (Ividella) pedroana** Dall & Bartsch

Plate 12, figure 12

Odostomia (Ividella) pedroana Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 172, pl. 19, figs. 8, 8*a*. Type locality, San Pedro, California.

One shell of this species was dredged in Coyote Bay, Concepcion Bay, Lower California, and another at the northeast end of Monserrate Island. Both are markedly more slender than the original figure and than most of the specimens from the California coast, but as the more obese form occurs in the Baker collection among a lot taken by Captain George D. Porter in the Gulf of California, it is evident that the slender form does not constitute a distinct gulf race. The most southerly record heretofore is that of a single specimen taken at Scammon Lagoon on the opposite side of the peninsula.

[36] Bull. 68, U. S. Nat. Mus., 1909, pp. 173, pl. 18, fig. 11, 11*a*.

[37] Bull. 68, U. S. Nat. Mus., 1909, p. 172.

48. **Odostomia (Miralda) porteri** Baker, Hanna & Strong, new species

Plate 12, figure 8

Shell small, slender, regularly elongate-conic, shining, milk-white; nuclear whorls small, opalescent, inclined at an angle and very deepy immersed in the succeeding turn; postnuclear whorls six, the first two marked by two strong, rounded, tuberculate spiral keels tending to turn up slightly at the edges, rather widely separated, the intervening sulci being crossed by strong and very strongly protractive, sinuous axial threads seeming to correspond with the indistinct tubercles; beginning in the suture in the second turn and appressed to the preceding keel a narrow, tuberculate spiral keel appears, increasing slowly to about three-fourths the size of the other two on the last turn, the sides sloping much less abruptly above than below, and separating from the next keel until the dividing sulcus is about three-fourths as wide as that between the first and second keels; the newly formed sulcus crossed by slightly retractive axial threads corresponding to those on the upper sulcus except in direction; sutures narrowly and rather indistinctly channeled; periphery marked by a low, narrow keel splitting off from the anterior keel on the penultimate turn, separating from it gradually and gradually increasing in size; base short, rounded behind, but tending to become concave on the umbilical side, marked by three nearly smooth, narrow basal keels beginning on the parietal wall, the sulci between the peripheral keel and the basal keels widening gradually as they advance and crossed by numerous fine lines of growth; aperture very irregularly ovate; outer and basal lips deeply crenulated by the external sculpture, the basal lip joining the columella at an obtuse angle; columella strongly curved, slightly grooved on its face, armed with a very strong tooth at its insertion; parietal wall roughened by the beginnings of the basal keels. Length, 1.9; diameter, 0.7 mm.

Holotype: No. 4047; Mus. Calif. Acad. Sci., collected by George D. Porter in the "**Gulf of California**"; two paratypes are in the Baker collection.

This species is very distinct from all *Odostomias* described from this coast. It resembles *O. hemphilli* Dall & Bartsch[38] by having the same number of spiral keels between the sutures and basal keels, but differs radically in being more slender, in the position and tuberculation of the spiral keels and especially in the marking of the sulci between the keels. In the key[39] to the subgenus *Miralda* it could be placed before *O. hemphilli* with some modification of the key to separate the two species.

The species is named for Capt. George D. Porter who collected it.

49. **Odostomia (Miralda) æpynota planicosta** Baker, Hanna & Strong, new subspecies

Plate 12, figure 14

Holotype: No. 4048; *paratypes:* Nos. 4049-4053, Mus. Calif. Acad. Sci., from **Cape San Lucas, Lower California**. These differ from **Odostomia (Miralda) æpynota** Dall & Bartsch[40] by having none of the spiral keels showing any of the tuberculation characteristic of the type, and in the larger size. Length, 2.16 mm.; diameter, 1.0 mm.

50. **Odostomia (Iolæa) delicatula** Carpenter

Plate 12, figure 15

Odostomia (*Evalea*) *delicatula* CARPENTER, Ann. Mag. Nat. Hist., Vol. 14, 1864, p. 47.

Odostomia (*Iolæa*) *delicatula* CARPENTER, DALL & BARTSCH, Bull. 68, U. S. Nat. Mus. 1909, pp. 183, 184, pl. 20, figs. 5, 5*a*.

Numerous specimens were taken at Cape San Lucas, Lower California, which agree well with the description and figure of this species.

---

[38] Bull. 68, U. S. Nat. Mus., 1909, p. 176, pl. 19, fig. 10.

[39] Op. cit., p. 176.

[40] Bull. 68, U. S. Nat. Mus., 1909, pl. 178, pl. 19, fig. 5.

51. **Odostomia (Menestho) grijalvæ** Baker, Hanna & Strong, new species

Plate 12, figure 16

Shell small, very thin, translucent, shining, everywhere marked by minute growth lines, elongate-conic, milk white; nuclear whorls small, exserted, inclined at an angle, rather deeply immersed in the succeeding whorl from which they are scarcely differentiated; postnuclear whorls 4¼, rather high between the sutures, decidedly, evenly rounded, contracted about evenly above and below, marked by three uneven, broad, low spiral cords, separated by two series of pitted spiral lines on each whorl leaving the middle cord nearly twice as broad as those above and below it, with a third pitted spiral line arising almost in the suture of the second turn and continuing until it circles the periphery; base rather long, evenly rounded, marked by two pitted spiral lines beginning close together on the parietal wall and separating as they advance; aperture very regularly elongate-pyriform; outer and basal lips very thin, showing the external sculpture very plainly within, *the pits appearing as minute horse-shoes opening outward;* peristome continuous; columella curved, reinforced by the base, very slightly reflected and marked by a moderate, entering fold at its insertion; parietal wall without callus. Length, 2.0 mm.; diameter, 0.85 mm.

Holotype: No. 4055; *paratype:* No. 4056, Mus. Calif. Acad. Sci., collected by G. D. Hanna and E. K. Jordan in 1925 at **Cape San Lucas, Lower California.**

This species differs from all others of the subgenus *Menestho* described from this coast in the number of spiral cords between the sutures except *Odostomia recta* (de Folin),[41] from which it differs in the arrangement of the cords, in being much more slender and in the well defined sutures. It does not fit well in the key of the subgenus

[41] *Odetta recta* de Folin, Les Fonds de la Mer, Vol. 2, 1872, pp. 167, 168.

Menestho[42] as arranged by Dall & Bartsch, but probably could best be placed between *O. grammatospira* and *O. pharcida.*

The species is named for Hernando de Grijalva who, with Mendoza, discovered Lower California in 1534.

52. **Odostomia (Menestho) navarettei** Baker, Hanna & Strong, new species

Plate 12, figure 17

Shell conical, white, composed of two smooth nuclear and four postnuclear whorls; sides of whorls flat; sutures deeply channeled; postnuclear whorls marked with prominent, rounded spiral cords, obsolete on the upper turns but showing eight on the penultimate; interspaces nearly as wide as the cords, deep; peripheral and basal cords indistinct, at least six; aperture ovate; lips slightly expanded basally. Length, 2.6 mm.; diameter, 1.4 mm.

Holotype: No. 4057, Mus. Calif. Acad. Sci., collected by Fred Baker in 1921 from **Amortajada Bay, San Jose Island, Gulf of California.**

This species is probably nearer to *O. æquisculpta* Carpenter[43] than any other from this coast, but differs in the straight sides, more globose form and heavier spiral sculpture. In the key to the subgenus *Menestho*[44] it could be placed after *O. æquisculpta.*

The species is named for the historian, Martin Fernandez de Navarette.

53. **Odostomia (Menestho) æquisculpta** Carpenter

Plate 12, figure 18

Odostomia (Evalea) æquisculpta Carpenter, Ann. Mag. Nat. Hist., 3rd Ser., Vol. 14, 1864, pp. 46, 47.

Odostomia (Menestho) æquisculpta Carpenter, Dall & Bartsch, Bull. 68, U. S. Nat. Mus., 1909, p. 191, pl. 20, fig. 3, 3*a*.

---

[42] Bull. 68, U. S. Nat. Mus., p. 184.

[43] See references under species No. 53.

[44] Bull. 68, U. S. Nat. Mus., p. 184.

Ten specimens from Cape San Lucas, Lower California, agree with the description and figure of the unique type, from the same locality, in all particulars except that they have more spiral cords. The type has four on the first, five on the second, six on the penultimate whorl, and six on the periphery and base. Our more mature shells show seven on the second, and nine on the penultimate whorl, with nine on the periphery and base. As these are the only specimens of the species which seem to have been reported, we infer that they represent a more characteristic form and it appears best not to establish a new subspecies at present.

Plate 11

Fig. 1. *Pyramidella* (*Longchæus*) *bicolor* Menke. Plesiotype, No. 4000 (C. A. S.) from San Luis Gonzaga Bay, Lower California; length 10 mm.; diameter, 3.75 mm.; p. 208.

Fig. 2. *Turbonilla* (*Chemnitzia*) *amortajadensis* Baker, Hanna & Strong, n. sp. Holotype, No. 4001, from Amortajada Bay, San Jose Island, Gulf of California; length 2.8 mm.; diameter .75 mm.; p. 209.

Fig. 3. *Turbonilla* (*Chemnitzia*) *muricata* (Carpenter). Plesiotype, No. 4002 (C. A. S.), from Monserrate Island, Gulf of California; length 2.6 mm.; diameter 1.0 mm.; p. 210.

Fig. 4. *Turbonilla* (*Strioturbonilla*) *schmitti* Bartsch. Plesiotype, No. 4003 (C. A. S.), from San Francisquito Bay, Lower California; length 2.66 mm.; diameter 1.0 mm.; p. 211.

Fig. 5. *Turbonilla* (*Strioturbonilla*) *nahuana* Baker, Hanna & Strong, n. sp. Holotype, No. 4004 (C. A. S.), from "Gulf of California"; length 2.5 mm.; diameter .8 mm.; p. 211.

Fig. 6. *Turbonilla* (*Strioturbonilla*) *chalcana* Baker, Hanna & Strong, n. sp. Holotype, No. 4005 (C. A. S.), from "Gulf of California"; length 3.6 mm.; diameter 1.1 mm.; p. 212.

Fig. 7. *Turbonilla* (*Pyrgolampros*) *gonzagensis* Baker, Hanna & Strong, n. sp. Holotype, No. 4006 (C. A. S.), from San Luis Gonzaga Bay, Lower California; length 6.4 mm.; diameter 1.4 mm.; p. 213.

Fig. 8. *Turbonilla* (*Pyrgolampros*) *pazensis* Baker, Hanna & Strong, n. sp. Holotype, No. 4011 (C. A. S.), from La Paz, Lower California; length 4.5 mm.; diameter 1.4 mm.; p. 214.

Fig. 9. *Turbonilla* (*Pyrgolampros*) *francisquitana* Baker, Hanna & Strong. Holotype, No. 4012 (C. A. S.), from San Francisquito Bay, Lower California; length 3.7 mm.; diameter 1.0 mm.; p. 216.

Fig. 10. *Turbonilla* (*Pyrgiscus*) *porteri* Baker, Hanna & Strong, n. sp. Holotype, No. 4013 (C. A. S.), from "Gulf of California"; length 5.2 mm.; diameter 1.25 mm.; p. 217.

Fig. 11. *Turbonilla* (*Pyrgiscus*) *johnsoni* Baker, Hanna & Strong, n. sp. Holotype, No. 4014 (C. A. S.), from "Gulf of California"; length 6.35 mm.; diameter 1.3 mm.; p. 218.

Fig. 12. *Turbonilla* (*Pyrgiscus*) *mayana* Baker, Hanna & Strong, n. sp. Holotype, No. 4015 (C. A. S.), from "Gulf of California"; length 4.9 mm.; diameter 1.4 mm.; p. 219.

Fig. 13. *Turbonilla* (*Pyrgiscus*) *tolteca* Baker, Hanna & Strong, n. sp. Holotype, No. 4016 (C. A. S.), from "Gulf of California"; length 6.25 mm.; diameter 1.5 mm.; p. 220.

Plate 11 continued on next page

Plate 11—*Continued from preceding page*

Fig. 14. *Turbonilla* (*Pyrgiscus*) *azteca* Baker, Hanna & Strong, n. sp. Holotype, No. 4017 (C. A. S.), from San Luis Gonzaga Bay, Lower California; length 6.35 mm.; diameter 1.5 mm.; p. 222.

Fig. 15. *Turbonilla* (*Pyrgiscus*) *lara* Dall & Bartsch. Plesiotype, No. 4021 (C. A. S.), from La Paz, Lower California; length 4.66 mm.; diameter 1.2 mm.; p. 223.

Fig. 16. *Turbonilla* (*Mormula*) *larunda* Dall & Bartsch. Plesiotype, No. 4022 (C. A. S.), from Coyote Bay, Concepcion Bay, Lower California; length 2.50 mm.; diameter 0.80 mm.; p. 223.

Fig. 17. *Turbonilla* (*Mormula*) *coyotensis* Baker, Hanna & Strong, n. sp. Holotype, No. 4023 (C. A. S.), from Coyote Bay, Concepcion Bay, Lower California; length 9.9 mm.; diameter 2.4 mm.; p. 223.

Fig. 18. *Turbonilla* (*Bartschella*) *excolpa* Dall & Bartsch. Plesiotype, No. 4026 (C. A. S.), from La Paz, Lower California; length 2.54 mm.; diameter 0.90 mm.; p. 225.

Fig. 19. *Turbonilla* (*Bartschella*) *subangulata* (Carpenter). Plesiotype, No. 4027 (C. A. S.), from Coyote Bay, Concepcion Bay, Lower California; length 2.33 mm.; diameter 0.91 mm.; p. 225.

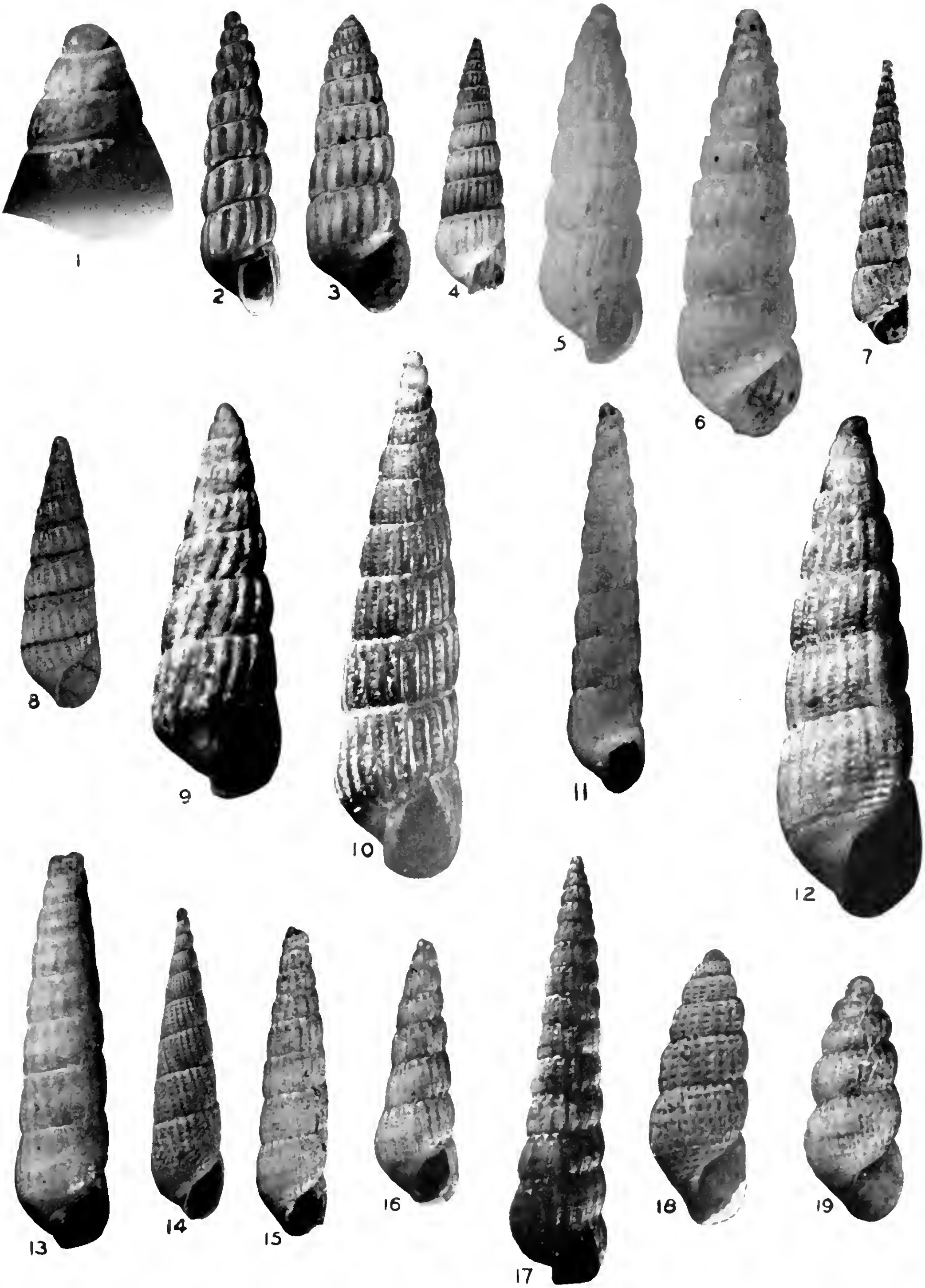

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

PLATE 12

Fig. 1. *Turbonilla (Pyrgisculus) monilifera* Dall & Bartsch. Plesiotype No. 4028 (C. A. S.), from La Paz, Lower California; length 4.33 mm.; diameter 1.5 mm.; p. 225.

Fig. 2. *Turbonilla (Careliopsis) stenogyra* Dall & Bartsch. Plesiotype, No. 4029 (C. A. S.), from Puerto Escondido, Lower California; length (incomplete) 2.16 mm.; diameter 0.73 mm.; p. 226.

Fig. 3. *Turbonilla (Cingulina) evermanni* Baker, Hanna & Strong, n. sp. Holotype, No. 4029 (C. A. S.), from Amortajada Bay, San Jose Island, Gulf of California; length 2.50 mm.; diameter 0.75 mm.; p. 226.

Fig. 4. *Turbonilla (Cingulina) evermanni* Baker, Hanna & Strong, n. sp. Photograph of another specimen (length 3.71 mm.; diameter 0.75 mm.), showing adult characters; this specimen was accidentally lost after the photograph was made; p. 226.

Fig. 5. *Odostomia (Salassia) scalariformis* (Carpenter). Plesiotype, No. 4031 (C. A. S.), from Cape San Lucas, Lower California; length 2.64 mm.; diameter 1.16 mm.; p. 227.

Fig. 6. *Odostomia (Salassia) gabrielensis* Baker, Hanna & Strong, n. sp. Holotype, No. 4032 (C. A. S.), from San Gabriel Bay, Espiritu Santo Island, Gulf of California; length 3.0 mm.; diameter 1.0 mm.; p. 227.

Fig. 7. *Odostomia (Chrysallida) audax* Baker, Hanna & Strong, n. sp. Holotype, No. 4038 (C. A. S.), from Cape San Lucas, Lower California; length 2.5 mm.; diameter .95 mm.; p. 230.

Fig. 8. *Odostomia (Miralda) porteri* Baker, Hanna & Strong, n. sp. Holotype, No. 4047 (C. A. S.), from "Gulf of California"; length 1.9 mm.; diameter 0.7 mm.; p. 236.

Fig. 9. *Odostomia (Pyrgulina) herreræ* Baker, Hanna & Strong, n. sp. Holotype, No. 4041 (C. A. S.), from "Gulf of California"; length 3.4 mm.; diameter 1.12 mm.; p. 233.

Fig. 10. *Odostomia (Chrysallida) vizcainoana* Baker, Hanna & Strong, n. sp. Holotype, No. 4034 (C. A. S.), from La Paz, Lower California; length 3.6 mm.; diameter 1.2 mm.; p. 229.

Fig. 11. *Odostomia (Ividella) mendozæ* Baker, Hanna & Strong, n. sp. Holotype, No. 4042 (C. A. S.), from Cape San Lucas, Lower California; length 2.0 mm.; diameter .95 mm.; p. 234.

Fig. 12. *Odostomia (Ividella) pedroana* Dall & Bartsch. Plesiotype, No. 4046 (C. A. S.), from Monserrate Island, Gulf of California; length 3.89 mm.; diameter 1.45 mm.; p. 235.

Plate 12 continued on page 246

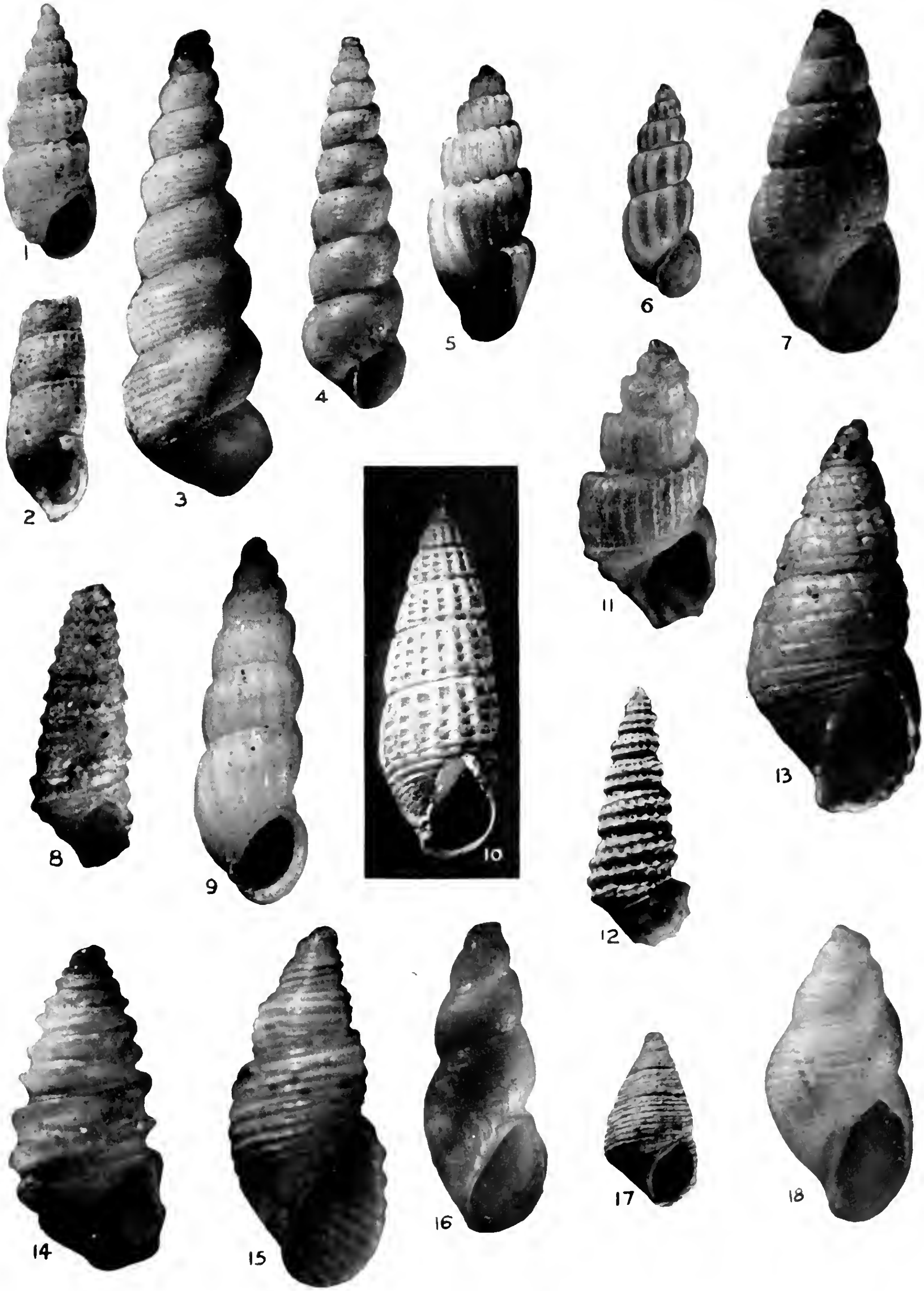

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

PLATE 12—*Continued from page 244*

Fig. 13. *Odostomia (Chrysallida) contrerasi* Baker, Hanna & Strong, n. sp. Holotype, No. 4040 (C. A. S.), from "Gulf of California"; length 3.75 mm.; diameter 1.80 mm.; p. 231.

Fig. 14. *Odostomia (Miralda) æpynota planicosta* Baker, Hanna & Strong, n. subsp. Holotype, No. 4048 (C. A. S.), from Cape San Lucas, Lower California; length 2.16 mm.; diameter 1.0 mm.; p. 237.

Fig. 15. *Odostomia (Iolæa) delicatula* Carpenter. Plesiotype, No. 4054 (C. A. S.), from Cape San Lucas, Lower California; length 2.25 mm.; diameter 1.10 mm.; p. 237.

Fig. 16. *Odostomia (Menestho) grijalvæ* Baker, Hanna & Strong, n. sp. Holotype, No. 4055 (C. A. S.), from Cape San Lucas, Lower California; length 2.0 mm.; diameter .85 mm.; p. 238.

Fig. 17. *Odostomia (Menestho) navarettei* Baker, Hanna & Strong, n. sp. Holotype, No. 4057 (C. A. S.), from Amortajada Bay, San Jose Island, Gulf of California; length 2.6 mm.; diameter 1.4 mm.; p. 239.

Fig. 18. *Odostomia (Menestho) æquisculpta* Carpenter. Plesiotype, No. 4058 (C. A. S.), from Cape San Lucas, Lower California; length 1.66 mm.; diameter 0.90 mm.; p. 239.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 8, pp. 247-251 JULY 10, 1928

VIII

OCCURRENCE OF SOME ASIATIC BIRDS IN ALASKA

BY

HARRY S. SWARTH

Curator, Department of Ornithology and Mammalogy

During the summer of 1927, Mr. C. G. Harrold, of Winnipeg, Manitoba, spent several months on Nunivak Island, Alaska, collecting birds and mammals for the California Academy of Sciences. The skill and energy that he displayed in the field resulted in a large and important collection, one that merits a detailed report. This will be finished as soon as possible, but the completion and publication of such a study will necessarily take some time and in the interim it seems desirable that certain outstanding discoveries be placed upon record at once, so as to make the facts available to others without delay. The data given regarding the several species here listed pertain to occurrences that must be taken into consideration in the compilation of the forthcoming American Ornithologists' Union *Check-List of North American Birds.* The birds here listed were all collected on Nunivak Island. This is a relatively large island, in Bering Sea, near the mainland coast of Alaska at a point about midway between the mouths of the Yukon and Kuskokwim rivers.

I am indebted to Dr. A. Wetmore, Assistant Secretary, Smithsonian Institution, and to Mr. J. H. Riley, of the Division of Birds, United States National Museum, for their identification of the species of *Anthus,* for their corroboration of my tentative identification of the species of *Prunella* and *Locustella,* and for the loan of specimens of *Pyrrhula.* It is gratifying, too, to be able to say that Dr. Wetmore and Mr. Riley agree with my disposal of *Pyrrhula cassini.* The above mentioned birds were all submitted to their scrutiny.

Charadrius mongolus mongolus Pallas

Two specimens: C. A. S. no. 31029, female, August 14; C. A. S. no. 31030, male, September 1. Two others were seen on August 14, one on September 11, and one on September 13. The basis for the inclusion of this species in the A. O. U. *Check-List* was the record by Harting[1] of the capture of two specimens on the Choris Peninsula, Alaska, in 1849. That those birds were actually taken on the Alaskan side of Bering Sea has been questioned, at least by inference,[2] but a later record by A. M. Bailey,[3] of one collected at Cape Prince of Wales on June 11, 1922, has placed the species on a secure basis among our North American birds. The *Check-List* definition of the manner of occurrence as "accidental" should probably be modified to "casual" or "rare," and the brackets enclosing the entry of the species in that volume should be removed, as, in fact, they probably should be also from other Asiatic species that have been taken in Alaska.

Pyrrhula pyrrhula cassini Baird

The collection includes three bullfinches from Nunivak Island, a take of startling interest, considering the period that has elapsed since Dall's specimen of *Pyrrhula cassini* was collected at Nulato, January 10, 1867, and the fruitless search that has been made for the species by collectors in Alaska since that time. The three skins (C. A. S. nos. 30973-30975) consist of a male in "adult" plumage (sex not determined by dissection and marked as a young bird on the strength of a "granulated" skull), October 13; a female, October 12; and a second female (sex not determined by dissection), October 16.

[1] Ibis, 1870, p. 389.
[2] Dixon, Auk, XXXV, 1918, p. 390.
[3] Condor, XXVIII, 1926, p. 85.

In the study of these birds I have been allowed to borrow from the United States National Museum the type of *Pyrrhula cassini* and three specimens of *"Pyrrhula pyrrhula kamtschatica,"* the latter collected at Petropaulski, Kamtschatka.

Pyrrhula coccinea, var. *cassini* Baird[4] was based upon Dall's Nulato specimen above mentioned, until now the only example of the genus to be taken in America. Due largely to the arguments of Stejneger[5] this bird has since been generally associated with a central Siberian species, named *Pyrrhula cineracea* by Cabanis.[6] The name *cineracea*, of course, has of late been regarded as a synonym of *cassini*. In *cineracea* the male is gray-breasted. The outstanding feature of our small Alaska series is the fact that the male is a red-breasted bird, which implies either a revision of our conception of *cassini* or else the presence of an additional species of *Pyrrhula* in North America.

The type specimen of *cassini* is not in very good condition. The skin contains no filling, the plumage on back and wings was damaged somewhat when the bird was shot, and the outer rectrix on one side is missing. On the original label it is marked male, or, rather, with the female sign inverted, which may be taken to mean male, but, as Stejneger *(loc. cit.)* has pointed out, there is no doubt that it was a female.

Females of the several species of *Pyrrhula* are very nearly alike, so much so that in most published descriptions of the species differences in the males alone are emphasized. A red-breasted bullfinch, a slightly differentiated subspecies of *Pyrrhula pyrrhula,* occurs upon Kamtschatka, nearer to Alaska than is the Siberian habitat of the gray-breasted bird to which the name *cassini* has been applied. The probable specific identity of *Pyrrhula cassini* Baird and that species, *Pyrrhula kamtschatica* Taczanowski,[7] has been suggested by Sharpe,[8] but apparently Stejneger's *(loc. cit.)* arguments to the contrary have carried conviction that the Alaskan type of *cassini* was a stray of the central Siberian species.

---

[4] Trans. Chicago Acad. Sci., i, 1869, p. 316, pl. 29, fig. 1.

[5] *In* Turner, Contributions to the Natural History of Alaska, 1886, p. 169; Proc. U. S. Nat. Mus., X, 1887, p. 103.

[6] Journ. für. Orn., XX, 1872, p. 316.

[7] Bull. Soc. Zool. France, VII, 1882, p. 395.

[8] Cat. Birds Brit. Mus., XII, 1888, p. 452.

The capture of our three specimens from Nunivak Island, including a red-breasted male, re-opens the question. These birds are obviously the same as the Kamtschatka form, and the only point at issue is the proper allocation of the type of *P. cassini.* The four females before me, one from Kamtschatka, two from Nunivak Island, and the type from Nulato, are so nearly alike that I can see no grounds for separating them. The various details of appearance in the Nulato bird cited by Stejneger *(in* Turner, 1886, p. 169) as placing it with *cineracea* rather than with a form of *pyrrhula,* are elusive and variable characters, and are, I believe, to be explained on the basis of individual or seasonal variation. Of such characters there may be mentioned the red marking on the innermost tertial, present on the male from Nunivak, absent from the two females; the white marking on the outer rectrices, which is present in varying degree on six of the seven specimens here assembled (absent from one, present on one, of the two males from Kamtschatka); shade of gray above and drab below, which seems to vary seasonally and certainly varies in different individuals. The two Nunivak Island females, taken at the same time, differ appreciably in shade of body color; one of them is more nearly like the Nulato skin than is the other.

