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Vol. XXI



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PROCEEDINGS

California Academy of Sciences

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PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

Vol. XXI, No. 1, pp. 1-2

MARCH 14, 1933

" 2 _____
**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 1

FOREWORD

BY

C. E. GRUNSKY

*President and Acting Director
California Academy of Sciences*

Early in 1932, under auspices of the California Academy of Sciences, and in conformity with arrangements made with the late Dr. Barton Warren Evermann, Director of the Museum and Steinhart Aquarium, and Executive Curator of the Academy, Mr. Templeton Crocker's scientific expedition on his yacht *Zaca* left San Francisco for an extended cruise to the Galapagos Archipelago, and to other islands of the Pacific Ocean and to the coast of Central America and Mexico. The *Zaca* was thoroughly equipped for scientific work. The following members of the Academy's staff of scientists were detailed to accompany the expedition: Mr. H. S. Swarth, Curator of the Department of Ornithology and Mammalogy, who, however, returned to San Francisco after the Galapagos Islands had been visited; Mr. H. Walton Clark, Assistant Curator of the Department of Ichthyology; Mr. John Thomas Howell, Assistant Curator of the Department of Botany; and Mr. Robert J. Lanier, Assistant Superintendent of the Academy's Steinhart Aquarium.

To this scientific staff Mr. Crocker added an artist, Toshio Asaeda, to make water color records of birds, reptiles, crabs, fishes and other marine life.

March 14, 1933

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The expedition departed from San Francisco on March 10, 1932, and returned to the same port on the following September 1st. It has come to be known as the "Templeton Crocker Expedition of the California Academy of Sciences, 1932."

Volume No. XXI of the Proceedings of the Academy has been set apart for the publication of the results of this expedition. It is anticipated that the examination and study of the large amount of material which has been secured will extend through several years. There is, in the circumstances, uncertainty both as to the number of pages which will be covered by the reports which are looked forward to, as well as to the rate at which the Academy's financial resources will permit publication. It is, in consequence, not possible to indicate at the outset, whether a subdivision of this volume into parts, as now seems probable, will ultimately be found necessary. If this should prove to be the case provision will later be made for such subdivision.

It remains to be noted that at a joint meeting of the Trustees and the Council of the Academy on September 19, 1932, Mr. Crocker was declared to be a "Benefactor" of the Academy. To this honor he had become entitled by reason of the fact that the entire expense of the expedition had been borne by him as a contribution to the scientific research activities of the Academy. The distinction thus conferred upon Mr. Crocker appears particularly appropriate in view of the fact that his grandfather, the late Charles Crocker, had endowed the Academy with \$20,000 to aid it in its scientific research activities, and that the late Colonel Charles Frederick Crocker, the father of Templeton Crocker, had been President of the Board of Trustees of the Academy for some years, continuing in this office to the time of his death in 1897.

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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

Vol. XXI, No. 2, pp. 3-9; plate 1

MARCH 14, 1933

**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 2

INTRODUCTORY STATEMENT

THE EXPEDITION ON THE YACHT *ZACA* TO THE GALAPAGOS
ARCHIPELAGO AND OTHER ISLANDS AND TO THE
COAST OF CENTRAL AMERICA AND MEXICO
MARCH 10 TO SEPTEMBER 1, 1932

BY

TEMPLETON CROCKER

Having the desire to further the scientific work along lines of natural history which has been quietly pursued by the California Academy of Sciences, the facilities which were at my command in 1932 for voyaging in the Pacific Ocean were offered to the late Dr. Barton Warren Evermann, then the Executive Curator of the Academy and Director of its scientific activities. This offer having been accepted, steps were at once taken to outfit my yacht *Zaca* for an extended scientific cruise. Not least among these preparations was the installation of tanks and a system of water circulation for the care of live fishes, as it was proposed to bring back as many as possible for the Academy's Steinhart Aquarium.

The *Zaca* is a motor equipped schooner with average cruising speed of about seven knots. Her length over all is 118 feet. The officer in charge of navigation was Captain Garland Rotch; the Medical Officer was Dr. Albert E. Larsen. The crew consisted of thirteen men, namely: First and Second Mates, Radio Operator, Chief and Second Engineer, Cook and assistant, Steward and assistant, and four seamen.

To the scientists who had been detailed for service on the expedition there was added a Japanese artist, Toshio Asaeda, who proved exceptionally expert in reproducing in water colors the marvelous specimens of marine life which were encountered on the expedition. Within the five months and three weeks that we were afloat, he painted some 300 individual specimens of fishes, crabs and other marine life, besides some birds, reptiles and insects, with remarkable fidelity to shape and color. Asaeda was also the photographer of the expedition and at its termination had some 1,400 photographs to his credit.

Cruising was uneventful. There were but ten hours of bad weather. Landings were made where desired without exceptional difficulties and explorations into the interior were arranged wherever there was promise of something unusual. We had quickly learned that it was not safe to let any one wander inland alone, so the rule was strictly enforced that any one off on an exploration must be accompanied by some one else. The members of the crew were always ready and soon became valuable aids as collectors.

Briefly stated this cruise of more than five months took us from San Francisco to the west coast of Mexico and Central America, to Cocos Island, the Tres Marias Islands, the Revillagigedo Islands, Cedros Island, Guadalupe Island and San Nicolas Island. Two months were spent at the Galapagos Archipelago. At all these places collections of fauna and flora were made and deep-sea dredging was resorted to for specimens from the ocean floor. The 168 stations occupied for dredging operations yielded much valuable material. At some of these stations we were pioneer explorers. The collections were successful to a maximum depth of 210 fathoms.

There were brought back 331 live fishes on the *Zaca* for exhibition in the Steinhart Aquarium. The extent of the collections of natural history specimens is indicated by the following preliminary statements furnished by the curators of the various departments of the California Academy of Sciences:

Botany: About 3,000 specimens of plants (not including duplicates) were obtained. Some species of flowering plants from the Galapagos had not been collected since the visit of Charles Darwin in the *Beagle*. Over 100 specimens of cacti were obtained, 40 of which are from the Galapagos; these latter are expected to serve as a basis of a critical study of the species found there. Over 200 specimens of marine algae were obtained at the Galapagos, and additional large collections were obtained from Lower California and other places where dredging was done. A large number of Hepaticae with smaller numbers of mosses and fungi were obtained in the tropical rain forests of the Galapagos Islands and Cocos Island.

Entomology: Although no trained entomologist accompanied the expedition, over 2,400 insects were taken by Mr. Maurice Willows

to whom I assigned this duty. The collections of Hemiptera and Diptera from the Galapagos are of special interest because these groups were largely neglected by the Academy's expedition of 1905-1906.

Ichthyology: A large collection of fishes was obtained by all the usual means employed in such work except explosives. Special attention was paid to tide pools and the use of a submarine light. Some excellent species were obtained in deep water with the dredges and trawls.

Herpetology: Since most of the localities visited had been previously explored by herpetologists, less attention was given to this branch of study. However, a snake was obtained on Duncan Island of the Galapagos, the second ever taken there. Forty sea snakes were taken along the Central American coast.

Paleontology: Investigations and collections for this department were made at numerous places and by most of the members of the expedition. Records of some of the raised beaches of the Galapagos show that extensive earth movements have taken place there within comparatively recent time. Fossils were collected at several points in the Galapagos Islands at localities additional to those which were made known by the Academy Expedition of 1905-1906. The large amount of dredging which was done resulted in the bringing together of a huge collection of marine shells. Excellent specimens of *Xenophora* were obtained along the Central American coast; the genus has apparently hitherto been obtained but once from western North America. Five specimens of a striking jet black *Mitra* (not *belcheri*) fully five inches long were dredged off the coast of Lower California. Brachiopoda, Echinoidea, Asteroidea, sponges, corals and many Crustacea were collected in large numbers and at many places.

Ornithology: A collection of about 400 specimens of birds was brought back by the expedition. By far the greatest number were taken on the Galapagos Islands where special effort was made to select certain species or particular plumages to fill out the Academy's series. One species of finch not known since the time of Charles Darwin and supposed to be extinct was found to have survived on some of the islands. The birds of these islands are of exceptional interest, not only because of their many remarkable peculiarities, but because the study of them was largely responsible for the formulation of Darwin's theory of evolution. By the use of the freezing equipment installed aboard the ship, it was possible to bring back numerous birds in the flesh.

Aquarium: The tanks on the deck of the *Zaca* were equipped for constant circulation of sea water. By heating this water from the exhaust of the motors it was possible to bring the tropical forms alive

from as far south as the Galapagos to San Francisco. Many of the gaudily colored fishes from warm waters seem to lose some of their brilliance when placed in the aquarium, although otherwise they appear normal in every way. The transportation of the living fishes called for constant vigilance. The water circulation apparently imposed no hardship on the fishes themselves, but its maintenance without interruption devolved on Mr. Lanier who was constantly giving these fishes his expert attention. No one else could have succeeded as he did. The live fish carried on the *Zaca* consumed 640 pounds of food during the cruise.

As one of the achievements of the expedition it is to be noted that an exploration of the fog belt or wet zone of the mountain on Indefatigable Island of the Galapagos group was undertaken, and its summit reached on May 9, 1932. Our party was the first to have ever made this ascent.

It gives me particular pleasure to record the fact that the courtesies extended to the members of the expedition wherever a stay was made, were numerous and wholehearted. The coöperation and good will of the governments of the several countries visited and of their representatives were always manifest and are gratefully acknowledged.

I wish to acknowledge also the resourcefulness of Captain Rotch and his splendid coöperation on all matters; the willingness and unselfishness of the crew, and above all the tolerance which every member of the cruise showed toward my authority.

An itinerary of the expedition together with a list of those who participated is attached hereto.

APPENDIX A

Members of the Expedition:

Mr. Templeton Crocker.
 Mr. Maurice Willows, Secretary to Mr. Crocker
 and collector of insects.
Captain Garland Rotch.
Mr. John Ozanne, First Mate.
Mr. Garth Basford, Chief Engineer.
Mr. Karl Elm, Second Mate.
Mr. Arnold Wehlin, Second Engineer.
Dr. Albert E. Larsen, Medical Officer.
Rene Gasse, Radio Operator.
H. Petersen, A/B.
B. Bendiksen, A/B.
Jack Ratikan, A/B.
Frank Taiga, A/B.
Henry Miller, First Cook.
Merle L. McPherren, Second Cook.
Pemassa Utu, Messboy.
Basil Kalhimanis, Messboy.

Scientific Staff:

Mr. Harry S. Swarth, in charge, Curator of the
 Department of Mammalogy and Ornithology.
 (Left expedition from Punta Arenas on June
 27 for San Francisco.)
Mr. H. Walton Clark, Assistant Curator of the
 Department of Ichthyology.
Mr. John Thomas Howell, Assistant Curator of
 the Department of Botany.
Mr. Robert J. Lanier, Assistant Superintendent
 of the Steinhart Aquarium.
Mr. Toshio Asaeda, Artist and Photographer.

APPENDIX B

ITINERARY OF THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932

By CAPTAIN GARLAND ROTCH

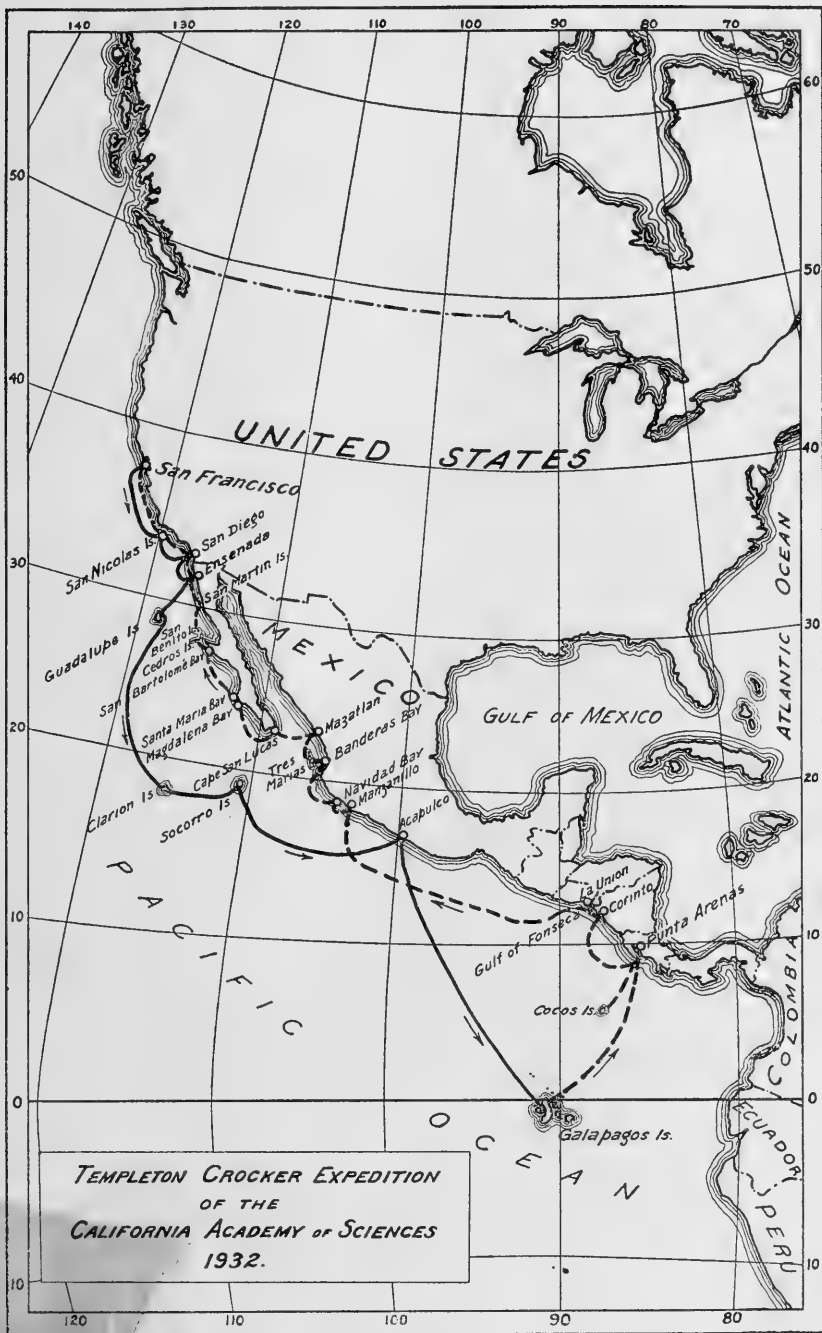
| <i>Place</i> | <i>Arrival</i> | <i>Departure</i> |
|---|----------------|------------------|
| San Francisco..... | | March 10 |
| San Nicolas Island..... | March 12 | March 13 |
| San Diego..... | March 14 | March 14 |
| Ensenada..... | March 15 | March 15 |
| Guadalupe Island..... | March 16 | March 18 |
| Clarion Island..... | March 22 | March 24 |
| Socorro Island..... | March 26 | March 29 |
| Acapulco..... | April 2 | April 7 |
| Galapagos Islands | | |
| Chatham (Wreck Bay)..... | April 15 | April 15 |
| Off Abingdon..... | April 16 | April 16 |
| Bindloe..... | April 16 | April 16 |
| Chatham (Wreck Bay)..... | April 17 | April 19 |
| Hood (Gardner Bay)..... | April 19 | April 22 |
| Charles (Post Office Bay)..... | | |
| (Black Beach Road)..... | | |
| (Cormorant Bay)..... | April 23 | April 27 |
| Albemarle (Villamil)..... | | |
| (Santo Tomas)..... | April 27 | April 30 |
| Brattle..... | April 30 | April 30 |
| Off Crossman..... | April 30 | April 30 |
| Indefatigable (Academy Bay)..... | May 1 | May 14 |
| Charles (Black Beach Road)..... | | |
| (Post Office Bay)..... | May 14 | May 20 |
| Albemarle (Iguana Cove)..... | | |
| (West Coast)..... | | |
| (Vicinity Elizabeth Bay)..... | | |
| (Tagus Cove)..... | May 21 | May 28 |
| Narborough (Northeast Coast)..... | May 28 | May 29 |
| Albemarle (Vicinity Cape Marshall)..... | May 29 | May 31 |
| Narborough (Northeast Coast)..... | May 31 | June 2 |
| James (James Bay)..... | June 3 | June 6 |
| Jervis..... | June 6 | June 7 |
| Duncan..... | June 7 | June 8 |
| Indefatigable (Conway Bay)..... | | |
| (North Coast)..... | June 8 | June 9 |
| Seymour (South)..... | June 9 | June 11 |
| (North)..... | June 11 | June 12 |
| James (Sullivan Bay)..... | June 12 | June 14 |
| Tower (Darwin Bay)..... | June 15 | June 16 |
| Punta Arenas..... | June 22 | June 26 |
| Cocos Island (Chatham Bay)..... | | |
| (Wafer Bay)..... | June 28 | June 28 |
| Punta Arenas..... | June 30 | June 30 |
| Braxilito Bay..... | July 1 | July 2 |
| Murcielago Bay..... | July 2 | July 3 |
| Port Parker..... | July 3 | July 4 |

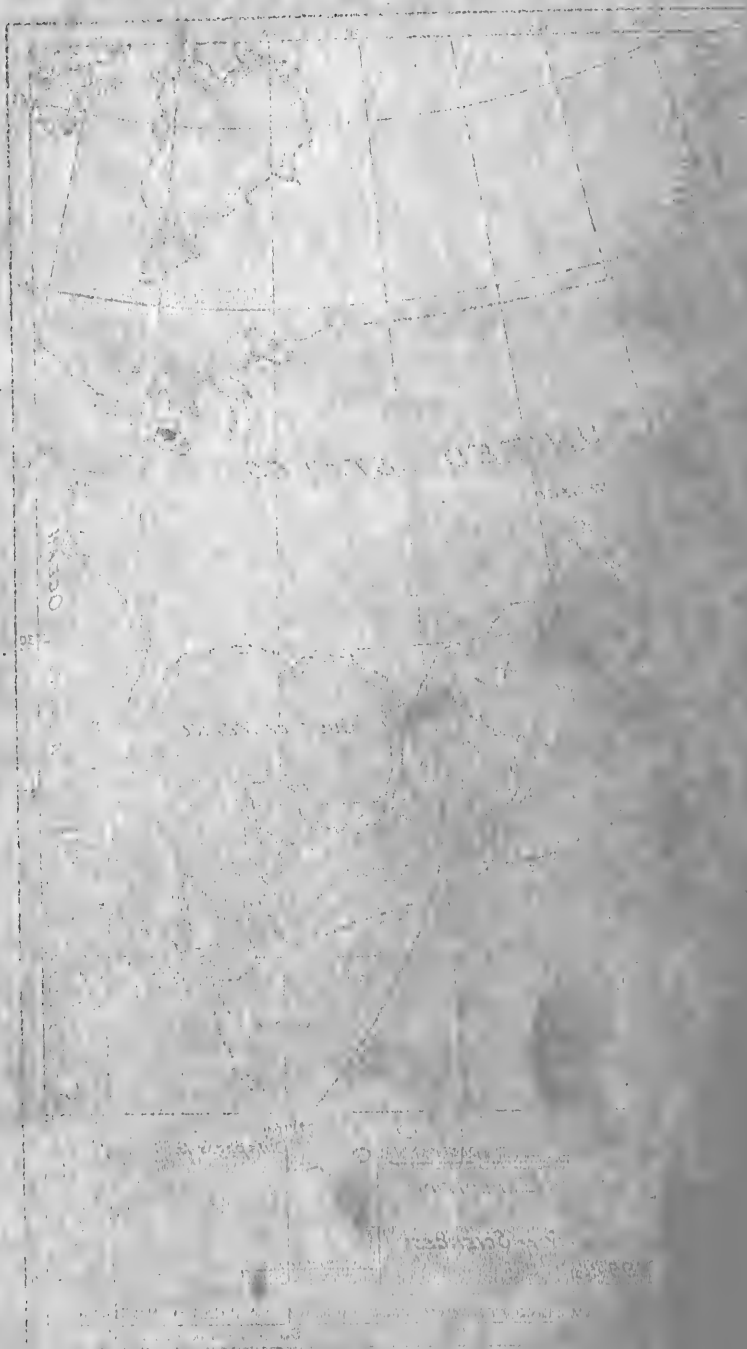
| <i>Place</i> | <i>Arrival</i> | <i>Departure</i> |
|--------------------------------------|----------------|------------------|
| Corinto..... | July 5 | July 5 |
| Gulf of Fonseca..... | July 6 | July 9 |
| La Union..... | July 9 | July 9 |
| Manzanillo..... | July 18 | July 18 |
| Navidad Bay..... | July 18 | July 19 |
| Banderas Bay (Puerto Vallarta)..... | | |
| (Punta Mita)..... | July 20 | July 22 |
| Maria Madre Island..... | July 23 | July 25 |
| San Juanito Island..... | July 25 | July 25 |
| Maria Madre Island..... | July 25 | July 27 |
| Isabel Island..... | July 27 | July 28 |
| Mazatlan..... | July 30 | Aug. 2 |
| Cape San Lucas..... | Aug. 5 | Aug. 7 |
| Magdalena Bay..... | Aug. 8 | Aug. 11 |
| Santa Maria Bay..... | Aug. 11 | Aug. 12 |
| San Bartolomé..... | Aug. 14 | Aug. 15 |
| Cedros Island (Southeast Coast)..... | Aug. 15 | Aug. 17 |
| Natividad Island..... | Aug. 17 | Aug. 17 |
| Cedros Island (South Bay)..... | Aug. 17 | Aug. 18 |
| San Benito Islands..... | Aug. 18 | Aug. 18 |
| San Martin Island..... | Aug. 19 | Aug. 21 |
| Ensenada..... | Aug. 22 | Aug. 22 |
| San Diego..... | Aug. 23 | Aug. 23 |
| Cortes Bank..... | Aug. 24 | Aug. 25 |
| San Nicolas Island..... | Aug. 26 | Aug. 28 |
| San Francisco..... | Sept. 1 | |

THE HISTORY OF THE UNITED STATES

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| 1776 | 1777 | 1778 | 1779 | 1780 | 1781 | 1782 | 1783 | 1784 | 1785 | 1786 | 1787 | 1788 | 1789 | 1790 | 1791 | 1792 | 1793 | 1794 | 1795 | 1796 | 1797 | 1798 | 1799 | 1800 | 1801 | 1802 | 1803 | 1804 | 1805 | 1806 | 1807 | 1808 | 1809 | 1810 | 1811 | 1812 | 1813 | 1814 | 1815 | 1816 | 1817 | 1818 | 1819 | 1820 | 1821 | 1822 | 1823 | 1824 | 1825 | 1826 | 1827 | 1828 | 1829 | 1830 | 1831 | 1832 | 1833 | 1834 | 1835 | 1836 | 1837 | 1838 | 1839 | 1840 | 1841 | 1842 | 1843 | 1844 | 1845 | 1846 | 1847 | 1848 | 1849 | 1850 | 1851 | 1852 | 1853 | 1854 | 1855 | 1856 | 1857 | 1858 | 1859 | 1860 | 1861 | 1862 | 1863 | 1864 | 1865 | 1866 | 1867 | 1868 | 1869 | 1870 | 1871 | 1872 | 1873 | 1874 | 1875 | 1876 | 1877 | 1878 | 1879 | 1880 | 1881 | 1882 | 1883 | 1884 | 1885 | 1886 | 1887 | 1888 | 1889 | 1890 | 1891 | 1892 | 1893 | 1894 | 1895 | 1896 | 1897 | 1898 | 1899 | 1900 | 1901 | 1902 | 1903 | 1904 | 1905 | 1906 | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 1938 | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
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The history of the United States is a complex and multifaceted story. It begins with the early colonial period, where European settlers established colonies along the Atlantic coast. The struggle for independence culminated in the American Revolution, which led to the formation of the United States as a sovereign nation. The early years of the republic were marked by the challenges of building a new government and a unified identity. The Constitution of 1787 provided the framework for the federal government, and the Bill of Rights guaranteed the fundamental liberties of the citizenry. The 19th century was a period of rapid expansion and growth, as the United States stretched across the continent. This era was also characterized by the struggle for westward expansion, the rise of the industrial revolution, and the emergence of the abolitionist movement. The Civil War (1861-1865) was a pivotal moment in American history, as it resolved the issue of slavery and preserved the Union. The Reconstruction period (1865-1877) followed, as the nation sought to rebuild and integrate the newly freed African Americans. The 20th century brought further challenges, including the rise of the Progressive Era, the Great Depression, and the Second World War. The post-war period saw the United States emerge as a superpower, leading the world in the Cold War and the Space Age. Today, the United States continues to evolve, facing new challenges and opportunities in the 21st century.







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No. 3

THE GENUS MOLLUGO IN THE GALAPAGOS ISLANDS

BY

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INTRODUCTION

One of the genera early recognized in the midst of a strange insular flora was the genus *Mollugo* of the Carpetweed Family. At Wreck Bay, Chatham Island, the first locality in the Galapagos Islands visited by the Templeton Crocker Expedition of the California Academy of Sciences, this genus was brought to special attention by the discovery of a broad-leaved form and a narrow-leaved form growing on sandy flats near the shore. Henceforth *Mollugo* was watched and collected with critical attention. Until the later days of exploration in the archipelago little seemed to be gained from this special consideration other than new distributional data for species well known, but in the last few weeks in the Galapagos Islands, several forms of *Mollugo* were found which were recognized immediately as different, either as new records for the archipelago or as plants new to science. Because of this special interest taken in the genus, it has been the first in the botanical collections of the Crocker Expedition to be studied critically, the results of the study being given in the following paper. Since a number of forms are described as new it has seemed proper to recount all that is known of the genus in the Galapagos Islands. As a result, the genus will probably come to be counted among the other genera having a notable endemic development in the islands.

The Galapagian species of *Mollugo* constitute a highly specialized group, perhaps most closely related to the North American species

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M. verticillata. From that species, the insular species are readily distinguished by the minutely but definitely tuberculate seeds. Although the island endemics are diverse in habit and floral characters, it is probable that they represent the differentiation and segregation of a single variable prototype, and hence are to be considered closely related. Differentiation would seem to have followed two lines, originating in a glabrous annual form with three and five stamens, the one line developing a subshrubby perennial habit and large flowers, the other line developing a low woody caudex and strikingly glandular herbage. In both lines there is an increase in the number of stamens, approaching or equalling eight, the sum of the five stamens opposite the sepals and the three stamens alternate with the cells of the capsule, two staminal arrangements which occur in the *M. verticillata* type. The geographic separation of the several forms on the different islands has undoubtedly been an important factor in the segregation and maintenance of the specialized developments.

Besides the large collection in the Herbarium of the California Academy of Sciences, made on the Academy expedition to the Galapagos Islands in 1905 and 1906, the writer was privileged through the courtesy of Dr. B. L. Robinson of the Gray Herbarium and Dr. L. R. Abrams of the Dudley Herbarium to borrow the specimens in those institutions. The following symbols are used in citing specimens: C, herbarium of the California Academy of Sciences; D, Dudley Herbarium of Stanford University; G, Gray Herbarium of Harvard University.

KEY TO THE SPECIES

1. PLANTS ANNUAL

- a. Seeds somewhat angular, microscopically ridged on back and reticulate on sides, very small; delicately branched glaucescent plants. 1. *M. Cerviana*
- a. Seeds roundish-reniform or ovate, not angled, finely tuberculate, sometimes ridged on back; plants more robust.
 - b. Flowers small, sepals 1-2 mm. long.
 - c. Seeds deeply ridged on back; style 0.5-0.75 mm. long; stamens 5-8. 5. *M. insularis*
 - c. Seeds not deeply ridged on back (somewhat ridged in *M. striata* and *M. gracillima latifolia*); style mostly less than 0.5 mm. long; stamens 3 (or 4).
 - d. Seeds distinctly subreniform; annuals.
 - e. Seeds generally brown and less than 0.5 mm. long; funiculus not prominent. 2. *M. gracillima*
 - e. Seeds generally black, 0.5 mm. or more long; funiculus prominent (except in *M. flavescens intermedia*) 3. *M. flavescens*
 - d. Seeds subovate, striate-lineate, about 0.5 mm. long, the funiculus not prominent; probably perennial. 4. *M. striata*
 - b. Flowers large, sepals 2-3 mm. long; stamens 8. 7. *M. floriana*

2. PLANTS PERENNIAL

- f. Stems, leaves, pedicels, and sepals not glandular-hairy.
 - g. Flowers 2 mm. long; herbaceous plants with spreading or prostrate stems.
 - h. Stamens 5-8; style 0.5-0.75 mm. long; seeds subreniform, deeply ridged, funiculus prominent . . . 5. *M. insularis*
 - h. Stamens 3; style about 0.33 mm. long; seeds subovate, merely striate-lineate, funiculus short and not prominent . . . 4. *M. striata*
 - g. Flowers 3-4 mm. long (2-2.5 mm. long in var.); twiggly plants with erect stems 1-4 dm. tall; seeds lineate on back . . . 8. *M. Snodgrassii*
- f. Stems, leaves, pedicels, and sepals glandular-hairy . . . 6. *M. Crockeri*

1. *Mollugo Cerviana* (L.) Seringe in DC., Prodr. 1: 392 (1824)

Pharnaceum Cerviana L., Spec. Pl. 1: 272 (1753).

Delicate annual with erect, glabrous stems, 3-15 cm. long; leaves glaucous, linear; flowers 1-3 on divaricate pedicels at the summit of almost leafless branches; sepals 4, 1.5-2 mm. long, elliptic; stamens 4; seeds 0.25-0.33 mm. long, minutely reticulate, somewhat angular.

Collections.—ALBEMARLE ISLAND: edge of lava flow at west base of Tagus Cove Mt., *Howell No. 9588* (C); slopes just east of head of Tagus Cove, *Howell No. 9603* (C). JAMES ISLAND: dunes, Sullivan Bay, *Howell No. 10017* (C). SOUTH SEYMOUR ISLAND: sandy flat back of beach, middle western coast, *Howell No. 9954* (C); *Wheeler, Rose, and Beebe in 1923* (G).

To find this small, widely distributed *Mollugo* so well established on the Galapagos Islands is of more than usual interest. The fact that the species has been found at some stations rarely visited by vessels would have it appear that this is a species not introduced by human agency, but rather one which has not been detected earlier because of its inconspicuous character. Its presence in the Galapagian flora adds a new note of strangeness to a distribution already remarkable.

2. *Mollugo gracillima* Ands., Stock. Akad. Handl. 226 (1854)

Root annual; stems mostly diffusely branched, spreading or suberect, generally 1-4 dm. long, glabrous; leaves 2-5 at nodes, linear or linear-oblongeolate, to 2 cm. long, 0.5-5 (or 10) mm. wide, acute or mucronulate, rarely obtuse, glabrous, not notably fleshy; flowers 1-4 at nodes; pedicels erect, divaricate or reflexed, 2-7 mm. long, generally sparsely hairy; sepals 4 or 5, 1-2 mm. long, oblong, the center green-veined, the margin whitish; stamens generally 3 (or 4), a little shorter than the sepals; styles short, plumose, 0.2-0.3 mm. long; mature capsule shorter to slightly exceeding the sepals; seeds reniform, generally less than 0.5 mm. long, minutely tuberculate, more or less finely lineate on the rounded back, brown with coppery sheen or rarely blackish, the persistent portion of funiculus not prominent, sometimes almost none.

Mollugo gracillima is one of the common, widely distributed herbs in the lower regions of the archipelago during and shortly following the short rainy period. It is most abundant and characteristic in sandy areas immediately inland from beaches but it also occurs in gravelly soil, or among rocks, or even in clay hollows, in the lower parts of the interior. It is variable in aspect and, to some extent, in technical characters, but it has not appeared best to segregate more than one of these variations taxonomically. Size and shape of leaves, length of pedicels, and size and color of seeds are variable, but the species can be rather readily distinguished from the closely related *M. flavescens* by the usually more diffusely branched spreading habit, by the tendency of the seeds to be lineate on the back, and by the less prominent funiculus. The figure of this species in Andersson's second work on the flora of the Galapagos Islands (Om Galap. Veg. t. 15, f. 3,—1857) was misnamed *M. gracilis*.

KEY TO SUBSPECIES OF *M. gracillima*

Seeds minutely lineate on back; leaves 0.5–3 mm. wide. 2a. *typica*
 Seeds rather prominently lineate on back; leaves 5–10 mm. wide. 2b. *latifolia*

2a. *Mollugo gracillima typica* Howell, nom. nov.

Mollugo gracillima Ands., Stock. Akad. Handl. 226 (1854).

M. gracilis Ands., Om Galap. Veg. t. 15, f. 3 (1857).

Stems spreading or suberect; leaves linear or linear-oblongate, 0.5–3 mm. wide, generally acute; flowers 1–1.5 mm. long; seeds generally coppery-brown and less than 0.5 mm. long, minutely lineate on the back.

Collections.—ALBEMARLE ISLAND: Villamil, *Stewart No. 1469* (C, G), *Howell No. 8965* (C); Iguana Cove, *Stewart No. 1468* (C, G), *Howell No. 9406* (C); Tagus Cove, *Stewart No. 1470* (C, G), *Howell No. 9511* (C). BARTHOLOMEW ISLAND: crevices of stratified ash, *Howell No. 10061* (C). BINDLOE ISLAND: volcanic sand on north-west coast, *Howell No. 8557* (C). CHARLES ISLAND: *Andersson in 1853* (type collection, G); *Stewart No. 1472* (C); Post Office Bay, *Howell No. 8803* (C); 2 or 3 miles south of Post Office Bay, *Howell No. 9374* (C). CHATHAM ISLAND: Wreck Bay, *Howell No. 8588* (C). INDEFATIGABLE ISLAND: Academy Bay, *Howell No. 9053* (C); Conway Bay, *Howell No. 9877* (C). JAMES ISLAND: James Bay, *Howell No. 9691, 9692* (C); Orquilla Bay, *Baur No. 153*, in part (G); Sullivan Bay, *Howell No. 10022* (C). JERVIS ISLAND: north end, only one plant seen, *Howell No. 9772* (C). NARBOROUGH ISLAND: north side on lava beds, *Stewart No. 1476* (C, G).

Several variants of subspecies *typica* are referred here and deserve mention. On Duncan Island (*Stewart No. 1474*, C, G, and *Howell No. 9839*, C), a form occurs with leaves shorter than usual and oblong-oblongate, and with the flowers glomerate at the nodes on very short pedicels. On South Seymour Island (*Howell No. 9949*, C)

is a form with leaves broader than usual, thus approaching subspecies *latifolia* which occurs on North Seymour Island, but in the southern plant the seeds are not conspicuously lineate. Rarely a plant assumes a perennial aspect, as not infrequently happens to annuals growing in desert regions, but such individuals are undoubtedly annuals affected by fluctuations of the seasonal rainfall.

2b. *Mollugo gracillima latifolia* Howell, subsp. nov.

Ramis patentibus vel prostratis; foliis oblanceolatis vel oblanceolato-spathulatis, 5–10 mm. latis, obtusis; floribus 1.5–2 mm. longis; seminibus fuliginosis, dorso striato-lineatis.

Stems spreading or prostrate; leaves oblanceolate or oblanceolate-spathulate, 5–10 mm. wide, obtuse; flowers 1.5–2 mm. long; seeds dark black-brown, 0.5 mm. long, the back striate-lineate.

Collections.—NORTH SEYMOUR ISLAND: marine bluffs, *Crocker* (type, C. A. S. Herb., No. 199033); crevices and shelves of marine bluff, *Howell No. 10001* (C); beach sand, *Howell No. 9980* (C).

The ridges on the backs of the seeds are prominent enough to impress the pattern on the closely enclosing walls of the capsule. In this seed-character *M. gracillima latifolia* resembles *M. verticillata* but differs from that species in the characters of flowers and fruit, and in the dull luster and the tuberculate sides of the seeds. With its broad leaves it might be placed in *M. flavescens* but its seeds are smaller and the funiculus less prominent. A specimen from Brattle Island (*Stewart No. 1471*, C) is old and nearly leafless but the seeds are rather prominently ridged so it is referred here until additional material can be studied.

3. *Mollugo flavescens* Ands., Stock. Akad. Handl. 226 (1854)

Root annual; stems erect or prostrate, rather sparsely branched, 1–3 dm. long, glabrous; leaves at nodes 2–5 (or 9), linear-oblanceolate or spatulate, 0.5–2 cm. long, 0.5–7 mm. wide, obtuse or acute, glabrous, somewhat fleshy-thickened; flowers 3–7 or more at nodes; pedicels generally spreading but some erect or reflexed, 2–4 (or 5) mm. long, mostly glabrous; sepals generally 5, 2 mm. long or nearly, oblong, green-veined with whitish margin, sometimes brownish-tinged; stamens 3 (or 4), slightly shorter than the sepals; style 0.3–0.5 mm. long; capsule slightly shorter than the sepals; seeds turgid-reniform, a little more than 0.5 mm. long, scarcely lineate, black-brown or black, dull or with iridescent sheen, tuberculate, the persistent portion of the funiculus deflexed and prominent (except in subsp. *intermedia*).

As compared to *M. gracillima*, *M. flavescens* and its subspecies have a most limited distribution. The typical subspecies would seem to occur only on Chatham Island and on the north side of Indefatigable Island. The two variants described here as new are confined to one island each, subsp. *angustifolia* being found on James Island and subsp. *intermedia* being found on Charles Island. The species as here defined seems to be a natural entity but one closely related to *M. gracillima*.

KEY TO SUBSPECIES OF *M. flavescens*

- a. Funiculus prominent.
 - b. Stems spreading or prostrate; cauline leaves oblanceolate to oblanceolate-spathulate, mostly twice as long as the pedicels; style about 0.3 mm. long.....*3a. typica*
 - b. Stems strictly erect; cauline leaves linear or linear-oblanceolate, those subtending the upper flowers much-reduced; style 0.3-0.5 mm. long.....*3b. angustifolia*
- a. Funiculus not prominent; stems erect but somewhat spreading; upper leaves reduced but generally equalling the flowers....*3c. intermedia*

3a. *Mollugo flavescens typica* Howell, nom. nov.

Mollugo flavescens Ands., Stock. Akad. Handl. 226 (1854).

Stems spreading or prostrate, 1-2 dm. tall; basal leaves subspathulate 1-2 cm. long, 2-5 mm. wide, cauline leaves oblanceolate to oblanceolate-spathulate, 0.4-1 cm. long, 2-3 mm. wide; pedicels loosely spreading or deflexed, subglabrous; style about 0.3 mm. long; funiculus prominent.

Collections.—CHATHAM ISLAND: *Andersson in 1853* (type collection, G); southwest end, *Baur No. 154* (G); Wreck Bay, *Howell No. 8574* (C). INDEFATIGABLE ISLAND: north side, *Snodgrass and Heller No. 667* (D, G), *Howell No. 9904* (C).

3b. *Mollugo flavescens angustifolia* Howell, subspec. nov.

Caulibus erectis, 2-3.5 dm. altis, ramis paucis, substrictis ascendentibus; foliis basi spathulato-obovatis, caulinis linearo-oblanceolatis, 1-1.5 cm. long, circa 1 mm. latis, supremis brevioribus quam 0.5 cm. longis; pedicellis erectis, glabris, floribus subcongestis; stylo 0.3-0.5 mm. longo; funiculo prominenti.

Stems erect, 2-3.5 dm. tall, the few branches almost strictly ascending; the basal leaves spathulate-obovate but the cauline leaves linear-oblanceolate, 1-1.5 cm. long and 1 mm. or less wide at the lower nodes, the uppermost reduced and mostly less than 0.5 cm. long; pedicels erect, glabrous, the flowers subcongested in small glomerules; style 0.3-0.5 mm. long; funiculus prominent.

Collections.—JAMES ISLAND: in pockets and flats of volcanic sand on nearly barren lava flow, James Bay, *Howell No. 9710* (type, C. A. S. Herb., No. 199031); cinder gravel on lower slopes of high cone at Sullivan Bay, *Howell No. 10032* (C).

3c. *Mollugo flavescens intermedia* Howell, subspec. nov.