My conclusions are as follows: That the type of *Pyrrhula coccinea,* var. *cassini* Baird is the same as the form of *Pyrrhula pyrrhula* that occurs on Kamtschatka and which has been named *Pyrrhula kamtschatica* Taczanowski. This name will be replaced by *Pyrrhula pyrrhula cassini* Baird, the appellation to be used in our *Check-List* for the Alaska bullfinch. The central Siberian form which has gone under the name of *Pyrrhula cassini* Baird will become *Pyrrhula cineracea* Cabanis.

Anthus spinoletta japonicus Temminck & Schlegel

One specimen: C. A. S. no. 30778, female, September 10. There is a prior record for this bird in North America, based upon the capture of one on St. Paul Island, in the Pribilof group, on August 29, 1916.[9] That specimen is in the United States National Museum, and being examined by Dr.

[9] Hanna, Journ. Wash. Acad. Sci., vol. 9, 1919, p. 176; Auk, vol. 37, 1920, p. 251.

Wetmore and Mr. Riley during their scrutiny of the bird here recorded, it proved to be not *japonicus* but a somewhat unusually colored example of *Anthus spinoletta rubescens.*[10]

The present is therefore the first recorded occurrence of the Japanese Pipit within the confines of the A. O. U. *Check-List.*

Locustella ochotensis (Middendorff)

One specimen: C. A. S. no. 30760, female, bird-of-the-year, September 15. The range of Middendorff's Grasshopper-warbler includes the north-eastern coast of Siberia and the Kurile Islands, so that its occurrence in Alaska is no more extraordinary than that of some other Asiatic birds that regularly cross Bering Sea. The capture of this bird adds to our *Check-List* a species and genus in the family Sylviidæ.

Prunella montanella (Pallas)

One specimen: C. A. S. no. 30759, female, October 3. Again a species that extends across Siberia to the shores of Bering Sea, and thus of not entirely unexpected occurrence in Alaska. The capture of this accentor, a relative of the English "Hedge Sparrow," adds to our *Check-List* not only a new species and genus, but a new family, the Prunellidæ ("Accentoridæ").

---

[10] Riley and Wetmore, Condor, XXX, 1928, p. 193.

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 9, pp. 253-265, 17 text figures JULY 10, 1928

IX

A COMMENSAL POLYNOID WORM FROM CALIFORNIA

BY

TAGE SKOGSBERG

Hopkins Marine Station, Pacific Grove, California

In the course of an ecological reconnaissance of Elkhorn Slough, Monterey County, California, Mr. G. E. MacGinitie of the Hopkins Marine Station found a very fascinating association of four species living in the mud of the shallow flats characteristic of that locality. These four species belong to widely different groups, viz., one to the Echiuroidea, one to the Polychæte family Polynoidæ, one to the crabs, and one to the bony fishes. Two of these species were known to science, viz., the crab *(Scleroplax granulata* Rathbun), and the fish *(Clevelandia ios* Jordan & Gilbert). The remaining two proved to be new. The echiuroid has since been described as *Urechis caupo* by Dr. W. K. Fisher of Hopkins Marine Station and Mr. MacGinitie,[1] who have also given an account of the ecology of the association. They also included in their paper a brief description or diagnosis and a figure of the Polynoid worm. The present paper describes the species in greater detail and gives 17 figures showing structural characters. No information is given in this paper as to the behavior of this animal, reference being made to the account of Fisher and MacGinitie.

---

[1] Annals and Magazine of Natural History, Tenth Ser., Vol. 1, No. 2, pp. 204-213, pl. 10, February, 1928.

July 10, 1928

The taxonomy of the family Polynoidæ is in several respects very unsatisfactory. Most of the species are described in a superficial manner and the principles of the generic subdivision are very uncertain and inadequate. A large number of genera have been established, but very little has been done in the way of their critical evaluation and delimitation. Some authors appear to be inclined to accept most of these genera, while others prefer to lump many of them into more comprehensive units. For instance, Bergström (Die Polynoiden der schwedischen Südpolarexpedition 1901-1903, Zoologiska Bidrag, vol. 4, Uppsala, 1916) includes in the genus *Harmothoë* Kinberg the entire genera *Hermadion* Kinberg, *Lagisca* Malmgren, *Evarne* Malmgren, *Parmenis* Malmgren, *Eunoa* Malmgren and parts of the genera *Polynoe* Savigny, *Antinoë* Kinberg, and *Lænilla* Malmgren. On the other hand, Chamberlin (The Annelida Polychæta, Mem. Mus. Comp. Zool., Harvard College, Cambridge, Mass., 1919) recognizes all these genera as valid.

Lacking a sufficiently wide experience to pass a critical judgment on the relative merits of these opposing views, I have decided to accept, tentatively, Bergström's wide conception of the genus *Harmothoë* and have referred my new species to this genus.

Harmothoë adventor Skogsberg[2]

Diagnosis: Body depressed; ratio between length and width, 2.7 – 3.4 : 1; maximum length, about 40 mm. Number of somites, 37 or 38. Anus on pygidium. Elytra cover body completely, or mid-dorsal portion of body naked, 15 in number, present on somites II, IV, V, VII, and on alternate somites to XXIII inclusive, and then on XXVI, XXIX, XXXII; smooth, with moderate number of rounded tubercles along edge. Prostomium 1.4 – 1.7 times longer than wide, with two small, mammilliform anterior processes, which sometimes are nearly absent. Two pairs of eyes of moderate size on posterior half of prostomium. Median tentacles about twice as long as lateral tentacles, subequal in length to prostomium. Dorsal cirri long. Tentacles, palpi, and cirri with minute papillæ. Each notopodium and neuropodium

[2] Skogsberg in Fisher & MacGinitie, Ann. Mag. Nat. Hist., Tenth Ser., Vol. 1, No. 2, p. 213, pl. 10, fig. 3, February, 1928.

near middle of body with 50-100 bristles all with simple tips and distinct pectination; notopodia, as well as neuropodia, with two kinds of bristles. Some of notopodial bristles stronger than neuropodial, with strong tips; others weak, with thread-like tips. Some of neuropodial bristles with pectination along distal $\frac{1}{4} - \frac{1}{6}$ and with strong tips; others with pectination along distal $\frac{1}{2} - \frac{1}{3}$ and with thread-like tips. Each somite with dorsal crossband of pigment.

Description: Greatest length recorded in preserved specimens, 40 mm., exclusive of prostominal and anal appendages. The large specimens usually very heavily built, somewhat more so than the smaller ones. Body widest at, or somewhat in front of, the middle, tapering usually somewhat anteriorly and posteriorly, but some specimens are subuniform in width nearly throughout; anterior and posterior extremities well rounded. Ratio between length (measured as above) and greatest width of body (between tips of parapodia, exclusive of bristles), 2.7 – 3.4 : 1; relatively wide and narrow specimens are found among the large sizes. Somites 37 or 38, exclusive of the pygidium; the somite next to the pygidium quite small (fig. 2) with small and weak parapodia, cirri, and bristles; the somites in front of this gradually increase in size the farther anteriorly they are located, but the notocirrus of the next but last somite is usually quite large, three times or more length of corresponding structure of last somite. The elytra may cover the body completely; often, however, the two members of each pair are barely in contact with one another; or a zone about half as wide as an elytron along mid-dorsal line may be naked. In all the specimens recorded the prostomium was completely covered by the first pair of elytra; and the anus, which is located dorsally at the anterior end of the pygidium (fig. 2), appears always to be covered by the last pair of elytra.

The prostomium (measured from tips of anterior processes) is about 1.4 – 1.7 times longer than wide, widest at or near the middle, with well-rounded lateral sides, and with quite small, mammilliform anterior processes of varying size. In some specimens these processes are so reduced in size that they can hardly be distinguished; those represented in figure 1 were the largest seen. When well developed, they are about as long as wide and rounded distally. The prostomium is split anteriorly by the ceratophore of the median tentacle which begins at or somewhat in front of the middle; behind the ceratophore its surface is usually almost evenly vaulted, without a distinct mid-dorsal groove. There are two pairs of eyes of moderate size on posterior half of prostomium, the members of each pair being far apart; anterior pair sometimes somewhat larger than the posterior. Ceratophore of median tentacle about as long as prostomium or somewhat shorter, about half as wide as long or somewhat narrower, widest in front of middle where its sides are well rounded. Median tentacle tapers gradually distally and is about twice as long as prostomium or somewhat longer. Ceratophores of lateral tentacles of moderate size, about half size of ceratophore of median tentacle or somewhat less. Lateral tentacles subuliform and about half as long as median or somewhat less.

Palpi about twice as long and thick as median tentacle or somewhat less and of about same shape as this but constricted proximally.

The proboscis when fully everted, is cylindrical and about twice as long as wide or somewhat more or less, bearing along its anterior edge 18 papillæ, 9 of which are dorsal and 9 ventral. These papillæ (fig. 9) either subequal in size, or those near median plane somewhat larger than lateral ones; seen from the outside, these papillæ appear to be conical and each has on the inside a rather large rounded triangular process. Two pairs of fairly large, subequal, triangular, brown, chitinous teeth (fig. 8) in the mouth, one dorsal and one ventral pair, the two members of each pair located close together on either side of median plane; laterally to and connected with each of these four teeth, is a chitinous plate, the outer edge of which is free and apparently cutting.

Parapodium of first somite (fig. 1) somewhat shorter than prostomium is wide and about twice longer than wide; antero-distally it has a small, mammilliform process, shorter than ⅓ of width of parapodium and lacking distal bristles. (This process undoubtedly corresponds to one of the tips of the parapodium, probably to the tip of the notopodium, since it contains an aciculum.) Free ends of cirrophores of the two cirri about as long as wide; the two cirri about same shape as median tentacle, the dorsal one about as long as the palpi, the ventral somewhat (1/4 – 1/3) shorter. Dorsal cirri present on the following somites: III, VI, VIII and on alternate somites to XXIV inclusive, then on XXV, XXVII, XXVIII, XXX, XXXI, XXXIII, XXXIV, XXXV, XXXVI, and XXXVII; these cirri (fig. 1) about same shape as those on first somite; most of them subequal in size, sometimes even slightly longer than greatest width of body (exclusive of bristles), sometimes decidedly less; a few of the anterior and posterior may be somewhat shorter, and the one of somite XXXVII (fig. 2), as previously noted, quite short. Each of these cirri has a subconical cirrophore, quite short in comparison with the cirri, and about twice as long as wide or frequently even somewhat shorter; ventral cirrus of second somite somewhat different from the other ventral cirri, its cirrophore directed more or less anteriorly, about half as long as dorsal cirrus of first somite or somewhat less; most of remaining ventral cirri (fig. 10) subuliform, somewhat shorter than the one of the second somite, about 1/3 as long as the parapodium to which they belong or slightly less. Tentacles of prostomium, palpi, and all the cirri furnished with minute, mammilliform papillæ; on the ventral cirri these are quite few; in case of remaining structures, they are more or less numerous.

All the neuropodia (fig. 10) of same fundamental shape; subcylindrical in ventral view, their distal half slightly narrower than the proximal; obliquely truncate postero-distally, and furnished antero-distally with a flattened, mammilliform process about half as long as average width of neuropodium in ventral view; seen from behind (figs. 11, 12), this process either triangular or truncate triangular. In the middle of the body the neuropodia are about as long as the body proper is wide or slightly shorter, and about 0.30 as wide as long in ventral view. Anteriorly and posteriorly the neuropodia gradually decrease in size, the most anterior and posterior ones also being somewhat wider relatively. Notopodium (fig. 11) quite small, distinctly shorter than width of neuropodium, about as long as wide, more or less obliquely truncate distally, and dorso-distally furnished with a narrow peg-like appendage, about as long as rest of notopodium. Of the two acicula, the one of the neuropodium ends near the point of the flattened antero-distal portion; the one of the notopodium ends at the tip of the peg-like appendage.

Notopodium (fig. 12) with a large but varying number of closely set bristles, arranged as in a brush, gradually increasing in length the more ventrally they are placed; ventral bristles reaching to or slightly beyond tip of neuropodium, the dorsal ones about half as long or slightly less. The number of bristles in the notopodia near the middle of the body varies from about 50 to about 100, the number gradually increasing with the size of the specimens; in fairly large specimens (35–40 mm.) these notopodia have usually 70-80 bristles. Of these bristles, the dorsal ones (about ½ to ¾ of the total number) are nearly straight or but gently curved, narrowly lanceolate, their distal ½ or ⅓ furnished with closely set cross-rows of short, fine spines which end a short distance from the strong, simple tip of the bristle (fig. 14). The ventral bristles (fig. 15) usually are gently or moderately curved, ending in a fine, hair-like tip, and furnished along their distal ½ to ⅓ with a dense series of fine, short spines and at least sometimes with cross-rows of exceedingly small spines very difficult to detect. The neuropodium has also a large and varying number of bristles but these, generally speaking, are arranged in a narrow, dorso-ventral plane. The number of bristles in the somites referred to above is usually between 70 and 80, the lowest number counted was 58, the highest 84. Just as in the notopodium there are two kinds of bristles; the dorsal ones (about ⅓ of the total number) issuing along the dorsal ⅓ of the neuropodium; and the ventral ones situated near the tip. The dorsal ones (fig. 17) are quite long as a rule, about ½ the length of the neuropodium or even more, gently curved, with fine, nearly thread-like tip, and furnished along the distal ½ – ⅓ with moderately strong, closely set pectinae. The ventral bristles (fig. 16) gradually decrease in length the more ventrally they are situated; the most dorsal of them are about half as long as the neuropodium or somewhat less; the most ventral only about ½ – ⅓ of this length; their distal ¼ – ⅙ is distinctly set off from the proximal part, has a gently curved, strong, simple tip and, dorsally, a closely set series of moderately strong pectinae ending at some distance from the tip. The bristles of the neuropodium are more slender than the lanceolate bristles of the notopodium.

The cirri of the pygidium have the length, shape and structure of the longest dorsal cirri of the parapodia or they may even be somewhat longer.

The preelytrophores (a term to designate the dorsal processes just inside the cirrophores on the segments lacking elytra) are small on the third somite (fig. 1), fairly large on the sixth somite, and increase gradually in size to a point somewhat behind the middle of the body, from where they decrease posteriorly. When typically developed, they are narrowly mammilliform, frequently of about the same shape and direction as the cirrophores but slightly smaller than these.

The nephridial papillæ (fig. 10) frequently are rather large, 2-3 times longer than wide, and rounded distally; sometimes distinct on every somite from somite VI to somite XXXVI; sometimes only from somite VIII to XXXV.

As previously noted, the elytra are well developed and are present on all the somites which do not have cirri; all of them deciduous, i. e., they very readily fall off, and have along the margin a moderate number of tubercles (of the "Kugel-Typus"), each furnished at the tip with one or a few short, fine, hair-like processes (fig. 13); their surface is, for all practical purposes, smooth; only a few small scattered tubercles may be found. The first elytron (fig. 3) is rather small, broadly ovate, flattened antero-laterally; the second (fig. 4) and third (fig. 5) are asymmetrically kidney shaped, being strongly concave anteriorly; the fourth (fig. 6), which is between two and three times larger than the first, is also asymmetrically kidney shaped, but the anterior concavity is less pronounced; the fifth (fig. 7), which is still somewhat larger, is subovate in outline and flattened antero-laterally; the remaining ones agree fairly well with the fifth, are rather large in the anterior ⅔ of the body, and decrease somewhat in size in the posterior ⅓ of the body. All elytra vary somewhat in shape.

Median tentacle fairly light gray-green except near tip where there is no pigmentation. Lateral tentacles fairly dark brown with unpigmented tips; palpi lack pigment or nearly so; cirri of first somite and ventral cirrus of second somite about same color as the median tentacle; most of the dorsal cirri have a zone of gray-green near tip; ventral cirri unpigmented or nearly so; ventral side of body unpigmented, the mid-ventral zone and the region around the mouth richly blood colored, evidently due to the transparency of the skin; dorsum with fairly broad, gray-green cross-bands, one on each somite, extending onto the preelytrophores and sometimes onto the elytrophores. Proboscis but slightly pigmented. The first elytron is light gray, except along the antero-lateral edge which is unpigmented. Of the other elytra, those on the anterior half of the body have a light gray band along posterior edge but otherwise unpigmented; the ones on the posterior half of the body are nearly unpigmented. Pigmentation somewhat variable.

Type: No. 633, Mus. Calif. Acad. Sci., collected by G. E. MacGinitie on the shallow mud flats in **Elkhorn Slough, Monterey Co., California.**

Remark: The specific name *adventor* refers to the peculiar mode of living of this animal. It means, the guest at an inn. It may be noted in this connection that the specific name of the Echiuroid, with which this species is associated, means innkeeper.

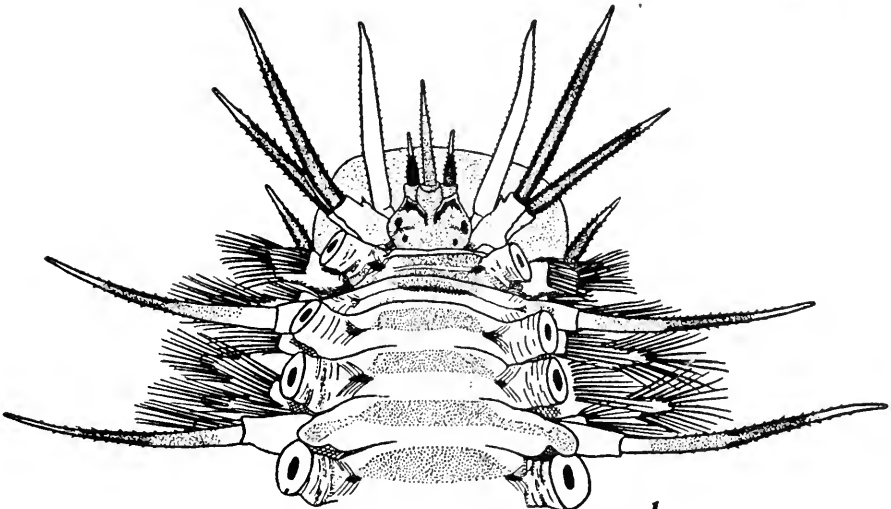
Harmothoë adventor Skogsberg.

Fig. 1. Anterior portion of body from dorsal side. Proboscis partly everted. Stippling indicates pigmentation. Bristles greatly reduced in number and very diagrammatic. Type.

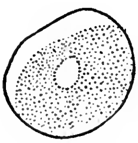
Fig. 2. Posterior portion of body from dorsal side. Shows small size of posterior somites and position of anus. Stippling indicates pigmentation. Most cirri represented only by their cirrophores. Bristles, especially of anterior somites, reduced in number and very diagrammatic. Not type.

Figs. 3–7. First, second, third, fourth and fifth left elytra. Pigmentation indicated by stippling. Type.

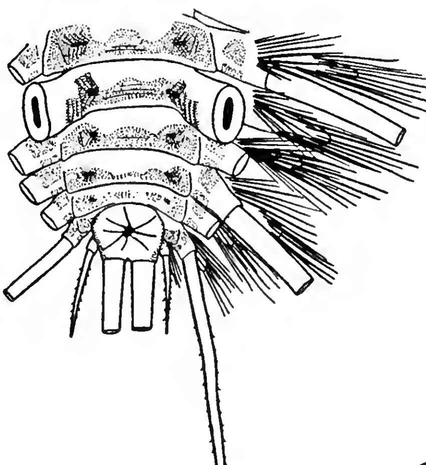
Fig. 8. A pair of teeth from mouth. Thickness of chitin indicated by relative darkness. Not type.



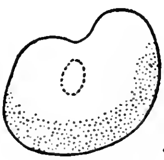
1



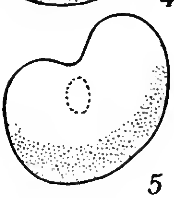
3



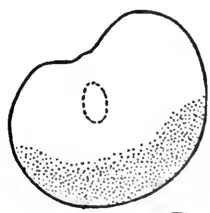
2



4

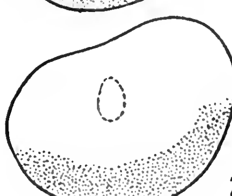


5



6

8



7

Harmothoë adventor Skogsberg.

Fig. 9. Papillæ along anterior edge of proboscis, seen from different sides. Not type.

Fig. 10. Three parapodia from left side near middle of body; ventral view. Bristles greatly reduced in numbers and diagrammatic. Not type.

Fig. 11. Right 20th parapodium from behind, with bristles omitted, but with acicula indicated. Not type.

Fig. 12. Right 16th parapodium from in front. Preelytrophore indicated. Bristles greatly reduced in numbers and diagrammatic. Not type.

Fig. 13. Edge of an elytron to show marginal tubercles. Not type.

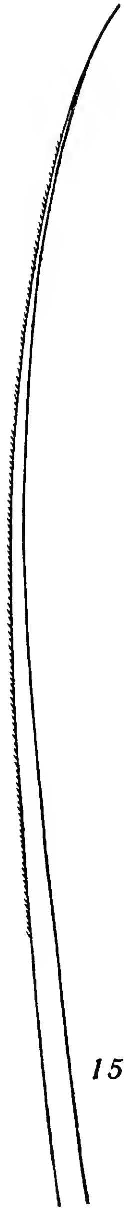
Fig. 14. Dorsal bristle from notopodium of right 19th parapodium. Type.

Fig. 15. Ventral bristle from notopodium of right 19th parapodium. Type.

Fig. 16. Ventral bristle from neuropodium of left 15th parapodium. Not type.

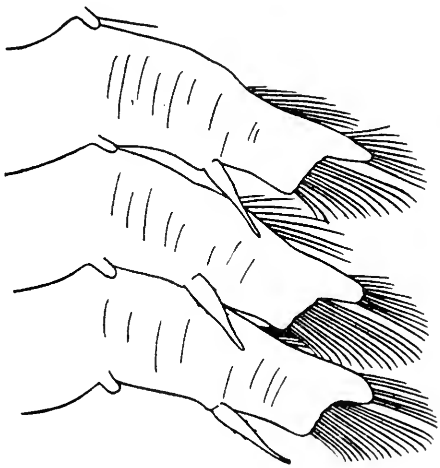
Fig. 17. Dorsal bristle from neuropodium of left 15th parapodium. Not type.

14

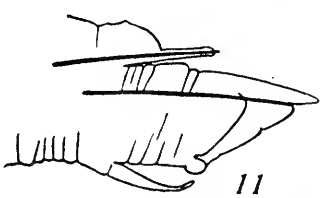


15

9



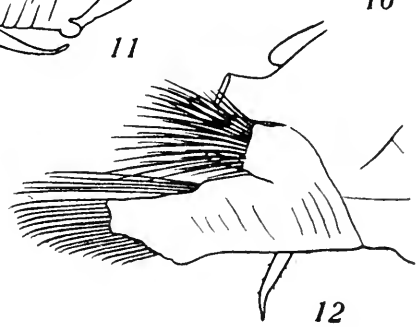
10



11

16

17



12

13

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, No. 10, pp. 267-295, 26 text figures JULY 10, 1928

X

STRUCTURE AND BEHAVIOR OF THE AMPHIPOD, POLYCHERIA OSBORNI

BY

TAGE SKOGSBERG

Hopkins Marine Station, California

AND

G. H. VANSELL

University of California

When compared with the social insects, most crustacea undoubtedly have a very simple ecology. However, in many cases the great simplicity may be apparent only and due to our lack of detailed information. It should be remembered that, to a very large extent, this field of inquiry is still a virgin one, and future investigations probably will reveal much complexity of habits and behavior where simplicity is anticipated. Indeed, some crustacea are known to have ecological features of great interest. Especially among the amphipods, many examples of unique behavior and adaptation are to be found.

In the present paper an account will be given of some of the habits of a marine amphipod occurring in a compound ascidian on the west coast of North America. It has been judged advisable to include also a description of the external morphology of this species, since this is very incompletely known.

The genus *Polycheria,* which was established by Haswell (1879,Proc.Linn.Soc.N.S.Wales,vol.4), belongs, together with four other genera, to the family Dexaminidæ Leach. None of these five genera has been submitted to a careful morphological analysis, and so our knowledge of what constitutes the generic characteristics in this family is still very unsatisfactory. A result of this is that many of the characteristics included in the description given below are not specific but of a higher systematic value, later on to be transferred to the description of the genus, or, in some cases, perhaps even to that of the family.

Polycheria osborni Calman

Polycheria osborni Calman, 1898, p. 268, pl. 32, fig. 2.

Description: Female: Maximum length in the natural, somewhat curled position, exclusive of antennæ, somewhat more than 4 mm.; when straight, inclusive of telson, somewhat less than 6 mm. Without stating how the measurements were made, Calman (p. 269) records the length of 7 mm. Shape of body in lateral view, about as in Calman's figure 2; only the body proper is sometimes slightly deeper, relatively. Rostrum (fig. 24) very small, slightly bent down. Lateral eyes slightly smaller than in Calman's figure. Body grayish pink or slightly variegated in living individuals; eyes red to violet, when seen at certain angles with a white reflection. Ventral side of thorax with fine, white spots often arranged in two cross-bands, sometimes irregularly arranged. When preserved, the specimens are whitish, with dark eyes.

First antenna (fig. 2): Somewhat more than 0.5 length of body. With 23 joints; of these the 21 distal are subequal and taper gently distally; second joint, 5-6 times longer than wide, gently tapering distally, about 0.3 the total length of joints 3-23; first joint somewhat shorter than second and about twice longer than wide; first joint with 1-3 short hairs on dorsal side and 3-6 on ventral; second joint with about 3-5 short hairs along dorsal margin; ventral margin with spaced, fairly long to short hairs, often arranged in groups of 2-4; third joint with a varying number (about 5-10) of distal bristles, about as long as joint or somewhat longer or shorter; each of joints 4-14, inclusive, with a ventro-distal group of four bristles, one of which is sensory and about as long as joints; one somewhat shorter than the sensory; and two about as long as total length of 3-4 of these joints on joints 10-14, inclusive, somewhat shorter on preceding joints. On joints 15-22, inclusive, a similar ventro-distal group of bristles occurs but without sensory bristle; the long bristles of these joints decrease slightly in length the more distally they are located. Distal (23rd) joint with five distal bristles, two of which are short, three about as long as the long bristles on the preceding joint. Joints 5, 7, 9, 11, 13, 15, 17, and 19 usually have two short dorso-distal hairs. On some of these joints only one of these hairs may be present; and a short hair may occur on one or two of the joints usually lacking these structures. Joints 21 and 22 have one and two, respectively, of these short, dorso-distal hairs. All bristles of this antenna are simple, i. e., not plumose.

Second antenna (fig. 5): About as long as first antenna and composed of 20-22 joints. Of these the three proximal are short, about as long as wide or even shorter; the fourth is 0.20-0.25 the length of the appendage, about five times longer than wide, gently tapering distally; the fifth somewhat shorter than fourth, subuniform in width throughout, and about eight times longer than wide; the remaining 15-17 joints are subequal in length, or some of the proximal are somewhat shorter than the distal. The first two joints lack bristles and hairs. The third joint has 5-7 bristles; 4-6 of these are ventral and about as long as or somewhat shorter than joint; dorsally there are one bristle, about as long as joint, and a few short hairs. Fourth joint with a varying number (frequently quite numerous) of rather short hairs along dorsal side; and with a few (about 4-7) short hairs along ventral side. Fifth joint with a varying number of short to moderately long hairs along dorsal side; along ventral side it has about 4-6 moderately short to rather long (somewhat more than 0.5 the length of joint) bristles and a few short hairs. With the exception of the distal joint, the remaining joints usually have a ventro-distal group of four bristles of about the same relative length as the corresponding bristles of the first antenna; in some specimens one or both of the short bristles may be absent in a few of these groups; and an extra bristle may appear on one or a few of the proximal of these joints. Distal joint with the same equipment of bristles as in the first antenna, but with four instead of three long bristles. Structure of bristles the same as in first antenna, with the exception that no bristles are specialized sensory structures.

Labrum: Broadly attached, almost circular in ventral outline, vaulted dorsally, concave ventrally, its distal third pubescent.

Labium (fig. 3): Consists of two well developed pairs of lobes, of which the ventral is about twice as large as the dorsal, the two members of ventral pair widely separated distally, ovate, with outer edges more convex than inner and notched about ⅔ distally; distal third pubescent. Members of dorsal pair closely approximated, ovate, with nearly straight inner edges, thin, hyaline, and naked.

Right mandible (fig. 8): The outer margin forms nearly an arc of a circle; without structural differentiations. Inner margin somewhat concave; furnished proximally with a large masticatory plate, distally to which some bristles and a movable tooth occur. Distal end of appendage forms a powerful, immovable tooth. Masticatory plate nearly as wide as long, obliquely subtruncate distally; near base of its inner margin there is a low, angular protuberance; its distal edge with numerous (about 30-50) small, subequal teeth; on outer margin a plumose bristle, about as long as process is wide or somewhat shorter. Bristles distally to masticatory plate subequal to and of the same structure as bristle of masticatory plate; their number usually two, but sometimes only one of them is present. Movable tooth powerful, about as long as masticatory plate is wide, deeply bifurcate; its two prongs gently curved, more or less unequal in size, the outer one the smaller; a few small, secondary teeth may be present. Distal tooth subequal to but more powerful than movable tooth; with 4-6 powerful secondary teeth of which the distal often is the largest. Along toothed edge of masticatory plate and at base of bristles fairly short to moderately long hairs occur.

Left mandible (fig. 6): This differs in the following respects from the right: bristles distally to masticatory plate number 2 or 3; the two prongs of movable tooth furnished, respectively, with 2 and 3-4 fairly strong, subequal, distal teeth.

First maxilla (fig. 18): First endite of moderate size, about as long as wide, rounded distally. With two bristles, one distally, the other on inner margin frequently near distal end; distal bristle subequal in length to endite; the other slightly longer to 0.5 this length; both bristles with fine tips and with long, soft secondary bristles near middle and short ones distally. Distal half of endite with fine, short hairs. Second endite subrectangular, 1.5 – 2.0 times longer than the first, its truncate distal edge with 7 powerful bristles; these are often subequal in length and about as long as endite or a little less, usually denticulate in the middle, and with strong tips. Palp one-jointed and reaches to or slightly beyond tip of second endite; subuniform in width to near distal end which tapers abruptly; about three times longer than wide; with 5 (seldom 6) bristles at and near tip; bristles of slightly different lengths, the longest subequal to length of palp; structurally they agree with bristles of first endite. Fine, short hairs occur along inner and distal margins of palp.

Second maxilla (fig. 19): Both lobes well developed, the inner about ⅓ shorter than the outer. Inner lobe about three times longer than wide, rounded distally, its inner distal margin with 6 (4-7) bristles of somewhat variable length; variations irregular, but usually no bristle is longer than the longest in figure nor shorter than 0.5 this length; short, fine hairs along inner and distal margins of lobe. Outer lobe three times longer than wide, slightly widened distally to middle, rounded distally; distal margin with 10 (9-11) bristles, subequal in length to those of inner lobe; short, fine hairs along inner and distal margins of lobe. All bristles of this appendage agree structurally with those on first endite of first maxilla.