Caulibus erectis, subpatentibus, 1.5-2.5 dm. altis; foliis radicalibus spathulatis, basi cuneatis, caulinis oblanceolatis vel linearo-oblanceolatis, 0.5-1.5 cm. longis, 0.5-3 mm. latis; pedicellis patentibus, subglabris; stylo circa 0.3 mm. longo; funiculo brevi et non prominenti.

Stems erect but somewhat spreading, 1.5-2.5 dm. tall; basal leaves spathulate with cuneate base, cauline leaves oblanceolate or linear-oblanceolate, 0.5-1.5 cm. long, 0.5-3 mm. wide; pedicels spreading, subglabrous; style about 0.3 mm. long; funiculus short and not prominent.

Collections.—CHARLES ISLAND: near Black Beach, *Howell No. 9353* (type, C. A. S. Herb., No. 199030); *Snodgrass and Heller No. 441* (G).

In appearance and in the technical characters of the seed, this plant is nearly intermediate between *M. flavescens* and *M. gracillima*. The plant is less diffusely branched than in *M. gracillima* and the leaves tend to be narrower than in typical *M. flavescens*. The persistent part of the funiculus is shorter and slenderer than that in most forms of *M. flavescens* but in the size and markings of the seed it is very near typical *M. flavescens*.

4. *Mollugo striata* Howell, spec. nov.

Herba perennis?; caulibus laxe patentibus vel ascendentibus, 1–2 dm. longis, subglabris, viridibus; foliis linearo-oblancoelatis, 1–2 cm. longis, 1–2 mm. latis, glabris, acutis obtusive; floribus 1–4 nodis; pedicellis patentibus, 1–3 mm. longis, minute pubescentibus; sepalis 5, 1.5–2 mm. longis, virescentibus, oblongis, glabris; staminibus 3, inclusis; stylo circa 0.3 mm. longo; capsula inclusa; seminibus tumidis, subovatis, parte inferiore ventre obliqua, nigris, 0.6–0.7 mm. longis, dorso striatis, lateribus tuberculato-lineatis, partibus persistentibus funiculi brevibus, prope deflexis, non prominentibus.

Root probably perennial; stems laxly spreading or ascending, 1–2 dm. long, subglabrous, green; leaves linear-oblancoelate, 1–1.8 cm. long, 1–2 mm. broad, glabrous, acute or obtuse; flowers 1–4 at nodes; pedicels spreading, 1–3 mm. long, minutely hairy; sepals 5, 1.5–2 mm. long, greenish, oblong, glabrous; stamens 3, included; style about 0.3 mm. long; capsule equalling the sepals, much-knobbed by the seeds; seeds turgid, subovate with the lower ventral part oblique, black, 0.6–0.7 mm. long, striate on back, tuberculate-lineate on sides, the persistent part of the funiculus short, closely deflexed, not prominent.

Collection.—WENMAN ISLAND: *Stewart No. 1477* (type, C. A. S. Herb., No. 133519; G).

From the rather poorly prepared specimens on which this species is based, it is not possible to state certainly whether the plant is perennial, but from the character of older stems which bear tufts of new growth near their ends as well as remains of dead twigs of earlier growth, it seems likely that the specimens are from a perennial plant. The character of the flower distinguishes it from *M. insularis*, and the large subovate seed marks it distinct from *M. gracillima* to which it is perhaps most nearly related.

5. *Mollugo insularis* Howell, spec. nov.

Herba annua vel perennis; caulibus 0.5–2 (vel 3) dm. longis, prostratis, glabris, viridibus; foliis oblancoelatis ad linearo-oblancoelatis, 0.5–2.5 cm. longis, 1–3.5 mm. latis, succulento-crassis, glabris, obtusis acutisve; floribus 3–8 nodis; pedicellis erectis, patentibus vel deflexis, 1.5–3 mm. longis, minute pubescentibus; sepalis 5, albis, virescentibus vel subferrugineis, ellipticis, 1–2 mm. longis, glabris; staminibus 5–8, inclusis; stylo 0.5–0.75 mm. longo; capsula inclusa vel sepalis aequilonga; seminibus subcompressis, nigris, 0.6 mm. longis, dorso costatis, lateribus subcostatis, costis transverse rugosis, partibus persistentibus funiculi prominentibus, deflexis.

Annual or perennial herb; stems 0.5–3 dm. long, prostrate, glabrous, green; leaves oblanceolate to linear-oblanceolate, 0.5–2.5 cm. long, 1–3.5 mm. broad, fleshy-thickened, glabrous, obtuse or acute; flowers mostly 3–8 at nodes; pedicels erect, spreading, or deflexed, 1.5–3 mm. long, minutely hairy; sepals 5, white, greenish or light brownish, elliptic, 1–2 mm. long, glabrous; stamens 5–8, included; style 0.5–0.75 mm. long; capsule included or equalling the sepals; seeds subreniform, thinnish, black, 0.6 mm. long, deeply ridged on back, shallowly ridged on the sides, the ridges transversely rugose, the persistent part of the funiculus prominent, deflexed.

Collections.—CHARLES ISLAND: Black Beach, *Howell No. 9378* (type, C. A. S. Herb., No. 199029). CHATHAM ISLAND: Sappho Cove, *Stewart No. 1466* (C, G); Bassa Point, *Stewart No. 1473* (C).

This species should be considered a perennial but plants growing in sandy or gravelly soil bloom the first year and do not persist, those growing in crevices of lava becoming perennial and developing a woody caudex similar to that in *M. Crockeri*. The lack of glandular pubescence and the peculiar seeds differentiate it from *M. Crockeri*, and the perennial base, flower, and seed mark it from *M. flavescens* and *M. gracillima*.

6. *Mollugo Crockeri* Howell, spec. nov.

Herba perennis; caulibus ligneis et persistentibus, ramis annuis, late patentibus, 0.5–2 dm. longis, glanduloso-pubescentibus, ferrugineis vel virescentibus; foliis basi tenuiter oblanceolatis, 1–2 cm. longis, 1–3 mm. latis, glanduloso-pubescentibus in margine et infra in media costa, caulibus linearibus, 0.5–2 cm. longis, 0.5–1 mm. latis, dense glanduloso-pubescentibus, subacutis, margine subrevoluto; floribus paucis, 1–3 nodis; pedicellis patentibus vel deflexis, 0.5 cm. longis, glandulosus; sepalis 5, oblongo-lanceolatis, 2–3 mm. longis, carneis, exteriore glanduloso-pubescentibus; staminibus 7, inclusis; stylo 0.6–0.7 mm. longo; capsula inclusa; seminibus circa 0.5 mm. longis, reniformibus, lateribus minute tuberculatis, dorso vix lineatis, partibus persistentibus funiculi prominentibus, deflexis.

Perennial herb; lower part of stems woody and persistent, the branches of annual duration, loosely spreading, 0.5–2 dm. long, glandular-hairy, terra-cotta color or greenish; basal leaves slender-oblanceolate, 1–2 cm. long, 1–3 mm. wide, glandular-hairy on margins and lower side of midrib, cauline leaves of the same color as stems, linear, 0.5–2 cm. long, 0.5–1 mm. wide, densely glandular-hairy, acutish, the margin somewhat revolute; flowers rather few, 1–3 at nodes; pedicels spreading or deflexed, 0.5 cm. long, glandular; sepals 5, oblong-lanceolate, 2–3 mm. long, flesh-color, glandular-hairy outside; stamens 7, included in calyx; style 0.6–0.7 mm. long; capsule included; seeds about 0.5 mm. long, reniform, black, finely tuberculate on sides, scarcely lineate on back, the persistent part of the funiculus prominent and deflexed.

Collection.—JAMES ISLAND: crevices of lava, Sullivan Bay, *Howell No. 10094* (type, C. A. S. Herb., No. 199026).

Mollugo Crockeri with its perennial woody base and highly glandular herbage is one of the most distinctive species of this genus to be described from the Galapagos Islands. It was only found at a single station but there it was locally abundant on a lava flow of fairly recent age. The perennial part of the plant never grows beyond the lava crevices, the herbaceous stems forming a low, loosely

spreading plant above the surface of the flow. It is an honor and pleasure to dedicate this distinctive species to Mr. Templeton Crocker, patron and commander of the latest expedition of the California Academy of Sciences to the Galapagos Islands.

7. *Mollugo floriana* (Rob.) Howell, comb. nov.

Mollugo flavescens var. *floriana* Rob., Proc. Amer. Acad. 38: 143 (1902).

Root annual; stems erect or somewhat loosely branching, 1.5–4 dm. tall, glabrous or finely glandular-pubescent; leaves linear-oblong or linear-oblongate, 1–3 cm. long, 1–3 mm. wide, glabrous or finely glandular-pubescent, herbaceous, 2–5 at a node, obtuse or acute; flowers 2–11 at nodes; pedicels erect or slightly divaricate, 0.4–1 cm. long, glabrous or glandular-pubescent; sepals 5, elliptic-oblong, 2–3 mm. long, glabrous or minutely puberulent, green-veined with white margins; stamens 8, nearly equalling or slightly exceeding the sepals; style 0.7–0.8 mm. long, stigmatic at the upper end; seeds turgid-reniform, nearly black, 0.4–0.7 mm. long, minutely tuberculate on sides, finely lineate on back, the persistent part of the funiculus deflexed and prominent.

The size of the flower and the number of stamens are characters of the species which find a resemblance in *M. Snodgrassii*. But the annual habit, the difference of herbage, and the smaller size of most of the flower parts in *M. floriana* make it amply distinct from *M. Snodgrassii*. This species might be considered an intermediate in relationship between the *M. flavescens*-*M. gracillima* group and *M. Snodgrassii*.

KEY TO SUBSPECIES OF *M. floriana*

Stems, leaves, and pedicels glabrous; seeds a little more than 0.5 mm. long..7a. *typica*
 Stems, leaves, and pedicels more or less finely glandular-pubescent; seeds a
 little less than 0.5 mm. long.7b. *gypsophiloides*

7a. *Mollugo floriana typica* Howell, nom. nov.

Mollugo flavescens var. *floriana* Rob., Proc. Amer. Acad. 38: 143 (1902).

Stems glabrous; leaves oblong-linear, glabrous; pedicels erect, glabrous; sepals glabrous; seeds about 0.6–0.7 mm. long.

Collections.—CHARLES ISLAND: Cormorant Bay, *Baur No. 157* (type, G), *Stewart No. 1467* (C, G).

7b. *Mollugo floriana gypsophiloides* Howell, subspec. nov.

Radice annua; caulibus erectis, subglabris vel glanduloso-pubescentibus; foliis linearo-oblongatis; pedicellis erectis, divaricatis, vel raro deflexis, glanduloso-pubescentibus; sepalis sparse et tenuiter glanduloso-pubescentibus, 2–3 mm. longis; staminibus 8; stylo 0.7–0.8 mm. longo; seminibus circa 0.4 mm. longis.

Stems subglabrous or finely glandular-pubescent; leaves linear-oblongate, subglabrous or finely pubescent; pedicels erect, divaricate, or rarely deflexed,

glandular-pubescent, tending to be densely so; sepals sparsely and finely glandular-pubescent; seeds about 0.4 mm. long.

Collections.—DUNCAN ISLAND: crevices of rocks on east side, *Howell No. 9828* (type, C. A. S. Herb., No. 199032); *Stewart No. 1475* (C).

8. *Mollugo Snodgrassii* Rob., Proc. Amer. Acad. 38:
144 (1902)

Suffrutescent perennial; stems erect, those near the base woody, the upper parts jointed and broom-like, green or brownish-tinged, 1–4 dm. tall, glabrous; leaves 2–5 at nodes, linear-oblongate, somewhat fleshy-herbaceous, 0.5–2 cm. long, 0.5–1 mm. wide, obtuse or acute, glabrous; flowers 1–3 at nodes; pedicels generally spreading, 0.5–2 cm. long, glabrous; sepals 5 or 6, 3–4 cm. long, oblong, greenish or brownish-tinged; stamens 7, nearly equalling or exceeding the sepals; style 1–2 mm. long, plumose-stigmatic at the end; mature capsule a little shorter than the sepals, irregular over enclosed seeds; seeds turgid-reniform, about 0.5 mm. long, finely tuberculate on sides and lineate on back, dark brownish-black or black, the persistent portion of the funiculus deflexed and prominent.

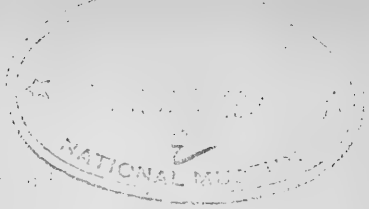
Collections.—ALBEMARLE ISLAND: Cowley Bay, *Stewart No. 1478* (C); east side of island 3 miles south of equator, *Ratikan* (C); 5 miles northeast of Webb Cove, *Howell No. 9450* (C); Elizabeth Cove, *Snodgrass and Heller No. 268* (D, G); Tagus Cove Mt., *Howell No. 9523* (C). NARBOROUGH ISLAND: Mangrove Point, *Snodgrass and Heller No. 309* (type collection, D, G).

Mollugo Snodgrassii var. *santacruziana* Christophersen,
Nyt. Mag. Naturvidenskab. 70: 75 (1931)

Cauline leaves to 3 cm. long; pedicels less than 1.5 cm. long; sepals 2–2.5 mm. long (ex char.)

This variety was described from plants collected at Academy Bay, Indefatigable Island, (type, *Christophersen No. 123*, Herb. Mus. Bot. Oslo), but no specimen has been seen from the island which can be referred here. Although the plant is described as a perennial, it would seem that it might be nearer *M. floriana* as the species of *Mollugo* are treated here. The longer leaves, the shorter pedicels, and the smaller flowers are exactly the characters which mark *M. floriana* as distinct from *M. Snodgrassii* when the duration of the plant is not considered. And, as has been pointed out in a discussion of *M. gracillima*, it is not unusual in deserts with a uniformly mild climate for an annual species to assume a temporary perennial aspect if the sporadic rains of the region are properly spaced. It is of particular interest that the very specimens of *M. gracillima* which provoked the earlier remark were plants with a perennial aspect collected at Academy Bay. It is noteworthy in this regard to mention that the vicinity of Academy Bay is one of the few localities in the lowlands of the Galapagos Islands where

truly desert conditions do not prevail, for here the more luxuriant development of the vegetation indicates that moisture borne on the southeast trade winds during the long dry period is precipitated not only at higher elevations in the interior but also occasionally in the lowlands. Intermittent but properly spaced rainfall during the dry season would undoubtedly produce the perennial effect that is noted. In connection with the distribution of *Mollugos* in the archipelago, the occurrence of a variety of *M. Snodgrassii* is scarcely to be expected on the south side of Indefatigable Island, but the occurrence there of *M. floriana* might have been anticipated since Academy Bay lies between the station for *M. floriana* on Charles Island and the station for *M. floriana gypsophiloides* on Duncan Island.



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**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 4

CHARACTERS OF TWENTY-FOUR NEW SPECIES OF HEMIPTERA FROM THE GALAPAGOS ISLANDS AND THE COAST AND ISLANDS OF CENTRAL AMERICA AND MEXICO

BY

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A study of the Hemipterous Insects brought back by the Templeton Crocker Expedition of the California Academy of Sciences has brought to light a number of forms new to science, the descriptions of which are given in the following pages. Of most interest are the sixteen new species from the Galapagos Islands.

The relationships of these are entirely with the American fauna. Some are very close to well-known continental species, while others have become more strongly differentiated in response to their insular environment. Notable among these latter forms is that described below as *Diaphnidia crockeri* which introduces striking coloration into a genus hitherto containing species that are only monochromatic, or at most with a few fuscous or black markings.

No trained entomologist accompanied this expedition, but Mr. Crocker very generously delegated his secretary, Mr. Maurice Willows Jr., to act as entomologist when not occupied with other duties. Mr. Willows' efforts resulted in the addition of 2,400 insects to the collection of the Academy, among which were many species new to the Academy collection in addition to a number of new species described here and to be described in later papers.

March 14, 1933

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SPECIES FROM THE GALAPAGOS ISLANDS

1. *Geotomus murinus* Van Duzee, n. sp.

Apparently allied to *obscurus* Sign.; piceous with the legs and antennæ paler and the puncturation of the elytra reduced. Length 5.5 mm.

Head regularly rounded before; as long as its width immediately before the eyes; anterior margin a little recurved; tylus but slightly elevated, the cheeks scarcely meeting before it; surface but feebly wrinkled; marginal setæ six in number with one below the margin either side the tylus, and another discal either side near the eye. Pronotum broader anteriorly, shaped as in Signoret's figure 161, the sides subparallel and narrowly recurved, with a few bristles within the anterior angles; disk with a median arc of confused punctures behind the ocelli and an irregular transverse row of coarse punctures behind the callosities, terminating either side in a field of more obscure punctures extending to near the anterior angle. Scutellum moderately convex with scattering punctures that omit the basal field. Elytra with a row of regular punctures either side of the claval suture and a partial second row on the corium; disk of corium with a few nearly obsolete punctures. Opaque area beneath shaped about as in Signoret's figure 155 but with its marginal extension shorter and broader and the angles of the posterior field more acute; osteolar canal flattened and opaque like the adjacent surface, slightly widened and rounded at tip, the opening forming a small notch. Rostrum attaining intermediate coxæ; hind femora with a few minute teeth before the apex; hind tibiæ terete, with their spines longer than their thickness. Antennal segments I, II and III subequal, the middle of II about reaching apex of head. Ocelli placed at about their own diameter from the eyes; tarsi pale.

Holotype, a unique female, C. A. S. Ent. No. 3625, taken by Mr. Willows at Tagus Cove, Albemarle Island, May 27, 1932. This is close to a species from Arizona and northern Mexico, but the latter has the eyes much narrowed inferiorly, the osteolar canal broader and more oblique at apex and the pronotum broader interiorly.

2. *Thyanta similis* Van Duzee, n. sp.

Size and aspect of *antiguensis* Westwood and best distinguished from that species by comparative notes. Length 7 mm.

Head a very little but obviously shorter proportionately than in *antiguensis*. Antennal segment III shorter than II, equal in the allied species. Sides of the pronotum rectilinear in *antiguensis*, slightly emarginate in *similis* with the intrahumeral smooth vitta scarcely distinguished; the humeri a little more angled and marked with a slender black marginal line. Scutellum longer, the apex narrower and more angled. Membrane hyaline with a rather broad fuscous longitudinal vitta either side. Rostrum attaining apex of ventral II, a little shorter in *antiguensis*. Connexivum immaculate. Basal genital plates of female flat, convex or subtumid in *antiguensis*.

Color dull green varied with paler and tinged with red in places as in *antiguensis*, the punctures concolorous or but little darker than the adjoining surface; pronotum and scutellum with a median pale line more or less distinct.

Holotype, female, C. A. S. Ent. No. 3626, taken on Jervis Island, June 6, 1932, by Mr. Maurice Willows. *Paratype*, one female taken on Charles Island at Post Office Bay, April 24, 1932, by Mr. Willows;

the latter specimen is more croceous, marked with reddish areas and apparently is not fully pigmented. The ultimate tergal segment seems to have a fringe of pale hairs in this species.

3. *Nysius (Ortholomus) naso* Van Duzee, n. sp.

A large species with the head porrect and strongly produced; testaceous to rufo-testaceous, with a vitta against each eye, a transverse band on the callosities and the disk of the scutellum black; elytra whitish veined with fuscous. Length 5 mm.

Head as long as wide across the eyes, extended in the same plane as the pronotum, conically produced as far before the eyes as the width between the eyes. Antennæ long, segment I scarcely attaining the apex of the tylus; II two and a half times as long as I; III two-thirds as long as II; IV as long as III, fusiform. Rostrum attaining third ventral segment; segment I reaching the base of the head; segments I, II and III subequal, each about twice the length of IV. Pronotum twice as wide on hind margin as on anterior, one-half wider than long, but little depressed anteriorly; callosities forming a narrow elevated ruga, median line broadly, very feebly, depressed. Scutellum with the usual Y mark feebly elevated. Elytra milky subhyaline, the veins slightly prominent, surface minutely sericeous pubescent.