Maxilliped (figs. 1, 12): First endite about 0.50 as long as second endite, slightly longer than the greatest width of the latter, 2-3 times longer than wide, and rounded distally; near distal end with 4-6 moderately strong bristles about 0.33 the length of endite. Second joint of protopodite about 0.5 as long as wide; with about 4 subequal, distal bristles on inner edge similar to those of palp. Second endite large, nearly subequal in length to palp, about 2.5 times longer than wide, scythe-like, with inner margin nearly straight; along distal ⅔ of inner margin with 10-14 spines, the 1-2 distal ones of which usually are somewhat larger than the others, which vary considerably in size; maximum length of spines about 0.33 the width of endite; between all spines there is a thin, hyaline, subtriangular structure of somewhat variable shape; proximal ⅓ of inner edge of endite with fine pubescence. Palpus: First and third joints subequal in length, somewhat shorter than first endite; third joint broader distally than proximally, rounded subtriangular, frequently even more so than in figure 12. Second joint somewhat wider than remaining joints, about 0.75 – 0.80 as wide as second endite, with strongly convex inner margin, and about 1.5 times longer than first joint. Fourth joint subconical, often with angular outer edge, its length usually subequal to 0.5 the width of third joint. First joint with 4-7 bristles near distal end. Second joint usually with three subparallel, oblique rows of bristles on inner ventral side; of these rows, the two proximal sometimes very irregular; each of the two proximal rows with about 6-8 bristles; distal row with 9-12; 2 or 3 bristles may be found ventrally on lateral side of joint. Third joint with about 20 bristles distally, half of which are ventral, half dorsal; on ventral side 2-5 bristles occur near middle of joint and 3-7 on distal end of joint near outer margin. Most bristles of these three joints subequal, nearly as long as second joint is wide, and all of them resemble structurally the bristles on the palp of the first maxilla. Fourth (distal) joint with a single bristle near, or somewhat proximally to, middle of outer side, about as long as joint or somewhat shorter; a short, powerful spine at tip of joint, near which three weak, subequal bristles occur, about as long as or slightly shorter than spine.

First gnathopod (figs. 7, 22): First joint short, about as long as wide or somewhat shorter; with anterior, narrowly mammilliform endite about as long as joint or somewhat shorter. Second joint long, somewhat shorter than total length of next four joints, about 4 to 5 times longer than wide. Third joint about as long as wide or slightly shorter. Next three joints about 1.5 times longer than wide, the fifth being slightly larger than the fourth and sixth; the fourth and sixth somewhat wider distally than proximally, the fifth *vice versa*. Seventh joint somewhat curved, claw like, usually somewhat shorter than width of sixth. Endite of first joint with 2-4 bristles, usually shorter than endite; 2 small bristles are often found anteriorly near base of joint; and a couple of short ones may occur distally on inner side of joint. Second joint with 2 postero-distal bristles, about 0.5 as long as width of joint or somewhat shorter; along anterior side about 5-11 fairly short bristles occur; and near middle of this side, there are 4-8 bristles about as long as joint is wide or somewhat longer or shorter. Third joint with 3-6 postero-distal bristles of unequal lengths, the longest about as long as joint; a short bristle is often found on inner side of joint near anterior margin. Fourth joint with a varying number (about 25-45) of bristles of different lengths, most of them concentrated along distal half of posterior margin; greatest length of these bristles usually subequal to length of joint. Fifth joint with about 15-22 bristles along posterior margin; besides, there are about 6-15 scattered bristles, most of which occur on inside of joint; maximum length of these bristles subequal to width of joint. Sixth joint, like the preceding one, has but few scattered bristles on outer side. On inner side a large number of bristles of different lengths occur, usually arranged in about the following manner (fig. 7): near anterior edge 5-8 oblique cross rows, with a maximum number of about 9 in each row, and usually with a smaller number in the proximal rows than in the distal; towards the posterior edge, there are three or four obliquely longitudinal rows, two of which may form a single row; largest number of bristles in each row about 7; sometimes the rows are not quite distinct; besides these bristles, a few scattered ones always occur. Maximum length of bristles of this joint subequal to length of joint. Palmar edge of this joint about 0.33 the length of seventh joint, hyaline, furnished with numerous, closely set, minute spines. Seventh joint with a short bristle proximally to middle of anterior side, about 0.25 – 0.33 the length of joint; near tip of joint, 4 short points occur; entire surface of joint with closely set, minute spines. Nearly all the bristles of this appendage with fine pectination along distal half; a few may have rather long, fine secondary bristles near middle.

Second gnathopod (figs. 4, 9): Of about the same size as the first, from which it differs in shape only in the following respects: first joint about twice longer than wide, with somewhat shorter, triangular endite; fifth joint wider distally than proximally; sixth joint about twice longer than wide or somewhat more and but slightly wider distally than proximally. Endite of first joint with 1-4 bristles, the longest about as long as endite; a very short bristle is often found anteriorly near base of joint and another short one near base of endite. Along anterior side of second joint about 5-10 bristles; most of these are short, one to a few moderately long (maximum length subequal to width of joint). Postero-distally this joint has 2-5 bristles of different lengths, the longest sometimes somewhat longer than width of joint; along posterior side this joint has 5-11 bristles of varying length, the longest about as long as joint is wide. Third joint postero-distally with 1-3 bristles, the longest of which is about as long as joint. Fourth joint with about 14-25 bristles of different lengths, most of which are concentrated along distal half of posterior margin; greatest length of these bristles about twice the length of the joint or slightly more. Fifth joint with about 15-40 bristles of different lengths, most of which are concentrated postero-distally, where some of them form two longitudinal rows along edge of joint; maximum length of these bristles slightly exceeds length of joint. Sixth joint (fig. 9) has bristles arranged in about the same manner as in the first gnathopod, but there are only 4-5 cross rows of bristles on inner side near anterior margin, and the number of bristles is somewhat less; maximum length of bristles somewhat less than length of joint. Hyaline plate of the palmar edge of this joint somewhat lower and longer than in first gnathopod, being about 0.5 the length of the seventh joint; its structure the same as in the preceding appendage. Seventh joint and structure of bristles about the same as in the preceding appendage, only the seventh joint is slightly shorter.

First pereiopod (figs. 10, 23): First joint slightly shorter than wide, with narrow, mammilliform process about as long as joint or slightly shorter. Second joint about 0.30 the length of leg and about 2.5 times longer than wide. Third joint somewhat shorter than wide. Fourth joint slightly shorter than second and about three times longer than wide. Total length of fifth and sixth joints subequal to length of second joint, the fifth being somewhat shorter than the sixth; the sixth about 3.5 – 4.5 as long as wide. Distal joint curved, claw like, nearly as long as preceding joint is wide. Process of first joint with 2-4 bristles, the longest subequal to or somewhat shorter than process; opposite to process, this joint has about 3-6 bristles of different lengths, the longest about as long as process. Second joint has 4-8 bristles along anterior side, 3-5 along posterior side, and 2-4 postero-distally; third joint with 2 or 3 postero-distally; fourth joint with 3-6 along anterior side, 2-3 antero-distally, 3-6 along posterior side, and 3-4 postero-distally; fifth joint with about 3 antero-distally, 1 at the middle of posterior side, about 2-3 postero-distally, and frequently 1-2 distally on outer side; sixth joint with a group of about 1-3 anteriorly and somewhat proximally to tip, 1 or 2 somewhat proximally to these, 5-11 antero-distally, 2-3 along posterior side, 1 on inside of base of postero-distal finger like process, 3 at tip of finger, and 1 near base of distal joint; distal joint with 1 somewhat proximally to middle of anterior side, and 1 posteriorly a short distance from tip. Most bristles of second to fifth joints usually quite short, and many of them (proportion variable) are sensory spines of type shown in figure 21; maximum length of these bristles usually does not exceed width of joints, and most bristles are decidedly shorter. Sixth joint: bristles in group somewhat proximally to distal end of anterior side and those proxmally to these are rather short and strong; antero-distal bristles of different lengths, the longest frequently somewhat longer than width of joint, and none of them is spine like; bristle at base of finger-like process is about as long as joint is wide or even somewhat longer, and usually somewhat longer than the other bristles on the posterior side of joint; bristle near base of distal joint rather short and spine-like, just as bristles at tip of finger. Anterior bristle of distal joint fine and about 0.5 as long as joint or somewhat more; posterior one nearly vestigial.

Second pereiopod: First joint differs from corresponding joint of first pereiopod mainly in having a shorter and blunter process; frequently the process is even rounded subrectangular. Proportions of remaining joints about the same as in the mentioned leg. Second joint with 3-10 bristles along anterior side, 2-7 along posterior side, and 2-3 postero-distally; third joint with 1-3 postero-distally; fourth joint with 2-6 along anterior side, 2-3 antero-distally, 3-6 along posterior side, and 2-4 postero-distally; fifth joint with 2-3 antero-distally, usually with 1 near middle of posterior side, 2-4 postero-distally, and frequently 2 distally on outer side; sixth and seventh joints with the same number and arrangement of bristles as in the preceding leg. Types and relative lengths of bristles about the same as in the preceding leg.

Third pereiopod (fig. 20): Of about the same size as the two preceding legs, but the second joint is slightly larger relatively, and the fifth joint is about 2.5 times longer than wide and somewhat larger than the sixth which also is about 2.5 times longer than wide. The first joint may lack bristles, or it may have 1-3 on anterior side and 1-3 posteriorly; second joint with 3-8 bristles along anterior side and 3-7 along posterior side; third joint with 1-2 antero-distally; fourth joint with 3-7 along anterior side and 2-6 along posterior side; fifth joint with 2-6 along anterior side and 2-5 along posterior side; sixth joint with 1-3 anteriorly and somewhat proximally to distal end, 4-6 antero-distally, 1-4 along posterior side; distal joint with 1 bristle anteriorly and somewhat distally to the base and 1 posteriorly and somewhat proximally to tip. The bristles of this leg differ from those of the preceding leg mainly in the following respects: they are somewhat fewer and slightly weaker, at least in some specimens; in some specimens but a few of them are sensory spines, while in others the proportion of these spines is about the same as in the preceding leg; the third joint has the bristles antero-distally instead of postero-distally; the antero-distal bristles of the sixth joint are somewhat shorter, and there is no bristle at the base of the finger like projection of this joint; the spine of this joint near base of distal joint is either vestigial or absent.

Fourth pereiopod: Of about the same size as the preceding leg, but the second and fourth joints are subequal in length; of the fifth and sixth joints, the total length of which is somewhat less than the length of fourth joint, the sixth is slightly the longer; the sixth joint is about twice longer than wide, the fifth somewhat less. First joint with 2 or 3 bristles anteriorly and about 1 posteriorly; second joint with 4-7 bristles along anterior side, 2-3 antero-distally, 4-9 along posterior side, and 2-3 postero-distally; third joint with 2 or 3 antero-distally; fourth joint with 4-9 along anterior side, 2-3 antero-distally, 4-6 along posterior side, and 2-4 postero-distally; fifth joint with 1-2 along anterior side, 2-3 antero-distally, 1 near middle of posterior side, 2-3 postero-distally, and frequently with 2 distally on outside of joint; sixth joint with about the same number and arrangement of bristles as in the first pereiopod; seventh joint with 2 bristles of the same type, size, and location as in the first pereiopod. The bristles of this leg differ from those of the first pereiopod mainly in being somewhat longer and more powerful on the average; and one of those in the antero-distal group of the sixth joint is a spine which is not the case in any of the three preceding legs.

Fifth pereiopod (fig. 25): First joint with subtriangular process about as long as or somewhat shorter than corresponding process of first pereiopod; fourth, fifth, and sixth joints either of about the same strength as in the preceding leg or somewhat heavier and wider; of the fifth and sixth joints, the total length of which is subequal to length of fourth joint, the sixth is slightly the longer; the sixth joint is about twice longer than wide, the fifth somewhat less. First joint with 1-2 bristles on process, and usually none anteriorly, second joint with 4-8 bristles along anterior side, 1-3 antero-distally, 6-14 along posterior side, and 1-3 postero-distally; third joint with 2-3 antero-distally; fourth joint with 3-9 along anterior side, 2-5 antero-distally, 2-5 along posterior side, and 2-5 postero-distally; fifth joint usually with 1 near middle of anterior as well as of posterior side, about 2-3 antero-distally as well as postero-distally, and frequently 2 distally on outside of joint; sixth joint with about the same number and arrangement of bristles as in the first pereiopod; seventh joint with 2 bristles of the same size, structure, and location as in the first pereiopod. The bristles of this leg have about the same lengths and types as in the fourth pereiopod (those in figure 25 are, on the average, somewhat shorter than usual).

Marsupial plates (fig. 11): A pair of these occurs on each of the following four appendages: second gnathopod, first, second, and third pereiopods. All of them are about similar in shape; slender, about eight or nine times longer than wide, subuniform in width throughout, rounded distally, and somewhat notched at places where bristles are inserted. The ones on the first and second pereiopods are subequal, slightly longer than the ones on the second gnathopods, and 0.33 longer than the ones on the third pereiopods. The first pair has about 22-30 bristles on each member; the second and third, 23-35; the fourth, 14-26; posterior side, one the average, with a somewhat smaller number of bristles than the anterior. All bristles naked; most of them about half as long as plates or somewhat shorter or longer, the proximal being, on the average, somewhat shorter than the others.

Gills (fig. 11): Six pairs; one pair on second gnathopods and one on each of the five pairs of pereiopods. About two to three times longer than wide, more or less narrowly subobovate to subovate, flattened on one side in the case of the three anterior ones, nearly symmetrical in the case of the two posterior. The three anterior subequal in length to second joints of corresponding appendages; the fourth about half as long as this joint or somewhat more; the fifth somewhat smaller.

Pleopods (fig. 13): The three pairs about similar in shape; biramous, with exopodite and endopodite many-jointed and subequal in size. Protopodite rectangular, somewhat longer than wide, with about 6-12 bristles, some of which are near distal end, some more proximally; most of these bristles fine and about half as long as joint is wide; two, situated near distal end of inner margin, are short, rather strong, and furnished with 2-3 pairs of retroverted teeth. Exopodite with 12-16, endopodite with 9-15 joints; it should be emphasized, however, that the proximal joints are very indistinct, hard to detect, and that sometimes traces of joints can be found down to the bases of the two branches. Each distinct joint has on either side a densely plumose distal bristle; those on distal joints somewhat more than half as long as branches, the proximal ones shorter. Proximally to the distinct joints a few bristles may be found, usually much shorter than the distal.

First uropod (fig. 16): The process from which this appendage issues has 4-10 fine, lateral bristles which are about as long as first joint of appendage is wide and furnished with moderately long, fine hairs. First joint (protopodite) of appendage about 2.5 times longer than its average width, slightly tapering distally; along outer edge it has 10-18 bristles of the same type as and either about as long as or somewhat longer than bristles proximally to appendage; ventroproximally 2-3 similar bristles occur; on dorsal side, there are two longitudinal rows of rather short spines, the inner row near or on inner margin of joint; there are 2-6 spines in outer row, 4-9 in inner. Exopodite about as long as first joint. endopodite subequal in length to exopodite or usually slightly shorter; both are similar in shape, gently tapering distally, about 7-8 times longer than wide. Exopodite with 3-8 rather short spines along outside, 1-5 along inside; endopodite with 2-9 along outside and with 1-4 somewhat longer ones along inside; average length of short spines about half the width of branches, the long ones about twice longer. Distally the exopodite has two spines, one about as long as branch is wide or somewhat shorter, the other about 0.25—0.33 the length of branch. Endopodite with only one distal spine, subequal to the long distal one of exopodite. On either side of distal spines of exopodite and endopodite, the chitinous wall forms a short, strong spine. Long, distal spines lack sensory hair; the same is frequently also true in regard to the long spines on inner edge of endopodite. Most of the remaining spines appear usually to have a sensory hair, although this frequently is very difficult to detect; in other words, most of them have about the same structure as the bristle represented in figure 21. Edges of exopodite and endopodite with dense, exceedingly short hair.

Second uropod (fig. 15): Somewhat smaller than the first, but difference in size somewhat variable; relative size frequently as in figures 15 and 16. Protopodite about 2-3 times longer than wide, of subuniform width throughout; frequently with a longitudinal row of about 3 short spine on dorsal side, but these spines may be absent; distally on inner margin may be found 1-3 fine bristles of about the same type and length as the bristles on the outside of the protopodite of the first uropod. Exopodite about 1.3 – 1.5 times longer than protopodite; endopodite somewhat shorter; both 7-8 times longer than wide and taper distally. Exopodite with 1-4 spines along outside, 0-3 along inside, and 2 distally; endopodite with 1-5 along outside, 2-4 along inside, and 1 distally. Relative length and structure of spines about as in the first uropod; and chitinous walls of exopodite and endopodite form short, strong spines distally, just as in the first uropod. Hairiness as in first uropods.

Third uropod (fig. 14): Somewhat smaller to slightly larger than first. Process on which this appendage is inserted with a short spine near inner edge. First joint about as long as wide or frequently somewhat longer; in most specimens with a dorsal, longitudinal row of 3-5 short spines, frequently fairly near to outer edge, and with 1-3 short bristles or spines near inner edge. Exopodite 1.5 – 2.0 times longer than protopodite, about 5-6 times longer than wide, tapering distally; endopodite of about the same shape and width as but 1.5 times longer than exopodite. Exopodite with 0-5 (usually 3-5) short spines along outside, 4-7 along inside and a short hair near tip. Endopodite with 4-7 short spines along outside, 3-9 along inside, and a short hair near tip. Sometimes this branch has 1-14 fine bristles of varying length along inner and outer edges, and such bristles may also be found on exopodite. Structure of spines and hairiness as in first uropod.

Telson (fig. 17): Elongate, about twice longer than wide, tapering distally, split longitudinally in the middle nearly to base, the two members close together and pointed distally. Outer edge of each member usually with 5 spines, but occasionally only 3 or 4 are developed; these spines have about the same size and structure as the short spines of the uropods, the distal being slightly longer than the proximal. Short, fine hair, such as found along the edges of the uropods, appears usually to be absent.

Habitat: *Polycheria osborni* was first described from Puget Sound, Washington, where eight specimens, all females bearing ova, were found "in nests in *Amarœcium.*" In Monterey Bay, California, the species is fairly common in the rocky tide pools, where it lives in cavities of the compound ascidian *Amaroucium*. The surface temperature in the tide pools usually is somewhere between 50° and 55° F.; only seldom 48° or 49° and 57° or 58° are recorded.

Remarks: The specific allocation of this form is somewhat uncertain, since Calman's (1898, p. 268) description if *Polycheria osborni* (recorded from Puget Sound, Washington) is quite superficial and incomplete. However, Calman's and our specimens undoubtedly show similarities sufficient to make their identification at least highly probable. The only differences worth notice are as follows. According to Calman's figures, (1) the palp of the first maxilla has 7, instead of 5, bristles (only a few of the Monterey Bay specimens had 6 bristles); (2) the distal joint (finger) of the first gnathopod is somewhat longer, relatively.

Stebbing (1906, p. 520) considers *Polycheria osborni* identical with *P. tenuipes* Haswell (1879), *P. obtusa* G. M. Thomson (1882), and possibly also with *P. brevicornis* Haswell (1879), three forms described from Australia and New Zealand. We have not judged it advisable to follow this identification on account of the very incomplete descriptions and remoteness of habitats of these forms.

In order to establish the range of variation, ten specimens were carefully examined. All these specimens were from the same locality; and several of them were taken in the same tide pool. As will be seen from the description given above, nearly all the external characters exhibit a more or less pronounced variability. In spite of this, there can be no reasonable doubt about all the specimens belonging to the same species.

This variability is very significant, since it demonstrates the necessity of a more careful morphological analysis of the systematic units than has hitherto been practiced by most of the investigators of this group. Most of the specific descriptions of the Amphipods are very short, and little or no attention has been paid to the variability. If *Polycheria osborni* can exhibit such plasticity at a locality where the physico-chemical conditions are unusually constant, an even greater variability may characterize the species at localities of more varied conditions, and, especially, within its entire range of distribution. Of course, it is possible that this species is unusually variable, but a high degree of variability may characterize many other species of the group. In other words, many forms, now accepted as valid species, may be founded on modifications.

All the specimens carefully examined (ten) were females; and no males were found among 30-40 individuals which were studied in a more superficial manner. It should be observed that eight specimens recorded by Calman (1898) also were females.

Some of the specimens on which our description is founded, together with some of the *Amaroucium* colonies, have been deposited with the institution that has published this report.

Habits and behavior of Polycheria osborni

Polycheria osborni is found in sheltered parts of rocky tide pools, where it lives in cavities or burrows which it makes in the tough, semitranslucent tests of the various species of the genus *Amaroucium,* a composite ascidian. It appears to prefer places which are not exposed to the air even during the lowest tides, but this choice is by no means universal. Frequently specimens are found above the water line; but in this case the habitat usually seems to be moist and cool crevices, the openings of which are more or less covered by a heavy, overhanging growth of algae. The animal does not occur on the lower side of loose rocks but always on the exposed side which is washed by moving water. This preference is intimately connected with the peculiar mode of feeding characteristic of this species. The pale ascidian colonies in which many of the zooids are dead appear to be preferred. Sometimes only one or a few specimens are found in a fairly large group of ascidians; sometimes the amphipods are so numerous that they actually crowd each other. This crowding is probably not due to any tendency to form colonies but simply to the fact that the young tend to make their burrows as soon as they have left their mother. The spreading of the species, to a large extent, appears to be carried out by the currents caused by waves and tides. The number of specimens in a colony can readily be counted. Each individual shows up, through the semitranslucent test, as a pinkish body somewhat larger than the ascidian zooids.

When in its burrow, *Polycheria* lies on its back. The burrow fairly closely conforms to the general shape of the body and usually is but slightly larger than this (fig. 26). Sometimes specimens are found that are not quite covered; in these cases the cavities are not yet finished. When completed, the burrow is deep enough to house the entire animal; as a matter of fact, its depth is subequal to the depth of the body proper of the animal and the length of the pereiopods. The edges of the burrow are held firmly by the distal fingers of the first, second, fourth and fifth pereiopods, and it is by the movements of these legs that the burrow is opened and closed. When open, the aperture of the burrow is irregularly elliptical, about 2.5 – 3.0 times longer than wide and about as long as the animal when this is in its natural, somewhat curled position. When closed, the long edges of the ellipse are pressed together, forming as it were, a slightly zigzag seam, the stitches of which are represented by the eight distal fingers of the four pairs of pereiopods noted above. The length of the seam about equals the length of the aperture of the open burrow. The zigzag shape, of course, is due to the pull of the legs. When the burrow is closed, the fingers of the pereio-

July 10, 1928

pods usually are the only parts of the animal to be seen and even they may be out of sight. Sometimes, however, the antennæ are held out even in this condition. While the first, second, fourth, and fifth pereiopods are directed more or less upwards when the animals lies on its back in the burrow, the third pair is directed slantingly downwards (fig. 26). Its function has not been established with certainty, but it appears to anchor the animal to the bottom of the burrow. In any case, the structure of its distal end indicates that it has a function somewhat similar to the one of the remaining pereiopods.

While the animal lies undisturbed in its burrow, the latter is kept open and the three pairs of pleopods are intermittingly beating back and forth, thus causing a rather strong current of water, the main direction of which is backwards. It was observed that the fanning of the pleopods ceases for a short time when the animal is disturbed, and that it becomes somewhat more rapid and intense when the water is slightly stale. A somewhat more developed staleness and a fairly moderate rise of temperature soon causes the death of the animal. The current moves from the head end and the sides of the burrow down to the middle portion of the ventral side of the animals where the gills are located. From there it continues backwards to the abdomen whose upward direction causes it to shoot almost straight up. The rising current, of course, also sucks in some water from behind, but this contribution is insignificant. The course of the current can readily be established by pouring carmine suspended in sea water over the burrow. The function of the current appears to be primarily respiratory. At any rate, most of the water seems to be drawn in from the sides of the burrow and does not pass through the antennæ. However, at least some of the current passes through these appendages, and there can hardly be any doubt that it partly serves as a carrier of food.

As far as we have been able to decide, the food consists almost exclusively of detritus and small animals and plants.

Diatoms are frequently found on the mouth parts and in the stomach. *Polycheria* does not go out hunting for food, as do most of the other members of the amphipod group. Instead, it lies in its burrow waiting for the food to come its way, carried there by the currents produced either by the animal itself or by waves and tides. The first and second antennæ, which are quite long and furnished with numerous rather long hairs, are carried ventrally (i. e. upwards) somewhat laterally, and slightly anterior to the head (fig. 26). For long periods they are kept perfectly still. Then, all of a sudden, they are quickly bent down towards the gnathopods and maxillipeds which seize them and carry out combing movements. The structure of these appendages is interesting to study from the viewpoint of this function. The bending probably takes place whenever edible material comes in contact with the antennæ. The sensory hairs on the first antennæ undoubtedly help in the chemical analysis of the material caught. After the food particles are combed off by the gnathopods and the maxillipeds, they are transferred to the mandibles and maxillæ which seize them and begin mastication and the transportation to the mouth. As will be seen from the description, the mandibles and the first maxillae are quite strong masticatory organs. During these processes the gnathopods are pressed over the mouth parts. After their completion, the gnathopods are raised and spread to make ready to receive the antennæ again. However, they do not remain idle when there is no food to be handled but are always ready to be used for cleaning other parts of the body.

When undisturbed, the animal usually remains in the same position in its burrow; but sometimes, for some unknown reason, it turns around so that its head comes to be where its posterior end was. If exposed to a minor mechanical stimulus, for instance the light prodding with a needle near its burrow, it closes the aperture of the burrow in the manner described above and keeps perfectly still. Soon, however, its pleopods begin to fan and in a little while its antennæ may be extended. On the other hand, a more or less decided rise in the temperature of the water, a strong, mechanical stimulus, or a chemical stimulus, such as oxygen deficiency or the adding of a harmful compound to the water, causes the animal to desert its haunt. After a rather short swimming dash, it begins to crawl around on the substratum. When swimming, it is propelled exclusively by the pleopods; and it moves anteriorly with great speed with the dorsal side down. While swimming, the animal shows a fairly strong positive heliotropism, a characteristic not evident in crawling. The positive heliotropism is probably correlated with the preference of this species for the exposed side of the rocks in the tide pool. In walking or crawling, the animal moves sluggishly in the anterior direction occupying the same position as in the burrow, i. e., with its ventral side up. It uses its first, second, third, and fourth pereiopods which are held dorsally (i. e., downwards). The fifth pereiopod is held ventrally (i. e., upwards) in walking. Only occasionally does it help in locomotion. Its main function appears to be to help the first, second, and fourth pereiopods in opening and closing the aperture of the burrow. The peculiar habit of always keeping the ventral side up is so thoroughly established in this species that even the young crawl on their backs when they leave the brood pouch of the mother. The walking is always slow, and the animal feels its way by gently touching the objects ahead with its antennæ.

Contrary to most of the other members of the amphipod group, *Polycheria* is exceedingly sluggish, a characteristic presumably connected with the habit of living in a burrow. A specimen may settle down on the rounded tip of an *Amaroucium* colony, apparently in a very uncomfortable position, get a firm hold of the test, and then remain for several hours without exhibiting any appreciable movements, except the intermittent flipping of the pleopods. Indeed, even if many specimens are kept in a quiet aquarium, one may watch them for hours without anything happening.

When hunting for a location for a new burrow, the animal is distinctly selective. If placed on a soft sponge or on an ascidian other than *Amaroucium,* it does not settle down but crawls around restlessly and finally swims away. If kept in an aquarium with no *Amaroucium,* it scouts around until it finally dies, apparently from exhaustion. It may be mentioned in this connection that the species appears not to be very resistant. It is difficult to keep alive in an aquarium for more than a couple of days and usually dies before most of the other animals.

In making its burrow, the animal does not dig in the strict sense of this word. It lies on its back, grasps the surface of the ascidian test with its first, second, fourth, and fifth pereiopods and then begins to pull slowly. The tough test slowly yields. In this way the back of the animal is gradually pushed into the test; and finally it is so deep down that the edges of the cavity thus formed can be pulled over the animal. This operation required, when observed in an aquarium, several hours. This mode of making the burrow is probably the reason why the *Amaroucium* colonies with many dead zooids are preferred; in these colonies the tests are presumably softer and thus yield more readily to the pull. However, *Polycheria* is fully capable of making its burrow in young and vigorous colonies as well. The cavities of the dead zooids have not been observed to be appropriated by the full grown *Polycheria.* On the other hand, the young specimens, recently out from the brood pouch, evidently prefer any small depression they can find.

The females carry eggs and young in their brood pouch throughout the summer months. In some females as many as 70-80 eggs were counted. The eggs hatch at different times, and the young are forced out of the brood pouch by the mother who for this purpose uses her gnathopods. The young leave through the anterior opening of the brood pouch, and while the mother is trying to force them out they cling tenaciously to the hairs of the mother evidently reluctant to leave their shelter. The number of young forced out each time varies from one to four. At this stage the young measure about 0.3 – 0.4 mm. in length, exclusive of the antennæ. Immediately after having been removed from the marsupial pouch, the young begin to hunt around for a lodging place. As noted above, they usually do not select an even place for their first burrow but prefer a small depression which they turn into a burrow in the same manner as do the larger specimens. They appear frequently to settle near the mother. This is indicated by the fact that one often finds a large specimen surrounded by the burrow of many young ones. On the other hand, they are probably often washed away by the currents of waves before they have a sufficiently strong hold. In this manner, as noted previously, the species is dispersed.

The living together of *Polycheria* and *Amaroucium* can probably not be regarded as a case of commensalism. As far as we have been able to observe, the ascidian does not draw any benefit whatsoever; it simply furnishes *Polycheria* with a home. At the same time, it is also doubtful that *Polycheria* harms its host to an appreciable extent.

As will be seen from the above account, the ecology of *Polycheria osborni* is quite simple, as far as we have been able to establish. At the same time, it exhibits some peculiar and interesting features, the most outstanding among which are its habit always to be oriented with its ventral side up, a character presumably acquired in connection with its habit of living in a burrow and its mode of feeding. *Its orientation and mode of feeding presumably are the same as in the ancestral forms of the Cirripedia,* and the species may serve as an analogous example to illustrate the origin of this group. However, while in the Cirripedia this mode of living led to profound morphological changes in *Polycheria* only slight deviations from the related genera resulted.

Bibliography

Calman, W. T.

1898. On a Collection of Crustacea from Puget Sound. <Annals N. Y. Acad. Sci., XI:13.

Haswell, W. A.

1879. On some additional New Genera and Species of Amphipodous Crustaceans. <Proc. Lin. Soc. N. S. Wales, IV.

Stebbing, T. R. R.

1888. Report on the Amphipoda collected by H. M. S. Challenger during the years 1873-1876. <Rep. Challenger, Zool., XXIX.

1906. Amphipoda. Tierreich, Schulze. XXI. Berlin.

Thomson, G. M.

1882. Additions to the Crustacean Fauna of New Zealand. <Trans. N. Zealand Inst., XIV.

Polycheria osborni.

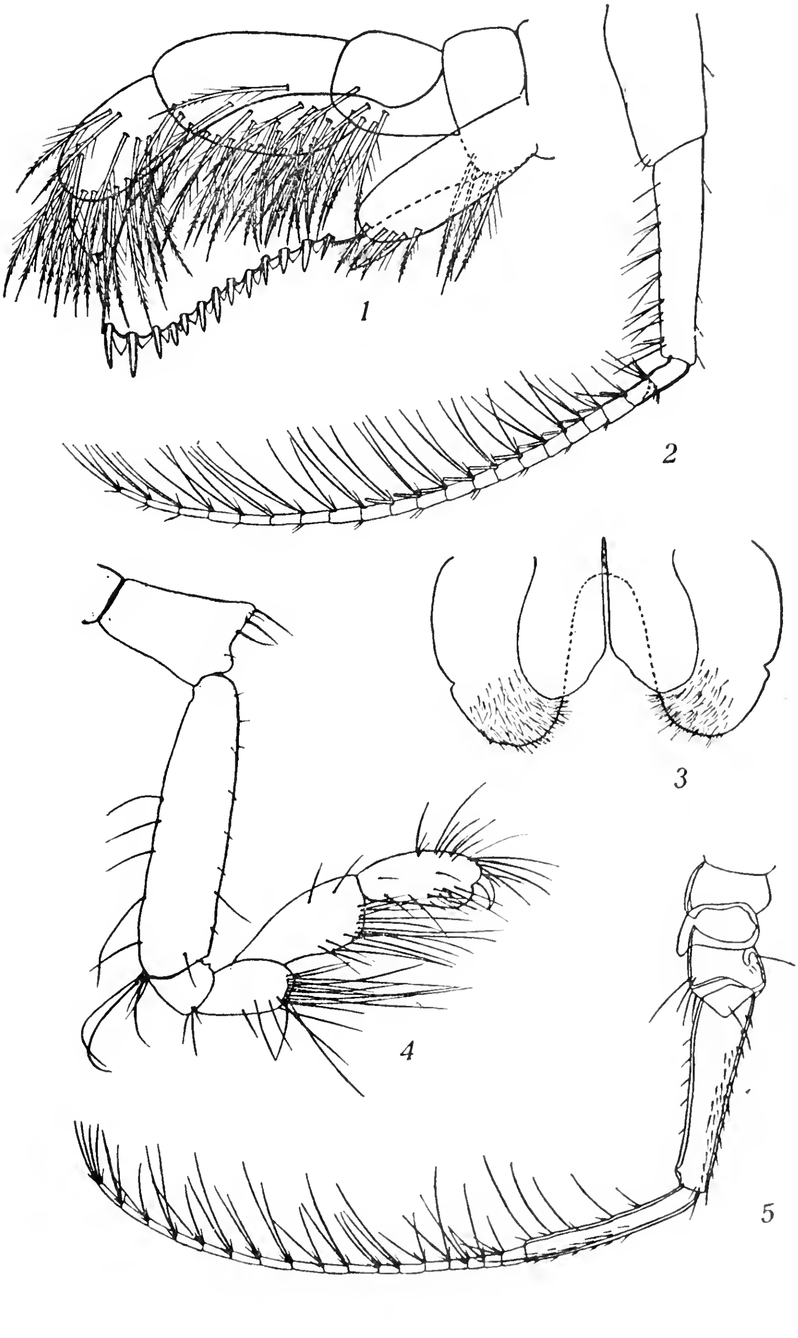
Fig. 1. Left maxilliped from ventral side. Palp covered by second endite. Next to distal joint seen in tilted position and so its characteristic subtriangular shape is not brought out. Magnification unknown.

Fig. 2. First antenna. ×53.

Fig. 3. Labium, seen from dorsal side. ×120.

Fig. 4. Left second gnathopod. ×67.

Fig. 5. Second antenna. ×53.


1
2
3
4
5

Polycheria osborni.

Fig. 6. Left mandible. Magnification unknown.

Fig. 7. Two distal joints of right first gnathopod, from inside. ×217.

Fig. 8. Right mandible. Magnification unknown.

Fig. 9. Two distal joints of left second gnathopod, from inside. Distal joint with fine, short hairs all over. ×217.

Fig. 10. Two distal joints of left first pereiopod, from inside. ×150.

Fig. 11. Gill and marsupial plate of first perciopod. ×33.

Fig. 12. Two distal joints of palp of maxilliped. Magnification unknown.

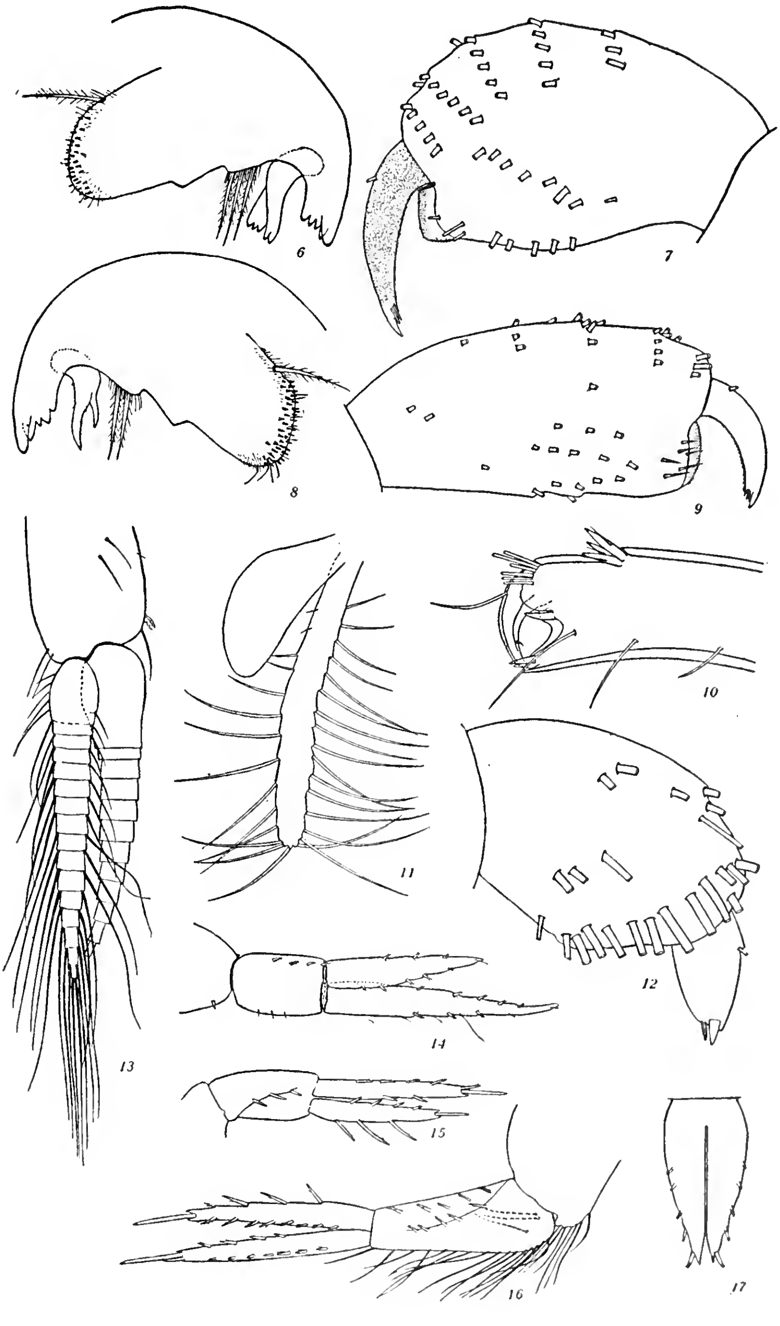
Fig. 13. Second pleopod. Magnification unknown.

Fig. 14. Third uropod, slightly tilted, from dorsal side; lateral side up. ×60.

Fig. 15. Second uropod, from dorsal side; exopodite up. ×60.

Fig. 16. First uropod, from dorsal side; exopodite down. ×60.

Fig. 17. Telson, from ventral side. ×60.


6
7
8
9
10
11
12
13
14
15
16
17

Polycheria osborni.

Fig. 18. First maxilla. ×290.

Fig. 19. Second maxilla. ×290.

Fig. 20. Third pereiopod. ×40.

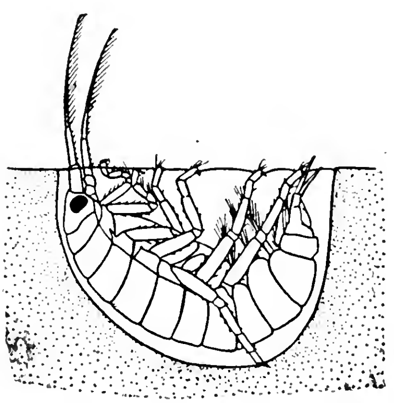
Fig. 21. Sensory spine. Magnification unknown.

Fig. 22. Left first gnathopod, from inside. ×72.

Fig. 23. Right first pereiopod, from inside. ×40.

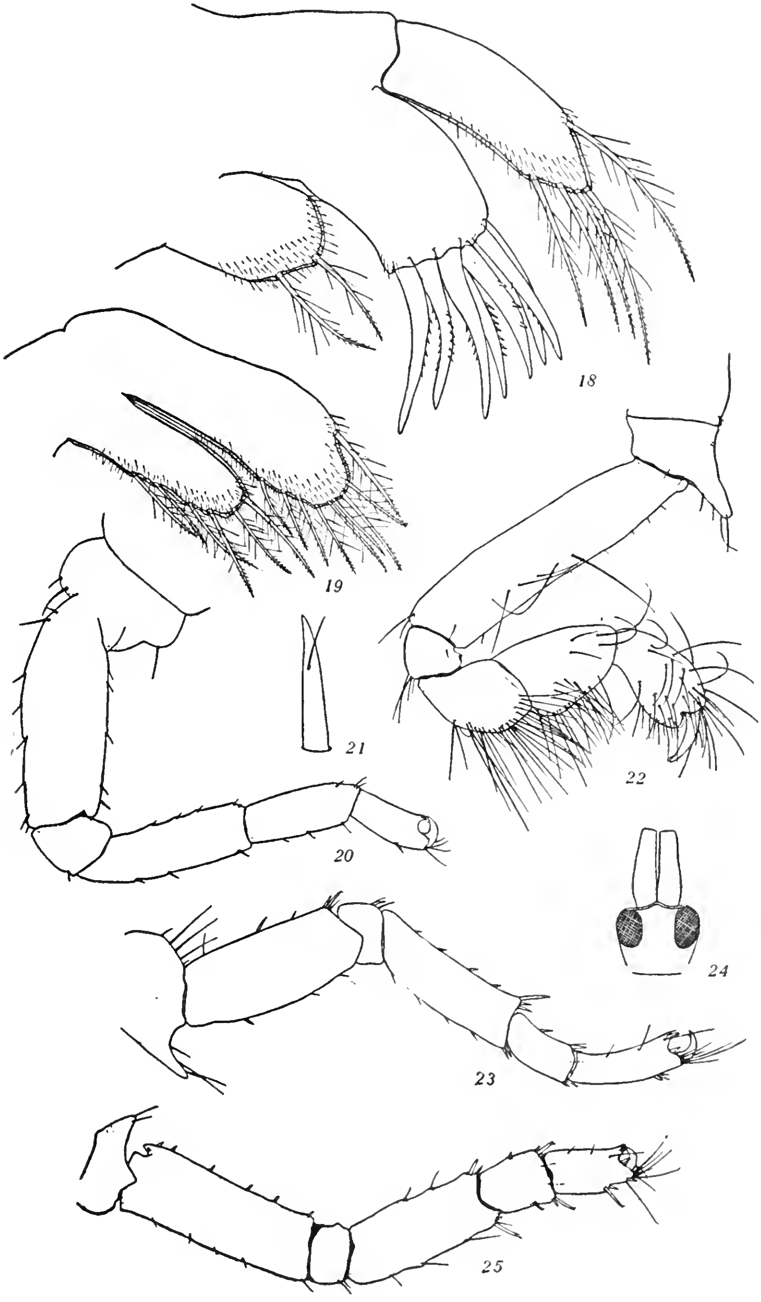
Fig. 24. Head, with bases of first antennæ, from above. ×15.

Fig. 25. Fifth pereiopod, from inside. ×40.



26

Fig. 26. *Polycheria osborni* in its burrow.


18
19
20
21
22
23
24
25

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, NOS. 11 AND 12, pp. 297-360 MAY 22, 1929

XI

REPORT OF THE PRESIDENT OF THE ACADEMY FOR THE YEAR 1928

BY

C. E. GRUNSKY

President of the Academy

The last year's annual report opened with an expression of regret that the excellent work which is being done in the various departments of the Academy is not more fully recognized by the many public-spirited citizens of California who are so circumstanced that they frequently do not know just what use to make of surplus wealth. This statement should again be repeated and later in this report an opportunity will be pointed out which it is hoped will catch someone's fancy.

The membership has not changed materially during the year, being now made up of:

Patrons	19
Honorary Members	18
Life Members	84
Fellows	40
Members	935
Total	1096

On January 1, 1928, the number of members stood at		1101
New members added during the year	55	
Members lost by death	22	
Members resigned	24	
Members dropped for non-payment of dues	14	
	60	
Net loss during the year		5
Leaving the membership on January 1, 1929, at		1096

The Academy carries on its list of patrons the following names:

Living

Mr. George C. Beckley
Dr. Frank E. Blaisdell
Mr. William B. Bourn
Hon. William H. Crocker
Mr. Peter F. Dunne
Dr. Barton Warren Evermann
Mr. Herbert Fleishhacker
Mr. W. M. Giffard
Hon. Joseph D. Grant
Mr. Edward Hohfeld
Mrs. Albert Koebele
Mr. A. Kingsley Macomber
Mr. John W. Mailliard
Mr. Joseph Mailliard
Mr. M. Hall McAllister
*Mr. Ogden Mills
Mr. William C. Van Antwerp
Mr. Edward P. Van Duzee
Dr. E. C. Van Dyke

Deceased

Mr. William Alvord
Mr. Charles Crocker
Mr. John W. Hendrie
Mr. William F. Herrin
Mr. Henry M. Holbrook
Mrs. Charlotte Hosmer
Mr. James Lick
Mr. Alexander F. Morrison
Mr. Amariah Pierce
Mr. Ignatz Steinhart
Dr. John Van Denburgh

Those who were called by death in 1928 are as follows:

Mr. John B. Badaracco	Member	February 26, 1928
Mr. M. E. Beall	Member	September 1928
Mr. J. O. Beebe	Member	March 12, 1928
Dr. F. B. Carpenter	Member	July 16, 1928
Mrs. Crawford W. Clarke	Life Member	February 3, 1928
Dr. William Leon Dawson	Member	April 30, 1928
Dr. Bashford Dean	Honorary Member	December 6, 1928
Mr. Charles W. Doe	Member	January 12, 1928
Mr. C. L. Fox	Member	March 13, 1928

*Deceased January 29, 1929.

Dr. Charles Henry Gilbert	Fellow	April 20, 1928
Mr. George Herrmann	Member	September 2, 1928
Mr. Beverly L. Hodghead	Member	October 16, 1928
Mr. Mark Keppel	Member	June 16, 1928
Mr. Leverett Mills Loomis	Life Member	January 12, 1928
Mr. Milnotte McCants	Member	September 4, 1928
Dr. George W. Merritt	Member	March 8, 1928
Dr. John F. Newson	Life Member	November 1928
Mr. W. W. Sargeant	Member	December 4, 1928
Mr. E. E. Schmitz	Member	November 19, 1928
Mr. Gailliard Stoney	Member	March 6, 1928
Professor Albert Van der Naillen	Life Member	October 28, 1928
Mr. H. C. Worth	Member	June 2, 1928

In the year 1928 eleven free lectures were delivered at the stated meetings of the Academy, as follows:

JANUARY 4. "Palestine, its People, its Agriculture and its Native Flora." Illustrated. By Dr. W. L. Jepson, Professor of Botany, University of California, Berkeley.

MARCH 7. "Mount Shasta." Illustrated. By Mr. Pierre J. Denand, Associated Oil Company, San Francisco.

APRIL 4. "Reminiscences of early Academy days." By President Grunsky, Vice-Presidents Edwards and Von Geldern, Miss Alice Eastwood and others.

MAY 2. "Nature Study and Education." Illustrated. By Mr. Harold Stein, Educational Director, Boy Scouts of America, San Francisco.

JUNE 6. "Observations on a recent trip to Europe." By Mr. C. B. Lastreto, San Francisco.

JULY 5. "The Conservation of Fish and Game in California and the Work of the Associated Sportsmen of California." By Mr. E. R. Kauffman, President-Editor, Pacific Sportsman.

AUGUST 1. "The Garden of Shakespeare's Flowers in Golden Gate Park." By Miss Alice Eastwood, Curator, Department of Botany, California Academy of Sciences, San Francisco.

SEPTEMBER 5. "The Captain Hancock Expedition to the Galapagos Islands." Illustrated with moving pictures. By Mr. Joseph R. Slevin, Curator, Department of Herpetology, California Academy of Sciences, San Francisco.

October 3. "California State Parks and Monuments." Illustrated. By Mr. Winfield Scott, Director of Public Relations, Western Division, National Lumber Manufacturers Association.

November 7. Captain Hancock's Galapagos Motion Pictures.

December 5. "Color Photography." Illustrated. By Mr. C. H. Sawyer, San Francisco.

The Sunday lectures at the Museum of the Academy in Golden Gate Park retain their popularity, and the kindness and good-will of those who contribute of their knowledge and experience on these occasions is sincerely appreciated. The following 32 Sunday lectures were delivered during the year 1928:

January 8. "A Geological Trip to the Channel Islands with Notes on Their Relations to the Mainland." Illustrated. By Mr. Leo George Hertlein, Assistant Curator, Department of Paleontology, California Academy of Sciences.

January 15. "Mountains and Valleys of Colombia." Illustrated. By Mr. Frank M. Anderson, Honorary Curator, Department of Paleontology, California Academy of Sciences.

January 22. "Early Entomologists on the Coast, and the Relation of the California Academy of Sciences to their Work." Illustrated. By Dr. E. C. Van Dyke, Associate Professor of Entomology, University of California, Berkeley.

January 29. "Organization and Purposes of the Department of Entomology, California Academy of Sciences." By Mr. E. P. Van Duzee, Curator.

February 5. "Large and Small Moths." Illustrated. By Mr. Hartford H. Keifer, Assistant Curator, Department of Entomology, California Academy of Sciences.

February 12. "Organization and Purposes of the Department of Fishes, California Academy of Sciences." By Mr. H. Walton Clark, Assistant Curator.

February 19. Special Program given by the United States National Park Service. "Cliff Dwellers and other Indian Matters Chiefly from the Standpoint of the Archæologist." By Mr. J. L. Nusbaum, Superintendent, Mesa Verde Park. Other members spoke and stereopticon slides and moving pictures were shown.

FEBRUARY 26. "Organization and Purposes of the Department of Ornithology and Mammalogy, California Academy of Sciences." By Mr. Harry S. Swarth, Curator.

MARCH 4. "The Gulls of the San Francisco Bay Region." Illustrated. By Mr. Joseph Mailliard, Curator Emeritus, Department of Ornithology and Mammalogy, California Academy of Sciences.

MARCH 11. "Arrangement and Care of the Museum Collection of Birds and Mammals, in the California Academy of Sciences." By Mrs. Mary E. McLellan Davidson, Assistant Curator.

MARCH 18. "Organization and Purposes of the Department of Herpetology, of the California Academy of Sciences." By Mr. Joseph R. Slevin, Curator.

MARCH 25. "Organization and Purposes of the Steinhart Aquarium of the California Academy of Sciences." By Mr. Alvin Seale, Superintendent.

APRIL 1. "Collecting Fishes for the Steinhart Aquarium." Illustrated. By Mr. Wallace Adams, Assistant Superintendent of the Steinhart Aquarium.

APRIL 8. "Circumnavigating Iceland." By Dr. George Haley, Professor of Biology, St. Ignatius College, San Francisco.

APRIL 15. "Organization and Purposes of the Department of Exhibits, of the California Academy of Sciences." By Mr. Frank Tose, Chief.

APRIL 22. "Organizations and Purposes of the Library, of the California Academy of Sciences." By Mr. Ignatius McGuire, Assistant Librarian.

APRIL 29. "Personal Experiences in the Philippines." By Dr. Albert W. Herre, Chief, Department of Fisheries, Bureau of Science, Manila, P. I.

MAY 6. "Songs of Some California Birds." Illustrated. By Mr. C. A. Harwell, Principal, Thousand Oaks School, Berkeley.

MAY 13. The California State Floral Society had an exhibit of flowers in the Auditorium of the Academy from May 12 to May 13, open each day from 10 to 5 o'clock.

MAY 20. "Salt." By Dr. George J. Pierce, Professor of Botany and Plant Physiology, Stanford University.

MAY 27. "Indians of the Southwest." By Mr. Harold Stein, Education Director, Boy Scouts of America, San Francisco.

October 7. "California's Native Trees, the Crowining Glory of her State Parks." By Dr. W. L. Jepson, Professor of Botany, University of California. Illustrated.

October 14. "Saving the Redwoods." Illustrated. By Mr. J. D. Grant, Chairman, Board of Directors of Save the Redwoods League.

October 21. "The State Park Survey." Illustrated. By Professor H. W. Sheperd, Department of Landscape Design, University of California.

October 28. "The California State Park System." By Colonel Charles B. Wing, Chief, Division of Parks, Illustrated.

November 4. "State Parks—A Good Investment." By Mr. William E. Colby, Chairman, California State Park Commission. Illustrated.

November 11. "Western Mountain Scenery." By Mr. Francis P. Farquhar, San Francisco. Illustrated.

November 18. "The History of the Sierra Nevada." By Mr. Francis P. Farquhar, San Francisco.

November 25. "Some Problems in Game Conservation." By Dr. H. C. Bryant, Director, Bureau of Education, California Division of Fish and Game, San Francisco. Illustrated.

December 2. "The Sea Lions of the California Coast." Illustrated. By Mr. Paul Bonnot, Assistant, California Fish and Game Commission, San Francisco.

December 9. "Age of Oaks in the Bay Region and Some Reasons why they die." Illustrated. By Dr. James J. W. McMurphy, Assistant Professor of Botany, Stanford University.

December 16. "The Eye: Its Structure and Function." Illustrated. By Dr. F. W. Weymouth, Associate Professor of Physiology, Stanford University.

List of Academy Publications in 1928

That the Academy is actively prosecuting scientific research is evidenced by its publications. The following have been issued within the year:

OCCASIONAL PAPERS, No. XV.—Studies on Marine Ostracods, Part II, External Morphology of the Genus Cythereis with Descriptions of Twenty-One New Species, by Tage Skogsberg; pp. 1-144, plates 1-6, 23 Text Figures. (Issued August 24, 1928.)

OCCASIONAL PAPERS, No. XVI.—The Amphibians of Western North America. An Account of the Species Known to Inhabit California, Alaska, British Columbia, Washington, Oregon, Idaho, Utah, Nevada, Arizona, Sonora and Lower California. By Joseph R. Slevin; pp. 1-144, plates 1-23. (Issued September 15, 1928.)

Proceedings, Fourth Series

Vol. XVI, No. 21, pp. 681-684, plates 25 and 26—Description of a New Species of Lizard from Malpelo Island, by Joseph R. Slevin. (Issued February 28, 1928.)

Vol. XVI, No. 22, pp. 685-688, plates 27 and 28—Descriptions of Two New Species of Fishes from off Cape San Lucas, Lower California, by Barton Warren Evermann and H. Walton Clark. (Issued February 28, 1928.)

Vol. XVI, No. 23, pp. 689-698—Report of the President of the Academy for the Year 1927, by C. E. Grunsky. (Issued May 22, 1928.)

Vol. XVI, No. 24, pp. 699-758—Report of the Director of the Museum for the Year 1927. By Barton Warren Evermann. (Issued May 22, 1928.)

Vol. XVI, 1927 to 1928—Index to Volume XVI, Fourth Series.

Vol. XVII, No. 1, pp. 1-29, plate 1, 11 text figures—Notes on Lower Tertiary Deposits of Colombia and their Molluscan and Foraminiferal Fauna, by F. M. Anderson. (Issued June 22, 1928.)

Vol. XVII, No. 2, pp. 31-65, 34 text figures—New Mycetophilidæ taken in California and Alaska, by M. C. Van Duzee. (Issued June 22, 1928.)

Vol. XVII, No. 3, pp. 67-87—A Key to the Species of Eucalyptus Grown in California, by Eric Walther. (Issued June 22, 1928.)

Vol. XVII, No. 4, pp. 89-139—Tertiary and Pleistocene Mollusca from the Galapagos Islands, plates 2-7, five text figures. By William Healey Dall and Washington Henry Ochsner. (Issued June 22, 1928.)

Vol. XVII, No. 5, pp. 141-185, plates 8, 9—Land Shells of the Galapagos Islands, by William Healey Dall and Washington Henry Ochsner. (Issued June 22, 1928.)

Vol. XVII, No. 6, pp. 187-203, plate 10—West American Mollusca of the Genus Phasianella, by A. M. Strong. (Issued June 29, 1928.)

Vol. XVII, No. 7, pp. 205-246, plates 11 and 12—Some Pyramidellidæ from the Gulf of California, by Fred Baker, G. Dallas Hanna and A. M. Strong. (Issued June 29, 1928.)

Vol. XVII, No. 8, pp. 247-251—Occurence of some Asiatic Birds in Alaska, by Harry S. Swarth. (Issued July 10, 1928.)

Vol. XVII, No. 9, pp. 253-265, 17 text figures—A Commensal Polynoid Worm from California, by Tage Skogsberg. (Issued July 10, 1928.)

Vol. XVII, No. 10, pp. 267-295, 26 text figures—Structure and Behavior of the Amphipod, Polycheria osborni, by Tage Skogsberg and G. H. Vansell. (Issued July 10, 1928.)

Items of Interest

The Treasurer's report presents the facts relating to the Academy's financial standing. There has, during the year, been a further reduction of the Academy's indebtedness to the Hibernia Savings and Loan Society from $215,000 to $205,000. In addition to the $10,000 payment on capital account which this involved, an investment was made, out of surplus, in 55 shares of American Trust Company stock amounting to $6,471.50. Otherwise the net income of the Academy has as heretofore been practically all expended in the care and maintenance of its property and in furthering research work and adding to its natural history material.

The Museum of the Academy and the Steinhart Aquarium have been open as usual free to the public every day in the year. Favorable location in Golden Gate Park has resulted in a sustained large attendance. There were 540,702 visitors to the Museum and 956,845 to the Aquarium.

Last year the resignation of Mr. W. W. Sargent, who had long been Secretary of the Board of Trustees, was noted. This year we note with sorrow his name among the members whom the Academy has lost by death. Death has taken, too, Mr. Leverett M. Loomis, who for many years was Curator of the Department of Ornithology, and, later, Director of the Museum, whose valuable services to the Academy in securing exemption from taxation and in securing from San Francisco the right to erect Academy buildings in Golden Gate Park will be recalled by older members. The Academy has had but few members who could claim such unflagging interest in the affairs of the Academy and in the study of birds as Mr. Loomis.

The Diamond Anniversary of the founding of the Academy was celebrated on April 4, 1928. On this occasion there was a reception at the Museum with appropriate addresses by Joseph D. Grant, Vice-President of the Board of Trustees;

Dr. Barton Warren Evermann, Director of the Museum, and the President.

At the regular meeting on the evening of the same day, Reminiscences were indulged in to which there were contributions notably by Vice-President George C. Edwards and Otto von Geldern, and by Miss Alice Eastwood, the President, and others.

It is with no little satisfaction that the fact can be recorded that the President elect of the United States, Herbert C. Hoover, has long been a member of the Academy.

About the middle of the year a munificent offer was made to the Academy by Mr. Leslie Simson of Berkeley, California, which is perhaps best explained by reproducing a statement which has been given wide circulation, but which has not as yet produced any result. This statement is as follows:

"The people of San Francisco, recognizing the high order of the scientific and educational work which is being done by the California Academy of Sciences ever since its organization in 1853, granted the Academy some years ago the right to erect its museum and research buildings in Golden Gate Park. The Academy, without expense to the City, maintains there its Natural History Museum, in a building erected at its own expense, and open every day free to the public.

"The generous bequest to the Academy by the late Ignatz Steinhart has enabled it to add the Aquarium. The City of San Francisco supplies to the Academy the funds which are necessary for the operation of the Aquarium.

"Now another public-spirited citizen comes forward offering to go to Africa to spend about four years there collecting specimens of wild animals for the Academy. He has lived in Africa and is an experienced, skillful hunter of big game. He knows what can be done. He proposes to meet all expenses of the expedition and to have the specimens prepared and shipped from time to time as they become available, and delivered, without cost to the Academy, at San Francisco.

"What he proposes to do would, if an expedition were organized for the purpose, cost the Academy more than half a million dollars. He conditions his proposal upon suitable assurance from the Academy that the material which he furnishes will be properly housed, but he couples this condition with the further offer that if the Academy will accept his proposition, he will at once place to the credit of the Academy one hundred and fifty thousand dollars as a contribution toward the cost of a suitable addition to the Academy buildings in Golden Gate Park, he to receive income from this sum, however, during his life time.

"The Academy desires to accept this proposition, but is not so circumstanced as to do so without outside help. It would make its tentative acceptance positive, if someone would now come forward with a gift or an endowment of about two hundred thousand dollars. This amount is named as a minimum. It is far short of erecting the housing facilities which are needed for the African Exhibit. It would have to be supplemented with a loan, and even then the Academy would still be far behind what is needed to keep its activities abreast of the growth of the Pacific Slope. The Academy has urgent immediate need for facilities comparable with those which people of means have been or are supplying in all the large American cities.

"New York, for example, has that great institution, the richly endowed American Museum of Natural History, an expedition from which has for some years been in Africa collecting material for habitat groups. Chicago has its Field Museum and is now adding an aquarium. The latter alone will cost about three million dollars, furnished by a public-spirited citizen. Los Angeles already has material on hand for an African Exhibit and is now erecting a building at a cost of about one and one-half million dollars to house the same.

"Some one may be waiting for this opportunity, not alone to establish a personal or family memorial in Golden Gate Park, but also to make available for the furthering of scientific activities the munificent donation of service and financial aid covered by the pending generous offer above explained. This can be done by gift or an endowment, by a trust, or otherwise.

"Further information relating to the activities and aspirations of the Academy will be gladly furnished."

The Committee which has this matter in charge and by whom this circular was issued expressed to the Trustees the conviction that every possible effort should be put forth to secure such a donation of funds or an endowment as would make the acceptance of Mr. Simson's generous offer possible.

It would be most appropriate for San Francisco to provide the necessary funds and also the funds for an addition to the Steinhart Aquarium which should be provided in the near future. But this would probably involve a bond issue and would take time. Unless some generous friend comes forward and helps out, the offer by Mr. Simson as stated in the circular may have to be declined. This would indeed be unfortunate.

The scientific and other activities of the Academy during the year will be fully reviewed in the Report of the Director of the Museum, and it need only be added that the Curators in charge of the several departments and the Superintendent of the Aquarium may well be proud of the results, achieved with the means at command.

To all who have contributed by giving of their time and knowledge and who, like Mr. Edward Hohfeld, have assisted with advice and to those who have added to the Academy's wealth of natural history and other material the Academy expresses its obligation and appreciation.

The new year is begun with confidence in continued usefulness and the hope and desire for an increasing rate of progress.

XII

REPORT OF THE DIRECTOR OF THE MUSEUM FOR THE YEAR 1928

BY

BARTON WARREN EVERMANN

Director of the Museum and of the Aquarium

The Annual Report of the Director for the year 1927 was presented to the Academy at the Annual Meeting, February 15, 1928.

The present report sets forth briefly the scientific and educational activities for the calendar year 1928.

Personnel

Only a few changes in the personnel of the Museum and the Aquarium have occurred in the year. Officer Patrick O'Brien, on account of ill health, served as day watch for only a small part of the year. Mr. O'Brien was an efficient and faithful officer who had been detailed to the Academy for many years and everyone at the Museum misses him greatly.

Mr. Ignatius McGuire, assistant librarian, left the Academy May 31, and Mr. Thomas Cowles was appointed June 13 to the vacancy. Mr. Hartford H. Keifer, assistant curator of entomology, resigned August 9 to accept a position with the State Bureau of Plant Quarantine and Pest Control, Sacramento. On November 5, Miss Amy Williamson was appointed an assistant in the Department of Entomology.

Miss Lucie Hicks, office assistant, having gone to the Hawaiian Islands September 18, resigned October 12. Miss Melba Lewis was appointed temporarily to this position September 24 and served until November 30, and was succeeded December 3, by Miss Evelyn Larsen.

Miss Marian Berney assisted in the Department of Botany during the month of July.