Color testaceous, becoming rufo-testaceous on the head, pronotum anteriorly, sides of the scutellum, tergum and beneath; marked with black as follows: head, except a broad dorsal vitta, a transverse line on the callosities, not attaining the margins, disk of the scutellum, sternum, a large spot on each of the pleural pieces, a large mark of the basal disk of the venter which sends a vitta either side to connect with a band on the sixth ventral segment, and the base of the genital segment. Legs pale testaceous, the femora dotted with black, apical tarsal segment black; antennæ rufo-testaceous, the basal segment with a dusky spot; elytral veins, including commissure and apical margin, blackish. Membrane hyaline with a median fuscous vitta over a black vitta on the tergum.

Holotype, a unique male, C. A. S. Ent. No. 3627, taken on Charles Island, May 14, 1932, by Maurice Willows.

4. *Creontiades castaneum* Van Duzee, n. sp.

A distinct chestnut-brown species with the pronotum and scutellum almost piceous; antennæ and legs varied with paler, the hind margin of pronotum slenderly whitish. Length 5.5 mm.

Male. Vertex between the eyes one-half the width of an eye; deeply sulcate; oblique frontal striæ almost obsolete; clypeus prominent with a slight transverse depression before its base. Antennæ: segment I stout, slightly shorter than the pronotum; II twice the length of I; III a little less than twice the length of I (15:26); IV equal to I. Pronotum almost twice as wide as long, smooth and polished, without rugæ, callosities moderately prominent. Scutellum nearly equilateral, minutely rugulose and depressed on disk at base, polished at apex and along the lateral margins. Elytra parallel, opaque, impunctate. Rostrum attaining apex of hind coxæ.

Color chestnut, becoming almost piceous on the pronotum, scutellum, pleuræ, base of abdomen and apical one-half of hind femora, basal two-thirds of antennal II and narrow base of III and IV pale, as is also the rostrum, apex of coxæ, trochanters and base of femora; tip of rostrum and of the last tarsal segment and the tibial

spines black; hind tibiæ brown, becoming pale at apex; hind edge of pronotum slenderly whitish and there is an obscure pale spot within the basal angles of the scutellum and another either side of its apex; genital segment pale. Whole upper surface clothed with decumbent pale hairs. Basal antennal segment with a subapical black bristle on its inner face. Membrane fuscous.

Holotype a unique male, C. A. S. Ent. No. 3628, taken by Mr. Maurice Willows on Chatham Island, April 17, 1932.

5. *Creontiades willowsi* Van Duzee, n. sp.

Aspect of *debilis* V. D. but with larger eyes and much narrower vertex in the male, with segment I of antennæ more slender and with the membrane enfumed about as in *rubrinervis*. Length 6 mm. to tip of membrane.

Head small with very large prominent eyes, especially in the male; vertex narrow, but slightly convex, its width between the eyes but one-half the width of an eye; median sulcus distinct, oblique rugæ somewhat obscure; tylus narrower and more prominent than in *debilis*. Pronotum polished, about twice as wide as long (32:17); hind tibiæ a little longer than the elytra to tip of cuneus (85:75). Vestiture very fine, pale and deciduous, fully matured examples being nearly glabrous.

Color yellowish testaceous, about as in *femoralis* and *rubrinervis*, a little darker than in *debilis*; hind submargin of pronotum usually with a slender fuscous line; tips of tarsi and rostrum and a minute dot on extreme base of hind tibiæ and the eyes black; apex of hind femora very slightly darker; membrane distinctly enfumed.

Described from a series of 24 specimens taken on Jarvis Island, June 6, and Sullivan Bay, James Island, June 13, 1932, all taken by Mr. Willows, to whom I take pleasure in dedicating this interesting addition to the Mirid fauna of these islands.

Holotype, male, C. A. S. Ent. No. 3629, and *allotype*, female, No. 3630, from Jarvis Island.

6. *Pœciloscytus vegatus* Van Duzee, n. sp.

Allied to *cuneatus*; a little more slender with the second antennal segment longer, the basal segment black and the legs darker. Length 3 mm.

Head longer than wide (11:7). Pronotum with the sides more deeply sinuate, the hind margin distinctly impressed behind the prominent humeri; collar broader than in *cuneatus*. Antennæ longer than in the allied species; segment I as long as width of vertex between the eyes, distinctly surpassing apex of tylus; II nearly five times as long as I (5:24); III and IV subequal, together one-third the length of II. Rostrum attaining base of genital segment.

Color fusco-testaceous as in *cuneatus*; basal segment of the antennæ and the tylus piceous; the callosities and an indistinct ante-humeral spot infuscated; a median vitta on the vertex, bifurcate before, and the disk of the pronotum posteriorly slightly embrowned; antennal segments III and IV and apex of II darker; collar and narrow hind edge of pronotum paler. Legs pale brown with a paler subapical spot on the femora beneath; apices of tibiæ and tarsi infuscated; coxæ and venter pale brown; genital segment yellowish; rostrum testaceous, black at tip; basal

angles and narrow sides of scutellum brown and a brownish cloud covers the clavus and inner field of the corium; cuneus reddish, pale at base and tip; membrane lightly infuscated, with paler nervures.

Holotype, a unique male, C. A. S. Ent. No. 3631, taken at Tagus Cove, Albemarle Island, May 27, 1932, by Mr. Willows.

7. *Fulvius geniculatus* Van Duzee, n. sp.

Aspect of *imbecilis* Say but with shorter antennæ, white coxæ and fuscous legs with pale knees. Length 3.5 mm.

Head as long as broad across the eyes. Eyes produced on the gula. Antennæ short, segment I scarcely as long as width of head across the eyes; II twice as long as I, very slightly clavate at apex; III a little longer than I, linear (IV wanting); II nearly as long as posterior width of pronotum. Rostrum attaining fifth ventral segment. Pronotum nearly as long as head; shaped as in *imbecilis*, with similar prominent callosities.

Color fuscous brown becoming piceous on pronotum anteriorly and on the head; basal lobe of scutellum with an obscure reddish mark either side; corium with a transverse whitish band opposite middle of clavus which is extended along the costal margin; extreme tip of clavus touched with pale; base of cuneus with a yellowish white lunule; antennæ rufo-fuscous; apical third of segment II white; rostrum testaceous brown; coxæ white, narrow base and apex of I and broader base of II and III brown; legs fuscous brown, paler on the tibiæ and tarsi, the knees narrowly whitish; membrane moderately enfumed, darker in the cell, nervures brown, venter brown, more or less tinged with rufous.

Chatham Island, April 18, 1932, one male (*holotype*, C. A. S. Ent. No. 3632); James Island, June 4, 2 males; Jervis Island, June 6, 1 female; Narborough Island, May 28, one female (*allotype*, C. A. S. Ent. No. 3633).

The shorter antennæ, partly white anterior coxæ and fuscous legs will distinguish this species from *imbecilis* Say. In Reuter's key of 1895 and in Poppius' key of 1909 this runs to *quadristillatus* Stål from Brazil, but the white anterior coxæ will distinguish it.

8. *Diaphnidia crockeri* Van Duzee, n. sp.

Pale yellowish testaceous, polished, elytra faintly green, beautifully marked with red. Length 3 mm.

Head half as wide as the pronotum; front and vertex together convex, polished; the front tumidly projecting above base of tylus, with a few erect pale bristles; viewed from above scarcely projecting before the eyes. Anterior margin of pronotum one-half as long as the posterior; sides straight, sharp but scarcely carinate on posterior lobe; transverse sulcus distinct, not attaining the margins; hind edge broadly excavated. Scutellum large, the lobes but poorly differentiated, exposed portion of basal nearly as long as the posterior lobe. Elytra diaphanous, parallel, the costa but feebly arcuate posteriorly; cuneus as long as greatest width of corium. Basal segment of antennæ short, stout, scarcely exceeding apex of tylus; II linear, four times the length of I (III and IV covered in mounting).

Color pale yellowish testaceous, polished; elytra obviously tinged with bluish green, the costal and subcostal nervures green; commissure with a broad Y-shaped red mark the forks of which reach to the middle of the scutellar margin; corium

with a row of three large red dots, one on basal third, another opposite apex of clavus, the third at middle of apical margin; a similar red dot occupies the basal angle of the membrane, and the apex of the membranal nervures are red; the male has a red mark behind the inner angle of the eye, and two divergent spots are indicated on the posterior lobe of the pronotum; antennal II slightly infuscated in male; tips of tarsi blackish.

Described from one male (allotype) and one female (holotype) taken on James Island, June 4, 1932. *Holotype*, C. A. S. Ent. No. 3634, and *allotype*, No. 3635.

This is the first brightly colored species known to me in this genus. It is a most beautiful insect under a lens and it gives me pleasure to dedicate it to Mr. Templeton Crocker whose generosity and personal interest in the scientific aspects of the expedition made possible these large and valuable additions to the collections of the California Academy of Sciences.

9. *Platymetopius æquinoctialis* Van Duzee, n. sp.

Related to *cinereus* but with the colors darker, the lines of the vertex broad and continuous, the elytra tinged with fulvous, and the apical areoles mostly black. Length 4 mm.

Vertex nearly twice as long as its basal width (12:7); depressed along the median line, anterior edge sharp, apex subacute. Pronotum as long as basal width of vertex, broadly arcuate behind. Median third of ultimate ventral segment produced for one-third the length of the segment, truncate at apex; pygofer with a few scattering short bristles.

Color fulvo-testaceous becoming darker on elytra apically and more grey on pronotum and apex of vertex; median line of vertex anteriorly, an arcuate vitta either side attaining base of vertex and a slender line just behind the apical margin, briefly reflected on to the vertex above the ocelli, whitish. Pronotum with seven longitudinal lines, the median less distinct; scutellum with three such lines. Elytra greyish fulvous, deeper colored apically; round white dots wanting across middle of elytra, those adjacent to apical transverse veinlets edged with black, or mostly so, with a short white marginal vein beyond the costa; face and below pale yellow; dots at base of tibial spines a little darker and there is a brown cloud on the apex of the ultimate ventral segment.

Holotype a unique female, C. A. S. Ent. No. 3636, taken by Maurice Willows at Tagus Cove, Albemarle Island, May 24. The percurrent pale lines of the vertex and the black apical areoles will roughly distinguish this from the many allied North American species.

A single male from James Island, June 4, has the entire vertex eaten away so it cannot safely be placed.

10. *Deltocephalus insularis* Van Duzee, n. sp.

Allied to *signatifrons* V. D. but a little larger and darker with the apex of the head a little more rounded, and different markings on the vertex. Length 4 mm.

Vertex a little shorter than its basal width (6:8); surface feebly convex, not at all depressed, apex in a blunt almost rounded angle; front slightly longer than wide (12:10); clypeus large, flat, almost parallel-sided. Elytral venation essentially the same as that of *obesus* but with the nervures more prominent, the costal areole broader and the sutural areole of the clavus furnished with one or two transverse veinlets connecting the apex of the adjoining nervure with the suture. Ultimate ventral segment of the female essentially truncate across its entire width. Male valve small, obtuse at apex; plates scarcely longer than the valve, narrow, truncate at apex, hardly more than passing the middle of the pygofers, the latter heavily armed with stout bristles.

Color testaceous-grey, becoming more yellowish on the head, anterior margin of the pronotum and scutellum; vertex with a transverse blackish vitta behind the ocelli that is notched at the middle anteriorly and before which are two subapical brown points; behind this vitta are two small brown dashes; pronotum with four or six brown points behind the pale anterior margin and showing five obscure pale longitudinal vittæ; elytral nervures pale, mostly edged with fuscous, the transverse veinlets often thickened and white; scutellum with the basal angles, two points between them, and the impressed line fuscous; front slightly suffused with brown, with pale arcs; hind femora with one apical brown point beneath, the tibiæ in the male about thrice annulate with fuscous; base and apex of tergum with a whitish band.

Holotype, male, C. A. S. Ent. No. 3637, taken April 17 on Chatham Island. *Allotype*, female, C. A. S. Ent. No. 3638, taken April 24, on Charles Island. This species pertains to subgenus *Hebecephalus* of DeLong's Monograph of *Deltocephalus*.

11. *Scaphoideus discalis* Van Duzee, n. sp.

Size and form of *neglectus* Osb. but with the elytral markings nearly as in *sanctus* Say; face heavily marked with black. Length 4 mm.

Vertex about as in *neglectus*, its length one-fourth less than its basal width (7:10); eyes wider posteriorly than in any of our related species, not obviously narrowed there. Pronotum as long as basal width of vertex. Elytra shorter and less flaring at apex than in *neglectus*. Apex of last ventral segment of female truncate with a slight angle either side. Valve of male subacutely triangular; plates narrower and more acute at apex than in *sanctus*, the pygofers more heavily fringed with bristles.

Color white slightly tinged with yellow; vertex mostly immaculate, the ocelli, a wide pair of minute points before the apex, a close pair on hind margin either side against the eyes and the incised median line basally, fuscous or black; pronotum immaculate but darkened by the black mesonotum showing through; scutellum tinged with yellow, the basal angles a little darker; elytra polished, subopalescent white, marked with a common broad transverse brown band the basal margin of which is parallel with the scutellar margin of the clavus, its apical margin slightly concave; this band becomes obscure on the costal areole and carries a large semi-circular white spot either side and a smaller median white spot divided by the commissure and broken out slenderly either side to the claval suture; the margin above the white areas bordered with blackish; a narrow blackish band covers the apical transverse nervures and margins the outer apical areole, the apical nervures being pale; apical submargin with a narrow fuscous line; face tinged with yellow with a broad basal black band in which is a narrow sinuate white line; a narrow black band crosses the entire face at lower margin of the eyes; apex of clypeus and cheeks black.

and there may be a black line across the base of the clypeus; legs pale with the fore and middle femora and a series of minute dots at the base of the tibial spines fuscous; abdomen pale yellow with the tergum, a line on the base of the male plates, the base of the female pygofer, a mark on the apex of the connexival segments and the basal ventral segment, black; male valve, except its extreme edge, and the oviduct and apex of the last ventral segment of the female piceous.

Described from two pairs taken on Chatham Island, April 17, by Mr. Willows. *Holotype*, male, C. A. S. Ent. No. 3639, and *allotype*, female, No. 3640. This is a strongly marked species like *cruciatus* but the form of the elytral saddle recalls *sanctus*.

12. *Athysanus digressus* Van Duzee, n. sp.

Allied to *obscurinervis* Stål but wanting the two round spots on the anterior margin of the head. Length 4 mm.

Vertex more than twice broader than long (15:7), rounded before as in *exitiosus*; pronotum a little longer than the vertex (10:7); front as long as its basal width, its sides rather abruptly narrowed to the base of the clypeus, nearly rectilinear below in the related species; anterior femora with a series of short spines on basal two-thirds, terminating in two longer ones. In *obscurinervis* the small spines are smaller and there are three longer ones on apical one-third. Ultimate ventral segment of female feebly sinuate, in the related species broadly subangularly emarginate. Valve of male subacutely triangular; plates long, exceeding the pygofer; sides sinuate before the middle, apex obtuse, about as in *obscurinervis*.

Color as in *obscurinervis* but with elytral nervures paler; transverse black band of vertex produced anteriorly in a triangle, more or less developed; marginal round black spots wanting but certain dark individuals of *digressus* show a pale brown crescent on the front of the vertex superior to the location of the round black spots; front with the median line and lateral arcs brown; legs and beneath pale, the latter more or less infuscated in the darker males; pronotum with about six black dots on anterior submargin; basal angles of scutellum with the usual black marks.

Described from nine males and nine females taken by Mr. Willows as follows: Chatham Island, April 17; James Island, June 4; Jervis Island, June 6; Sullivan Bay, James Island, June 13, and North Seymour Island, June 12. *Holotype*, male, C. A. S. Ent. No. 3641, and *allotype*, female, No. 3642, from Chatham Island.

This species seems to be widely distributed on the islands and to show the same variation in color as is found in *obscurinervis* Stål. The want of the black spots on the front of the head, the abruptly narrowed frontal apex and the form of the ultimate ventral segment of the female are certainly of specific value and will, perhaps, best distinguish this species. For the purpose of comparison I have considered the neotropical *obscurinervis* and our well known *exitiosus* as specifically distinct as I do not feel entirely satisfied that they are identical.

13. *Oliarus galapagensis* Van Duzee, n. sp.

Aspect of *excelsus* Fowl., smaller with longer and narrower vertex; elytra with heavy punctate veins; apical cross-veins bordered with fuscous. Length 5 mm.

Vertex nearly twice as long as wide at base, its bounding carinæ arcuate rather than angulate; front about as in *franciscanus* Stal, including the clypeus one-half longer than wide (22:14); frontal ocellus small but distinct. Mesonotum with five evident carinæ. Elytra hyaline with strong punctate nervures; the transverse nervures and those separating the apical areoles bordered with fuscous; clavus with an irregular subbasal sutural brown spot and a smaller discal mark; costa slightly and evenly arcuate; wings feebly hyaline, with fuscous nervures; legs pale brown, lighter on the tibiæ and tarsi, the coxæ and incisures whitish, spines tipped with black; pleuræ and ventral segments fuscous, the latter slenderly edged with pale; hind tibiæ with one small spur before the middle. Apical angles of front, as in *franciscanus*, without pale spots.

Holotype, a unique female, C. A. S. Ent. No. 3643, taken by Mr. Willows seventeen miles northwest of Tagus Cove, Albemarle Island, May 22, 1932. Apparently the Galapagos Islands show no such development of this genus as we find in the Hawaiian Islands. The relationships of the present species are entirely with those of the North American fauna, to some species of which it is quite closely allied.

14. *Philates breviceps* Van Duzee, n. sp.

A small species with short vertex, more broadly tumid mesonotum, and unicarinate front. Length 4 mm.

Vertex two-thirds as long as wide at base (8:12); surface depressed, obliquely rugose, ecarinate; anterior margin sharp, but slightly reflexed, the sides more elevated posteriorly against the eyes. Front a little shorter than its greatest width (16:18); obviously carinate. Pronotum as long as the vertex, ecarinate. Mesonotum broadly tumid, not as abruptly depressed posteriorly as in the other species; carinate on basal one-half; the lateral carinæ short, diverging posteriorly; commissural margin of elytra, viewed from the side, distinctly concavely arcuate. Hind edge of ultimate ventral segment with a small notch either side of the broad median lobe.

Color lurid brown more or less irrorate and marked with blackish on either side the vertex at base and on the angles and base of the mesonotum; elytra with a broad whitish vitta above the bullæ, bordered below by a blackish cloud that may be extended to the apical angles; apical margin with the usual brown dashes; femora, at least the posterior, infuscated; antennæ and their sockets infuscated; extreme tip of the head with a pale spot.

Holotype, female, C. A. S. Ent. No. 3644, taken by Mr. Willows at Black Beach Road, Charles Island, April 25, 1932. A male taken at the same time is too immature to be made a type. Two nymphs also were taken.

15. *Philates servus* Van Duzee, n. sp.

Allied to *productus* but with the carinæ of front and vertex obsolete or nearly so; notch of last ventral segment of female shallow and straight. Length, male 4-5 mm., female, 5-5.5 mm.

Vertex almost as long as its basal width between the lateral carinæ (11:12); median carina obsolete or slightly indicated anteriorly, the margins carinately elevated, oblique rugæ obsolete. Front distinctly widened opposite the antennæ, median carina obvious, at least below; lateral carinæ obsolete. Pronotum little more than one-half the length of the vertex (7:12); scarcely carinate but with the disk depressed behind the vertex. Mesonotum distinctly tumid before the depressed apex; median carina strong, lateral slender, obsolete anteriorly. Elytra not quite twice as long as wide (7:4). Last ventral segment of female with a broad shallow median notch, its fundus or base rectilinear.

Color testaceous-brown obscurely irrorate or varied with darker; apical margins of elytra with the usual brown dashes distinct; tibiæ and tarsi more obscure, the tarsal claws and tip of rostrum black; hind femora dusky brown; male with a black subapical point either side the mesonotum and there is a blackish cloud from middle to apex, scarcely indicated in the female, with a suggestion at inner angle of clavus; there may also be black irrorations on sides of mesonotum, on the pleuræ, sides of face and apex of front. In both sexes there is an impressed black point at base of elytra that apparently is characteristic of the genus. Hind femora of male distinctly infuscated.

Holotype, male, C. A. S. Ent. No. 3645, and *allotype*, female, No. 3646, from Tagus Cove, Albemarle Island, May 25. Two males taken on James Island, June 4, together with nymphs, may belong here but more material is needed to decide the matter. In all the species of this genus known to me the elytra of the males are distinctly produced to the obtusely angled apex, not truncate as in the females, a character not mentioned by either Stål or Osborn, both of whom record males.