The employees of the Museum January 1, 1929, were as follows: Dr. Barton Warren Evermann, Director and Executive Curator of the Museum, and Editor of the Academy publications; Susie M. Peers, Secretary to the Board of Trustees; Joseph W. Hobson, Recording Secretary of the Academy; Alice Eastwood, Curator, and Kate E. Phelps, assistant, Department of Botany; Edward P. Van Duzee, Curator, Amy Williamson, assistant, Dr. Edwin C. Van Dyke, Honorary Curator, Dr. Frank E. Blaisdell, Research Associate, Walter M. Giffard, Research Associate, and Dr. Frank R. Cole, Associate Curator in Dipterology, Department of Entomology; Frank Tose, Chief, and Russell Hendrick, Clara Tose, and Cecil Tose, assistants, Department of Exhibits; Dr. Barton Warren Evermann, Curator, and H. Walton Clark, Assistant Curator, Department of Fishes; Joseph R. Slevin, Curator, Department of Herpetology; Dr. Walter Kendrick Fisher, Curator, Department of Invertebrate Zoology; Thomas Cowles, Assistant Librarian; Harry S. Swarth, Curator, Mary E. McLellan Davidson, Assistant Curator, and Joseph Mailliard, Curator Emeritus, Department of Ornithology and Mammalogy; Dr. G. Dallas Hanna, Curator, Leo George Hertlein, Assistant Curator, Frank M. Anderson, Honorary Curator, and Dr. Roy E. Dickerson, Research Associate, Department of Paleontology; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Raymond L. Smith, general assistant; Mabel E. Phillips, check-room attendant; William C. Lewis, janitor; Hugh Jones, assistant janitor; Johanna E. Wilkens, charwoman; Aris Partidos, Lecture attendant; Frederick C. Kracke, day watch; Archie McCarte, night watch.

The Aquarium staff and employees January 1, 1929, were as follows: Dr. Barton Warren Evermann, Director; Susie M. Peers, Secretary, part time; Constance W. Campbell, stenographer, part time; Evelyn Larsen, office assistant, part time; Alvin Seale, Superintendent; Wallace Adams, Assistant Superintendent; Dora Arnold, doorkeeper; Clynt S. Martin, chief engineer; B. T. Culleton, first assistant engineer; R. J. Fletcher, second assistant engineer; Clyde E. Guidry, chief attendant; Jack Solini, first assistant attendant; L. R. Solini, second assistant attendant; J. N. Angelucci, third assistant attendant; Frank J. Maxwell, relief engineer and attendant; S. J. Shenefield, carpenter and general utility man; Charles W. Hibbard, assistant collector; Patrick O'Neill, janitor; Patrick McArdle, assistant janitor; James Cavanaugh, day watch.

The following changes in the Aquarium personnel occurred in the year:

Mr. Robert J. Lanier, assistant attendant and electrician, resigned February 29, to accept the responsible position of Superintendent of the Shedd Aquarium, Chicago, and Mr. J. N. Angelucci was appointed assistant attendant.

Mr. Chester L. Duncan, assistant collector, resigned February 16, and was succeeded February 18, by Charles W. Hibbard.

Cooperation with Public and Private Schools, with Other Institutions, and with Individuals

The Museum continues its policy of being of service to the public through cooperation with schools both public and private, with other museums and institutions, and with individuals. Our public exhibits are increasing in number each year, and our research collections are receiving important additions from time to time through our own field explorations, through gift, and by purchase.

The number of specialists and others who make use of our research material increases each year. This is particularly true of the departments of Botany, Entomology, Ornithology and Mammalogy, Herpetology and Paleontology.

Study skins of birds and other animals, and specimens in other groups have been loaned from time to time to teachers in the schools of San Francisco, Berkeley, Oakland and elsewhere.

Habitat groups of birds and other animals have been loaned for circulation among the schools of Berkeley and to Castilleja School at Palo Alto.

Visitors to the Museum and the Aquarium

Visitors to the Museum in 1928 totaled 540,702. While this number is not quite as large as in 1927, it nevertheless is greater than in several previous years. It represents an average daily attendance of 1454.

Visitors to the Aquarium in 1928 totaled 956,845, which is an increase of 91,211 over that for the previous year, and represents an average daily attendance of 2621.

Visitors to the Museum

	1916	*1917*	*1918*	*1919*	*1920*	*1921*	*1922*	*1923*	*1924*	*1925*	*1926*	*1927*	*1928*
January....	.....	23,170	25,260	17,241	27,013	25,755	19,038	15,270	32,364	34,989	26,528	33,791	35,859
February...	.....	22,058	23,698	17,586	23,450	25,679	18,534	20,529	44,439	29,295	34,183	24,580	36,669
March......	.....	31,606	26,810	27,397	25,419	28,279	27,922	26,341	39,935	39,168	38,677	34,624	31,414
April.......	.....	32,175	23,274	25,994	32,208	24,939	36,057	21,911	41,332	40,257	36,746	38,452	42,965
May.......	.....	26,154	26,391	28,369	37,107	25,517	27,237	37,597	48,152	38,137	52,913	47,414	43,129
June.......	.....	32,123	29,843	32,248	36,207	29,406	27,131	39,511	58,281	51,775	53,799	51,630	51,100
July........	.....	37,193	31,420	48,028	52,492	43,186	36,263	64,530	91,329	69,921	83,707	84,282	84,406
August.....	.....	24,619	31,137	43,730	53,470	39,422	34,787	50,849	105,130	77,847	81,362	66,870	73,282
September..	16,448	27,866	29,847	34,007	42,013	31,458	28,408	69,870	82,814	63,737	57,615	56,443	54,882
October....	36,933	20,629	14,743	30,463	33,500	24,861	19,459	66,894	43,074	40,418	44,654	43,520	36,094
November..	27,718	21,810	8,531	25,246	19,347	18,593	19,080	48,766	37,611	35,634	30,420	30,581	26,685
December...	15,002	21,693	19,588	21,188	21,340	15,062	13,339	36,707	21,572	32,245	34,555	30,827	24,217
Totals for the years...	96,101	321,096	290,542	351,497	403,566	332,157	307,255	498,775	646,033	553,423	575,159	543,014	540,702

Grand total since opening of the Museum September, 1916.. 5,459,320

Visitors to the Aquarium

	1923	1924	1925	1926	1927	1928
January	......	82,283	72,153	38,259	44,300	53,454
February	......	119,001	61,213	66,032	39,515	54,105
March	......	88,172	97,986	82,153	58,151	57,083
April	......	83,245	79,021	64,830	65,337	78,735
May	......	97,083	75,187	94,521	87,961	104,230
June	......	112,785	94,717	91,451	70,151	110,206
July	......	145,703	128,261	127,999	142,738	151,881
August	......	148,899	144,208	124,635	115,230	115,915
September	29,800	116,032	106,492	86,645	87,909	92,755
October	209,671	71,273	72,350	79,108	66,117	51,521
November	145,434	67,500	59,074	49,741	44,643	50,554
December	96,757	48,376	52,929	48,423	43,582	36,406
Totals for the years	481,662	1,180,352	1,043,591	953,797	865,634	956,845

Grand total since opening of the Aquarium September, 1923...... 5,481,881

Schools Visiting the Museum in 1928

Following is a list of the schools, the grades, teachers, number of pupils, and dates of visits in 1928:

Schools of City and County of San Francisco

Date 1928		School	Grade	Number Pupils	Teacher
Jan.	12	Le Conte	3A	34	Lea Reid
"	21	Boy Scouts		45	H. Stein
"	26	Lowell High	High 2	19	L. M. Elskamp
"	26	Guadalupe	4B	41	M. Brockkage
"	27	Grattan	Nature Club	25	Edna Fahey
"	28	Noe Valley Jr. High	7th	41	H. S. McQuilkin
Feb.	9	Guadalupe	3A	34	F. Bourne
"	14	Farragut	3B	36	M. Doody
"	15	Polytechnic High	L2	18	G. Webster
"	15	Glen Park	5B	41	J. Hylton
"	20	Golden Gate	1B	30	Helen Berta
"	21	Guadalupe	2B-2A	70	C. Sturgeon and B. Clark
Mar.	2	Lincoln	1A	26	A. O'Connell
"	2	Lincoln	1B	28	C. R. Murray
"	2	Lincoln	1B	24	M. Casey
"	8	Farragut	2B	37	M. McIlvain
"	8	Le Conte	1B	22	Vera J. Lyon
"	10	Farragut	5B	20	R. Resch
"	16	Polytechnic	L2	28	A. Webster
"	17	Parkside	Nature Club	6	J. Wagener
"	19	Marshall	3	30	M. Mack
"	20	Guadalupe	8A	24	K. L. Growney
"	20	Columbus	L-H-6	50	Shapero, Blumb
"	20	Commodore Sloat	3B	38	Esther Bahls
"	29	Excelsior	3B	37	H. Roskamp

Schools of City and County of San Francisco—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
April	9	Spring Valley	Bird and Flower	22	M. L. Guis
"	2	Pacific Heights	5A	32	E. Fuller
"	10	E. R. Taylor	6B	29	H. Teping
"	11	Balboa	2A-2B	40	L. M. Bujannoff
"	11	E. R. Taylor	4B	25	E. M. Roth
"	14	Farragut	5B	11	R. Resch
"	16	Garfield	Atypical	38	D. B. Thomas
"	18	Guadalupe	4A	35	C. Papini
"	18	John Muir	3A-3B	36	Cornelia Barrett
"	19	St. Joseph's Girls	9th	7	Sister Bernard Mary
"	19	Bernal	7-8	30	S. M. Gustafson
"	20	Bryant	3B	28	H. M. Duffy
"	20	Commodore Stockton	4A	40	R. H. Peabody
"	21	Bryant	5B	32	A. Hertz
"	24	St. Paul's	1-2-3	150	Sisters
"	24	Washington	6A	37	Rose Hagen
"	28	Commodore Stockton	Ungraded	28	Florence R. McInerney
"	29	Cabrillo	Kindergarten	19	M. Springer
May	2	St. Joseph's	8th	35	J. B. Praught
"	2	Pacific Heights	5B	33	R. E. Dreyfus
"	3	Adams	1A-1B	40	Misses Hurley and Fenn
"	7	Bryant	4B	44	E. G. Leary
"	7	Hearst	1A-1B	15	C. Laird
"	9	Monroe	8A	30	C. A. Davis
"	10	Denman	Kindergarten	30	E. Nolan
"	11	Presentation High	2d	10	T. McMahon
"	14	Commodore Stockton	Ungraded	40	A. Barter
"	15	Le Conte	3A-3B	21	P. Lobingier
"	16	Poly. H. S.	H. S.	19	H. J. Wilcox
"	16	Bernal	7-8-B	20	Olive T. Powell
"	17	Polytechnic	H. S.	12	H. J. Wilcox
"	17	Commodore Stockton	6B	32	M. Behm
"	17	Polytechnic H. S.	H. S.	21	H. J. Wilcox
"	18	Notre Dame	5-6	65	Sisters of St. Joseph
"	18	Daniel Webster	5B	38	Mabel J. Ludwig
"	18	Monroe	7A	76	D. Greenwood and F. Willitt
"	22	St. Vincent de Paul	5-6	32	Sisters of Charity
"	23	San Miguel	5A-5B	25	W. Chance
"	23	San Miguel	4A-4B	26	E. Coffey
"	23	Emerson	High 6	39	Miss Cheney
"	23	St. Rose Academy	4th	29	Sister M. Virginia
"	24	Sherman	3A	25	A. Mitchell
"	24	Denman	1B	36	N. A. Neumertel
"	25	Junipero Serra	4A-4B	55	M. Ahlgren and D. Long
"	25	Sarah B. Cooper	3A-3B	25	Julia Antipa and E. Antipa
"	25	St. Rose Academy	7th	26	Sister M. Daniel
"	25	Ashbury Heights Academy	Primary	11	Eva A. Bradshaw
"	26	Glenview Jr. High	H9	20	Miss Friedrich
"	28	St. Boniface	3-4-5-6	13	Sisters
"	28	St. Rose Academy	Second	14	Miss Smith
"	31	Taylor	2B	25	J. Antilla
June	1	Garfield	B First	27	M. Soule
"	4	Hancock	1A-2B	46	Misses Cohn and Melnetsky
"	5	Daniel Webster	1A-2B	52	F. M. Muller and M. Loewi
"	5	Commodore Stockton	5A	35	Mrs. H. Jacobs

May 22, 1929

Schools of City and County of San Francisco—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
June	6	R. S. Thornton	2nd-3rd	29	M. P. Henderson
"	6	Sherman	4A	29	Annette Schraft
"	6	Hancock	First	27	A. Aldrich
"	6	Daniel Webster	Service Club	20	A. G. Prout
"	6	Excelsior	4B	33	M. O'Shaughnessy
"	6	Argonne	5B	40	J. Thurber
"	7	Miss Gardis' Kindergarten		7	Miss Gardis
"	7	Sherman	7B	40	Aileen McCarthy
"	7	McKinley	First	23	L. Nolan
"	8	Guadalupe	3B	40	G. Gluesing
"	11	Le Conte	6B	23	Zetta Pegan
"	11	Jean Parker	4B	29	D. Parker
"	12	Commodore Stockton	6B	34	L. Brovelli
"	13	Sarah B. Cooper	3A-3B	50	Misses Meachum and Pillani
"	19	Patrick Henry	5A	15	A. M. Bryant
"	21	Lona Hazzard	All	30	Principal and Playground Teachers
Aug.	22	St. Ignatius	College	37	George Haley
"	29	Raphael Weill	3A	30	E. La Berge
"	29	Raphael Weill	3A-3B	34	I. Richartz
Sept.	4	Raphael Weill	3A	31	I. O'Brien
"	4	Raphael Weill	1A	21	Dora D. Davis
"	17	Patrick Henry	5A	24	E. MacLean
"	20	Lowell High	Biology 1	52	G. Kast
"	20	Guadalupe	6B	32	Miss T. B. Cummings
"	21	Frank McCoppin	6A	33	M. M. Johnson
"	21	Excelsior	3B	34	A. M. O'Leary
"	21	St. Vincent's High	Freshman	39	Sister M. Aloysius
"	24	Oak Grove	6-7-8	23	Cleo McCullough
Oct.	4	Redding	3B	20	G. Gardner
"	4	Commodore Stockton	3A	30	Florence A. M. Sweeney
"	5	Roosevelt	2B-3A-3B	36	H. Ekoos
"	6	John Swett Jr. High	8A	6	H. E. Nicholson
"	9	Raphael Weill	5A	42	T. McCullough
"	11	Excelsior	4B	37	Ethel M. Bryant
"	18	Bryant	Ungraded	24	M. Irwin and D. Doyle
"	19	Glen Park	7B	28	E. Coller
"	19	Francis Scott Key	2B	32	C. Bain
"	19	St. Agnes	Commercial	12	Sisters of Presentation
"	23	Alamo	Kindergarten	15	D. A. Rathjen
"	25	Frederick Burk	4th	19	Misses Savia and Conway
"	25	Raphael Weill	5A	44	L. McCullough
"	25	H. S. of Commerce	10th	20	G. L. Allen
"	26	Bryant	4d	28	E. G. Leary
"	31	Patrick Henry	1B	38	M. Matthaie
"	31	Le Conte	4A-4B	27	E. I. Daly
"	31	Alamo	Kindergarten	16	D. A. Rathjen
"	31	St. Ignatius	College	23	George Haley
"	31	H. S. Commerce	10th	15	G. L. Allen
Nov.	1	Farragut	4A	34	E. McKeown
"	2	Glen Park	Ungraded	13	Gail Harrington
"	6	Columbus	6th	39	M. Elkins
"	13	Patrick Henry	3B	30	Miss Windle
"	20	Frank McCoppin	7A	36	Mrs. Freeman
"	21	Frederick Burk	3-4	17	Rose Gerson
"	22	Dudley Stone	3B	33	B. K. Newman

Schools of City and County of San Francisco—*Continued*

Date 1928	School	Grade	Number Pupils	Teacher
Nov. 27	Andrew Jackson	1A-1B	52	Mrs. Prescott and Mrs. Anderson
" 28	Frank McCoppin	4A	43	Miss L. Fleming
" 28	Bryant	3A	30	A. Kammerer
" 20	Parkside	7-8	20	E. Schmid
Dec. 7	High School of Commerce	L2	20	E. P. Cornell
" 7	Bay View	6A	38	D. Adelberg
" 11	Grant	7B	27	May A. Malloy
" 17	State Teachers College	Freshman Biology	21	Edith A. Pickard

Schools Outside of San Francisco

Jan. 20	Pittsburg	High School	12	Mildred Bennett
Mar. 2	U. C. Davis	General Zoology	19	Tracy I. Storer
" 3	San Jose	Boy Scouts Troop	22	J. Owen Maurice, S. M.
" 3	Univ. of Calif.	Zoology	26	Dr. Grinnell and W. H. Burt
" 16	Gault of Santa Cruz	6th	35	Edith E. Fikes
" 20	I. O. O. F. Home, Gilroy		20	Two Teachers
" 21	Hillsborough		34	N. M. Packwood
April 10	St. Clair, Santa Clara	8th	33	F. H. Biagini
" 13	Pittsburg Grammar	7th-8th-9th	172	E. Hill, H. Weimar, W. Youngberg
" 13	U. C. Landscape Design		7	H. W. Shepherd
" 13	Columbus, Berkeley	3-4	120	M. S. Suendermann, M. Osbourne, E. L. Fisher, E. Abernathy
" 14	Santa Rosa Jr. High	8B	8	William C. Larkin
" 21	Alexander Hamilton Jr. High	49	20	Marjorie Harris and M. F. Ashley
" 28	State Orphans Home of I. O. O. F., Gilroy		16	Mrs. E. C. Frazee
May 12	San Anselmo	5th	9	Minnie Legge
" 12	Jefferson Union, Santa Clara Co.	8th	26	Norma Hogg
" 12	Whittier, Berkeley	H6	24	M. Lobb
" 13	Berkeley Teachers	Elementary	40	Miss C. A. Paroni
" 19	Washington, Oakland		10	Jennie L. Brothers
" 24	Lincoln, Berkeley	High 5th	33	Edith Bailey
" 26	Tracy Grammar	Advanced Orchestra	34	Ernest G. Dobney
" 29	Le Conte, Berkeley	High 6th	34	R. E. Clayton
" 29	Soscol, Napa Co.	2-3-6-7	9	Daphne M. Harris
" 29	Knightsen, Contra Costa	7th	14	Miss A. M. McKinnon
" 31	Jefferson, Colma	4-5	26	Hazel A. Madonna
June 2	St. Joseph's, San Jose	8th	16	Sister Mary Aquinas
" 4	Melrose, Oakland	7-8	17	M. E. Geary
" 5	Lincoln, Alameda	5th	20	Ethel Linton
" 6	San Jose High School	10A-10B	58	Lotta L. Bland
" 6	San Jose High School	10A-10B	48	Myrtle L. Judkins
" 11	Millbrae	1-2-3-4-5-6	40	Teacher
" 16	Mayfield	30	30	E. M. Knight
" 28	University of California		45	S. F. Light
Sept. 12	Sunol	5-6-7-8	30	Bernard Johnson, G. E. Henry
Oct. 5	Corralitos	7-8	28	C. G. Bradley
" 13	Clawson, Oakland	H4th	15	Bertha Feibush
" 29	U. C. Davis, Zoology	1A	27	Dr. Tracy I. Storer

Schools Outside of San Francisco—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
Nov.	3	Sacramento Jr. College	Freshman	15	A. W. Bell
"	18	U. C. Zoology		116	Joseph Dixon
"	25	Tamalpais High	Biology	24	J. R. Mackie
"	27	Washington	Low 6th	33	Rose Hagen
Dec.	8	Highland, Oakland	6th	11	E. A. Peebles
"	13	Burbank Jr. High, Berkeley	H8	25	Myra I. Streightif

Summary

Schools of San Francisco

Total Number of Pupils	4363	4363
Total Number of Teachers	152	
Total Number of Classes	172	

Schools Outside of San Francisco

Total Number of Pupils	1509	1509
Total Number of Teachers	51	
Total Number of Classes	60	
		5872

Schools Visiting the Aquarium in 1928

Following is a list of the schools, the grades, teachers, number of pupils, and dates of visits in 1928:

Schools of City and County of San Francisco

Date 1928		School	Grade	Number Pupils	Teacher
Jan.	17	Commodore Sloat	5A	27	M. d'Erlach
"	17	Troop 20, B. & A.		23	Harold E. Jonson
"	18	Happy Hours Kindergarten		8	Miss B. Rogge
"	21	Boy Scouts		95	H. Stein
"	26	Lowell High	High 2	19	L. M. Elskamp
"	26	Guadalupe		41	McBrockhage
"	28	Noe Valley Jr. High	7th	41	Mrs. H. S. McQuilkin
Feb.	14	Farragut	3B	36	M. Doody
"	21	Guadalupe	1B-2B	70	C. Sturgeon, B. Clarke
"	21	Cub Pack Boy Scouts		20	Harold E. Jonson
"	24	Lowell High		24	Mr. Comell
"	20	State Teacher's College		24	L. Reid
Mar.	8	Le Conte	1B	22	Vera J. Lyon
"	9	Polytechnic High		9	Mr. Bonson
"	10	Farragut	5B	20	R. Resch
"	13	Poly. High School		11	H. J. Wilcox
"	13	Polytechnic		23	H. J. Wilcox
"	14	Polytechnic	H	20	H. J. Wilcox
"	15	Chinese Baptist Mission	First Year English	25	Marguerite A. Colder
"	16	Polytechnic High	L2	81	A. Webster
"	16	Polytechnic High	L2	28	A. Webster
"	19	Marshall	3	30	Mack

Schools Visiting Steinhart Aquarium in 1928—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
Mar.	20	Guadalupe	8A	24	K. L. Growney
"	29	Excelsior	3B	37	H. Roskamp
"	30	Hamilton Jr. High	H9	12	M. V. Goldsmith
"	31	Hysino	1st	76	
April	10	E. R. Taylor	6B	29	H. Teping
"	10	Pacific Heights	5A	32	E. Fuller
"	11	Balboa School	2A-2B	40	Lubov M. Bujannoff
"	13	St. Ignatius College	College Soph.	33	George Haley
"	18	Guadalupe	4A	35	Cecelia Papini
"	18	John Muir	3A-3B	36	Cornelia Barrett
"	19	Bernal	7-8	30	S. M. Gustafson...
"	20	Commodore Stockton	4A	40	R. H. Peabody
"	20	Bryant	3B	28	H. M. Duffy
"	20	Bryant	5B	32	Adele Hertz
"	24	Le Conte	1A	22	Miss M. McCauley
"	24	St. Paul's	1-4-5	150	Sisters
"	25	Sunnyside	2B	29	Miss Bernstein
"	27	Polytechnic H. S.	H2	23	E. Koehler
"	27	Com. Stockton	Ungraded	29	Florence R. M. Inerney
"	27	Cabrillo	Kindergarten	19	M. Springer
May	2	Pacific Heights	5B	33	Miss R. E. Dreyfus
"	3	Adams	1A-1B	40	Misses Hurley & Fenn
"	4	Grattan	2A-2B	26	Wilda Holland
"	7	Bryant Cos.	4B	44	E. G. Leary
"	7	Hearst	1A	16	C. Laird
"	7	Hearst	1B-2A	28	C. Foley
"	9	Monroe	8A	30	C. A. Davis
"	10	Denman	Kindergarten	30	E. Nolan
"	11	Presentation High	Second Year	10	I. McMahon
"	11	Poly. H. S.		12	E. Koehler
"	11	Poly. H. S.		23	E. Koehler
"	12	Jefferson Union	8th	26	(Miss) N. Hogg
"	14	Commodore Stockton	Ungraded	40	A. Barter
"	14	Poly. H. S.		20	E. Koehler
"	15	Kate Kennedy	1B-2H	38	M. d'Or
"	15	Le Conte	3A-3B	21	R. Lobingier
"	15	Miss Hamlin's	5-7	6	Miss Catharine Cox
"	15	Bernal	7-8	20	O. F. Powell
"	17	Commodore Stockton	6B	32	Miss M. Behm
"	18	Notre Dame des Victoires	5-6	65	Sister of St. Joseph
"	18	Daniel Webster	5B	38	Mabel J. Ludwig
"	18	Monroe	7A	76	D. Greenwood, F. Willett
"	22	St. Vincent de Paul	5-6	30	Sister of Charity
"	23	San Miguel	4A-4B	26	E. Coffey
"	23	St. Rose Academy	4th	29	Sister M. Virginia
"	23	San Miguel	5A-5B	25	W. Chauce
"	24	Argonne	4A-4B	39	E. Duncing
"	24		Ungraded	17	M. Carmichael, E. Cunningham, H. Peksen
"	24	Denman	1B	36	N. A. Neumerkel
"	24	Sherman	3A	25	Mrs. Mitchell
"	25	Sarah B. Cooper	3A-3B	25	J. Antipa
"	25	Commodore Stockton	4B-5B	74	L. Mitchell, J. Koenecke
"	25	Monroe	6B-7A	73	N. P. Hackley, M. Crane
"	25	Junipero Serra	4A-4B	55	Misses Ahlgren & Long
"	25	St. Rose Academy	7th	26	Sister M. Daniel
"	25	Francisco Jr. High	L7	11	Miss Barber
"	28	St. Boniface	3-4-5-6	46	Dominican Sisters

Schools Visiting Steinhart Aquarium in 1928—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
May	28	St. Rose Academy	2nd	14	Miss Smith
"	28	Bernal	7B	30	H. Searight
"	31	Taylor	2B	25	Mrs. J. Antilla
June	1	Taylor	6B	27	A. Simonetta
"	1	Garfield	B1	27	M. Soule
"	1	Edison	4A	65	C. Reed, R. S. Miller
"	1	Garfield	1B	30	K. V. V. Smyth
"	4	Hancock	1A-2A	46	Mrs. Cohn, Miss Melnetsky
"	5	Pixley Mem. Free Kindergarten		5	Mme. Marie Light Plise
"	5	Sherman	2A	26	R. Brouillet
"	5	Commodore Stockton	5A	35	H. Jacobs
"	5	Daniel Webster	1A-1B	52	F. M. Mullen, Miss Loewi
"	5	Jean Parker	1A-1B-5B-6A	100	N. Valsangiacomo, N. Duane, M. Guinasso, R. Crowley
"	5	Excelsior	4B	33	M. O'Shaughnessy
"	5	Sherman	4A	29	Annette Schraft
"	6	Daniel Webster	Service Club	20	Mrs. Pront
"	6	Argonne	5B	40	Josephine Thurber
"	7	Argonne	1B	30	Miss A. M. O'Connor
"	7	Argonne	1B	30	E. L. Woelffel
"	7	Argonne	1A	22	Mrs. D. LeLande
"	7	McKinley	1st	23	L. Nolan
"	7	Kindergarten		7	Miss Gardis
"	7	Sherman	7B	40	A. McCarthy
"	8	Guadalupe	3B	40	G. Gluesing
"	11	Le Conte	6B	23	Zetta Pegan
"	12	Jean Parker	4B	29	D. Parker
"	12	Monroe	5	120	Miss Davini, Miss Bray, Miss Donohue
"	12	Polytechnic	Latin Class	22	J. L. Dixon
"	13	Sarah B. Cooper	3A-3B	50	Miss Bellani, Mrs. Meachum
"	27	Ellen Stark Ford Home		24	Martha Shaw
"	13	State Teacher's College	Nature Study Class	35	Edith A. Pickard
July	18	Telegraph Hill Settlement		20	Miss Hamilton
"	19	Homewood Terrace Orphanage	All grades	35	Miss Hoffman
Aug.	1	Telegraph Hill Settlement		14	V. Hamilton
"	20	Frank McCoppin	7B	12	Helen Davis
"	29	Raphael Weill	2B	30	Jean A. Clayton
"	29	Raphael Weill	3A	30	E. La Berge
"	31	Raphael Weill	2A	31	Sara R. Meek..
"	31	Raphael Weill	2A	34	A. J. Johnson
Sept.	4	Raphael Weill	1A	21	Dora D. Davis
"	4	Raphael Weill	3A	31	Miss I. O'Brien
"	7	Raphael Weill	3B	31	M. McCosher
"	13	Raphael Weill	4A	34	B. G. Dryfoos
"	17	Patrick Henry	5A	24	E. MacLean
"	20	Guadalupe	6B	32	L. B. Cummings
"	21	Excelsior	3B	34	A. M. Oheary
"	22	Vallejo St. Vincent High	Freshmen	39	Sister Aloysius
"	28	Paul Revere	Kindergarten	48	E. Cartright
Oct.	5	Roosevelt	2B-3A-3B	36	E. Ekoos
"	6	State Teacher's College	Extension Class	25	Miss Reid
"	9	Raphael Weill	5A	42	T. McCullough
"	10	Kiddie Kastle	Kindergarten	18	Miss Rosenthal
"	11	Excelsior	4B	37	Ethel M. Bryant

SCHOOLS VISITING STEINHART AQUARIUM IN 1928—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
Oct.	—	Lincoln	1st	60	A. O'Connell
"	15	Farragut	Junior Primary	31	M. Hayes
"	18	Bryant	Ungraded	24	M. Irwin, D. Doyle
"	19	Francis Scott Key	2B	32	C. Bain
"	19	Glen Park	7B	30	E. Coller
"	24	Commodore Stockton	A3	32	Florence R. McInerney
"	25	Raphael Weill	5A	42	T. McCullough
"	25	Francisco Jr. High	H-8	19	H. Gordon
"	25	H. S. Commerce	10th	20	G. L. Allen
"	26	Bryant	4A	28	E. G. Leary
"	26	John Muir	3A	36	F. Bleuler
"	26	Columbus	3rd	20	Miss E. Dunn
"	30	Le Conte	4A-4B	26	E. I. Daly
"	30	St. Ignatius College		22	George Haley
"	31	Le Conte	3A	29	Miss Michel
"	31	Patrick Henry	1B	38	M. Matthais
"	31	H. S. Commerce	10th	15	G. L. Allen
Nov.	1	Farragut	4A	34	E. McKeown
"	1	Excelsior	2B	28	M. R. Rogers
"	2	Glen Park	Ungraded	13	Gail Harrington
"	2	Bernal	8A-8B	60	H. Searight, M. Beale
"	6	Columbus	6th	38	Mrs. Elkins
"	6	S. F. State Teacher's College		18	Lea Reid
"	6	Le Conte	1A	21	Vera L. Humphreys
"	9	Le Conte	3A	30	R. Lobingier
"	23	Frank McCoppin	6A	35	M. Johnson
"	27	Andrew Jackson	1B-1A	55	Mrs. Prescott, Mrs. Anderson
"	28	Bryant	3A	30	A. Mammerer
"	28	Frank McCoppin	4A	40	L. Fleming
Dec.	7	Parkside	7-8	25	E. Schmid
"	7	Bay View	6A	38	D. Aidelberg
"	11	Grant	7B	27	May A. Malloy
"	17	Wolf Cub Troop 19		19	Morris Zutrov, Cubmaster
"	17	State Teacher's College	Freshmen Biology	20	Edith A. Pickard
"	18	S. F. Teacher's College	Freshmen Biology	40	Edith A. Pickard
"	26	St. Joseph's	1-2-3-4	50	Sister Esther

SCHOOLS OUTSIDE OF SAN FRANCISCO

Jan.	20	High School, Pittsburg, Cal.		12	Mildred Bennett
Feb.	3	San Jose, Boy Scout Troop 22.		24	J. Aven Hansen, Scoutmaster
"	11	Stanford University, Palo Alto		10	Professor Starks
Mar.	2	Lincoln	1A-1B-2A	77	Misses A. O'Connell, Casey, Murray
"	3	University of California, Berkeley		26	Dr. Joseph Grinnell
"	16	Gault, Santa Cruz	6th	35	Edith E. Fikes
"	16	Hillsborough Dist., San Mateo Co.	6-8	34	N. M. Packwood
"	20	Columbus, Berkeley	H6-L6	50	Eva W. Blumb, Florence Shapero
April	10	St. Claire, Santa Clara	8th	30	Fr. A. Biagini
"	13	Columbus, Berkeley	3-4	120	M. S. Suenderman, E. Ahernethy, E. L. Lisher, M. Osborne

Schools Outside of San Francisco—*Continued*

Date 1928		School	Grade	Number Pupils	Teacher
April	13	Pittsburg Grammar, Pittsburg, Cal.	7-8-9	178	Elroy Hill, Helen Weimar, Willa Youngberg
"	16	Garfield Jr. High, Oakland	Special	38	Mrs. Irene C. Branson
"	21	R. H. Condie, Piedmont	Piedmont Boy Pioneers	7	2 Leaders
"	21	Alexander Hamilton Jr. High, Oakland	H9	20	Marjorie Harris
"	24	Washington, Alameda	A6	37	Rose Hagen, 6 mothers
"	28	State Home for Orphans, Gilroy		18	Mrs. E. C. Frazee
May	2	St. Joseph's, Alameda		35	Father Praught
"	5	Berkeley Teacher's School	11	36	Instructor
"	11	Burlingame High	Senior	12	R. W. Watson
"	12	San Anselmo, Marin Co.	5th	9	Minne Legge
"	12	Whittier, Berkeley	H6	24	M. Lobb
"	16	Emerson, Berkeley	Low 6	25	L. G. Rush
"	24	Lincoln, Berkeley	H5	33	Edith Bailey
"	26	Edgemont, San Bruno	5th	7	L. Lazzarini
"	26	Glennview Jr. High	H9	20	Mary Friedrich
"	26	Alviso, Newark, Alameda Co.	8th	11	Mrs. E. Madruga
"	26	Tracy Grammar	Orchestra	33	Ernest G. Dobney, 7 adults
"	29	Knightsen, Contra Costa Co.	7-8	14	Miss McKinnon
"	31	Jefferson, San Mateo Co.	4-5	26	Hazel A. Madonna
"	31	Washington, Alameda	B7-A8	56	Miss Anderson, Miss Hamilton
June	2	St. Joseph's, San Jose	8th	16	Sr. M. Aquinas, S. N. D.
"	5	Jefferson, Colma	5-6	48	M. Tobias, Miss Belli
"	6	San Jose High	10A-10B	106	Misses M. L. Judkins, L. L. Bland
"	6	R. S. Thornton School, Colma	2-3	25	M. P. Henderson
"	11	Millbrae, San Mateo	1-2-3-4-5-6	40	Miss F. Schroter, Miss Farrell
"	16	Mayfield	8th	30	E. M. Knight
"	26	Stanford University	Premedical Students	6	Professor Starks
"	28	University of California		45	Prof. S. F. Light
Aug.	1	St. Vincents Orphanage, San Rafael		150	
Sept.	12	Sunol Glen School, Sunol	5-6-7-8	30	V. Bernard, Johnson Prisi, Grace E. Henry
"	22	St. Anselm's Junior Y.L.I. No. 1		25	Mrs. Wm. G. Tahy, Director
Oct.	5	Corralitas Union, Santa Cruz Co.	7-8	28	Elma G. Bradley
"	17	Miss Ransom's School, Piedmont	V	13	Mrs. Regula Bernays
"	24	St. Mary's High School, Berkeley	2d Year	25	Brother Michael
"	27	Emerson	5-6	9	A. Hoag
Nov.	3	Sacramento Junior College, Sacramento	Freshmen	15	A. W. Bell
"	9	University High School, Oakland	10th-Biology	100	Mrs. Ermyn Lucas, Mrs. Jean M. Nelson
"	17	Stanford University	Medical Students	16	Professor Starks
"	20	Burbank Junior High, Berkeley	Ungraded	11	L. M. Robinson
"	27	Washington, Alameda	A-6	30	Rose Hagen, 3 mothers

Schools Outside of San Francisco—*Continued*

Date 1928	School	Grade	Number Pupils	Teacher
Nov. 30	Burbank Junior High, Berkeley	H8	22	Mrs. Carrie L. Smith
Dec. 1	Solomi Lodge, Los Angeles	4 to 7	11	James
" 8	Highland, Oakland	6th	11	E. A. Peebles
" 13	Burbank Jr. High, Berkeley	H8	31	Myra I. Steightif
" 22	Ferndale Union High, Ferndale		16	Ernest G. Dobney

Summary

Schools of San Francisco:

Number of Visiting Pupils	6087	
Number of Visiting Teachers	188	
Number of Visiting Classes	208	

Schools Outside of San Francisco:

Number of Visiting Pupils	1916	
Number of Visiting Teachers	70	
Number of Visiting Classes	81	
Total, Pupils		8003
Total, Teachers		258
Total, Classes		289

Department Report

Department of Botany

The herbarium now numbers 161,200 mounted specimens, an increase of 10,000 during the year. There are, besides, many duplicates, and the entire collection from the Revillegigedo Islands which is still in the possession of the collector, H. N. Mason, whose report is not yet ready. The rest of the collection from the 1925 expedition of the California Academy of Sciences has been determined by the curator and the results will soon be published. The specimens are in the herbarium and the duplicates distributed.

Several collecting trips were taken by the curator. The first was to Del Norte County, March 20-30, especially to study Arctostaphylos in flower and to do general collecting. Thirty-five species were collected with many duplicates. On May 15-19, San Luis Obispo County was explored through the kindness of Mr. Louis and Miss Gertrude Sinsheimer who took me around in their automobile. Seventy-eight species were collected with duplicates and among them several that seem to be undescribed. June 5-15 was spent on a trip to the mountains east of Round Valley, Mendocino County. This was on horseback and to the little explored mountain summits. Two hundred and nine species were collected. A small collection of 37 species was made at Claremont while attending the annual meeting of the Pacific Division of the A. A. A. S. at Pomona College.

The most important trip was in October and November through parts of New Mexico and Arizona by automobile as the guest of Mrs. Charles W.

McKelvey of Boston, Mass., who collected for the Arnold Arboretum of Harvard University. We met at Lamy on the Atchison, Topeka and Santa Fé R. R., and from there went to Santa Fé. This was our center for five days. We then drove to Albuquerque via the Sandia Mountains, and the following day went to the summit, an altitude of 10,400 feet. We then went on to Gallup and spent a day in the Zuñi Mountains. Three hundred and one specimens were collected in New Mexico, several topotypes among them. In Arizona we collected at the Painted Desert, the Meteor Mine, the Petrified Forest, Padre Cañon, and San Francisco Mountain to 11,000 feet elevation. We spent twelve days at the Roosevelt Dam, every day taking a trip to a different locality. Five days were given to the country around Prescott and on the road to Phoenix where we parted November 10. One thousand, one hundred and ten numbers were recorded from Arizona. The collection has all been determined and labelled but is not yet incorporated in the herbarium.

Duplicates have been sent in exchange to the following institutions: 37 to the National Herbarium, Washington, D. C.; 177 to the New York Botanical Garden, Bronx Park, New York; 15 to the Royal Herbarium, Kew, Surrey, England; 26 to the Gray Herbarium, Cambridge, Mass.; 445 to the Field Museum of Natural History, Chicago, Ill.

Specimens have been received in exchange from the following; 95 from the Arnold Arboretum, Jamaica Plain, Mass.; 1075 (625 of which were mounted) from the Gray Herbarium, Cambridge, Mass. This included specimens from the following: Wright, Cuba; Pringle, Mexico; Hayes, Panama; Moore, Venezuela and Bermuda; Berlandier, Texas; Bolander, California, and Palmer, California. Forty genera and 589 species were added to our collection; 345 from Dean E. D. Merrill, University of California, a collection from Southern China made by Major and Mrs. Clemens; 39 from Royal Herbarium, Kew, Surrey, England. This is part of the Schultz collection in South Africa and added eight genera and 35 species; 1453 from Pomona College, Claremont, Calif. This consists chiefly of duplicates from the Jones Herbarium and added two genera and 94 species; 706 from Field Museum of Natural History, Chicago, Ill. This is a duplicate set of the Dr. Gaumer collection in Yucatan and is mounted, but not yet incorporated in the herbarium.

By purchase the following collections have been received: 400 Washington specimens from Wm. Suksdorf, in Bingen, Wash. One new genus and 96 species were added, several being duplicates of his types; 1651 Argentine specimens from S. Venturi, Tecuman, Argentina. These are not yet incorporated in the herbarium and some are undetermined; 1382 Mexican, chiefly from Sinaloa, collected by Mrs. Ynes Mexia, of which 38 genera and 507 species were additions; 25 mosses from A. J. Grout; 46 southern Oregon species from Professor L. F. Henderson, State University, Eugene, Ore.; 100 Hawaiian specimens from Otto Degener, College of Hawaii, Honolulu, of which five genera and 45 species were additions; 709 Chinese plants from E. D. Merrill collected in Fukien Province, China, by Major and Mrs. Clemens, not yet incorporated in the herbarium.

Gifts have been received from the following: Mrs. E. C. Sutliffe, 700 Lake St., San Francisco, 20 specimens of Hepaticæ from Yosemite National Park and 15 received in exchange from the Sullivant Moss Society; E. C. Johnston, Petaluma, Calif., a very complete collection of the plants from the Pribilof Islands with photographs and plates; Dr. F. E. Blaisdell, his mother's valuable collection of ferns consisting of 200 specimens; J. C. Otis, 4320 First Ave., N. E., Seattle, Wash., a collection of 48 grasses and sedges from Washington, beautifully preserved and named by well-known authorities; from Wm. Vortriede, State Gardener, Sacramento, Calif., 136 specimens from near Sacramento and the Lake Tahoe region; 176 from Sequoia National Park, collected and donated by Mrs. Charles Derby, 488 Route C, San Jose; 241, chiefly exotics, from Golden Gate Park and California gardens from Eric Walther, Golden Gate Park, of which three genera and 54 species were additions.

Twenty-eight fine photographs of rare and beautiful trees on the estate of the late Senator Bard, Berylwood, Hueneme, Ventura Co., donated by Miss Florence Bolton. Lewis Allen, Golden Gate Park, contributed nine exotics from his garden, all new to our collection. Cecil Hart, Montebello, Calif., 13 from southern California for identification. Chester Dudley, Modesto, Calif., 13 Californian species, one a weed not before reported from California; Mildred E. Harter, Lindsay, Calif., 28 from Tulare Co.; H. H. Kiefer, Sacramento, Calif., 11 from Marysville Buttes; Albert B. Reagan, Queets River Day School, Queets, Wash., 10 from Arizona; Mrs. A. F. Rodda, 2616 Sacramento St., San Francisco, 12 from Death Valley; L. S. Smith, Forest Service, Tahoe District, 26 from Tahoe region.

Dr. George Haley, on his trip to Maine during the summer, collected 44 species and many duplicates on Mt. Washington. They are not yet labelled.

Mrs. E. C. Van Dyke made a most interesting collection in southern California, adding 288 specimens and several new to our herbarium. The Academy allowed these two each a small sum to help defray expenses.

The curator continues to give popular lectures to clubs and schools, carries on the California Botanical Club with a meeting or excursion almost every week, also the bimonthly class of gardeners in the evening at the herbarium. A great many specimens are sent for identification from all parts of the State, especially the exotics that are constantly being introduced into the gardens of California.

The exhibition of native plants and the exotics growing out-of-doors is kept up throughout the year by my assistant, Mrs. George H. Phelps. This is one of the most popular features of the Museum and during the year several hundred species are exhibited, labelled with scientific name and the common name if there is one, also the locality from which native species come and the country in the case of the exotic. Besides efficiently looking after this flower show, my assistant mounts all the specimens, distributes them into the herbarium, looks after drying the specimens coming in and in every possible way relieves the curator of much detail herbarium work.

ALICE EASTWOOD, *Curator.*

DEPARTMENT OF ENTOMOLOGY

The year 1928, in the Department of Entomology, saw about the usual number of additions, and the work of assimilation of the accumulated material proceeded about as in the previous year. The accessions to the department number 39,624 specimens, over 16,000 of which comprise the C. L. Fox collection of Hymenoptera, which was received by bequest. Other large items include 6399 specimens from the Chiricahua Mountains, Arizona, purchased from J. A. Kusche; 1930 from Kern County, California, and 1262 from Austin, Texas, presented by Mr. J. O. Martin; 2957 from China purchased from Mrs. Dora E. Wright; 2094 from southern California presented by Dr. E. C. Van Dyke, and 3779 taken by H. H. Keifer during field work about Oroville, California. These have all been mounted and incorporated into the general collection. In addition to these Dr. Van Dyke added several thousand specimens to his collection of Coleoptera, now a part of the Academy collection, and has obtained from his correspondents a number of valuable paratypes for the Academy collection. A few smaller donations to the Department collection call for particular mention on account of their special value: Dr. Wm. Barnes, of Decatur, Illinois, gave us 269 determined moths to fill in vacancies in the Academy series; Mr. Henry Bird of Rye, New York, 22 Papaipemas, about doubling our series in this genus of prettily marked moths, the larvæ of which live as borers in the stems of various species of the larger herbaceous plants; Mr. W. T. Davis of New Brighton, New York, gave us paratypes of four rare western cicadas; Dr. Wm. M. Wheeler of Harvard University gave us 267 ants, representing practically all the varieties known to inhabit the west coast of the United States; Dr. Carl J. Drake gave us 64 determined aquatic Hemiptera, mostly new to our collection; and Mr. S. N. Allman 207 determined insects from Australia, a region but poorly represented in our collection. Other valuable donations to the department were received from friends of the Academy. Mr. Louis S. Slevin gave us 1066 insects, mostly moths, taken at Carmel, California, and including some rare species; Dr. H. E. Nast contributed 1538 insects, mostly moths from Idaho, a most welcome addition to our Lepidoptera collection; Mr. Gorton Linsley, 321 insects of which 200 were European Coleoptera largely new to our collection. Other donations were received from Dr. H. A. Scullen, A. C. Davis; M. C. Van Duzee, and others.

Field work in this department was restricted to the three months of part-time work by Mr. H. H. Keifer about Oroville, California, and two days' work by the Curator at Yorkville, Mendocino County, as the guest of Mr. E. R. Leach.

The death of Mr. C. L. Fox, which occurred in London, England, on March 16, 1928, was a sad loss to the Department of Entomology. For many years he was an active member of the Academy and a most generous contributor to this department. By his will he left his entire collection of Hymenoptera, as already mentioned, to this department of the Academy. Mr. Fox was a tireless and unusually efficient collector and had accumulated these Hymenoptera during the preceding four or five years. He had just begun working up his material and had studied the Bembecids and the genus Pepsis and had commenced work on the genus Nomada, when failing health compelled his return to England where he could be with his relatives. His labors will result in a large addition to the value of the Academy collection of Hymenoptera.

The months of August and September were spent by the curator in the East. He represented the Academy at the Fourth International Entomological Congress at Ithaca, and after the meeting visited many of the larger public and private collections of insects in the East, including those at the Museum of Comparative Zoology at Cambridge, the American Museum of Natural History at New York; the Philadelphia Academy of Natural Sciences, the National

Museum at Washington, the Carnegie Museum at Pittsburgh, the Field Museum at Chicago, the Illinois Natural History Survey Museum of Urbana, the collections at Cornell University at Ithaca, and the Iowa State College at Ames. Among the private collections inspected were those of Dr. Wm. Barnes at Decatur, Illinois, the largest collection of North American Lepidoptera in the world; Mr. H. C. Fall's collection of Coleoptera at Tyngsboro, Mass.; Dr. Wm. M. Wheeler's great collection of ants at Boston, the large Hemiptera collection of Mr. H. G. Barber at Roselle, New Jersey; of J. R. de la Torre Bueno at White Plains, New York and of Dr. H. H. Knight and Dr. Carl J. Drake, at Ames, Iowa. Your curator has returned with the conviction that while some of these eastern collections of insects are larger than that at the California Academy of Sciences, there is none that can surpass it, if indeed, equal it, in its two strongest groups, the west American Coleoptera and the Hemiptera. All of the larger collections mentioned are much ahead of the Academy in equipment, especially in the matter of cases, and many had larger staffs of workers. Apparently, with the more liberal appropriations came a greater diversion of effort into more popular channels, while the smaller funds available at the Academy have been more largely reserved for strictly systematic work.

Mr. H. H. Keifer, who had been with this department of the Academy for about three years, left in August to take a position with the State Department of Agriculture at Sacramento, and Miss Amy Williamson took his place in November. Mr. J. O. Martin worked throughout the year, on part-time, arranging the Academy collection of Coleoptera, with expert advice and help from Dr. E. C. Van Dyke and Dr. F. E. Blaisdell. Thus far, of the beetles over 91,000 specimens from the Van Dyke collection and 15,000 from the Blaisdell collection, with many from the L. S. Slevin and J. O. Martin collections, have been incorporated with the Academy material into the general collection. The curator has spent some time during 1928 arranging the Hemiptera, and thus far has incorporated over 19,000 specimens from his private collection into that of the Academy. In the spring Dr. W. S. Blatchley spent about a month classifying the Academy collection of Orthoptera, but the want of cases made it impossible to proceed with the arrangement of these or the dragonflies or moths, as well as the Hymenoptera and Diptera. Unless more cases are provided soon the work on the Coleoptera and Hemiptera also will be held up. The Department of Entomology is faced with the very serious problem of securing cases for the rich and invaluable collections that have been presented to it by our local specialists. It will hardly do to break faith with those who have given us their valuable private collections with the understanding that they shall be properly arranged and cared for.

E. P. Van Duzee, *Curator.*

Department of Exhibits

The Department of Exhibits reports as follows for the year 1928:

The preparation of the collection of salted bird skins from Nunivak Island, commenced last year for the Department of Ornithology, has been completed.

The land and sea iguanas secured on the Hancock Expedition to the Galapagos Islands, and brought back in cold storage, have been skinned and preserved.

Several of the iguanas have been mounted, and most of the accessory material for making habitat groups has been modeled.

Three large whale skulls have been prepared and hung in the whale court.

The collection of birds of Golden Gate Park has been overhauled, some new specimens mounted, and cases have been remodeled to some extent to better adapt them to the requirements of this exhibit. It is hoped to have the collection completed within the coming year.

A collection of birds of California, which are candidates in the competition for a State Bird has been assembled and placed on exhibition in the Bird Hall.

The work of overhauling the entire series of habitat groups has been commenced, and five of the six large groups in the Bird Hall have been completed. In addition, the panel groups adjacent to them have been inspected and placed in excellent condition. This has entailed a considerable amount of work, but the improved appearance of the groups and the knowledge gained in regard to the action of time, light, etc., has made the effort worth while.

In addition to this work a number of wax models of various species of fungi have been made. Most of these are by Miss Clara Tose who has rendered valuable assistance throughout the year.

Mr. Russell Hendrick acted as assistant in exhibits until July, when he left the Academy to attend college. Part time assistance has been given by Cecil Tose after school hours.

From April 30 to June 5, in conjunction with Mr. Joseph Mailliard and with Mr. Russell Hendrick as assistant, an expedition was undertaken to Creston, Kootenay Valley, British Columbia. Valuable additions to the collections of Ornithology and Mammalogy were secured.

Frank Tose, *Chief.*

Department of Fishes

Work upon the Check-List of Fishes of North and Middle America by Jordan, Evermann, and Clark, upon which the authors have been engaged for several years occupied a good deal of time during the year. This consisted chiefly of such routine as numbering of orders, genera and species, verifying references, punctuation, etc.

The study of the collection of Revillagigedo Fishes was practically completed. The species have now been identified, their names entered in the book catalogue and a card catalogue prepared and arranged in alphabetic order, the cards giving information as to where each specimen is to be found in the general collection. A preliminary report was written and is now being elaborated. There are still a few perplexing questions to be solved.

Work with the general collection of fishes continues. The general collection is composed of special collections received from time to time, such as the Chinese fishes reported on by Evermann and Shaw, and the Hawaiian collection of Jordan and Evermann and reported on by them. These were easily disposed of; but there was in addition much miscellaneous material most of which has been arranged in categories for further attention, some of the categories being as follows:

1. Tagged, identified, book-catalogued. A card catalogue was made of these, giving their position on the shelves. As many as will fit into the glass-stoppered

bottles at hand are being transferred. An attempt is being made to find all tagged specimens and treat them similarly.

2. With labels giving identification, locality and date; these to be tagged, entered in book and card catalogued.

3. With only locality and date labels; work on these to be finished.

4. Still others with even fewer data, such as only the field tags. Attempts to be made to unravel these.

The type specimens have been card-catalogued, and all but the photographs have been assembled in one room in the center of the basement of the aquarium. The photographs are stored in a metal filing case in the Director's office.

As time permits, abstracts are being edited or prepared of articles published dealing with the general subject of fishes. As a by-product of this work, a card catalogue of all new genera of fishes published from time to time is being added to the catalogue of genera at hand. It is thus made possible to keep track of current investigations and their results.

Fish breeding with attempts to procure pure pedigreed stock is being continued. The work was first begun for the purpose of obtaining unusually attractive exhibit or aquarium fishes and much toward this end has been achieved. In the meantime, many interesting problems and lines of research have suggested themselves which it would require a special report to deal with adequately.

Howard Walton Clark, *Assistant Curator.*

Department of Herpetology

It became necessary to omit the usual field activities of the department during 1928 owing to the work connected with the publication of the Amphibians of Western North America; nevertheless, owing to the generosity of various friends of the Academy the department is able to report very creditable additions to its collections, 1388 specimens having been added during the year.

Gifts of specimens have been received as follows: From F. X. Williams, 1; Miss L. S. Foster, 1; Charles E. Burt, 59; Frank Arundel, 2; Louis S. Slevin, 6; Albert Benstein, 1; L. H. Hodson, 1; Leslie Thompson, 2; Albert E. Colburn, 2; Dr. G. Dallas Hanna, 7; Steinhart Aquarium, 131; Paul D. R. Ruthling, 40; J. R. Chambers, 22; H. Walton Clark, 2; H. Trost, 1; Mrs. Domingo Ghirardelli, 1; E. R. Leach, 1; Frank Tose, 4; T. H. Shaw, 2; Dr. E. C. Van Dyke, 6; L. M. Klauber, 3; D. R. Bull, 2; Russell Hendrick, 1; Walter Bittel, 1; and John K. Strecker, 526.

Specimens have been secured from 23 states as follows: Alabama, 10; Arizona, 1; Arkansas, 48; California, 190; Florida, 7; Georgia, 4; Illinois, 6; Indiana, 1; Kansas, 18; Kentucky, 2; Louisiana, 393; Michigan, 43; Mississippi, 5; Missouri, 43; Nebraska, 4; New Jersey, 3; New Mexico, 3; New York, 12; North Carolina, 62; Ohio, 3; Pennsylvania, 1; Texas, 282; and Utah, 1.

Specimens have been received from other localities as follows: Africa, 4; Argentine Republic, 2; Australia, 17; Brazil, 3; Canada, 3; China, 118; Cocos Island, 1; Cuba 1; Las Tres Marietas Islands, 17; Malpelo Island, 37; and Mexico, 44.

Especial thanks are given Mr. John K. Strecker for his very generous donation of 526 specimens, and to Captain G. Allan Hancock for 43 excellent photographs of reptile studies, etc., taken by Mr. George E. Stone, photographer of the Hancock Expedition to the Galapagos Islands, in which the department participated.

The opportunity to secure the part-time services of Miss Lucie Hicks for cataloguing and arranging the department library was taken advantage of, with the result that 1382 separates have been bound, numbered, and card-catalogued.

The completion of the installation of the amphibian collection occupied considerable time. 5727 specimens have been checked, card-catalogued, and put into clean bottles and alcohol. In addition to this, 967 lizards and snakes have been labeled, card-catalogued, and permanently installed in the collection.

JOSEPH R. SLEVIN, *Curator*.

DEPARTMENT OF LIBRARY

Due to the unexpected change in administration of the Library in June, the incoming Assistant Librarian was for a time at somewhat of a disadvantage with regard to the general routine in force. Mrs. Davidson, as well as Mr. Van Duzee, was very helpful in acquainting him with the main procedure. The statistical record was not discovered for some time and when found was so obscure that there is no exact report on accessions available. No doubt there was a normal growth of the Library in subscriptions and exchanges; and if a considerable amount of the regular appropriation had not been called upon for transfer to the publications deficit, the purchases of separate titles would also have been quite usual. Exact statistics for the coming year are to be kept for all classes of accessions.

New exchanges during 1928 numbered 25, somewhat fewer than last year; it is planned in 1929 to expand the exchange list systematically as soon as sufficient information concerning institutions and their publications can be obtained. Plans are also under way to check the Library's serial holdings completely, to fill up gaps in incomplete sets as far as possible by exchange, and to compile a want-list of the rest, to be obtained possibly from other libraries in exchange for our duplicates. It is hoped to publish this list of serial holdings, if not as part of the union-list of serials to be issued in the near future by the Special Libraries Association of San Francisco for the holdings in all the special libraries of the city and of the Public Library, then as some sort of supplement to it.

In checking the serial holdings the shelves of the Library will be thoroughly revised. This has not been practicable heretofore on account of their badly crowded condition, which is to be remedied by the installation of temporary wooden shelving. When duplicates and unaccessioned material shall have once been segregated, it will be possible to take a thorough inventory of the Library's collections, a procedure that apparently has not been done since removal to its present quarters.

Relief from excessive crowding in the collection and the comparatively easy accessibility of it will render the completion of the catalogue more or less a matter of routine, to be undertaken in conjunction with the check of the serials. Library of Congress cards will be bought for new accessions so as to make the catalogue as nearly uniform as possible. This project will involve checking and cataloguing the Department collections as well; none of these has been touched during the year, except that of the Department of Herpetology on which Miss Hicks continued her work of listing separates.

An order file on cards has been instituted and regular forms for entering current serials have been adopted so that an accurate record of current business is immediately available. The work with the Academy's publications has been taken over entirely by Mr. Smith, who had previously assisted in the distributions. Records of distribution and inventories of each separate number published have been started on cards, so that the stock of publications on hand may be easily ascertained.

Miss Arnold has continued to assist part-time in the Library, in putting each day's accessions on the shelf, writing analytic cards for important serials, and in handling secretarial work. Her knowledge of Slavic languages is invaluable. The binding done during the year was meager, partly due to the restriction of funds. Binding is one of the pressing needs of the Library; for lack of it several sets are deteriorating rapidly, and separate numbers, particularly if slight, are especially liable to loss when unbound.

Another pressing need is clerical assistance to take care of general routine duties so that work on bibliographies, systematic examination of booksellers' catalogues, and other constructive projects may be undertaken at no sacrifice of daily routine. An instance of such a project is the check-list of all the Academy's publications which has been started but which can be worked at only fitfully because of the urgency and amount of the routine.

This report is perhaps one more of promise than of performance. If so, it is due to the fact that as far as time permitted the incumbent's attention during his six months in the Library was directed toward a general survey of the state of the Library and to a consideration of its needs for the functions it should fulfill. These needs seem to him to be, primarily, the requirements of the research staff of the Academy; secondarily, those of the membership; finally, those of the community at large for an up-to-date, efficient, and comprehensive scientific library.

Thomas Cowles, *Assistant Librarian.*

Department of Ornithology and Mammalogy

Accumulated curatorial work and the desirability of pursuing studies upon material in the collection, made it desirable for Curator and Assistant Curator to spend most of the year upon these duties. The Curator has considered it as among his foremost responsibilities to push to completion a report upon the land birds collected upon the Galapagos Islands by the Academy expedition of 1905-1906, and other things have been subordinated to that end. The study is at this time perhaps one-half completed. A report upon the Arizona collections of 1927 has been finished and the paper turned in for publication.[1] Mrs. M. E. Davidson, Assistant Curator, has devoted most of her time to current curatorial duties, of which the cataloguing of specimens and the re-arrangement of parts of the collections have been the most time-consuming. She has also been engaged in a study of a collection of birds from Torres Strait Island and Guadal-

[1]This report has been completed and published. See Proc. Calif. Acad. Sci., ser. 4, vol. 18, no. 12, pp. 267-383, plates 27-32, 7 text figures, April 26, 1929.

canar, of the Solomon Group;[2] and in studies of the Guadalupe Petrel, Northern Elephant Seal,[3] and Beaked Whale. Some time, too, has been spent upon various details concerned in the completion of Leverett M. Loomis's "Monograph of the Tubinares." This important study was left perhaps nine-tenths finished at Mr. Loomis's death, and Mrs. Davidson, as the one person who was familiar with his work and with what he had in mind, has undertaken to put the manuscript in shape for the printer. It is of importance to the science of ornithology that this monograph be published.

Mr. Joseph Mailliard, Curator Emeritus, made one field trip, as noted beyond, but otherwise his time has been devoted in great part to the banding of birds, locally. In the vicinity of the Museum he has banded birds assiduously, mostly Nuttall Sparrows, and with interesting results. Recently he has built a bungalow in Marin County, to be used as another base for this work.

The only field work during the year was carried on by Mr. Joseph Mailliard. Together with Mr. Frank Tose and Mr. Russell Hendrick, he spent the time from April 30 to June 5 in the vicinity of Creston, British Columbia, collecting birds and mammals.

Mr. Mailliard and the Curator attended the American Ornithologists' Union Meeting at Charleston, South Carolina, November 19-23. At that meeting the Curator read a paper entitled "A New Bird Family (Geospizidæ) from the Galapagos Islands,"[4] and he also presented the reel of moving pictures obtained by Mr. Joseph Slevin upon the Galapagos Islands, showing the activities of the Flightless Cormorant and the Penguin.

Mrs. Davidson's work on Mr. Loomis's *Monograph of the Tubinares* necessitated examination of material not in the Academy's collection. In the furtherance of this and other objects, she devoted the month of July to an eastern trip, during which ten days were spent at the American Museum of Natural History, New York, twelve at the United States National Museum, and one day at the Museum of the University of Kansas.

During 1928 there were added to the collection: Birds, 985 study specimens and 89 plumage ornaments; birds' eggs, 17 sets; mammals, 152. The British Columbia trip of Mr. Mailliard and his associates was the most important single accession. Another large addition to the collection was made by exchange with Mr. Griffing Bancroft, of San Diego, whereby the Academy obtained a representative lot of Lower California birds, mostly new to our collection, in return for duplicate eggs that had been held for such exchange purpose.

Details of the several accessions are as follows: Birds. *Gift:* David Barry, Jr., 2; Charles Boatright, 6; F. E. Booth, 2; Daniel B. Bull, 31; Bureau of Biological Survey, 89 (plumage ornaments); R. Cabot, 1; California Fish and Game, 3; Sam Davidson, 2; E. W. Gifford, 7; W. W. Green, 1; H. H. Hunt, 1; C. E. Kruger, 1; John McLaren, 2; Memorial Museum, 1; Harry Meyer, 1; James Moffitt, 1; A. C. Montgomery, 4; T. Mori, 3; J. V. Patton, 8; Warren Phillips, 1; A. W. Robison, 9; Raymond Smith, 1; J. W. Steinbeck, 4; Steinhart Aquarium, 3; Sullivan's Pet Shop, 2. *Expedition:* Russell Hendrick, 6; Joseph

[2]This study has been completed and published. See Proc. Calif. Acad. Sci., ser. 4, vol. 18, no. 10, pp. 245-260, April 5, 1929.

[3]This study also has been completed and published. See Proc. Calif. Acad. Sci., ser. 4, vol. 18, no. 9, pp. 229-243, pls. 25, 26, April 5, 1929.

[4]Since published in Proc. Calif. Acad. Sci., ser. 4, vol. 18, no. 2, pp. 29-43, 6 text figs., January 29, 1929.

Mailliard, 392; H. S. Swarth, 14; Frank Tose, 18. *Purchase:* J. A. Kusche, 33; D. M. Gorsuch, 74. *Exchange:* Griffing Bancroft, 272.

Eggs. *Expedition:* Joseph Mailliard, 2 sets; Frank Tose, 15.

Mammals. *Gift:* George E. Bailey, 8; H. Walton Clark, 1; Adolph Holm, 4; Mrs. E. F. Maggio, 1; J. M. Oberman, 1; A. W. Robison, 2; James J. Silvey, 1; Steinhart Aquarium, 4; E. C. Van Dyke, 1. *Expedition:* Russell Hendrick, 1; Joseph Mailliard, 109. *Purchase:* Sam Davidson, 3; J. A. Kusche, 11; H. E. Wilder, 1. *Exchange:* L. M. Huey, 4.