16. *Philates vicinus* Van Duzee, n. sp.

Allied to *servus* but with the apex of head a little more rounded and the surface of mesonotum between the lateral carinæ polished. Length 6 mm.

Vertex slightly longer than wide at base between the carinate edges (12:11); surface depressed, flat, obliquely rugose, the margins strongly acutely reflexed anteriorly, apex obtusely rounded; front distinctly carinate, its sides obtusely angled at the antennæ, rectilinear either side, its apex tumidly produced leaving the profile somewhat arcuate. Pronotum long, but slightly shorter than the vertex (10:12) the obtuse lateral carinæ distinguished by a deep groove exteriorly. Mesonotum with a very prominent median carina, the adjoining compartments polished. Ultimate ventral segment of female deeply notched, its fundus feebly arcuate. The hind tarsi in this genus are short and broad, in this type they are flattened and ragged, probably through some accident.

Color testaceous-brown, obscurely irrorate with fuscous; subapical points on mesonotum and a dot near the basal angles black; antennæ and anterior and intermediate tarsi brown, the latter and the rostrum tipped with black; on either side

at base of clypeus with a brown line; apical elytral margin with the usual brown dashes; base of front slightly infuscated.

Holotype, a unique female, C. A. S. Ent. No. 3647, taken on Jarvis Island, June 6. The extent of fuscous coloring varies much in this genus, one specimen of *major* taken by the expedition being almost black with a broad pale dorsal vitta. All the known species are represented in the present material and most of them show darkened specimens, while two males of *productus* are pale testaceous and one is a clear light green, these three perhaps immature. The subapical impressed points on the mesonotum may be infuscated or concolorous.

KEY TO THE KNOWN SPECIES OF PHILATES

- Vertex one-half as long as wide at anterior angle of eyes; distinctly obliquely striate; Charles Island *breviceps* n. sp.
- Vertex about two-thirds as long as wide at anterior angle of eyes 1
- 1. Ultimate ventral segment of female deeply notched either side of a rounded median lobe 2
- Otherwise 3
- 2. Front and vertex with distinct median carina; lateral carinae of front distinct at base; tip only of tarsi black; North Seymour Island . *productus*
- Carinae of front obsolete, of vertex nearly so; Tower Island *cinerea*
- 3. Median notch of ultimate ventral segment of female deep, its fundus nearly straight; tarsi infuscated *vicinus*
- Median notch of ultimate ventral segment of female shallow 4
- 4. Median notch of ultimate ventral segment of female with its fundus or base straight *servus*
- Median notch of ultimate ventral segment of female with its fundus minutely notched *major*

SPECIES FROM THE ISLANDS AND COAST OF CENTRAL AMERICA AND MEXICO

17. *Parajalysus punctipes* Van Duzee, n. sp.

Honey-yellow with the pronotal spines, dots on legs and antennae and a line on apical margin of corium black. Length 5 mm. to tip of elytra.

Head nearly vertical before; vertex convex, polished, with the median line and a spot either side obviously paler, anteriorly prominent above base of tylus. Antennae as long as entire body from tip of tylus to apex of membrane; segment I longer than II and III together, slender, briefly clavate at apex; IV fusiform, equal to III but a little shorter than II. Pronotum with a golden sheen; anterior lobe with four smooth pale granules either side; pronotal spines long, black, the median posterior spine preceded by a short pale carina. Scutellum small, smooth and tuberculate posteriorly. Elytra hyaline with a black line on the costal half of the apical margin. Beneath paler, the venter and a callous on each side of the pleural pieces whitish. Antennae and tibiae obscure castaneous, indistinctly dotted with black; femora pale distinctly dotted with black, their clavate apices pale castaneous; antennal incisures pale, apex of tarsi black. Rostrum attaining intermediate coxae.

Holotype, a unique male, C. A. S. Ent. No. 3648, taken at Coseguina, Nicaragua, July 7, 1932, by Mr. Maurice Willows. This seems to be nearest to *P. concivis* Horvath from Peru but it is smaller and the proportionate lengths of the antennal segments are different.

18. *Arphnus tripunctatus* Van Duzee, n. sp.

Soiled whitish testaceous with a point at tip of scutellum, one at apex of each elytron and apical segment of antennæ black. Length 4 mm.

Head one-half longer than its width at base of antennæ; tylus short as in *tristis*, projecting before the bucculæ as far as one-half the length of the bucculæ. Segment I of antennæ as long as one-half the width of vertex between the eyes; II one-half longer than I in female, a little shorter in male (5:4), distinctly clavate, especially in the male; III equal to I and II together; IV scarcely longer than I, fusiform, its apical one-half clothed with minute pale hairs. Eyes small. Pronotum as long as head, a little shorter than its basal width (15:18); median carina distinct on anterior lobe. Rostrum scarcely attaining intermediate coxæ in male, a little longer in female.

Color whitish testaceous, paler on the elytra, coarsely, closely punctate, the punctures concolorous on the elytra, more luteous on the pronotum and pleuræ; vertex with four longitudinal lines whitish farinose; median area of scutellum more fulvous; tip of clavus and of corium, the eyes and the apical segment of antennæ black or nearly so; apex of membrane with three pale fuscous marks; venter obscurely punctate and rugulose; coxæ castaneous; lower surface of head, a lateral vitta on the pleuræ and a shorter one next the base of the elytra pale farinose.

Holotype, male, C. A. S. Ent. No. 3649, and *allotype*, female, No. 3650, and two male paratypes taken on Isabel Island, Mexico, July 27, 1932, by Mr. Maurice Willows. The large size, short tylus and pale color will distinguish this species.

19. *Lygus keiferi* Van Duzee, n. sp.

Aspect of *rubicundus* but narrower with longer antennæ and less opaque elytra. Length 4 mm.

Vertex about one-fourth narrower than an eye (5:7), the eyes much more deeply notched for the reception of the antennæ; apex of head less produced than in *rubicundus*, the tylus scarcely exceeding the cheeks. Segment I of antennæ much longer than in *rubicundus*, a little longer than the width of an eye viewed from above (8:7); II as long as from front of head to tip of scutellum, three and one-half times as long as I; III one-half longer than I; IV equal to I. Pronotum not quite twice as wide as long (13:23); narrower anteriorly than in the allied species, the anterior angles broadly rounded; surface polished, obscurely rugose. Scutellum a fourth wider than long, feebly convex and minutely shagreened. Elytra about a fifth longer to tip of corium than their greatest combined width (32:26). Rostrum just passing hind coxæ. Hind tibiæ nearly a third longer than the corium (40:32). Whole upper surface clothed with short pale hairs.

Color reddish testaceous, at times almost sanguineous or again subhyaline and tinged with green, especially along the costa; pronotum paler anteriorly; scutellum

with an abbreviated pale vitta at apex; inner margin of cuneus and sometimes the apex of the corium narrowly sanguineous; antennæ and legs testaceous, the apical half of hind femora more or less red, with an obscure pale subapical annulus; coxæ and disk of venter whitish, sides more or less sanguineous including a pale longitudinal vitta; tip of rostrum and tarsi blackish; membrane faintly enfumed, a pale spot at apex of areoles, apex of veins sanguineous.

Described from three females taken on Socorro Island, March 27, by Mr. Willows, a long series of both sexes taken on the same island, May 4-9, 1925, by Mr. H. H. Keifer, and two taken by Mr. Keifer, April 30, 1925, on Clarion Island. *Holotype*, male, C. A. S. Ent. No. 3651, and *allotype*, female, No. 3652, taken by Mr. Keifer at 2,000 feet elevation on Socorro Island, May 9. The slender antennæ and anteriorly strongly narrowed pronotum recall *olivaceus* Reuter.

20. *Aligia plena* Van Duzee, n. sp.

Aspect of *jucunda* Uhler, with the elytra strongly marked as in some *Scaphoideus*. Length 5.5 mm.

Vertex as in *jucunda*, its length one-third its width; transverse impression deeper than in its ally; margin subacute as in that species. Front broader than in *jucunda*, nearly as wide at base as long (15:18); clypeus scarcely widened at apex; cheeks broadly angled below the eye above which is a deep sinuation. Elytra much more than twice longer than broad (72:28); venation similar to that of *jucunda*, the costal node with three recurved veins, the radial connected to the claval suture by about sixteen transverse veins; second transverse vein incomplete in the type. Last ventral segment of female obtusely angularly produced at apex.

Color strongly contrasting, about as in *Scaphoideus lobatus* V. D.; vertex whitish, four marks on anterior margin, two dots against each eye and a basal dash either side the middle black, incised line brown, abbreviated before, basal field with a large fulvous spot on either side; face black; frontal arcs and disk of loræ fulvous; cheeks white varied with ferruginous. Pronotum fulvo-testaceous edged with whitish and varied with blackish, these marks leaving two white spots behind each eye. Scutellum white; lateral areas and median vitta of anterior lobe fulvous, two dots on anterior lobe and two marginal dots on posterior black, this posterior lobe with a discal yellowish cloud. Elytra pale fulvous becoming whitish hyaline on the costal and apical areas and on the scutellar margin; veins and some irregular marks on the clavus and disk of corium blackish; clavus with a large common median white spot and a smaller one on the suture on basal one-third; corium with a row of about four white spots along the disk; apical margin blackish.

Wings smoky hyaline with fuscous veins. Abdomen and pectus black varied with yellowish on the disk of the venter, connexivum, disk of pygofer and margin of propleuræ. Legs black; anterior and intermediate tibiæ and tarsi, spines of hind tibiæ and base of hind tarsi pale.

Holotype, a unique female, C. A. S. Ent. No. 3653, taken by Mr. Willows at Port Parker, Costa Rica, July 4, 1932.

21. *Acanalonia clarionensis* Van Duzee, n. sp.

Testaceous-brown, green when teneral, more or less irrorate and marked with fuscous; front with strong median carina; vertex very short, distinguished from front by a carina; costa strongly arcuate. Length, male 5, female, 7 mm.

Male: vertex very short, its median length one-fifth its width; median carina about as wide as long; anterior edge distinctly carinate. Front scarcely longer than wide, its greatest width at the antennæ is to its length either side the base of the clypeus as 20:22; median carina strong, not continued on the clypeus; sides parallel at the eyes, a little arcuate from there to the antennæ, then abruptly converging to the clypeus. Pronotum about as long as the width of the vertex, ecarinate. Scutellum twice as long as the pronotum; median carina wanting, lateral more or less distinct; disk convex before the apex. Elytra not twice as long as wide (80:55), the costa broadly arcuate from base to apex of clavus. The females are longer and have the elytra more truncate at apex. Last ventral segment of female cut out nearly to its base either side of a broad lingulate median tooth, this tooth nearly twice as long as wide (8:5) and rounded at apex.

Color testaceous-brown, more or less irrorate with fuscous, especially on the inner and apical areas and in a wide longitudinal vitta below the bullæ, the darker specimens showing a short whitish radial vitta just above the bullæ and a more or less distinct pale dorsal vitta covering the vertex, the pro- and mesonotum between the lateral carinæ, and the commissural areole; usually there are a few blackish marks along the outer two areoles on the corium, the apical dashes nearly obsolete in pale specimens. Immature individuals are green while adults vary much in the extent of infuscation.

Described from two pairs taken by Mr. Willows on Clarion Island, March 22, 24, 1932, and a long series taken by Mr. H. H. Keifer on Clarion Island, April 26 to May 1, 1925. Among Mr. Willows' material is one male labeled Socorro Island, March 26. *Holotype*, female, C. A. S. Ent. No. 3654, and *allotype*, male, No. 3655, taken on Clarion Island, March 24, by Mr. Willows.

22. *Acanalonia excavata* Van Duzee, n. sp.

Allied to *conica* Say but with shorter vertex and very distinct genital characters. Length 9 mm. to tip of elytra.

Vertex one-half as long as wide between the eyes, flat, ecarinate, in the same plane as the pronotum, separated from the front by an obscure carina that does not reach the eyes. Front slightly wider than its greatest length (23:20), ecarinate, sides parallel as far as the antennæ, rectilinear from there to the apex; clypeus ecarinate. Pronotum as long as vertex, ecarinate and without impressed points. Mesonotum about four times as long as pronotum, median carina obsolete, lateral nearly so, as are the subapical impressed points. Elytra nearly twice as long as wide (140:75). Last ventral segment of female trisinate, the median sinus broad and deeper than the lateral, and separated from them by a sharp black-tipped tooth.

Color clear light green, irrorate with paler on dorsum and with a pale median area, narrowed to a line on the vertex. Mesonotum with four vague fulvous clouds anteriorly, the lateral carinæ indicated by green lines; costal edge and veins in part paler; apical brown dashes nearly obsolete; beneath pale, the tarsi fulvo-testaceous; eyes castaneous.

Holotype, female, C. A. S. Ent. No. 3656, taken July 7, 1932, by Maurice Willows, on Coseguina Slope, Nicaragua.

This seems to be close to *decens* Stål but that is larger with the vertex as long as its basal width according to Melichar. But he says the front has a distinct middle keel reaching to the clypeus while Stål in his original description says "front not longitudinally carinate." Following Stål this might well be *decens* except for its much smaller size. It seems best for the present at least to consider it as distinct.

23. *Dascalia tumida* Van Duzee, n. sp.

Form nearly of *edax* V. D.; larger, with the pronotum tumidly elevated anteriorly and the elytra rounded at apex. Length 7 mm. to tip of elytra.

Vertex at middle line about one-third its basal width (5:14); medially depressed. Front as long as broad, flat, ecarinate; sides feebly arcuate, base depressed, leaving the basal edge subacute medially; clypeus ecarinate, its base rectilinear. Pronotum ecarinate, as long as vertex, its edge slightly elevated. Mesonotum 5.5 times as long as pronotum, tumidly elevated anteriorly above the vertex to a height equal to the basal width of the clypeus; disk behind the prominence flattened and longitudinally feebly sulcate. Elytra a little more than twice longer than its greatest width (11:5); a little narrowed toward the rounded apex; clavus scarcely elevated at base, leaving the commissure straight; costal area opposite the bullæ nearly one-third the total width of the elytra (15:50); venation heavy but obscured by the coriaceous texture of the elytra, with one prominent vein from the bulla, that curves out at the apex of the node and then in to join the apical series of transverse veins. Wings smoky hyaline with fuscous veins. Hind tibiæ with two subapical teeth.

Color dark yellowish varied with fuscous-brown, especially on the base of the clavus, on the costal margin below the bullæ to the node, and on the inner apical field from before the apex of the clavus, the disk of the pronotum becoming piceous. Beneath pale with the coxæ and clypeus, its base excepted, fuscous; legs varied with brown.

Holotype, a unique female, C. A. S. Ent. No. 3657, taken by Mr. Willows at Acapulco, Mexico, April 3, 1932. This runs to *grisea* Fabr. in Melichar's key but is quite a distinct species. It has much the aspect of my *edax* from Lower California but the longer and tumid pronotum and rounded apex of the elytra will at once distinguish it.

24. *Euidella grossa* Van Duzee, n. sp.


Aspect of *altamazonica* Muir but much larger, more deeply colored and with longer basal segment of antennæ. Length to tip of elytra 6 mm.

Macropterous female; vertex as in *altamazonica*, scarcely exceeding the eyes, its length to front of head as seen from above equal to its width between the eyes; carinæ distinct. Front moderately convex, its length nearly twice its greatest

width (15:8); its width at apex over one-half its greatest width (5:8), median carina distinct; clypeus flat, tricarinate. Antennæ passing apex of front; segment I slender, about one-half the length of II. Pronotum not wider than head; lateral carinæ diverging, straight, terminating at hind angle of eye far from hind margin; mesonotal carinæ equally prominent, lateral rectilinear and slightly diverging. Elytra long, surpassing abdomen by one-third their length; wings fully developed. Basal segment of hind tarsi twice as long as II and III together; spur flat, the arcuate edge armed with very minute black teeth.

Color testaceous-brown; pleuræ with a pale area; elytra fuscous; clavus whitish, infuscated at base and apex; costal areole and outer two apical areoles whitish; veins obscurely granulate, with minute hairs; wings somewhat infuscated apically, with fuscous veins.

Holotype, female, C. A. S. Ent. No. 3658, taken by Mr. Willows at Port Parker, Costa Rica, July 4, 1932. The large size and deep fuscous vitta covering the whole median area of the elytra, will distinguish this species and will justify its description from a unique female.



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No. 5

THE CACTACEAE OF THE GALAPAGOS ISLANDS

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FOREWORD

The *Cactaceae* of the Galapagos Islands are among the most interesting plants of the archipelago, not only scenically because of their size and aspect but also botanically because of their peculiar morphologic characters and local distribution. This study on their taxonomy has been based mainly on the collections obtained by the Templeton Crocker Expedition of the California Academy of Sciences and by Alban Stewart, botanist on the Academy Expedition of 1905-1906. Through the kindness of Dr. J. M. Greenman, it has been possible to study critical specimens of the Galapagian *Cactaceae* in the Herbarium of the Missouri Botanical Garden. In the citation of specimens under each species, the specimen is in the Herbarium of the California Academy of Sciences unless otherwise indicated.

March 14, 1933

OPUNTIA

Introduction. Although the members of the genus *Opuntia* are among the most conspicuous floral features in the lowlands of the Galapagos Islands, the group has been one of the least understood from a taxonomic point of view. The reason for this is, of course, the meagre material prepared for study by the earlier explorers in the islands, explorers who, with a single exception, were nonbotanical in their major interests and who cannot be criticized for neglecting so difficult and time-consuming a task as the preparation of cactus specimens. So it is that in Robinson's *Flora of the Galapagos Islands* (1902) only five specimens of Galapagian *Opuntia* were known on which studies in the genus could be based. Stewart, as botanist of the California Academy of Sciences Expedition of 1905-1906, obtained a series of eighteen specimens in the genus, and while it was by far the best collection that had been made, it is to be regretted that specimens were not prepared on every island where he observed and studied plants growing. In this collection only one new species was distinguished and, due to incomplete specimens, the true floral characters of *O. galapageia* were confused and misinterpreted. This confusion was responsible in part for the course of Britton and Rose who recognized only a single species on the islands in their monographic study of the *Cactaceae* (1919), reducing the other species to synonymy. During the visit of the Templeton Crocker Expedition to the Galapagos Islands in the past year, a second large series of *Opuntia* totaling forty-two specimens was obtained for the Academy collection. Due to exceptionally favorable rains, the desert lowlands were blooming as had never before been seen by a botanist, and one of the advantages reaped was *Opuntia* in abundant flower and fruit.

As in the recent study of Galapagian *Mollugos*, what is attempted in this account of the genus *Opuntia* in the Galapagos Islands is as accurate and complete a taxonomic representation of this complex group as is possible at the present time. But as yet no collections are known from Bindloe, Chatham, Culpepper, Duncan, and Narborough islands (on all of which *Opuntias* have been recorded in field accounts), while from the large island of Albemarle, very inadequate collections have been made, so that with further exploration, a fuller picture of the genus will probably be attained. However a single specific complex as proposed by Britton and Rose is scarcely tenable in the light of the diverse floral and fruiting characters that have been disclosed, and the almost perfect geographic isolation afforded the several entities insures the relative morphologic stability which is believed to mark the species here presented.

KEY TO THE SPECIES OF *Opuntia*

- a. Fruit 1.5–5 cm. long, mostly rounded at the base, the ovary-cavity extending nearly or quite throughout the fruit at maturity.
- b. Fruit without spines or with few, mostly inconspicuous spines; spines of branch-joints bristly or somewhat stiffish; north-central and northern islands.
- c. Arborescent; perianth-segments less than 1.5 cm. long; fruit 1.5–2.5 cm. long; James, Jervis, and Abingdon islands. 1. *O. galapageia*
- c. Shrubby; perianth-segments 2 cm. long; fruit 3–5 cm. long; Tower and Wenman islands. 2. *O. Helleri*
- b. Fruit conspicuously spiny; spines of branch-joints rigid and stiff; Albemarle Island.
- d. Perianth-segments 1–1.5 cm. long; areoles of branch-joints 1.5–2 cm. apart, very numerous; northern Albemarle Island. 3. *O. insularis*
- d. Perianth-segments 2–2.5 cm. long; areoles of branch-joints 2–3 cm. apart; southern and southwestern Albemarle Island. 4. *O. saxicola*
- a. Fruit 5–17 cm. long, turbinate or obconic, the ovary-cavity filling only the upper part of the fruit at maturity.
- e. Seeds more than 5 mm. long; spines of the branch-joints mostly bristly; arborescent; southern islands. 5. *O. megasperma*
- e. Seeds less than 5 mm. long; spines stiff and generally rigid; south-central islands.
- f. Shrubby; spines 1 cm. or less long; North Seymour Island. 6. *O. Zacana*
- f. Arborescent; spines of branch-joints 2–13 cm. long; southern Albemarle, Indefatigable, Barrington, and South Seymour islands. 7. *O. Echios*

1. *Opuntia galapageia* Hensl., Mag. Zool. and Bot.
1: 467 (1837)

Arborescent or subarborescent, 2.5–4 m. tall, always with a distinct trunk, the trunk to 2 m. tall and in mature specimens covered with flaky bark of ruddy-brown, the crown generally rather dense and rounded, the branches rarely drooping; branch-joints light green, elliptic or elliptic-obovate to round, 2.5–4 dm. long, 1.5–3 dm. wide; leaves not known; areoles 2–4.5 cm. apart, copiously filled with brown hairs and with very few or no glochids; spines varying from nonpungent bristles to acicular pungent spines, bright straw-yellow, generally more than 20 but rarely almost lacking, 3.5–6 cm. long; flowers small, perianth-segments about 1.3 cm. long (from Hensl., *loc. cit.*, pl. 14); fruit oblongish or round, 1.5–2.5 cm. long, 1.5–2.5 cm. in diameter, the fruit-areoles generally not spiny but with glochids, the ovary-cavity almost completely filling the fruit at maturity; seeds 2.5–4 mm. long.

Collections.—ABINGDON ISLAND: *Stewart No. 3001*. BARTHOLOMEW ISLAND: *Howell No. 10058*. JAMES ISLAND: James Bay, the region of the type locality, *Howell No. 9733*; north side, *Stewart No. 3012*; Sullivan Bay, *Howell No. 10006* and *10009* (trunk-joint). JERVIS ISLAND: near north end, *Howell No. 9783, 9784* (joints spineless), *9785*, and *9786* (trunk-joint); *Stewart No. 3013*. GALAPAGOS ISLANDS: *L. Agassiz in 1872* (Herb. Mo. Bot. Gard.).

Opuntia galapageia was not found in flower but from the very small size of the fruits it seems certain that the perianth-segments are small as they were originally described and figured by Henslow. In his studies in Galapagian *Cactaceae* (1911), Stewart confused *O. galapageia*, which he obtained neither in flower nor fruit, with the large-flowered species, *O. megasperma*, here described as new. Britton and Rose (1919) follow Stewart in misinterpreting the original description. The Agassiz specimen cited above was obtained on either James or Jarvis Island as can be determined from the account of the route of the *Hassler* in the Galapagos Islands (1875).

2. ***Opuntia Helleri*** K. Sch. in Rob., Proc. Amer. Acad.
38: 180 (1902)

Shrub, 0.3–2.5 m. tall, forming thickets 3–7 m. across, mostly without a distinct trunk; branch-joints pale yellowish-green or glaucous blue-green, elliptic to broadly oblanceolate, rather narrowly obtuse above and somewhat cuneate at the base, 2.5–3.5 dm. long, 1–1.8 dm. wide; leaves slender, 8–9 mm. long; areoles 2–3.5 cm. apart, with brown hairs and with few or no glochids; spines nonpungent bristles or stiffer and somewhat acicular, brown or yellowish-brown, generally 20 or more but rarely almost lacking, to 3–5 cm. long; flowers large, perianth-segments about 2 cm. long, yellow; fruit round to broadly oblong, 3–5.5 cm. long, 2–4 cm. in diameter, fruit-areoles with glochids and usually with 1, 2 or more spines, the ovary-cavity almost completely filling the fruit at maturity; seeds rather large, 4.5–6 mm. long.

Collections.—TOWER ISLAND: *Stewart No. 3005*; near Darwin Bay, *Howell No. 10099, 10100* (joints nearly spineless), *10101* (trunk-joints). WENMAN ISLAND: *Stewart No. 3006* (type locality).

Opuntia Helleri is mainly distinctive for its shrubby habit and bristly spines, large flowers and relatively small fruit. On Tower Island where the species was studied in the field, the plants grow in localized colonies, forming low dense thickets. When such thickets grow along the edge of rocky escarpments as they do on the east side of Darwin Bay, the stems hang in pendent masses 2 m. or more in length. On the bluffs of Wenman Island the species has the same pendent habit according to Stewart (1911, p. 113).

3. ***Opuntia insularis*** Stewart, Proc. Calif. Acad. Sci.,
4th ser., 1: 113 (1911)

Shrubby, 0.6–2 m. tall, or becoming arborescent and 3–4 m. tall, almost always with a distinct trunk, the trunk developing flaky ruddy-brown bark in age, the crown with few large joints; branch-joints dull green, ovate to oblong or oblong-elliptic, 3–5.5 dm. long, 2–3 dm. wide; leaves slender and pungently acute, 6–9 mm. long; areoles 1.5–2 cm. apart, prominently raised, copiously hairy, glochids numerous; spines rigid and pungent, sordid yellow, 2–4 cm. long, generally more than 25 in number; flowers small, perianth-segments yellow, 0.8–1.5 cm. long; fruit roundish, 2–4 cm. long, 2–3 cm. in diameter, the fruit-areoles with slender spines and glochids, the ovary-cavity almost completely filling the fruit at maturity; seeds 3–4 mm. long.

Collections.—ALBEMARLE ISLAND: Tagus Cove, *Stewart No. 3041* (type, C. A. S. Herb. No. 1275); Tagus Cove, *Howell No. 9516, 9601* (trunk-joints), and *9605*; summit of Tagus Cove Mt., 4000 ft., *Howell No. 9577, 9578* (young plant); east shore, 3 miles south of Equator, *Howell No. 9626*.

Opuntia insularis is a well marked and distinctive species readily distinguished from all other *Opuntias* on the islands by its rigid spines and small flowers, fruits, and seeds. It is also remarkable in the large joints, numerous areoles, and very long slender cauducous leaves. The distribution of the species as it is now known on the northern part of Albemarle Island is a highly natural one. With future exploration to the southward it is not unlikely that forms intermediate between *O. insularis* and *O. saxicola* might be found and might even be expected in the vicinity of the Perry Isthmus. South of the isthmus *O. saxicola* appears to be the dominant species, at least on the west side of the island, as *O. insularis* is to the north.

An interesting phenomenon was observed in the orientation of the branch-joints of *O. insularis* growing on the slopes of Tagus Cove Mt. The branch-joints of an individual almost always grow in one plane so that a fan-shaped plant-crown is developed; and further, the crowns of all the plants tend to develop along parallel planes, so that in looking across the mountain slope one looks on the broad side of the cactus crowns, while in looking up or down the mountain one sees crowns only slightly wider than the thickness of the joints. This development of the crowns is probably the effect of a constant wind on the branch-joints, which are among the largest in the genus *Opuntia*. Exceptions to the prevailing scheme do occur but the whole effect is generally noticeable and impressive.

4. *Opuntia saxicola* Howell, spec. nov.

Plate 2, fig. 1

Fruticosa vel subarborescens, 1–3 m. alta, corona rotunda, trunco semper distincto, fere brevi, maturo cortice lamelliformi, ferruginea, ramis non pendulis; articulis ramorum viridibus vel griseo-viridibus, obovatis, ellipticis vel rotundis, 2.5–3 dm. longis, 2–2.5 dm. latis; foliis caducis 3.5–4 mm. longis; areolis 2–3 cm. separatim, lanuginibus fuscis, glochidiis; spinis subrigidis, pungentibus, ochraceis, ad 9 cm. longis, interdum sparsis, fere pluribus quam 20; floribus magnis, segmentis perianthii 2–2.5 cm. longis, citrinis; fructu late turbinato, basi vix angusto, 3–4 cm. longo, 2.5–3 cm. diametro, areolis fructuum glochidiis et spinis gracilibus, maturo fructu prope complito caverna ovarii; seminibus 3–3.5 mm. longis.

Shrubby or subarborescent, 1–3 m. tall, always with a distinct trunk but the trunk generally short, at maturity covered with flaky bark of ruddy-brown, the crown generally rounded, the branches not drooping; branch-joints light green or grey-green, obovate to elliptic and round, 2.5–3 dm. long, 2–2.5 dm. wide; leaves 3.5–4 mm. long; areoles 2–3 cm. apart, brown-hairy, with glochids; spines subrigid, pungent, brownish-yellow, to 2 or 3 (or to 9) cm. long; sometimes sparse but generally more than 20; flowers large, perianth-segments 2–2.5 cm. long, bright lemon-

yellow; fruit broadly turbinate, only slightly narrowed at base, 3-4 cm. long, 2.5-3 cm. in diameter, fruit-areoles with slender spines and glochids, the ovary-cavity almost completely filling the fruit at maturity; seeds 3-3.5 mm. long.

Collections.—ALBEMARLE ISLAND: near the shore on rather recent lava flow, five miles northeast of Webb Cove, *Howell No. 9453* (type, C. A. S. Herb., No. 200894), *9452* (joint with very long spines), *9454* (joint with very short spines), *9455* (trunk-joints); Villamil, *Howell No. 8963*.

Opuntia saxicola, with its small fruit filled with seeds at maturity, is probably nearest to *O. insularis* and these two species should perhaps be closely related to *O. galapageia*. On the coastal rocks of the southern part of Albemarle Island *O. saxicola* is the most abundant cactus and it is probably the only *Opuntia* on the southwestern coast. At Villamil on the southeast coast it is associated with *O. Echios* but on the lava pavements a short distance inland where specimens of the two species were obtained, plants of *O. saxicola* were much more numerous. It is not unlikely that the *Opuntia* forest traversed by the trail to Santo Tomas was of *O. Echios* but no specimens were obtained to settle this question. Also there are no specimens at hand to name the *Opuntia* reported by Stewart as growing at an elevation of 2,700 ft. in the crater of Villamil Mt. (1911, p. 113). A specimen of a seedling three joints high, collected at Villamil, *Howell No. 8964*, can be referred to *O. saxicola* since it grew in a nearly pure stand of this species. One specimen from South Seymour Island, *Howell No. 9918*, seems referable to *O. saxicola* but is an anomaly in the distribution of the species. Only one such plant was seen on South Seymour Island.

5. *Opuntia megasperma* Howell, spec. nov.

Arborescens vel raro fruticosa, 1-5 m. alta, corona rotunda, ramis adscendentibus densis compactisque, trunco fere distincto, 2-3 m. alta, 1 m. diametro, maturo cortice lamelliformi ferruginea; articulis ramorum viridibus, obovatis vel late oblanceolatis, 2-4 dm. longis, 1.5-2 dm. latis; foliis caducis, 7 mm. longis, acuminato-triangularibus; areolis 2-4 cm. separatim, lanuginibus copiosis fuscis, glochidiis nullis; spinis stramineis vel ochraceis, capillaro-echinatis vel 1-5 subrigidis, 30-40 vel spinis prope nullis, 2-3.5 cm. longis; floribus magnis, segmentis perianthii 2-3 cm. longis; fructu oblanceolato-turbinato vel obovato-turbinato, 5-17 cm. longis, 3-7.5 cm. diametro, areolis fructuum glochidiis nullis, caverna ovarii complenti solum superiore parte fructus maturi; seminibus 6-13 mm. longis, compressis vel crassiusculis et fere angularibus.

Arborescent or shrubby, 1-5 m. tall, generally with a distinct trunk, the trunk to 2 or 3 m. high and to 1 m. in diameter, in mature specimens covered with flaky, checkered bark of ruddy-brown, the crown rounded, densely and compactly branched, the branches ascending; branch-joints light green, obovate to broadly oblanceolate, 2-4 dm. long, 1.5-2 dm. wide; leaves 7 mm. long, acuminate-triangular; areoles 2-4 cm. apart, copiously filled with brown hairs, glochids lacking; spines straw-yellow to brownish-yellow, all bristly or with 1-5 stiffer spines intermixed, the bristly spines 30-40 or sometimes almost none, 2-3.5 cm. long; flowers large, perianth-segments 2-3 cm. long; fruit oblanceolate-turbinate to obovate-

turbinate, 5–17 cm. long, 3–7.5 cm. in diameter, fruit-areoles bristly but without glochids, the slender base of the fruit sterile at maturity; seeds 6–13 mm. long, compressed or thickened and somewhat angular.

Type of *Opuntia megasperma* Howell: Black Beach, Charles Island, *Howell No. 9360*, C. A. S. Herb. No. 200889.

Opuntia megasperma is remarkable in the genus *Opuntia* for the extreme sizes attained by diameter of trunk, length of fruit, and size of seed. The trunk of the largest specimen seen on Hood Island measured 2.9 m. in circumference or 0.92 m. in diameter, although Stewart (1911, p. 111) reports that extreme sizes of "as much as 4.5 ft." are reached. This is probably the thickest trunk attained by any *Opuntia* although it is approached by *O. Echios gigantea* in the cactus forests of Indefatigable Island in the vicinity of Academy Bay. The largest fruit seen is in the type of the species and measured 17.5 cm. in length and 5.5 cm. in diameter when fresh. Two fruits somewhat smaller measured 13 x 7.5 cm. and 9.5 x 6.5 cm. The thickened seeds found in the type are probably the most massive seeds in the genus. Only two species of *Opuntia* are recorded by Britton and Rose with seeds attaining a length of 10 mm., while in the type of *O. megasperma*, seeds 11–12 mm. long are not uncommon and the average length is at least 10 mm. This extreme diameter and thickness of seeds found in subspecies *typica* are due to the unusual development of the bony marginal band, and the irregularities of shape result from the crowded packing of the seeds within the ovary-cavity.

KEY TO THE SUBSPECIES OF *O. megasperma*

Seeds 9–13 mm. broad, 5–9 mm. thick. a. *typica*
 Seeds 6–8 mm. broad, 3–4 mm. thick. b. *orientalis*

5a. *Opuntia megasperma typica* Howell, subspec. nov.

Segmentis perianthii ad 3.5 cm. longis; fructu 8–17 cm. longis; seminibus 9–13 mm. longis, 5–9 mm. crassis.

Perianth-segments to 3.5 cm. long; fruit 8–17 cm. long; seeds 9–13 mm. long, 5–9 mm. thick.

Collections.—CHAMPION ISLAND: *Stewart No. 2098*. CHARLES ISLAND: *Neboux in 1838* (Herb. Mo. Bot. Gard.); Black Beach, *Howell No. 9360* (type), *9361* (an old joint nearly spineless), *9362* (possibly the first branch-joint at top of trunk, with stiff and bristly spines intermixed), *9363* (trunk-joint); Black Beach, *Stewart No. 2099*; small crater south of Post Office Bay, *Howell No. 8845* (trunk-joint), *8846*; southeast side, *Stewart No. 3000*.

5b. *Opuntia megasperma orientalis* Howell, subspec. nov.

Segmentis perianthii ad 2.5 cm. longis; fructu 6–8 cm. longis; seminibus 6–8 mm. longis, 3–4 mm. crassis.

Perianth-segments to 2.5 cm. long; fruit 6–8 cm. long; seeds 6–8 mm. long, 3–4 mm. thick.

Collections.—GARDNER ISLAND (near Hood Island): *Howell No. 8784*; *Stewart No. 3002*. HOOD ISLAND: near Gardner Bay, *Howell No. 8725, 8724* (trunk-joint); *Stewart No. 3003* (type, C. A. S. Herb., No. 50219); *Stewart No. 3004* (seedling).

6. *Opuntia Zacana* Howell, spec. nov.

Plate 2, fig. 2

Frutex, 1–1.5 m. (raro 2.5 m.) altus, trunco nullo, ramis patentibus et radicantibus; articulis ramorum viridibus, obovatis, basi nonnihil cuneatis, 3.5 dm. longis, 2.5 dm. latis; foliis caducis ignotis; areolis 2.5 cm. separatim, lanuginibus fuscis, glochidiis paucis; spinis brevissimis, rigidis, flavescentibus, ad 1 cm. longis, circa 10 paucioribusve; floribus ignotis; fructu turbinato, 5.5–8.5 cm. longis, 3.5–4.5 cm. diametro, areolis fructuum glochidiis sed spinis raris, paucissimis brevissimisque, caverna ovarii complenti parte solum superiore fructus maturi; seminibus 4 mm. longis.

Shrub, 1–1.5 m. tall (rarely to 2.5 m.), without a trunk, the branches spreading and rooting along the ground; branch-joints light green, obovate, somewhat cuneate at base, 3.5 dm. long, 2.5 dm. wide; leaves not known; areoles 2.5 cm. apart, filled with brown hairs and with few glochids; spines very short and rigid, pale yellow, to 0.8 or 1 cm. long, about 10 or fewer; flowers unknown; fruit turbinate, 5.5–8.5 cm. long, 3.5–4.5 cm. in diameter, fruit-areoles with glochids but only rarely with very few short spines, the cuneate base of the fruit sterile at maturity; seeds 4 mm. long.

Collection.—NORTH SEYMOUR ISLAND: *Howell No. 9957* (type, C. A. S. Herb., No. 200890).

This is the first truly shrubby *Opuntia* with stiff spines to be described from the Galapagos Islands. A short trunk is discernible only in very young plants but it is early concealed in the development of the bushy spreading habit. *Opuntia Zacana* is closely related to *O. Echios* of which it might be considered a subspecies if there were not such great differences in habit, spines, and fruit. Furthermore the habit and the characters of joints, spines, and fruits are nearly without variation, the species everywhere presenting a more uniform aspect than is found in any other Galapagian *Opuntia*. It is remarkable that *O. Zacana* on North Seymour Island is so very different from the *Opuntia* occurring on South Seymour Island and on the north side of Indefatigable Island. This new *Opuntia* further emphasizes the very local endemic cast which marks the flora of North Seymour Island.

In naming this species it is a pleasure to associate with it the name of the *Zaca*, the yacht of Mr. Templeton Crocker which was such an agreeable home during the six months of scientific exploration.

This also serves as an opportunity to express appreciation to the members of the party and especially to the crew of the *Zaca* for their helpful consideration of inconveniences attendant on the preparation of large botanical collections and especially their tolerance and coöperation during the trying preparation of the extensive series obtained in *Cactaceae*.

7. *Opuntia Echios* Howell, nom. nov.

Opuntia myriacantha Weber in Bois, Dictionn. d'Horticult. 894 (1898); Bull. du Mus. d'Hist. Nat. Paris 5: 313 (1899). Not *O. myriacantha* Link et Otto in Steud., Nom., ed. 2, 2: 221 (1841).

Arborescent, 2–8 m. tall, always with a distinct trunk, the trunk to 4 m. tall, and in mature specimens covered with brown flaky bark, the crown rather irregularly and openly branched, the branches sometimes drooping; branch-joints light green, elliptic to narrowly obovate, 3–5 dm. long, 1.5–2.5 dm. wide; leaves 3 mm. long; areoles 2–3 cm. apart, filled with brown hairs and glochids; spines varying from acicular to slender-subulate and rigid, pungent, straw-yellow to brownish-yellow, generally 15–20 or rarely lacking, generally to 5 or 6 cm. long or to 13 cm. long; flowers large, perianth-segments 2.5 cm. long; fruit turbinate, 5–9 cm. long, 3–4 cm. in diameter, fruit-areoles with acicular spines and glochids, the narrowed base of the fruit sterile at maturity; seeds 3–4 mm. long.

Opuntia Echios is the arborescent *Opuntia* of the Galapagos Islands with stiff spines and large flowers and fruits. The original identity of Weber's species, *O. myriacantha*, is not certain. His first description published in 1898 is obviously taken from a growing plant with no flowers and from the characters described it is not possible to distinguish the plant from the several species in the Galapagos Islands. Moreover no specimens were cited which can serve to identify the name. The second and more ample account published by Weber in 1899 is also taken from a growing plant which bore flowers and fruits, and two specimens are cited which were intended to be representative of the species. Because of the incompleteness of the first description, the second description which definitely places the species is here accepted as the one on which *O. myriacantha* Weber is established.