During the past year five new metal storage cases were purchased, enabling a rearrangement of parts of the collection. In particular, a different method of arranging small mammals and their skulls has been inaugurated, entailing tedious labor that has fallen to Mrs. Davidson and which is now nearly accomplished. With the additional cases acquired in the last two years we have been fairly well able to care for incoming specimens, though the collections are by no means satisfactorily arranged. Now, however, with every foot of floor space occupied, we are practically at a standstill, and under present conditions it can not be expected that the collections make any notable growth. This applies to the rooms wherein are placed the cases containing small and medium sized mammals and all the birds, and also, most emphatically, to the store room housing the large mammal skins. This room is crowded to such an extent as to discourage efforts to secure more large mammals. There is literally no more space wherein to store them. Furthermore, this room is not properly placed and protected, and dampness enters to a harmful degree.

The outstanding needs of the department are: (1) Floor space, for storage cases and also for tables or benches to be used in cataloguing, studying and otherwise handling specimens. (2) A new metal-lined storage room for large mammals. (3) An additional assistant, the greater part of whose time could be devoted to field work. These are all essential to the further growth of the department.

HARRY S. SWARTH, *Curator.*

DEPARTMENT OF PALEONTOLOGY

Investigations were carried on in the department almost continuously during 1928 by Mr. F. M. Anderson, Honorary Curator, Mr. L. G. Hertlein, Assistant Curator, and the Curator. This has resulted in very substantial progress being made in the systematic arrangement of parts of the collection and the identification of much hitherto undetermined material. Other portions also of the collection have been studied by outside students among whom should be recorded: Dr. Remington Kellogg; Dr. Alexander Wetmore; Mr. J. W. Gidley; Dr. David Starr Jordan; Mr. U. S. Grant IV; Dr. Fred Baker; Mr. A. M. Strong; Dr. H. A. Pilsbry; Dr. Junius Henderson; Dr. S. Stillman Berry; Dr. Joseph A. Cushman; Mr. C. C. Church; and Mr. W. M. Grant.

The work on the vertebrates and diatoms of the famous deposit at Shark Tooth Hill, Kern County, California, has been practically completed. The identification of the various large collections of west Mexican marine mollusks has progressed through several families, chiefly through the efforts of Messrs. Baker and Strong. The marine Pliocene of San Diego, California, has received much attention from Messrs. L. G. Hertlein and U. S. Grant IV. The completion of reports on the Tertiary of northern South America by Mr. F. M. Anderson marks the termination of a task begun in 1914. He is continuing with various collections of Cretaceous fossils.

Many important collections of fossils have been made during the year by the staff of the department, and a few others have been purchased. Messrs. Anderson, Hertlein and the writer collected extensively in the Cretaceous in northern California and southern Oregon and in the vicinity of Coalinga. The Tertiary and Quaternary in San Diego, Los Angeles, Monterey, Kern and Fresno counties furnished some valuable material, usually especially selected to fill gaps in the collection on hand. The Associated Oil Company continued to contribute large suites of samples of fossil-bearing sediments secured during the work of exploration for oil. In this manner the Academy has come into the possession of a collection unrivalled in any institution elsewhere in the world.

Mr. Charles H. Sternberg, the veteran fossil hunter, made a trip to central Lower California during the year, and a portion of the collection of Cretaceous mollusks brought back by him was purchased by the Academy; this included some very fine examples of ammonites.

Through donation the Academy received a collection of living mollusks, mostly west American, from Mrs. O. N. Sanford, of San Francisco. This had been assembled by her husband many years ago and contains numerous sets of shells of historic interest.

The heirs of the late D. D. Baldwin, a resident of the island of Maui, Hawaii, presented the Academy with the residue of his famous collection of shells. This so-called "residue" is really of vast proportions; it was received in nine large packing cases which await the receipt of our standard storage cases, before being unpacked. It seems that Mr. Baldwin spent a lifetime gathering this collection and the data recorded with the specimens conform to rigid scientific standards. A very large number of new species were described from it and it is said that a portion of it, included in the donation, was exhibited at the Alaska-Yukon Exposition in Seattle about 1910, where it won a beautiful gold medal. Before his death, Mr. Baldwin divided his collection and willed various portions to several of his relatives. One of these portions was later acquired by the Bishop Museum in Honolulu, but most of the remainder were not removed from the old homestead on Maui until they were packed and shipped to San Francisco.

The Academy is indebted to the following persons for contributing their shares of this magnificent collection: Mrs. J. L. Morrison; Mrs. Lillian B. Atwater; Mr. and Mrs. Duncan B. Murdoch; and Mrs. Winifred B. Weddick.

The task of packing and shipping the collection was placed in the care of Miss Lucie Hicks, formerly of the Academy staff. She has advised that without the aid of the above mentioned donors the undertaking would have been very difficult.

The collection had not been unpacked at the end of the year, so exact data as to its contents must be deferred to a subsequent report. It may be of interest to record at this time, however, that there are very large suites of the beautifully colored tree-dwelling snails of the genus *Achatinella* which was Mr. Baldwin's special love. He was an expert collector and obtained vast numbers of these fine shells in the early days of the settlement of the islands. The clearing away of the timber for the plantations has of course exterminated many of the most striking forms and they will never be obtainable again.

Outstanding loans of museum material at the end of the year were made to the following workers: A. M. Strong, Los Angeles, Calif.; Dr. Fred Baker, Point Loma, Calif.; Dr. S. Stillman Berry, Redlands, Calif.; Dr. Junius Henderson, University of Colorado, Boulder, Colo.; Bryant Walker, Detroit, Mich.; Dr. Paul Bartsch, U. S. National Museum.

G. DALLAS HANNA, *Curator.*

DEPARTMENT OF STEINHART AQUARIUM

We are glad to be able to report an increase not only in the number of specimens but also in the number of attractive species in the tanks of the Aquarium.

The exhibits now number 8895 specimens representing 363 species, an increase of 141 specimens and 63 species over 1927.

For the first time we are now able to show three tanks devoted exclusively to invertebrates, in which we are showing with good effect an Octopus, many Sea Anemones, Starfishes, Sea Urchins, Nudibranchs, Crabs, and Shellfish of several species. This improvement was made possible by installing a small separate circulating system using unfiltered sea water.

For convenience of comparison with former years we, as usual, group all the animals under the following heads:

Mammals	6 specimens of	3 species
Birds	2 specimens of	2 species
Reptiles	114 specimens of	38 species
Batrachians	84 specimens of	11 species
Fishes	8493 specimens of	291 species
Invertebrates	196 specimens of	18 species
Grand Total	8895 specimens,	363 species

We desire to thank the friends of the Aquarium who gave to the institution during the year 1476 animals, ranging from Jellyfish to Sea Lions and Crocodiles. A complete list of the gifts together with the name and address of each donor will be found in the body of the report.

The Chief Attendant, Mr. Clyde Guidry, reports that the following amounts of food were supplied to the animals during the year: 21,900 pounds of fresh fish; 1872 pounds of beef; 300 pounds of dried shrimp; 936 heads of lettuce, together with other foods making a total of 25,004 pounds.

The Collector, Mr. Chas. Hibbard, reports that 56 collecting trips were made in 1928, the total mileage for the collecting truck being 11,535 miles, and the amount of gasoline used was 630 gallons. The total number of specimens secured was 3089.

A number of very useful books have been added to the Aquarium Library during the year.

The attendance at the Aquarium shows an increase over last year, and the building is too crowded for comfort on Sundays and holidays.

We respectfully suggest the following as desirable improvements for the coming year: That the court in front of the building be properly paved with cement or brick, and that the city be asked to supply the Aquarium with an additional wing for fishes from the tropical Pacific, one room of which could be used for showing the life histories of aquatic and other insects of interest to the public.

Alvin Seale, *Superintendent.*

Report of the Committee on Conservation of Wild Life

The annual meeting of the Committee was held February 20, 1929. Brief reports from a number of the Academy's special observers were presented. These reports may be summarized as follows in so far as they relate to the game animals in the various national and state parks:

Yosemite National Park, E. P. Leavitt, Acting Supt.

California Valley Elk (transplanted)		19

Sequoia National Park, Col. John R. White, Supt.

Deer (estimated)		6,000
Black Bear (estimated)		250

Yellowstone National Park, Horace M. Albright, Supt.

Elk:		
Gallatin and Madison herds	14,150	
Jackson Hole herd	12,853	
		27,003
Buffalo:		
Lamar River herd	896	
Cold and Pelican Creek herds	100	
		996
Antelope	Actual count 526; estimate	625
Mountain Sheep	Actual count 170; estimate	500
Moose	Actual count 111; estimate	650
Mule Deer	Actual count 852; estimate	2,000
Black Bear	Actual count 227; estimate	350
Grizzly Bear	Actual count 103; estimate	140

Zion National Park, E. T. Scoyen, Supt.

Mountain Sheep	20
Mule Deer	350

Mount McKinley National Park, Henry P. Karstens, Supt.

Caribou	100,000
Dall's Mountain Sheep	50,000

Moose, increasing.
Grizzly Bear, increasing.

Glacier National Park, J. Ross Eakin, Supt.

Moose	Actual count 47; estimate	98
Mule Deer	Actual count 337; estimate	1,003
White-tail Deer	Actual count 956; estimate	1,822
Elk	Actual count 369; estimate	468
Mountain Sheep	Actual count 138; estimate	274
Mountain Goat	Actual count 162; estimate	420
Grizzly Bear	Actual count 32; estimate	100
Black Bear	Actual count 101; estimate	259

Crater Lake National Park, Charles Goff Thompson, Supt.

Black Bear	310
Black-tail Deer	3,600
Elk (Montana transplanted)	18

Note.—These estimates comprise all southern Oregon.

Rocky Mountain National Park, Roger W. Toll, Supt.

Black-tail Deer, estimated	3,000
Mountain Sheep, estimated	400
Elk, estimated	200
Black Bear	35

Grand Canyon National Park, M. R. Tillotson, Supt.

Antelope, transplanted from Nevada, count	9
Deer, on south rim, estimated	320
Mountain Sheep, not reported.	

Miscellaneous Notes

In 1914 and 1915, the California Academy of Sciences, with the cooperation of Miller and Lux, Inc., and the California State Fish and Game Commission, captured and distributed to 19 different state, municipal and private parks in California, 146 California Valley (or Tule) Elk. All were obtained from the Kern County herd that roams over the Buttonwillow ranch of Miller and Lux. No recent reliable reports regarding the results of these transplantings have been received. It is hoped that reliable reports may be forthcoming in time for publication in our 1929 report.

Under the recent state law providing for the establishing of Game Refuges by the State Fish and Game Commission, provision was made for the appointment of an Advisory Committee whose duty it is to examine and recommend to the Commission sites that are suitable for game refuges, public shooting grounds, feeding, resting or breeding grounds for water fowl. This law "authorizes and directs the Commissioners to expend, for a period of five years, beginning January 1, 1928, not less than one-third of all moneys collected annually from the sales of hunting licenses in the purchase, lease or rental, and the development, improvement, maintenance, and administration of land, or land and water, or land and water rights therefor, suitable for game refuges or public shooting grounds, or both, within the State of California. . . ." The same section also provides for the "appointment of a committee to be known as the game refuge and public shooting grounds advisory committee . . . which shall consist of the Director of the California Academy of Sciences, the Director of the Hooper Foundation for Medical Research of the University of California, and five other members to be appointed by the Fish and Game Commissioners. . . . The game refuge and public shooting grounds advisory committee shall hold meetings and make a survey of the state for the purpose of ascertaining the needs for game refuges and public shooting grounds and shall report its findings to the Fish and Game Commissioners."

The advisory committee has been appointed and consists of the following:

Appointed by the Fish and Game Commissioners:
Nathan Moran, San Francisco, Chairman.
Jacob Baum, Los Angeles.
H. L. Betten, San Francisco.
J. Dale Gentry, San Bernardino, Secretary.
Manley S. Harris, San Francisco.

Named in the organic act:
Dr. K. F. Meyer, Director, Hooper Foundation.
Dr. Barton Warren Evermann, Director, California Academy of Sciences.

This committee has had several meetings. The establishment of an Elk Park somewhere in the San Joaquin Valley, preferably as near as possible to the region now frequented by the sole remaining herd is receiving careful consideration. If the Tule Elk is to be saved from total extinction it is essential that an adequate refuge be provided very soon, and it is earnestly hoped the committee and the Fish and Game Commission may not needlessly delay taking the action necessary to provide such a sanctuary.

M. HALL MCALLISTER, *Chairman.*

PUBLICATIONS BY THE MUSEUM STAFF IN 1928

The following bibliography lists the papers published in the year 1928 by members of the Museum and Aquarium staffs.

Anderson, F. M.

1. Notes on Lower Tertiary Deposits of Colombia and their Molluscan and Foraminiferal Fauna. <Proc. Calif. Acad. Sci., ser. 4, vol. 17, no. 1, pp. 1-29, pl. 1, 11 text-figs., June 22, 1928.
2. Late Cretacic Fossils from Lower California. <The Pan-American Geologist, vol. L, pp. 283-284, November, 1928.

Davidson, M. E. McLellan.

1. On the Present Status of the Guadalupe Petrel. <Condor, vol. 30, no. 6, pp. 355-356, November, 1928.

Eastwood, Alice.

1. Trees of Mt. Tamalpais Region. <Out-of-Doors, February and March, 1928.
2. Midwinter Flowers on Mt. Tamalpais. <Trails, February, 1928.
3. Violets of Marin County, California. <Trails, March, 1928.
4. Flowers noted on the Trail to Little Carson Creek. <Trails, March, 1928.
5. Annual Report, Department of Botany for 1927. <Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 24, pp. 736-738, May 22, 1928.

Evermann, Barton Warren.

1. A Review of "An Introduction to Biology" by Alfred C. Kinsey. <Indiana University, Alumni Quarterly, vol. 15, no. 1, pp. 87-89, January, 1928.
2. A Plan for Disaster Preparedness. <Transactions Commonwealth Club of California, vol. 23, no. 4, pp. 69-138, May 15, 1928.
3. Annual Report of the Director of the Museum for 1927. <Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 24, pp. 699-758, May 22, 1928.
4. The Tule Elk of California. <Society of Engineers Year Book for 1928, no. 3, pp. 20-22, 2 illustrations, November 6, 1928.

Hanna, G. Dallas.

1. [Notes on microscopic fossils of North Colombian Shale]. In F. M. Anderson, "The Marine Miocene deposits of North Colombia." <Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 3, January 31, 1927, p. 88.
2. Abstract: Hanna, G. D. The photography of small objects. Trans. Amer. Micr. Soc., vol. 46, no. 1, 1927, pp. 15-25. <Biol. Absts., vol. 1, no. 6, October, 1927, p. 774.
3. Abstract: Hanna, G. D. Further notes on *Scalez petrolia*. Nautilus, vol. 41, no. 1, 1926, pp. 14-16. <Biol. Absts., vol. 1, no. 6, October, 1927, p. 953.
4. Abstract: Mottram, J. C. On the effects of B-radiation on *Colpidium colpoda* as seen in stained specimens. Journ. Roy. Micros. Soc. vol. 46, no. 11, 1926, pp. 123-126, 4 text-figs. <Biol. Absts., vol. 1, no. 6, October, 1927, p. 819.
5. Abstract: Tolman, C. F. Biogenesis of hydrocarbons by diatoms. Econ. Geol., vol. 22, no. 5, August, 1927, pp. 454-474, pls. 1-5, 1 text-fig. <Biol. Absts., vol. 1, nos. 7-8, November-December, 1927, p. 1200.
6. Abstract: Sprenger, E. Ein Beitrag zur Kenntniss der Diatomeenflora von Böhmen. I. Bacillariales aus der Umgebung von Hirschberg. Naturw. Zeitschrift, Lotos, vol. 74, nos. 10-12, 1926, pp. 183-218. <Biol. Absts., vol. 1, nos. 7-8, November-December, 1927, p. 1182. (Junior author with Joaquin Frenguelli).
7. Abstract: Giaj, Levra Piero. Diatomee della valle d'Aosta. Atti Soc. Ital. Sci. Natur., vol. 65, 1926, pp. 116-122. <Biol. Absts., vol. 1, nos. 7-8, November-December, 1927, p. 1181. (Junior author with Joaquin Frenguelli).

8. Abstract: Giaj, Levra Piero. Diatomce raccolte nell'orto botanico della Universitá di Genova, pp. 1-12, 2 pls., 1 text-fig., Torino, 1926. <Biol. Absts., vol. 1, nos. 7-8, November-December, 1927, p. 1181. (Junior author with Joaquin Frenguelli).
9. Abstract: Cholnoky, B. v. Ueber die Diatomeen-Assoziationen des Dorfes Szamosfalva bei Kolozsvár [The diatom associations about Szamosfalva in Koloszvár]. Hedwigia, vol. 66, no. 5, 1926, pp. 283-292, 1 fig. <Biol. Absts., vol. 1, nos. 7-8, November-December, 1927, p. 1005.
10. Abstract: Boyer, C. S. List of Quaternary and Tertiary Diatomaceæ from deposits of southern Canada. Canada Dept. Mines; Victoria Mem. Mus., Mus. Bull. no. 45, Biol. ser. no. 12; pp. 1-26, 1 distrbn. table. November 9, 1926. <Biol. Absts., vol. 1, nos. 7-8, November-December, 1927, p. 1198.
11. Abstract: Becking, L. B., C. F. Tolman, H. C. McMillan, John Field and Tadaichi Hashimoto. Preliminary statement regarding the diatom "epidemics" at Copalis Beach, Washington, and an analysis of diatom oil. Econ. Geol., vol. 22, no. 4, June-July, 1927, pp. 356-368, 11 text figs. <Biol. Absts., vol. 2, nos. 1-2, January-February, 1928, p. 27.
12. Abstract: Hanna, G. D. Paleontology of Coyote Mountain, Imperial County, Calif. Proc. Calif. Acad. Sci., ser. 4, vol. 14, no. 18, March 23, 1926, pp. 427-503, 10 pls., 1 fig. <Biol. Absts., vol. 2, nos. 1-2, January-February, 1928, p. 342.
13. Abstract: Lutz, A. Sur la *Schmardælla lutzi* Michaelsen. Comp. Rend. Soc. Brasiliene, Biol. vol. 96, no. 7, 1927, pp. 485-486. <Biol. Absts., vol. 2, nos. 1-2, January-February, 1928, p. 335.
14. Abstract: Voigt, Manfred. Diatoms from the dinner table. The China Journ. Sci. & Arts, vol. 5, no. 6, December, 1926, pp. 322-326, 3 pls. <Biol. Absts., vol. 2, nos. 3-5, March-May, 1928, p. 632.
15. Abstract: Hanna, G. D. & C. C. Church. A collection of recent foraminifera taken off San Francisco Bay, California. Journ. Paleo., vol. 1, no. 3, 1927 [1928], pp. 195-202. <Biol. Absts., vol. 2, nos. 3-5, March-May, 1928, p. 704. (Senior author with C. C. Church).
16. Means for obtaining data in earth bores. U. S. Patent Office, Patent no. 1,665,058, issued April 3, 1928, pp. 1-5, 1 pl.
17. The riddle of the origin of oil. The Record [Associated Oil Company], vol. 9, no. 4, April, 1928, pp. 6-7, 3 figs.
18. [Annual Report of the] Department of Paleontology [1927]. <Proc. Calif. Acad. Sci. ser. 4, vol. 16, no. 24, May 22, 1928, pp. 745-747. Bibliography, pp. 732-734.
19. An early reference to the theory that diatoms are the source of bituminous substances. <Bull. Amer. Assoc. Petrol. Geol., vol. 12, no. 5, May, 1928, pp. 555-556.
20. Freezing and thawing to disintegrate shales. (Senior author with C. C. Church). <Journ. Paleo., vol. 2, no. 2, June, 1928, p. 131.
21. The Monterey Shale of California at its type locality with a summary of its fauna and flora. <Bull. Amer. Assoc. Petrol. Geol., vol. 12, no. 10, October, 1928, pp. 969-983, pls. 7-10.

22. *Solen novacularis*, a name for an Eocene fossil from California. (Junior author with F. M. Anderson). <The Nautilus, vol. 42, no. 2, October, 1928, pp. 65-66.
23. The age of the diatom-bearing shales at Malaga Cove, Los Angeles County, California. <Bull. Amer. Assoc. Petrol. Geol., vol. 12, no. 11, November, 1928, pp. 1109-1111.

Hertlein, Leo George.

1. *Pecten* (*Patinopecten*) *lohri*, new name for *Pecten oweni* Arnold, a Pliocene species from California. <Nautilus, vol. 41, no. 3, pp. 93-94, January, 1928.
2. Preliminary Report on the Paleontology of the Channel Islands, California. <Journal of Paleontology, vol. 2, no. 2, pp. 142-157, plates 22-25, June, 1928.

Mailliard, Joseph.

1. Census of the Birds' Nests in the Music Concourse, Golden Gate Park, San Francisco, California, for 1927. <The Gull, vol. 10, no. 2, February, 1928.
2. Sparrow Hawk trying to fly with dead Quail. <The Gull, vol. 10, no. 3, March, 1928.
3. American Coot defending its Young. <The Gull, vol. 10, no. 8, August, 1928.

Slevin, Joseph R.

1. Description of a New Species of Lizard from Malpelo Island. <Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 21, pp. 681-684, pls. 25 and 26, February 28, 1928.
2. Annual Report, Department of Herpetology for the year 1927. <Proc. Calif. Acad. Sci., ser. 4, vol. 16. no. 24, pp. 741-742, May 22, 1928.
3. The Amphibians of Western North America. <Occasional Papers, Calif. Acad. Sci., no. 16, pp. 1-152, pls. 1-23, September 15, 1928.

Swarth, Harry S.

1. Winter Birds of California Highways. <National Motorist, vol. 4, no. 9, pp. 6, 23-44, 1 text-figure, February, 1928.
2. Annual Report, Department of Ornithology and Mammalogy for 1927. <Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 24, pp. 743-745, May 22, 1928.
3. Winter Occurrence of Sierra Nevada Rosy Finch and Black Rosy Finch in California. <Condor, vol. 30, no. 3, p. 191, May, 1928.
4. Review of Taverner's "A Study of Buteo borealis, the Red-tailed Hawk, and its varieties in Canada." <Condor, vol. 30, no. 3, pp. 197-199, May, 1928.
5. Occurrence of some Asiatic birds in Alaska. <Proc. Calif. Acad. Sci., ser. 4, vol. 17, no. 8, pp. 247-251, July 10, 1928.
6. A Bush-tit's Nest on a Pedestal. <Condor, vol. 30, no. 6, pp. 359-360, 1 text-figure, November, 1928.

Van Duzee, E. P.

1. Annual Report, Department of Entomology for 1927. <Proc. Calif. Acad. Sci., ser. 4, vol. 16, no. 24, pp. 738-740, May 22, 1927.
2. A Misidentified Hadronema. <Pan-Pacific Entomologist, vol. 4, p. 182, June 26, 1928.
3. Two Interesting Additions to the Hemipterous fauna of California. <Pan-Pacific Entomologist, vol. 4, pp. 190-191, June 26, 1928.
4. Our First Rhyparochromus. <Pan-Pacific Entomologist, vol. 5, p. 47, July 28, 1928.
5. A Rare Pentatomid. <Pan-Pacific Entomologist, vol. 5, p. 52, December 28, 1928.

Accessions to the Museum and Library

Following is a list of the more important accessions to the Museum and Library received in 1928:

Adams, Charles C., Director New York State Museum, Albany, N. Y.: New York State Museum Handbook, nos. 1-4. Gift.

Adams, Wallace, Steinhart Aquarium, San Francisco: 20 numbers of Tycos-Rochester; California Fish and Game, vol. 4, no. 3, vol. 6, no. 1; 6 U. S. Geological Survey topographic maps; and 36 specimens of fishes, *Agosia nevadensis* from Burrill's Ranch, 9 miles north of Beatty, Nevada. Gift.

Allen, Lewis, Golden Gate Park, San Francisco: 9 specimens of exotic plants. Gift.

Allman, S. L., University of California, Berkeley: 207 Australian insects. Gift.

American Council of Learned Societies, 907 Fifteenth St., Washington, D. C.: 1 copy, American Council of Learned Societies, Bull. no. 8, Oct., 1928. Gift.

American Museum of Natural History, New York: 2 copies, An efficient and safe degreasing tank for Bones, by James L. Clark. Gift.

Anderson, Frank M., California Academy of Sciences, San Francisco: 15 publications of American Institute of Mining Engineers Year-book, vol. 13, 1927, of Geological and Mining Society of American Universities, Stanford Section. Gift.

Anderson, Robert Van Vleck, Menlo Park, Calif.: Two publications on geology. Gift.

Arundell, Frank, Fillmore, Calif.: 1 tree toad, *Hyla regilla*, and 1 lizard, *Phyrnosoma blainvillii frontale*. Gift.

Bacon, Mr., of Hirsch and Kaye, San Francisco: 1 collection of shells, a portion of the collection made by Dr. R. E. C. Stearns, a former curator of the Department of Conchology of the Academy. Gift.

Bailey, Geo. E., San Mateo, Calif.: 8 skulls and antlers of mammals from British East Africa. Gift.

Barnes, Dr. William, Decatur, Ill.: 165 moths and 104 determined insects. Gift.

Barnhart, P. S., La Jolla, Calif.: 1 fish, *Scorpænichthys marmoratus*, from La Jolla. Gift.

Bayerische Akademie der Wissenschaften, München, Germany: Wilkens, Alexander. Hugo von Seeligers Wissenschaftliches Werk. Exchange.

Bernstein, Albert, San Francisco: 1 Rattlesnake, *Crotalus oreganus*, from Mt. Tamalpais, Marin County, Calif. Gift.

Bird, Henry, Rye, New York: 22 insects. Gift.

Bitting, Dr. A. W.: 2 pamphlets on Asparagus and Spinach by A. W. Bitting. Gift.

Bittel, Walter, San Francisco: 1 frog, *Rana boylii boylii*, from Marin County, Calif. Gift.

Blaisdell, Dr. F. E., San Francisco: 200 ferns from the collection of his mother, Mrs. Anna G. Blaisdell. Gift.

Boatright, Charles, 534 Eleventh Ave., San Francisco: 1 Paradise Bird, *Vidua paradisea*, in flesh; 1 Natal White-winged Whydah, *Penthetria albonotata;* 1 Gambel's Quail; 1 Lady Amherst's Pheasant; 2 Swinhoe's Pheasant; 1 Ornate Lory; and 1 Bleeding-heart Pigeon. Gift.

Boone, Mrs. Richard G., Berkeley, Calif.: 5 Wheeling, W. Va., newspapers published in April, 1865. Gift.

Booth, F. E., Woodland, Calif.: 1 partridge, *Arboricola gingica*, from Philippine Islands; and 1 Palawan Pheasant. Gift.

Brenner, Mrs. Gustave, 1899 California Street, San Francisco: 2 shells from the Dead Sea, and 1 small box of marine shells from Algeria. Gift.

British Museum of Natural History, London, England: 6 books and 1 pamphlet on various subjects. Exchange.

Bull, Daniel B., 920 Kellar Ave., San Jose, Calif.: 30 specimens of birds from Central and South America; and 2 frogs from Argentina. Gift.

Bureau of Biological Survey, U. S. Department of Agriculture, Washington, D. C.: 89 plumage ornaments (Birds of Paradise, Egret, Goura, and Grebe). Gift.

Burt, Charles E., Ann Arbor, Michigan: 19 snakes, 19 lizards, 2 turtles, 18 frogs, and 1 toad. Gift.

Cabot, R., 351 Divisadero Street, San Francisco: 1 Red-tailed Hawk from San Francisco. Gift.

California Division of Fish and Game, San Francisco: Fish Bulletin, nos. 2, 5-6, 8-9; 65 periodicals; 2 White-tailed Kites, from Solano County; 1 Whistling Swan from Ward Lakes, Lower Lake, Calif. Gift.

Carnegie Institution of Washington, Washington, D. C.: 13 publications. Gift.

Carnegie United Kingdom Trust, Edinburgh, Scotland: Lowe E. E., A Report on American Museum Work; Miers, Sir Henry, A Report on the Public Museums of the British Isles. Gift.

Cavanaugh, James, Steinhart Aquarium, San Francisco: 9 copies of Police Journal, "2-0," Dec., 1927-Sept., 1928. Gift.

Chambers, J. R., Año Nuevo Island, Calif.: 22 salamanders, *Aneides lugubris lugubris*, from Año Nuevo Island. Gift.

Clark, H. Walton, California Academy of Sciences, San Francisco: 1 Pacific Rattlesnake, *Crotalus oreganus*, from 3 miles west of Calistoga, Calif.; 1 Hoary Bat, from Golden Gate Park; 1 lizard, *Gerrhonotus scincicauda scincicauda*, from San Bruno Hills, San Mateo; 58 periodicals. Gift.

Close, Sir Chas., F. R. S., "Coytbury," St. Giles Hill, Winchester, England: 1 pamphlet on the Union Geographique Internationale. Gift.

Colburn, Albert E., Los Angeles, Calif.: 1 snake, *Elaphe chlorosoma*, from Sonora, Mexico; 1 Dotted Burrowing Snake, *Chilomeniscus stramineus*, from Cape San Lucas, Lower California, Mexico. Gift.

Comparative Zoology, Museum of, Cambridge, Mass.: 2 salamanders, *Scolecomorphus uluguruensis*, from Nyingwa, Uluguru Mountains, Tanganyika Territory. Exchange.

Cowles, Thomas, California Academy of Sciences, San Francisco: 1 small box of shark teeth from Chesapeake Beach, Chesapeake Bay, Maryland. Gift.

Dake, C. L., Rolla, Mo.: 1 geological pamphlet. Gift.

Davidson, Mrs. M. E., California Academy of Sciences, San Francisco: Rules and Regulations of Sequoia and General Grant National Parks; Morrisson, A. Cressy, The League of Nations, Cartels and the Tariff; 72 periodical numbers. Gift.

Davidson, Sam, 411 East Fourth Street, Tucson, Arizona: 1 Blackbird, *Agelaius phœniceus* subsp. from San Mateo Co.; 1 Fox Sparrow, *Passerella iliaca*, from San Mateo Co. Gift. 3 Kangaroo Rats from Fairbanks, Arizona. Exploration.

Davis, A. C., Garden City, California: 115 miscellaneous insects. Gift.

Davis, W. T., Staten Island, New York: 4 Cicadas. Gift.

Dawson, Mrs. William Leon, Santa Barbara, Calif.: Museum of Comparative Oology Journal, vols. 1 and 2; The Comparative Oologist, vol. 1, no. 1. Gift.

Degener, Otto C., 2220 Vancouver Highway, Honolulu, T. H.: 100 botanical specimens from the Hawaiian Islands. Purchase.

Derby, Mrs. Charles, 488 Route C., San Jose, Calif.: 176 botanical specimens from Sequoia National Park, Tulare County, Calif. Gift.

Deward, J. M., San Francisco: 1 Indian packamage? (Snake catcher). Gift.

de Young, M. H., Memorial Museum, San Francisco: Zeitschrift für die gesamte Ornithologie, vol. 3, 4, 1886-1888; List of Echinoids in the Collection of the California Academy of Sciences, May, 1875; 1 mounted duck, *Anas platyrhynchos*. Gift.

Direccion Oficial de la Obras Completas de Ameghino, La Plata, Argentina: 2 publications. Gift.

Dinuba Fire Department, Dinuba, Calif.: 1 Desert Tortoise, *Gopherus agassizii*. Gift.

Donor Unknown: 1 Desert Tortoise, locality unknown. Gift.

Drake, Dr. Carl J., Iowa State College, Ames, Iowa: 64 aquatic insects. Gift.

Dudley, Chester, Box 1331, Modesto, Calif.: 13 botanical specimens from Modesto. Gift.