The first specimen cited by Weber in the second description is the collection made by Neboux in 1838 which, according to Weber, was taken on Charles Island, but since *O. myriacantha* Weber has not since been detected on that island, the specimen would appear to have been either misdetermined or misplaced. The material of Neboux' collection in the Herbarium of the Missouri Botanical Garden which has been available for study through the kindness of Dr. J. M. Greenman consists only of fascicles of spines. Fragments of bark adhere to several of the fascicles so it is evident that the spine-bundles are from trunk-joints, and a close examination of the pad of copious brown hairs at the base of the spines discloses the

complete absence of glochids. This fact almost positively places the material as *O. megasperma*, for, among the other unusual characters of that species, the nearly or quite complete suppression of glochids is to be counted. Examination of the trunk-joints of all the other species in the islands discloses the presence of glochids in the trunk-areoles of each. So in this work the Neboux collection is referred to typical *O. megasperma* of Charles Island.

The second specimen cited by Weber in the later description, as well as the living plant on which the second description is based, were from the collection made by Louis Agassiz on the Hassler Expedition in 1872, material said to have been collected on Albemarle Island. But an examination of the route of the *Hassler* while in the Galapagos Islands (1875) shows that the only stop made on Albemarle Island was at Tagus Cove where it is quite certain no *Opuntia* grows except *O. insularis* Stewart. That *O. insularis* is not the same as *O. myriacantha* Weber is apparent from the description of the flowers and fruit of the latter species, *O. insularis* having small flowers and globular fruit, *O. myriacantha* being described with large flowers and obconic fruit. Furthermore the narrative of the Hassler Expedition (1875) states that after leaving Jervis Island on June 16, the following days were spent on Indefatigable Island before sailing for Panama on June 19. This means that the Hassler Expedition visited Conway Bay on the northwest side of Indefatigable Island which, with Post Office Bay, Tagus Cove, and James Bay, was one of the usual anchorages. Undoubtedly it was at Conway Bay where Agassiz collected the specimens of *O. myriacantha* Weber, the flowers and fruit of which according to Weber so well correspond to the flowers and fruits of the plants abundant near the shore of the anchorage. It is interesting however that the Agassiz specimen in the Herbarium of the Missouri Botanical Garden is a roundish joint 9 cm. long, smaller than any normal joints seen from the islands, and the areoles are even nearer together than are the areoles in *O. insularis*. It would appear that Weber preserved no material from the living plant he described, a conjecture supported by a communication concerning some of Weber's material from Monsieur H. Humbert at the Museum National d'Histoire Naturelle of Paris.

Because of the element of uncertainty which accompanies the cited specimens of *O. myriacantha* Weber and because it seems desirable to establish beyond doubt the new name proposed here, a type is definitely named from Conway Bay on the northwest side of Indefatigable Island. The giant *Opuntia* of the south side of Indefatigable Island is indicated as a subspecies with the appropriate name *gigantea*.

Type of *Opuntia Echios* Howell: Conway Bay, Indefatigable Island, Howell No. 9847, C. A. S. Herb., No. 200895 and 200896.

KEY TO THE SUBSPECIES OF *O. Echios*

- Branches not noticeably drooping; spines of branch-joints becoming 11–13 cm. long, rigid. a. *typica*
 Branches generally drooping; spines of branch-joints generally 2–3.5 cm. long, acicular. b. *gigantea*

7a. *Opuntia Echios typica* Howell, nom. nov.

Plate 3, fig. 3

Opuntia myriacantha Weber, *loc. cit.**Opuntia* sp. Stewart, Proc. Calif. Acad. Sci., ser. 4, 1: 115 (1911).

Crown not loosely or openly branched, the branches not noticeably pendant; branch-joints 3–5 dm. long, about 2 dm. wide; spines of branch-joints reaching 11–13 cm. long, stiff or rigid.

Collections.—INDEFATIGABLE ISLAND: Conway Bay, *Howell No. 9847* and *9848*; *L. Agassiz in 1872* (perhaps a young trunk-joint, Herb. Mo. Bot. Gard.). SOUTH SEYMOUR ISLAND: *Stewart No. 3015*; middle western part, *Howell No. 9919*.

Besides the collection cited above from South Seymour Island, a specimen representative of most of the plants of the island, two other collections were made on the island which deserve special mention. One, *Howell No. 9920*, has narrow oblongish joints and elongate fruit in which the ovary-cavity is centrally placed with sterile tissue above and below, the only fruit of the sort found on the Galapagos Islands. Until it can be studied further the form is referred to typical *O. Echios* to which it is most nearly allied. Only a single plant of this variation was seen. The second collection from South Seymour Island deserving particular mention is *Howell No. 9918*, from a plant which differed from all others seen on the island in its low shrubby habit, short spines, and short fruit in which the ovary-cavity extends nearly to the base of the fruit leaving almost no sterile tissue. These characters, which would be incongruous in *O. Echios*, definitely belong to *O. saxicola* of Albemarle Island and the plant is tentatively referred to that species as an anomaly in distribution.

7b. *Opuntia Echios gigantea* Howell, subspec. nov.

Plate 3, fig. 4

Ramis coronae fere patentibus, laxis, pendulisque; articulis ramorum circa 3 dm. longis, 2 dm. latis, spinis acicularibus, 2–3 cm. longis, fere sparsis vel nullis.

Crown rather loosely and openly branched, the branches generally more or less pendant, sometimes drooping to the ground; branch-joints about 3 dm. long and 2 dm. wide; spines of branch-joints acicular, 2–3 cm. long, generally sparse, sometimes lacking.

Collections.—ALBEMARLE ISLAND: Villamil, *Stewart No. 3008*; near Villamil, *Howell No. 8962* (joints nearly spineless). BARRING-

TON ISLAND: *Stewart No. 3007*. INDEFATIGABLE ISLAND: Academy Bay, *Stewart No. 3009, 3010*; Academy Bay, *Howell No. 9112* (type, C. A. S. Herb., No. 200893), *9111* (trunk-joint), and *9113*; southeast side, *Stewart No. 3011* (young plants).

This form of *O. Echios* is to be counted among the tallest species in *Opuntia*. Plants are commonly 3–4 m. tall wherever they occur but at Academy Bay on the south side of Indefatigable Island, trees 6–8 m. (or perhaps even 10 m.) tall are not infrequent. These trees are impressive and grotesque features of the landscape with their few ponderous and jointed branches pendant even to the ground.

CEREUS

Introduction. From the evidence at hand, which includes a series of fifteen specimens obtained on the Templeton Crocker Expedition, it would seem that the specific names used by Britton and Rose (1920) for the two Galapagian cacti of the *Cereus*-relationship are not correct. From the evidence obtained in the field supplemented by extensive collections, it has been possible to interpret the older and rather meager specimens and descriptions in a way which would not be possible except through a perfect intimacy bred in the field. Furthermore it seems evident that the two *Cereus*-like plants of the Galapagos Islands are representative of two distinct generic types, but without a wide and intensive study of the numerous genera segregated from *Cereus*, it is not possible here to confirm *Jasminocereus* and *Brachycereus*, the two monotypic and endemic genera proposed by Britton and Rose for the Galapagian species (1920). Since just now there is not time for as detailed a study as the situation requires, the plants are again referred to the old and broadly conceived genus *Cereus* with the specific names believed to be correct.

KEY TO THE SPECIES OF *Cereus*

- Arborescent, plants generally with a distinct trunk, attaining a height of 8–10 m.; stem with 12–18 ribs, generally 13–16; perianth-tube and fruit without spine-bundles; seeds finely tuberculate. . . 1. *C. Thouarsii*
 Subcaespitose, the stems erect, 0.3–0.6 m. long, sometimes as many as 300 in a colony; stem with 17–22 ribs, generally 20 or 21; perianth-tube and fruit stellate-spiny; seeds quite smooth. . . 2. *C. nesioticus*

1. *Cereus Thouarsii* Weber, Bull. Mus. d'Hist. Nat. 5: 312 (1899)

C. galapagensis Weber, *loc. cit.*

C. sclerocarpus K. Sch. in Rob., Proc. Amer. Acad. 38: 179 (1902).

Jasminocereus galapagensis (Weber) B. & R., Cactaceae 2: 146 (1920).

Not *Brachycereus Thouarsii* B. & R., Cactaceae 2: 120 (1920).

Collections.—GALAPAGOS ISLANDS: *L. Agassiz in 1872* (photographs of specimen, Herb. Mo. Bot. Gard.). ALBEMARLE ISLAND:

5 miles northeast of Webb Cove, *Howell No. 9457*; east side, 3 miles south of Equator, *Howell No. 9628*; Villamil, *Stewart No. 2095*. CHARLES ISLAND: near Post Office Bay, *Howell No. 8847*; Black Beach, *Howell No. 8916*; *Stewart No. 2090*. CHATHAM ISLAND: Wreck Bay, *Stewart No. 2091*. INDEFATIGABLE ISLAND: Academy Bay, *Howell No. 9296*, *Stewart No. 2096*; Conway Bay, *Howell No. 9849*. JAMES ISLAND: James Bay, *Howell No. 9734*, *Stewart No. 2097*; Sullivan Bay, *Howell No. 10007*.

Both the specimen cited by Weber and the data given by him from the record of Du Petit-Thouars indicate that *Cereus Thouarsii* is the arborescent *Cereus* of the Galapagos Islands. Weber's description of the fruit (after Du Petit-Thouars, 1841) is exactly that of the arborescent *Cereus*. The Engelmann data mentioned by Weber are based on the specimen collected on the Hassler Expedition, photographs of which have been available for study from the Herbarium of the Missouri Botanical Garden. These photographs show a relatively low cylindrical stem, clothed with stiff, somewhat divaricate spines which are not so dense but that the ribs are easily discernible between them. It is evident that there are only 7 rows of spines visible on the half of the stem exposed to view, or, at most, 14 rows of spines in the whole circumference. Since in *C. nesioticus* K. Sch. there are usually 20 or more rows of spines (very rarely 17 or 18), and since the spines are always so dense that ribs can never be seen in that species, it seems undeniable that the photographs are of a young specimen of *C. Thouarsii* Weber and not *C. nesioticus* K. Sch., names considered synonymous by Britton and Rose. This conclusion is borne out by a comparison of the photographs with *Howell No. 8916*, a specimen of a young plant of *C. Thouarsii* collected on Charles Island. No specimen of *C. nesioticus* in the large series seen from the islands resembles the photographs which, in the absence of other material, must serve as the basis for the identity of *C. Thouarsii*.

2. *Cereus nesioticus* K. Sch. in Rob., Proc. Amer. Acad.
38: 179 (1902)

Brachycereus Thouarsii B. & R., Cactaceae 2: 120 (1920), not *Cereus Thouarsii* Weber, Bull. Mus. d'Hist. Nat. 5: 312 (1899).

Collections.—ABINGDON ISLAND: south side, *Stewart No. 2092*. ALBEMARLE ISLAND: 5 miles northeast of Webb Cove, *Howell No. 9456*. JAMES ISLAND: James Bay, *Howell No. 9709*; Sullivan Bay, *Howell No. 10008*. NARBOROUGH ISLAND: northeast side, *Howell No. 9607*, *9608*, *Stewart No. 2093*; southeast side, *Howell No. 9630*, *9631A*. TOWER ISLAND: *Stewart No. 2094*.

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proposed in vol. 2, page 120, and the genus *Jasminocereus*
in vol. 2, page 146.



Fig. 1. *Opuntia saxicola* Howell, spec. nov. Plant from which the type specimen was collected, 5 miles northeast of Webb Cove, Albemarle Island. Photographed by J. T. Howell.



Fig. 2. *Opuntia Zacana* Howell, spec. nov. Plant from which type specimen was collected, North Seymour Island. Photographed by J. T. Howell.



Fig. 4. *Opuntia Echinos gigantea* Howell, subsp. nov. Academy Bay, Indefatigable Island. Photographed by Toshio Asaeda.

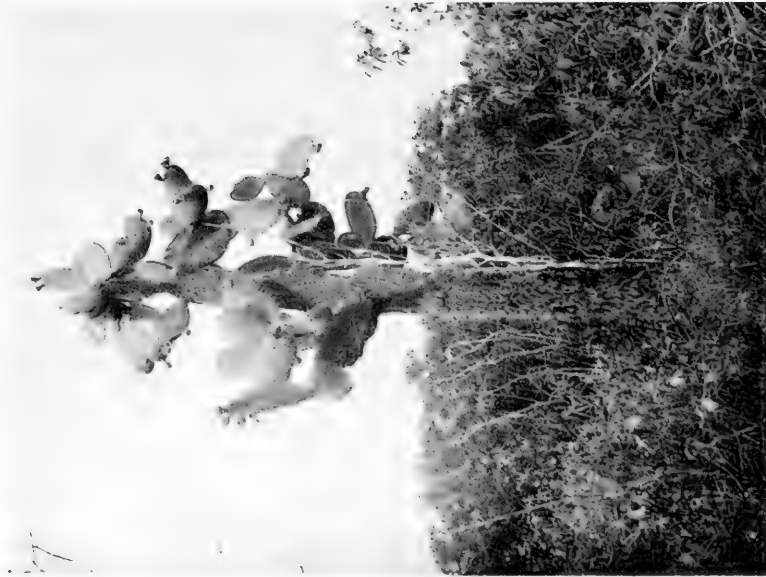


Fig. 3. *Opuntia Echinos typica* Howell, nom. nov. Plant from which the type specimen was collected, Conway Bay, Indefatigable Island. Photographed by J. T. Howell.



PROCEEDINGS
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THE TEMPLETON CROCKER EXPEDITION OF THE
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No. 6

FORMICIDAE OF THE TEMPLETON CROCKER EXPEDITION

BY

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On the Templeton Crocker Expedition of the California Academy of Sciences, 1932, special attention was paid to the collection of insects by Mr. Maurice Willows, Private Secretary to Mr. Crocker. The ants here described were collected by him in various localities on the Galapagos and Revillagigedo Islands, Cocos Island and on the coasts of Central America and Mexico. Though the collection is small, Mr. Willows has added two new subspecies and two varieties to a rather well-known ant fauna. The most interesting find is a *Crematogaster* on one of the Galapagos Islands. For some unknown reason this cosmopolitan genus does not seem to be very fond of certain insular environments. It does not occur in the British Isles, New Zealand, Norfolk and Lord Howe islands, Hawaii and many small islands in the Pacific Ocean and is poorly represented even in the Antilles. Its occurrence in the Galapagos is therefore rather unexpected.

March 22, 1933

MAR 29 1933

GALAPAGOS ISLANDS

Odontomachus hæmatoda bauri Emery

Two workers and two deälated females from Chatham Island (IV.18.'32). This subspecies is known to occur only on Charles Island and Chatham Island, where it was originally taken by Dr. George Baur.

Crematogaster (Orthocrema) brevispinosa chathamensis
subsp. nov.

Worker: Length 2.5–3.3 mm.

Head slightly broader than long in the largest specimens, with slightly concave posterior border. Eyes elongate, flattened, near the middle of the sides. Clypeus convex, with nearly straight, transverse anterior border. Antennal scapes not reaching to the posterior border of the head; funiculi with distinctly 2-jointed club; basal funicular joints, except the first, broader than long. Thorax short; pro- and mesonotum convex and hemispherical; mesoëpinotal impression short and deep; base of epinotum short, anteriorly very convex and rising rather abruptly from the impression; declivity much longer, sloping; spines suberect, much shorter than their distance apart at the base, their tips slender and acute, sometimes slightly recurved. Petiole somewhat longer than broad, subelliptical, as broad behind as in front, with rounded sides and distinctly dentate posterior corners, anteroventrally with a strong spine, directed forward and downward. Postpetiole short and convex, narrower than the petiole, without median dorsal groove. Legs rather short and stout.

Mandibles, clypeus, front, gula and sides of head finely, longitudinally striate; posterior portion of head smooth and shining, with sparse piligerous punctures. Thorax subopaque, only the epinotal declivity shining; pronotum transversely, mesonotum and base of epinotum longitudinally striate; meso- and metapleuræ evenly and densely punctate. Petiole and postpetiole shining, the former smooth above and coarsely reticulate below, the latter delicately longitudinally rugulose. Gaster subopaque, finely punctate-shagreened.

Hairs pale, sparse, blunt and erect on the thorax, pedicel and gaster; head, scapes and gaster with long, sparse, appressed pubescence; legs with similar but finer pubescence.

Large workers red, with the thorax and posterior portion of the gaster black; trochanters and tarsi yellow; smaller workers darker, blackish, with mandibles, antennæ, tibiæ and tarsi reddish; trochanters yellow.

Described from ten workers taken on Chatham Island (IV.17.'32). Lectotype, C. A. S. Ent. No. 3689.

This is the first *Crematogaster* to be recorded from the Galapagos Islands. I believe I am not mistaken in attaching it to the common, widely distributed and very variable neotropical *C. brevispinosa* Mayr, though it differs from all the numerous described forms (10 subspecies and 14 varieties) of which I have seen specimens or descriptions. Only one of these, the subsp. *mancocapaci* Santschi, has been described from Ecuador, but this is quite different from the Galapagos form.

Tetramorium guineense Fabr.

A worker and winged female from Indefatigable Island (V.7.'32; V.5.'32) and a worker from Tagus Cove, Albemarle Island (V.27.'32). Previously recorded from Albemarle, Charles and Tower islands.

Tetramorium (Tetroginus) simillimum F. Smith

Six workers from James Island (VI.4.'32). A common pan-tropical "tramp" species, previously recorded from Charles Island.

Dorymyrmex pyramicus albemarlensis Wheeler

Two workers from Tagus Cove, Albemarle Island (V.25.'32), one from Indefatigable Island (V.6.'32) and one from Jervis Island (V.25.'32).

Camponotus (Myrmocladæcus) planus F. Smith
var. **peregrinus** Emery

A single minor worker (IV.17.'32) from Chatham Island, the type locality of the variety.

Camponotus (Myrmocladæcus) planus
var. **santacruzensis** Wheeler

Three minor workers and seven males from Indefatigable Island (V.1.'32; V.3.'32; V.5.'32; V.7.'32; VI.8.'32).

Camponotus (Myrmocladæcus) planus
var. **isabelensis** Wheeler

Four minor workers and a male from Tagus Cove, Albemarle Island (V.27.'32).

Camponotus (Myrmocladæcus) planus var. **hephæstus**
var. nov.

Worker major. Differing from the var. *isabelensis* Wheeler and resembling the var. *fernandensis* Wheeler in the shape of the head, which has the sides nearly straight and converging anteriorly, instead of convex and rounded. There are no erect hairs on the cheeks as in *isabelensis*. The mesoëpinotal impression is deeper and the superior border of the petiolar scale is sharper and more rounded than in either of these varieties; the pilosity and pubescence on the gaster is longer and somewhat more abundant, the legs and antennæ are distinctly darker red, the coxæ, except at their tips, black.

Worker minor. Differing from the minor worker of the var. *isabelensis* in having somewhat longer antennal scapes, in the darker red color of the legs and antennæ and the more abundant gastric pile, which is like that of the major worker.

Described from four major workers (V.22.'32) and four minor workers (V.21.'32; V.22.'32) from Iguana Cove, Albemarle Island and six minor workers (IV.28.'32) which are simply labelled "Albemarle," but which, owing to their dark appendages, evidently belong to this variety. There are therefore two varieties of *planus* (*isabelensis* and *hephæstus*) on Albemarle Island, just as there are two (*indefessus* and *santacruzensis*) on Indefatigable Island. Lectotype, C. A. S., Ent. No. 3690, major worker.

Camponotus (Pseudocolobopsis) macilentus F. Smith
var. **albemarlensis** Wheeler

A single male from Tagus Cove, Albemarle Island (V.27.'32), which I refer to this variety, measures 5.7 mm. and is pale honey yellow, with the posterior half of the gaster brown and a darker brown V-shaped spot on the ocellar region. The wings are distinctly tinged with yellow.