Eastwood, Miss Alice, California Academy of Sciences, San Francisco: 209 botanical specimens from near Covelo, Mendocino County; 78 from San Luis Obispo County; 35 from Del Norte County; 38 from Claremont, Calif.; 24 specimens of exotic plants; Edward Lee Greene, Illustrations of West American Oaks, 1889-90; Botanical Society of America, Pub. 91, 94; 38 miscellaneous periodicals. Gift.

Evermann, Dr. Barton Warren, California Academy of Sciences, San Francisco; Filene, Edward A., Contributions of Research to Business; Proc. of Sixth Annual Meeting of the Western Psychological Assn., June 18 and 19, 1926; Exten. Service Bull. no. 139, Iowa State College of Agriculture and Mech. Arts; The Evils of Standardized Education, Burr; A Book List of a Small Museum of Natural Science by Pollard; U. S. Agri. Farm. Bull. 1575; Suggestions for the Library of a Small Museum of Art by Tuckerman; Southern Calif. Acad. Sci. Bull., vol. 25, tpg. ind.; vol. 26, tpg. ind.; vol. 27, part 2; 126 pamphlets; 278 periodicals; 2 books; 3 photographs. Gift.

Facultad de Agronomia y Veterinaria, Universidad de Buenos Aires, Argentina: 1 pamphlet: Report 1928. Gift.

Field Museum of Natural History, Chicago, Ill.: 1 copy, Field Museum and the Child. Chicago: 1928. Gift.

Fitzhugh, William M., 2350 Broadway, San Francisco: 1 skull and horns of the Irish Elk, *Cervus giganteus*. Gift.

Florida State Museum, Gainsville, Florida: 3 snakes, *Liodytes alleni*. Purchase.

Folker, G. N., San Francisco, Calif.: 6 specimens of *Dendraster*, sea urchin. Gift.

Foster, Miss L. S., Indio, Calif.: 1 Rattlesnake, *Crotalus oreganus*, from Indio. Gift.

Gally, James, 340 Divisadero Street, San Francisco: Vererbung und Geschlechtsleben, Heft 2-4. Gift.

Ghirardelli, Mrs. Domingo, Hillsboro, Calif.: 1 lizard, *Plestiodon skiltonianus*, from Hillsboro. Gift.

Giffard, Walter M., P. O. Box 300, Honolulu, T. H.: 1331 insects, Delphacidæ. Gift.

Gifford, E. W., Museum of Anthropology, University of California, San Francisco: 1 dove, *Phlogœnas kubaryi;* 2 Cassin's Doves from Central America; 2 Panama Partridges; 2 Wood Ducks, *Aix sponsa*. Gift.

Gorsuch, D. M., 526 So. Guthrie Street, Tulsa, Okla.: 74 bird skins from Arizona. Purchase.

Grant, U. S., IV, Burlingame, Calif.: 2 pamphlets. Gift.

Gray Herbarium, Harvard University, Cambridge, Mass.: Fernald, M. L., Unverified Geographic Ranges, from Science, August 17, 1928; 626 botanical specimens. Exchange.

Green, Woodrow Wilson, 1235A 9th Ave., San Francisco: 1 Nuttall Sparrow from Golden Gate Park. Gift.

Grout, A. J., 1 Vine Street, New Brighton, Long Island, New York: 25 specimens of mosses. Purchase.

Haley, George, Berkeley, Calif.: 44 botanical specimens. Exploration.

Hancock, Capt. G. Allen, Los Angeles, Calif.: 126 photographic prints of the Galapagos Expedition of 1927-1928. Gift.

Hancock Galapagos Expedition: 20 land iguanas from Seymour Island; 21 sea iguanas, 7 crawfish and 5 fishes (3 species) from Tagus Cove, Albemarle Island, Galapagos; 1 lizard (*Anolis townsendi*), from Cocos Island; 27 lizards (*Anolis agassizii*) and 10 Skinks, new species, from Malpelo Island; 17 lizards from Tres Mariettas Islands; 4 rock iguanas, accessory material from Isabel Island; 15 eggs, from Isabel, White Friar, and Tower islands; 12 birds, in flesh, from Cocos, Malpelo, and Galapagos islands. Exploration.

Hanna, Dr. G. Dallas, California Academy of Sciences, San Francisco; 1 small lot of *Pedipes* from Bolinas Bay, Calif., Exploration; 1 snake from Lake County; Gift; 1 tree frog, *Hyla regilla*, from Siskiyou County. Exploration; 125 pamphlets and 4 books, mostly on geological subjects; Bull. U. S. Fish Comm., vol. 23, 1903, pt. 3, 1906; Heiden, Heinr. & R. W. Kolde: Die Marinen Diatomeen der Deutschen Südpolar-Expedition 1901-1903, 1 map of San Francisco by Harrison Godwin. Gift.

Hart, Cecil, Montebello, Calif.: 13 botanical specimens from southern California. Gift.

Harter, Mildred E., Lindsay, Calif.: 28 botanical specimens from Lindsay. Gift.

Henderson, J., New Zealand Geological Survey, Wellington, N. Z.: 1 copy each of N. Zealand Jour. Sci. and Tech., vol. 6, nos. 2 and 3. Gift.

Henderson, Prof. L. F., Agricultural College, Eugene, Ore.: 46 botanical specimens from Oregon. Purchase.

Hendrick, Russell, California Academy of Sciences, San Francisco: 3 Brandt Cormorant, 2 Ancient Murrelet, 1 Black Oystercatcher, and 1 weasel. Exploration.

Herrin, Miss Katherine: 11 pamphlets on botanical subjects. Gift.

Herrin, William Franklin, San Francisco: Curtis's Botanical Magazine, vols. 148-151, vol. 152, nos. 1, 3, 1922-28. Gift.

Hertlein, Leo George, California Academy of Sciences, San Francisco: San Diego Natural History, Museum Bulletin, nos. 48-50, 1928; 2 geological pamphlets; Preliminary Report on the Paleontology of the Channel Islands, California, by Hertlein; Sanford, O. N., Price list of West Coast Shells. Gift.

Hing, J. C., 843 Clay Street, San Francisco: 6 dried starfish, two species; 1 dried skin of salmon. Gift.

Hodson, L. H., Sausalito, California: 1 Gila Monster, from Florence, Arizona. Gift.

Holm, Adolph, R. G. D. Box 146, Redwood City, Calif.: 1 California Shrew Mole from south arm of Portola Valley, San Mateo County, Calif.; 2 shrews from 5 miles west of Stanford University; 1 shrew from Santa Clara County, Calif. Gift.

Illinois State Geological Survey, Urbana, Illinois: 2 pamphlets on engineering subjects. Gift.

Institut Geologic al Romaniei, Bucharest, Roumania: Roman, David & Alexandru Codarcea. Bibliographia Geologica a Romaniei. Exchange.

May 22, 1929

Iowa, State University of, The University Libraries, Iowa City, Iowa: MacBride, Thomas H., In Cabins and Sod-houses. 1928. Gift.

Johnston, E. C., Petaluma, Calif.: Collection of botanical specimens, photographs, and plants of the Pribilof Islands. Gift.

Kahn, Mrs. Florence Prag, San Francisco: Congressional Directory, 70th Congress, 1st Session. Gift.

Keifer, H. H., Capitol Building, Sacramento, Calif.: 11 botanical specimens from Marysville Buttes; 1 snake, *Bascanion constrictor vetustum*, from Oroville, Calif. Gift.

Klauber, L. M., San Diego, Calif.: 2 lizards from San Diego County. Gift.

Kruger, C. E., Laurel Hill, Bush and Presidio Ave., San Francisco: 1 Aztec Thrush, *Ridgwayia pinicola*, in flesh. Gift.

Kryshtofovich, A., Geological Committee, Leningrad, Russia: 5 separates on geological and mineralogical subjects. Gift.

Kundson, Mrs.: 1 lot of shell, rocks, and miscellaneous curios with cabinet. Gift.

Kusche, J. A., Hollywood, Calif.: 6399 miscellaneous insects; 33 bird skins and 11 mammal skins from Arizona. Purchase.

Lastreto, C. B., San Francisco: 18 pamphlets and 35 periodicals on various subjects. Gift.

Lawrence, H. M., 1111 Pine Street, San Francisco: 20 numbers of the National Geographic Magazine. Gift.

Leach, E. R., Piedmont: 1 snake, *Charina bottæ*, from Mendocino County, Calif. Gift.

Library of Congress, Washington, D. C.: Library of Congress. Classification, class P:P-PA. Washington: 1928. Exchange.

Lincoln, George S., 185 Eighth Ave., San Francisco: 1 small plate and 2 decorative spoons. Gift.

Linsley, Gorton, Oakland, Calif.: 121 miscellaneous insects; 200 European Coleoptera. Gift.

Los Angeles Board of Public Works, Los Angeles. Calif.: Hales, George P. Los Angeles City Hall. Gift.

Maggio, Mrs. E. F., 1560 Lombard Street, San Francisco: 1 Western Red Bat from San Francisco. Gift.

Mailliard, Joseph, California Academy of Sciences, San Francisco: 1 Barn Owl, female, and 1 Red-tailed Hawk, male. Gift. 1 Burrowing Owl and 1 White-throated Sparrow from Marin County, Calif.; 109 mammal skins and skulls and 319 bird skins and 2 sets of eggs from British Columbia; 6 mammal skins and skulls and 71 bird skins from Sonoma County, Calif. Exploration.

Martin, J. O., Berkeley, Calif.: 1262 miscellaneous insects. Exploration. 2092 miscellaneous insects and 205 moths. Gift.

McAllister, M. Hall, 2436 Jackson Street, San Francisco: Scientific American, April, May, June, 1928; 11 pamphlets and 13 periodical numbers. Gift.

McLaren, John, Golden Gate Park, San Francisco: 1 White-fronted Parrot, 1 American Barn Owl, and 1 Black Bear cub, from Golden Gate Park. Gift.

Mechanics Library, 57 Post Street, San Francisco: Periodical List, Mechanics Library, San Francisco. Gift.

Merrill, Dean E. D., University of California, Berkeley, Calif.: 709 botanical specimens, collected by Capt. and Mrs. Clemens in China. Purchase. 316 specimens of Chinese plants. Exchange.

Meyer, Harry, 1116 Financial Center Building, San Francisco: 1 Western Red-tailed Hawk (*Buteo borealis calurus*), from Salmon River, Calif. Gift.

Mexia, Mrs. Ynes, 1909 Lake Street, San Francisco: 1286 botanical specimens from Mexico. Purchase.

Michigan, University of, Zoological Laboratory, Ann Arbor, Michigan: 6 pamphlets on zoological subjects. Exchange.

Minister of Lands and Forests, Province of Quebec, Canada: 1 copy of Guide to the City of Quebec, 33rd edition, 1924. Gift.

Moffitt, James, 1879 Broadway, San Francisco: 1 Brandt's Cormorant from Marin County, Calif. Gift.

Montgomery, A. C., S. S. Montagu, San Francisco: 4 birds, in flesh, from China. Gift.

Mori, T., 1511 Geary Street, San Francisco: 1 Budgerygah (*Melopsittacus undulatus*), from Australia; 2 Button Quail (*Turnix*), from the Philippine Islands. Gift.

Morrice, Charles M., Bakersfield, Calif.: 2 boxes of fossil bones. Gift.

Museum of the American Indian (Heye Foundation), New York: 4 periodical numbers. Gift.

Nast, E. H., San Francisco: 65 moths. Gift.

Naturforscher-Verein zu Riga, Riga, Latvia: 2 publications. Exchange.

Naturwissenschaftlicher Verein für Steiermark, Graz, Austria: 1 book: Sölch, Joh., Die Landformung der Steiermark. Graz, 1928. Gift.

North Carolina Department of Conservation and Development, Raleigh, N. C.: Dept. of Conserv. & Devel., N. Carolina, Bull. no. 35, Jul., 1927; N. Carolina Geol. & Econ. Survey, vol. 2, 1907. Gift.

Oakland Free Library, Oakland, Calif.: Summary report of a survey of the Oakland Public Library, April, 1927. Gift.

Oberman, J. M., Mt. Shasta City, Calif.: 1 skeleton of Mule Deer from Mt. Shasta. Gift.

Observatoria Nacional, Rio Janeiro, Brazil: Calculo do nascer do occaso da lua, Rio de Janeiro. Gift.

Oil Bulletin, Los Angeles, Calif.: Oil Bull. for December, 1927, containing "Geological Sketch of Santa Rosa Island, Santa Barbara County, California" by William S. W. Kew. Gift.

Oliveira, Euzebio Paulo de, Director, Geological and Mineralogical Survey, Rio Janeiro, Brazil: Oliveira, Euzebio Paulo de, O que faz o servico geologico. Gift.

Otis, J. C.: 4320 1st Ave., N. E., Seattle, Washington: 48 specimens of grasses and sedges. Gift.

Pack, Herbert J., Utah Agricultural Experiment Station, Logan, Utah: 34 fishes (*Cottus beldingi*), various sizes, from Logan, Utah. Gift.

Parodi, Prof. Lorenzo R., Universidad de Buenos Aires, Buenos Aires, Argentina: 2 agricultural pamphlets. Gift.

Patton, J. V., Hollister, Calif.: 3 partridges (*Arboricola crudigularis*), and 4 other birds. Gift.

Peers, Susie M., California Academy of Sciences, San Francisco: Current issues of Science for 1928; 1 copy San Francisco Chronicle, April 22, 1906. Gift.

Pell, R. C., and Thomas F. Jones: Two fishes (*Hexanchus corinus*), from Sausalito, Calif. Gift.

Phillips, Warren, Game Warden, Golden Gate Park, San Francisco: 1 White-tailed Kite from Sebastopol, Calif. Gift.

Plummer, V. J., 3100 Wabash, Fort Worth, Texas: 22 samples of ocean dredgings. Purchase.

Proefener, John, 3709A 16th Street, San Francisco: 4 bound volumes. Gift.

Quaeris, Q. M., 132 Boulevard Mitiaire, Brussels, Belgium: Quaeris, Q. M., Notre Misère Scientifique; ses Causes; ses Remèdes. 1928. Gift.

Reagan, Albert B., Queets River Day School, Queets, Washington: 10 botanical specimens from Arizona. Gift.

Rixford, G. P., 1813 Pierce Street, San Francisco: 27 bound volumes of U. S. Reports. Gift.

Rijks Herbarium, Leiden, Holland: Suringar, J. Valckenier, Nieuve Planten II. 1927. Exchange.

Robison, Ansel W., 1072 Market Street, San Francisco: 2 birds from Palawan and China; 2 birds from Colombia; 4 birds; 1 Koala (*Phascolarctius cinereus*), from Australia. Gift.

Rodda, Mrs. Annie F., 2616 Sacramento Street, San Francisco: 1 specimen of echinoderm; 12 botanical specimens from Death Valley, Calif. Gift.

Royal Geographical Society of Australia, Brisbane, Australia: Reports of the Great Barrier Reef Committee, vol. 1, 1925. Gift.

Royer, J. S., 870 Lombard Street, San Francisco: 1 small box of shells from Midway Island. Gift.

Ruthing, Paul, Guadalajara, Mexico: 8 snakes, 2 lizards, 15 toads, and 15 frogs from Mexico. Gift.

San Diego Society of Natural History, San Diego, Calif.: Wright, W. S., The Desert Palm. Nat. Stud. Leaf. San Diego Nat. Hist. Soc. Exchange.

Sanford, Mrs. O. N., San Francisco, Calif.: 6 boxes of fossil and recent shells; 32 books and pamphlets on various subjects. Gift.

San Francisco Aquarium Society, San Francisco: 4 periodical numbers. Gift.

Schlesch, Dr. Hans, Cand Pharm., Gustavadolfsrade 14, Kopenhagen, Denmark: 1 lot of shells from Greenland. Exchange.

Schoenfeld, Mrs. Jonas, 2238 Pacific Ave., San Francisco: 1 German soldier's helmet; 1 Emu egg; 2 bridle bits, 1 fork, 1 spoon, and a piece of melted glass from the San Francisco fire of 1906; 2 souvenir straight edges from Germany; 1 book of pressed flowers from Jerusalem; 2 small silk tapestries; 5 pictures of the Albert Memorial in England; 1 war-time picture of U. S. Officers; 1 bead-covered bottle; 5 rifle shells; C souvenir pins of the St. Louis Exposition of 1904; 1 souvenir badge with pictures of the Kings of Germany in 1871; 1 basket decorated with shell designs; 1 carved wood pen holder; 4 buttons made from some sort of nut or seed; 2 mounted deer heads; 1 box of sea shells, mostly exotic species. Gift.

Science News-letter, Washington, D. C.: Science News-letter, Nov. 24, 1928. Gift.

Scullen, Prof. H. A., Oregon State Agricultural College, Corvallis, Oregon: 9 insects. Gift.

Seabra, de, A. F., University, Coimbra, Portugal: 3 separates written by donor. Gift.

Servios Geologicos, Lisbon, Portugal: Choffat, Paul, Cartas e Córtes Geológicos. Exchange.

Shaw, T. H., Peking, China: 1 frog (*Rana nigromaculata*), and 1 lizard (*Gecko swinhonis*), from campus of Tsing Hua College, Peking, China. Gift.

Silvey, James J., San Francisco: 1 seal, mounted. Gift.

Slason, Thompson, Bureau of Railway News & Statistics, Chicago: Railway Statistics of the U. S. of A. for the year ended December 31, 1927. Gift.

Slevin, Louis S., Carmel, Calif.: 1 salamander (*Ensatina eschscholtzii*), from Carmel; 5 salamanders from Carmel; 255 moths and 96 miscellaneous insects. Gift.

Smith, L. S., Forest Service, Tahoe District, Calif.: 26 botanical specimens from Nevada County, Calif. Gift.

Smith, Raymond L., California Academy of Sciences, San Francisco: 1 Nuttall Sparrow from Golden Gate Park; San Francisco. January, 1926. Gift.

Soldatov, Prof. V. K., Through U. S. S. R. Society of Cultural Relations with Foreign Countries, Moscow, U. S. S. R.: Soldatov, V. K., Note on Two Little Known Genera and Species from Shantar Islands, Okhotsk Sea. Gift.

Steinbeck, Mr. J. W., 611 Bristol Ave., Stockton, Calif.: 2 Cuckoo Doves from the Philippine Islands; 1 White-bellied Plumed Pigeon and 1 Cabot's Tragopan. Gift.

Steinhart Aquarium, Golden Gate Park, San Francisco: 2 skulls of Steller Sea Lion and 3 Steller Sea Lions, in flesh (2 immature) from Año Nuevo Islands, California; 1 Spoon-bill Duck, from Golden Gate Park; 70 salamanders and 57 frogs from Lagunitas, Calif.; 32 fishes (21 species), from various localities. Gift.

Stevens, J. B., Fellows, Calif.: 2 samples of Tulare Pliocene well cores. Gift.

Stolz, Mrs. F. L., 1800 Broadway, San Francisco: 1 bead weaver's bow loom with bead work on it by Susan Jackson, Tahoe, California; 3 mats from Niihau Island and 1 piece of tapa cloth. Gift.

Strecker, John K., Waco, Texas: 526 specimens of reptiles and amphibians from various parts of the United States. Gift.

Suksdorf, Wilhelm, Bingen, Washington: 400 botanical specimens from Oregon and Washington. Purchase.

Sullivan's Pet Shop, 1240 Market Street, San Francisco: 1 parrot (*Psephotus hæmatonotus*) from Australia; 1 Rosella (*Platycercus eximius*) from Australia. Gift.

Swarth, H. S., California Academy of Sciences, San Francisco: 4 bird skins from Arizona. Exploration. 92 photographic negatives and 23 prints, mostly trees; Jour. Mus. Comp. Oology, vol. 1, no. 3-4; vol. 2, no. 3-4; 28 periodicals, 5 separates, and 1 book by Rawstorne, Lawrence, Gamonia. London: 1905. Gift.

Swezey, O. H., H. S. P. A. Experiment Station, Honolulu, T. H.: 128 North American Delphadids. Gift.

Tanner's Council of America, 41 Park Row, N. Y.: Dictionary of Leather Terminology. Gift.

Thompson, Leslie, Carmel, Calif.: 1 Boyles' Milk Snake from Carmel Valley, Monterey County, Calif. Gift.

Tose, Frank, California Academy of Sciences, San Francisco: 3 water snakes from Creston, British Columbia, Canada; 1 Western Gull, 1 Black-crowned Night Heron, 2 Kildeers, 1 Coot, 1 California House Finch, 1 Pied-billed Grebe, 1 Murre, 1 Audubon Warbler from vicinity of San Francisco; 11 bird skins from Marin County; 1 copy Museum Craft, July 16, 1928. Gift.

Trost, H., deYoung Memorial Museum, Golden Gate Park, San Francisco: 1 snake (*Diadophis amabilis*), from Cloverdale, Calif. Gift.

Tucumán, Universidad Nacional, Mexico City, Mexico: 13 periodical numbers. Exchange.

United States National Park Service, San Francisco: 16 periodical numbers. Gift.

Universidad Nacional de Tucumán, Buenos Aires, Argentina: Lafone Quevedo, Samuel A., Tesoro de Catamarqueñismos. Buenos Aires. 1927; Borda, Manuel Lizondo, Historia de la Gobernación del Tucumán. 1928. Gift.

Vanadium Corporation of America, 120 Broadway, New York City: Simonds, Herbert R., Manufacturers' Research Broadens Use of Alloy Steels. Reprint from Iron Trade Review, Sept. 27, 1928; Automotive Springs, 1928. Gift.

Van Duzee, E. P., California Academy of Sciences, San Francisco: Pennsylvania Agri. Exper. Sta., 41st Annual Report, 1927-1928; 2 pamphlets and 3 periodical numbers. Gift. 402 miscellaneous insects. Exploration.

Van Duzee, M. C., 12 Abbotsford Place, Buffalo, New York; 9 Diptera. Gift.

Van Dyke, Dr. E. C., 2440 Stuart Street, Berkeley, Calif.: 1 *Myotis*, in flesh, from Alameda County, Calif.; 5 salamanders from California; 3 small lots of land shells from Coachella, Carpenteria, and Big Basin State Park, California; 2094 miscellaneous insects. Gift.

Van Dyke, Mrs. E. C., 2440 Stuart Street, Berkeley, Calif.: 282 botanical specimens from southern California. Gift.

Venturi, S., Tucumán, Argentina: 451 botanical specimens from Argentina. Purchase.

Viosca, Percy, New Orleans, Louisiana: 143 cricket frogs, 106 toads, 143 tree frogs, 3 species, from Louisiana. Purchase.

Vortriede, William, State Gardener, Capitol Park, Sacramento, Calif.: 136 botanical specimens from Sacramento and El Dorado counties, and 85 specimens from the Tahoe Region. Gift.

Walker, Winslow M., University of California, Berkeley, Calif.: Pipe from Nushagak, Alaska, brought in 1925 by Wesley F. Walker, 1525 Eighth Avenue, San Francisco. Gift.

Walther, Eric, Golden Gate Park, San Francisco: 241 specimens of exotic plants. Gift.

Wheeler, Dr. W. M., Bussey Institute, Forest Hills, Boston, Mass.: 267 ants. Gift.

Wilder, H. E., Carlotta, Humboldt County, Calif.: 1 Flying Squirrel from Humboldt County, Calif. Purchase.

Wilip, J., Tartu-Dorpat, Esthonia: 2 seismological publications. Gift.

Williams, F. X., Honolulu, T. H.: 1 salamander (*Oedipus* sp.), from Para, Brazil. Gift.

Winterhalter, W. K., 2211 Buchanan Street, San Francisco: 1 bottle containing some stones and chips of wood; 2 whale centrum vertebræ; 2 model Eskimo kayaks; 2 arrows and a leather pouch from Alaskan Indians; 12 cross-sections of various woods; 1 wooden bottle from Hungary; 1 pair of Elk antlers detached from skull; 5 pieces of paper cloth, 1 paper suit, and 1 pair of wooden soled shoes of German war-time make. Gift.

Wright, Mrs. Dora E., San Francisco, Calif.: 2957 Chinese insects. Purchase.

Wright, J. T., San Francisco, Calif.: 14 snakes, 92 lizards, and 10 frogs from Chekiang Province, China. Purchase.

Yale University, Bingham Oceanographical Collections, New Haven, Conn.: 8 periodical numbers. Gift.

Yalta, Crimea, Government Botanical Gardens: 1 botanical publication. Exchange.

Zoologisk Museum, Oslo, Norway: 2 pamphlets on Ornithology. Exchange.

Acknowledgments

In the past year many courtesies have been extended to the Academy by individuals and institutions that are interested in what we are doing for the community and the entire Pacific Coast in scientific research and educationally.

First of all our appreciation must be acknowledged of the kindness shown by those who gave one or more lectures in our Sunday afternoon free lecture course and at the regular stated Academy meetings.

Grateful thanks are also due the large number of friends who have donated specimens or books to the Museum or the Aquarium. The Southern Pacific Company, the Atchison, Topeka, and Santa Fé Railway System, the Matson Navigation Company, and the Los Angeles Steamship Company, have each continued their interest in the scientific and educational activities of the Academy, and each has extended many courtesies to the Academy and members of the Museum and Aquarium staffs that have aided us greatly in our field work. Without their cooperation so generously given our work in building up the Museum and Aquarium exhibits and study collections would have been seriously hampered.

FINANCIAL STATEMENTS

REPORT OF THE TREASURER

For the fiscal year ending December 31, 1928

January 1, 1928, Balance due Crocker First National Bank....		$ 4,133.96
Receipts:		
Dues	$ 3,665.00	
Charles Crocker Scientific Fund Endowment Income	1,719.75	
James Lick Endowment Income	69,211.63	
General Income	18,991.90	
John W. Hendrie Endowment Income	1,005.00	
Publication	503.30	
Interest	1,033.46	
Ignatz Steinhart Trust Interest	657.25	
Post Card Sales	1,041.04	
Southern Counties Gas Company of California (Bond Sale)	100.00	
Bills Receivable	13,000.00	
W. G. Wright Fund	10.00	
Duplicate Sales Account	23.80	
Total Receipts		$110,962.13
		$106,828.17

REPORT OF THE TREASURER—Continued

Expenditures:

Interest	$ 11,391.15	
Contingent Fund	554.59	
Salary Expense General	19,481.07	
Museum Department Salaries	20,424.04	
Museum Department Appropriations	12,371.36	
Bills Payable	10,000.00	
Bills Receivable	10,000.00	
Earthquake Insurance Sinking Fund	1,200.00	
Insurance	1,295.45	
American Trust Company Stock	6,471.50	
Wild Life Protection Fund	159.25	
Sundry Creditors	1,188.87	
Expense	2,696.41	
Library	4,761.00	
Publication	8,616.04	
Total Expenditures		$110,610.73
January 1, 1929, Balance due Crocker First National Bank		$ 3,782.56

M. Hall McAllister, *Treasurer.*

Examined and found correct,

McLaren, Goode & Co., *Certified Public Accountants.*

San Francisco, Calif., February 18, 1929.

INCOME AND OPERATING EXPENSES

For the fiscal year, January 1, 1928, to December 31, 1928.

Income:		
Charles Crocker Scientific Fund Endowment Income	$ 1,719.75	
James Lick Endowment Income	69,211.63	
General Income	18,991.90	
Dues	3,764.00	
Interest from Temporary Investments	1,033.46	
Profit on Post Card Sales	610.55	
Total Income		$ 95,331.29
Expenditures:		
General Expense	$ 2,755.56	
Salaries	39,958.86	
Interest	11,391.15	
Insurance	1,295.45	
Total Expenditures		$ 55,401.02
Net Income Transferred to Surplus Account		$ 39,930.27

SUMMARY OF SURPLUS ACCOUNT

December 31, 1928

Balance January 1, 1928		$520,625.92
Additions:		
Net Income for the year ended December 31, 1928	$ 39,930.27	
Sale of duplicate books	23.80	
Income from John W. Hendrie Trust	1,965.00	
Total Additions to Surplus		$ 41,919.07
		$562,544.99
Deductions:		
De Vry Motion Picture camera lost at sea	$ 147.00	
Depreciation	15,866.46	
Total Deductions from Surplus		$ 16,013.46
Surplus, December 31, 1928		$546,531.53

BALANCE SHEET

December 31, 1928

Assets

Property:		
Real Estate, 831-833 Market Street	$600,000.00	
Commercial Building, 833 Market Street	516,818.66	
Real Estate, Jessie Street	8,083.65	
		$1,124,902.31
Museum, Golden Gate Park:		
Building Construction	$192,025.92	
General Collections	190,431.72	
Library and Equipment	139,452.21	
Tools and Equipment	44,140.73	
Office Furniture	5,287.06	
		$ 571,337.64
Investment Securities		$ 26,090.58
Ignatz Steinhart Trust:		
Bills Receivable	$ 12,000.00	
Steinhart Aquarium Construction	263,390.29	
Steinhart Aquarium Equipment	27,129.87	
Steinhart Aquarium Revolving Fund	5,000.00	
Uninvested cash on hand	270.62	
		$ 307,790.78
Current Assets:		
Bills Receivable	$ 10,000.00	
Post Cards in stock	594.08	
Cash on hand	156.90	
Sundry Accounts	100.00	
		$ 10,850.98
Total		$2,040,972.29

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
Funds Held for Special Purposes:		
Alvord Bequest Botanical	$ 5,000.00	
Earthquake Insurance Sinking Fund Income	269.08	
W. G. Wright Fund	31.54	
Henry M. Holbrook Bequest	25.28	
Park Birds Handbook Fund	20.00	
Wild Life Protection Fund	69.91	
		$ 5,415.81
Reserve for Depreciation		$133,553.02
Ignatz Steinhart Trust:		
Principal	$250,000.00	
Interest	57,790.78	
		$307,790.78
Notes and Accounts Payable:		
Bills Payable	$205,000.00	
Accounts Payable, Sundry Trade Creditors	125.66	
Due Crocker First National Bank (Overdraft)	3,782.56	
Due Ignatz Steinhart Trust	270.62	
		$209,178.84
Surplus		$546,531.53
Total		$2,040,972.29

Susie M. Peers,
Secretary, Board of Trustees.

We have examined the foregoing Balance Sheet, together with the books and accounts of the California Academy of Sciences, and in our opinion, it is properly drawn up so as to exhibit a true and correct view of the Academy's affairs, as shown by the books.

McLaren, Goode & Co.,

Certified Public Accountants.

San Francisco, Calif.,
February 18, 1929.

INDEX TO VOLUME XVII, FOURTH SERIES

New names in **heavy-faced** type

A

B

March 28, 1930

D

E

F

G

H

I

J

K

L

O

P

R

S

T

U

V

W

Y

Z

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVII, No. 3, pp. 67-87 June 22, 1928

III

A Key to the Species of Eucalyptus Grown in California

BY

ERIC WALTHER

SAN FRANCISCO

Published by the Academy

1928

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, NOS. 4 AND 5, pp. 89-185, 5 text figs., plates 2-9 JUNE 22, 1928

IV

Tertiary and Pleistocene Mollusca From the Galapagos Islands

V

Landshells of the Galapagos Islands

BY

WILLIAM HEALEY DALL

AND

WASHINGTON HENRY OCHSNER

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1928

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

Fourth Series

Vol. XVII, No. 7, pp. 205-246, plates 11 and 12 June 29, 1928

VII

Some Pyramidellidæ from the Gulf of California

BY

FRED BAKER

G. DALLAS HANNA

AND

A. M. STRONG

SAN FRANCISCO

Published by the Academy

1928

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. XVII, Nos. 11 AND 12, pp. 297-360 MAY 22, 1929

XI

Report of the President of the Academy for the Year 1928

BY

C. E. GRUNSKY

President of the Academy

XII

Report of the Director of the Museum for the Year 1928

BY

BARTON WARREN EVERMANN

Director of the Museum

SAN FRANCISCO

PUBLISHED BY THE ACADEMY

1929