Camponotus (Pseudocolobopsis) macilentus
var. **narboroënsis** Wheeler

This variety was described from a single greasy and defective female specimen collected by the *Albatross* in 1899. I refer to the same variety three well-preserved females taken by Mr. Willows on Narborough Island (V.28.'32). They measure 8–8.5 mm. in length and are darker and more reddish than any of the other described varieties of *macilentus*. The dark brown bands on the gaster are broad. The head is slightly narrowed anteriorly, though less than in the var. *saphirinus* Wheeler from Indefatigable Island. The antennal scapes extend nearly twice their greatest diameter beyond the posterior border of the head.

Paratrechina longicornis Latreille

Six workers from Indefatigable (V.6.'32), Chatham (IV.17.'32); Charles (IV.24.'32) and Gardner (near Hood) islands (IV.22.'32). Previously recorded only from Charles.

Nylanderia vividula guatemalensis Forel
var. **itinerans** Forel

A single worker from Indefatigable Island (V.7.'32). Previously known from this island and Chatham.

Nylanderia fulva nesiotis Wheeler

Four workers from Hood Island (IV.20.'32), one from Iguana Cove, Albemarle Island (V.21.'32); two winged females from Tagus Cove, Albemarle (V.25.'32; V.27.'32) and one from James Island (VI.4.'32). Previously known from James and Indefatigable islands.

REVILLAGIGEDO ISLANDS

Solenopsis geminata Fabr.

A single worker of the typical black form from Socorro Island (III.26.'32) and a very small and more reddish specimen from Clarion Island (III.24.'32).

Camponotus (Tanæmyrmex) picipes Oliv. var. ?

Two minima workers from Socorro Island, 2000 ft. (III.7.'32). They probably represent an undescribed variety of the Mexican *picipes*, but further determination is impossible without the major worker.

COCOS ISLAND

Camponotus (Myrmaphænus) cocosensis Wheeler

Seven workers, four females and six males (VI.28.'32).

The *female* (undescribed) measures 11–12 mm. and resembles the worker major, but the head is less narrowed anteriorly and the antennal scapes are longer. Thorax elongate-elliptical, slightly broader than the head; mesonotum as long as broad; base of epinotum convex, decidedly shorter than the subperpendicular, concave declivity. Superior border of petiolar node rather deeply and semicircularly excised. Surface of head and thorax much smoother and more shining than in the worker. Erect hairs on the head and thorax shorter and sparser. Head and appendages reddish yellow; thorax and petiole deep red. Wings long (12 mm.), yellow, with somewhat darker resin yellow veins and pterostigma.

The *male* (undescribed) measures 6.5–7 mm. Head through the eyes very nearly as wide as long; cheeks straight; clypeus bluntly carinate; mandibles triangular, with well-developed but edentate apical border; eyes and ocelli large and prominent; antennæ long and slender. Thorax stout, with large mesonotum, much broader than the head; epinotum short and convex, with subequal base and declivity. Petiolar node low and thick, its obtuse superior border broadly impressed in the middle. Legs long and slender. Pilosity pale, sparse and of uneven length as in the female. Head and thorax subopaque as in the worker; scutellum and epinotum smoother and more shining. Head, genitalia, appendages and sutures of thorax brownish or reddish yellow; remainder of thorax dark brown; gaster black. Wings yellow as in the female but both membranes and veins distinctly paler.

COSTA RICA, NICARAGUA AND MEXICO

Ectatomma ruidum Roger

Ten workers from Port Parker, Costa Rica (VII.3.'32), Coseguina Slope, Nicaragua (VII.6.'32) and Puerto Vallarta, Mexico (VII.21.'32).

Holcoponera curtula Emery

A worker from Coseguina Slope, Nicaragua (VII.6.'32) and two from Maria Madre Island, Mexico (VII.26.'32).

Pseudomyrma gracilis Fabr. var. **mexicana** Roger

A single worker from Port Parker, Costa Rica (VII.5.'32).

Pseudomyrma pallida F. Smith

A single small worker, apparently belonging to this species, from Port Parker, Costa Rica (VII.4.'32).

Pseudomyrma sp.

A single female from Coseguina Slope, Nicaragua (VIII.7.'32) allied to *Ps. filiformis* Fabr., but specifically distinct. Owing to the difficulty of identifying female specimens of the genus *Pseudomyrma*, which is in need of revision, I refrain from introducing a new name.

Crematogaster (Orthocrema) brevispinosa Mayr
var. **minutior** Forel

A number of workers from Acapulco, Mexico (IV.3.'32), and Coseguina Slope, Nicaragua (VII.8.'32), one poorly preserved worker from Isabel Island, Mexico (III.27.'32), two females from Maria Madre Island, Mexico (VII.23.'32) and one from Cape San Lucas, Baja California (VIII.4.'32).

Solenopsis geminata Fabr.

A single worker from Port Parker, Costa Rica (VII.3.'32) and one from Coseguina Slope, Nicaragua (VII.7.'32).

Solenopsis sp.

A single small black male, with whitish wings from Isabel Island, Mexico (VII.27.'32).

Cryptocerus minutus Fabr.

Two minor workers from Acapulco, Mexico (IV.5.'32) and one from Port Parker, Costa Rica (VII.4.'32).

Acromyrmex octospinosus Reich

Three workers from Acapulco, Mexico (IV.5.'32).

Azteca velox Forel

Three very small workers from Acapulco, Mexico (IV.5.'32).

Anopolepis longipes Jerdon

Mazatlan, Mexico, one worker (VIII.1.'32).

Camponotus (Myrmothrix) sp.

A winged female and a male from Isabel Island, Mexico (III.27.'32) allied to *C. (M.) abdominalis* Fabr, but with much less developed pile on the enlarged antennal scapes of the female. It is not advisable to name this form without major workers.

Camponotus (Myrmobrachys) senex F. Smith

A single minor worker from Acapulco, Mexico (IV.5.'32).

Camponotus (Myrmocladæcus) rectangularis Emery

Four workers from Coseguina Slope, Nicaragua (VII.7.'32) and one from Port Parker, Costa Rica (VII.3.'32).

Camponotus (Myrmocladæcus) rectangularis

var. *willowsi* var. nov.

Worker minor. Differing from the typical form of the species and its var. *rubroniger* Forel in coloration, being deep black, with the exception of the posterior borders of the gastric segments and terminal tarsal joints, which are reddish, and the head, antennal scapes and first funicular joint, which are bright yellowish red. Cheeks, clypeus and mandibles yellow, mandibular teeth reddish. The dorsal surface of the gaster is less opaque and more glossy than in *rectangularis* and *rubroniger*, with distinctly longer and denser pubescence and even shorter hairs.

A single specimen from Acapulco, Mexico (IV.5.'32). There is in my collection a second specimen taken by Frederick Knab in the same locality. I here insert a description of a second variety of *rectangularis* which I took in Guatemala in 1911. Type, C. A. S. Ent. No. 3683.

Camponotus (Myrmocladæcus) rectangularis
var. *aulicus* var. nov.

Worker major and minor. Resembling *rubroniger*, but the head, thorax and petiole are of a more vivid red, the base of the first gastric segment of the same color and each gastric segment reddish posteriorly, with the extreme border golden yellow. Appendages, especially the tibiæ and tarsi, somewhat darker red than the head and thorax; cheeks, clypeus and mandibles more yellowish, the funiculi beyond the first joint blackish as in the other forms of the species. Dorsal surface of gaster with the same short pubescence and pile as in the typical *rectangularis* and the var. *rubroniger*.

Described from sixteen specimens, taken from a hollow twig at Zacapa, Guatemala, Dec. 13, 1911. Type in author's collection.

SANTA BARBARA ISLANDS, CALIFORNIA

Aphænogaster patruelis Forel subsp. *willowsi* subsp. nov.

Worker. Differing from the typical *patruelis* in having the base of the epinotum straight and horizontal, not convex, and in certain details of coloration. Head, pronotum, pedicel and gaster very smooth and shining, base of epinotum very finely and indistinctly transversely striate, especially on the sides; mandibles, clypeus, cheeks and meso- and metapleuræ sharply, longitudinally rugulose. The epinotal teeth, though very small and resembling those of the much paler subspecies *bakeri* Wheeler from Catalina Island, are more slender and fully twice as long as broad at their bases. Deep reddish castaneous, almost black; mandibles, gula, the 4-jointed clubs of the antennæ, scapes, trochanters, tips of coxæ and legs red, the femora and tibiæ dark brown, except at their bases and tips.

A single specimen from San Nicolas Island (III.15.'32). Type, C. A. S. Ent., No. 3684.



PROCEEDINGS

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APRIL 17, 1933

THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932

No. 7

DOLICHOPODIDAE AND PHORIDAE

BY

MILLARD C. VAN DUZEE

Buffalo, New York

Fifteen specimens of Dolichopods and two Phorids were sent me for determination. One *Chrysosoma* was taken on the western coast of Mexico on the return trip. This is the first species of this tropical genus to be described from Central or South America. One species of *Condylostylus* and three species of *Chrysotus* are here described as new, all from the Galapagos Islands. The two Phoridae represent two new forms of the rather small genus *Dohrniphora* and are described below.

This is a very interesting little collection, being a part of the collection of insects made on the Crocker Expedition by Mr. Maurice Willows, Jr., Private Secretary to Mr. Crocker, who had been placed in charge of collecting insects. I was much pleased to have the opportunity of studying these specimens.

April 17, 1933

1. *Condylostylus dentaticauda* Van Duzee, n. sp.

Male: Length 5 mm. Face wide, shining green, lower part with white pollen, longer than wide, rounded below; front shining green with long, delicate, white hairs at vertex and along the orbits; palpi and proboscis black, the former with pale hairs and black bristles; antennæ (Fig. 1) black, third joint small, a little conical, longest bristle on second joint nearly twice as long as antenna, arista slender, bare, black; beard white, not long or very abundant.

Thorax and abdomen dark green with blue reflections; abdomen with rather wide, black incisions, last segment violet above, hind margin of segments with short bristles, venter with long, black, bristle-like hairs; dorsum of thorax with four pairs of long acrostichal bristles and four pairs of dorsocentrals; scutellum with two pairs of large marginal bristles and a few small white hairs on the disk; hypopygium (Fig. 2) black, moderately large, rather slender, with quite short, slightly curved, black claspers that have a tooth-like corner on inner angle of tip and another near the middle of the inner edge.

All coxæ and femora black; front coxæ with white hair on anterior surface and small black bristles at tip; femora with long white hair below; front and middle tibiæ and fore basitarsi dark yellow; fore tarsi black from extreme tip of first joint; hind tibiæ and tarsi wholly black; front tibiæ with long, delicate, yellow hairs below; hind tibiæ with long bristly hairs on both upper and lower edges of posterior surface; hind tarsi with long black hair, all joints of nearly equal width, except last joint, which is a little narrower; length of front tibiæ as 82, posterior as 165, joints of front tarsi as 65-22-13-7-7; of posterior as 88-23-19-11-9. Calypters, their cilia and the halteres black.

Wings grayish with a slight brownish tinge in front of third vein to costa and from a little beyond tip of first vein to tip of second vein; first vein reaching nearly to the middle of the wing; costa with very short, recumbent hairs; second vein straight; third vein bent a little backwards towards tip; last section of fourth vein with its fork at nearly right angles, upper bend broadly rounded, beyond this bend running nearly straight to wing margin, fourth vein from cross-vein to fork as 35, from fork to wing margin as 26, but the vein ends slightly beyond the fork, being represented by a slight fold in the wing membrane; cross-vein a little sinuous, somewhat oblique, its length as 35; last section of fifth vein as 26, nearly reaching the wing margin.

Holotype, male, (C. A. S., Ent., No. 3691) taken by Willows, June 4, 1932, on James Island, Galapagos Islands.

This would run to *erectus* Becker in Abbe O. Parent's table of species of the American *Condylostylus* (Annales de la Société Scientifique de Bruxelles, tome xlix, p. 7, couplet 26) and is also near *aduncus* Van Duzee, from these it may be separated by the following addition of O. Parent's table:

| | |
|--|-------------------------------|
| 26. Hypopygial lamellæ yellow (Mexico)..... | <i>purpureus</i> Aldrich |
| — Hypopygial lamellæ (or claspers) black..... | 27 |
| 27. Hypopygium small, halteres yellow, (Paraguay)..... | <i>erectus</i> Becker |
| — Hypopygium large, halteres black..... | 28 |
| 28. Claspers long, curved; first joint of front tarsi of nearly equal length with the remaining four joints taken together, (Guatemala)..... | <i>aduncus</i> Van Duzee |
| — Claspers short, a little curved, with a sharp tooth on inner side near the middle and one at inner apical corner; first joint of front tarsi nearly one and one-half times as long as the remaining four joints taken together, (Galapagos Islands)..... | <i>dentaticauda</i> Van Duzee |

2. *Chrysosoma latiapicatum* Van Duzee, n. sp.

Male: Length 4.5 mm. Face wide, green, portion below the suture mostly blue, scarcely as long as wide, rounded below, covered with yellowish white tomentum (or coarse scales of pollen); front green, blue in the middle, orbits with a row of long white hairs; ocellar tubercle projecting; antennæ (Fig. 3) black; second joint with longest bristle one and a half times as long as antenna, third joint conical, as long as wide, arista nearly as long as the abdomen, bare, black, very slender with the apex distinctly widened, curved, snow-white with a black spine-like tip; palpi and proboscis black; former with white hairs and black bristles, the black orbital cilia reaching nearly to lower margin of eyes; beard long and abundant, white with many black bristles above.

Thorax and abdomen green with blue reflections, last abdominal segment blue; five pair of acrostichal bristles, last pair very long and slender; four pair of dorso-centrals; scutellum with one pair of large bristles and two pairs of long but slender hairs on the margin; bristles on hind margin of the abdominal segments very long and slender; hypopygium (Fig. 4) black with yellow appendages and two very long, more or less sinuous bristles composed of a number of hairs and projecting from the hypopygial appendages.

All coxæ and trochanters black; femora blue-black with long white hair below; all tibiæ and front and middle tarsi yellow, hind tarsi wholly black; front and middle tibiæ with three very long, slender bristles on posterior surface that are longer than the first joint of front tarsi; hind tibiæ ciliated with a row of stiff, black hairs on lower posterior edge that are longer than the diameter of tibia, and one bristle above at basal fourth as large as the hairs below; front tarsi (Fig. 5) with a row of long slender bristles of increasing length on first joint, last two hairs very long; second joint with a long bristle at tip; last four joints with a row of long hairs above, last joint flattened and widened, seen from the side it is arched so as to be concave below; middle tarsi with a row of long hairs below, fourth joint slightly widened, black with a thorn formed of long hairs at tip, fifth joint with dense, snow-white hairs on one side; fore coxæ with long white hair on anterior surface and black bristles; length of front tibiæ as 85, middle 116 and posterior as 160; joints of front tarsi as 90-31-30-20-7; of middle as 119-35-26-12-8; and of posterior as 54-48-22-13-7. Calypters and their cilia black; stem of halteres black, knobs pale yellow.

Wings grayish hyaline; costa with short recumbent hairs; first vein reaching nearly to the middle of the wing; second vein nearly straight; third vein bent back a little towards tip; fourth vein from cross-vein to fork as 35; from fork to wing margin as 17, fork forming less than a right angle with basal part of fourth vein, upper bend a little rounded, then running straight to wing margin.

Holotype, male, (C. A. S., Ent., No. 3692) taken by Willows July 21, 1932, at Puerto Vallarta, Jalisco, Mexico.

This is the only species of *Chrysosoma* known from South or Central America. In 1932 I described a species from Illinois as *Chrysosoma plumosa*, but Abbe O. Parent wrote me he thought it should go in the genus *Sciapus*. However, I scarcely see how *plumosa* could be placed in *Sciapus* as the arista is apical, not at all subapical or dorsal.

If we retain *plumosa* Van Duzee in *Chrysosoma* it would be the only species in the genus known from America before this new species was found by Mr. Willows.

3. *Chrysotus brevicornis* Van Duzee, n. sp.

Male: Length 1.8 mm. Eyes broadly touching in the middle of the face; face and front dark blue, dulled with brownish-gray pollen; palpi small, black; proboscis black; antennæ (Fig. 7) short, first joint yellow, second yellow at base, third black, very small, arista subapical; lower orbital cilia pale, with some black bristles below the head.

Dorsum of thorax, scutellum and abdomen dark blue, front of thorax more green; pleuræ black; dorsum of thorax with coarse brown pollen, the few acrostichal bristles placed in two rows; (I see but four pairs of dorsocentral bristles); abdomen a little depressed, its hairs mostly black; hypopygium black, small, with small yellow appendages, inner pair somewhat clavate with a small, curved, blackish spine at one apical corner, outer lamellæ pale yellow.

Front coxæ wholly yellow with long, bristle-like, yellow hairs; middle and hind coxæ black; femora, tibiæ and all basitarsi pale yellow, all tarsi black from tip of first joint; hairs on tarsi partly white, especially on apical part, and quite long; anterior femora (Fig. 8) with a row of about seventeen black bristles of about equal length, on lower posterior edge, their tibiæ with a row of rather long yellow hairs on lower anterior edge, the basitarsi with a row of black hairs or spines below that are nearly as long as diameter of joint; last joint of fore tarsi a little widened; middle femora with a few long yellow hairs below, their tibiæ with one long bristle at basal fourth of lower anterior surface; hind femora with three black bristles below near tip, otherwise bare below; hind tibiæ on upper surface with pair of bristles near basal fourth and two single bristles on middle third, also a row of long, stiff, black hairs on lower posterior surface; length of front tibiæ as 35, of middle ones 40 and of posterior pair 54; fore tarsi three-fourths as long as their tibia, middle and hind tarsi four-fifths as long as tibia; joints of front tarsi as 19-9-7-5-5; of middle as 22-10-7-6-6; of posterior pair 15-13-8-6-6. Calypters and halteres pale yellow, cilia of former black.

Wings grayish hyaline; third and fourth veins straight and parallel, fourth ending in apex of wing; last section of fifth vein slightly arched, its length as 30, cross-vein as 10; anal angle of wing prominent.

Holotype, male, (C. A. S., Ent., No. 3693) taken by Willows, June 7, 1923, at Indefatigable Island, Galapagos Islands.

4. *Chrysotus brevispina* Van Duzee, n. sp.

Male: Length 1.5 mm. Eyes contiguous on the face, leaving a very small, white pollinose triangle below, and a larger dark blue triangle above; palpi whitish yellow with whitish hairs; proboscis black; front dark blue, not much shining; antennæ (Fig. 9) with first joint yellow, second and third black, third a little yellow at base, arista subapical; lateral and inferior orbital cilia white.

Dorsum of thorax and the scutellum dark blue, former with brown pollen, latter shining; five pairs of acrostichal bristles in two rows and five pairs of dorsocentrals; scutellum with one pair of stout but rather short bristles. Abdomen green with most of its hair rather long and yellow, but with quite a number of black hairs; abdomen depressed; hypopygium mostly concealed, its outer lamellæ small black, a little yellowish at tip.

Front coxæ wholly pale yellow with long yellow hair; middle and hind coxæ black; femora and tibiæ pale yellow, tarsi yellow, shading into brown or black towards tip, hind tarsi brown nearly to base of second joint; front femora (Fig. 10) with a row of moderately long spines or little bristles, on lower anterior edge, that end in three longer bristles near tip, while some at base are very short; tibiæ with a row of bristle-like, erect, yellow hairs on lower surface, these appear black in certain lights, their basitarsi with a row of white hairs below that are nearly as long

as the diameter of the joint; middle tibiae with one large bristle below at basal third, (I cannot see any bristles above); hind tibiae with one rather small bristle at basal third of upper posterior edge and two near the middle above, and there seems to be one or two at tip, no bristles below but with a row of stout hairs on lower posterior edge that are not very long; middle femora with a row of bristle-like hairs on lower posterior edge; hind femora with three bristles on lower anterior edge near tip; length of front tibiae as 31, middle as 35 and posterior as 40; joints of front tarsi as 16-7-5-4-4; of middle as 18-8-7-4-4; posterior pair as 15-11-8-5-6. Calypters and halteres pale yellow, cilia of former black. Wings grayish (crumpled in type).

Female: Colored as in the male; face quite wide with a little white pollen; palpi as in the male; front femora and tibiae without long hair or bristles. All females taken at Iguana Cove, Albemarle Island, Galapagos Islands, by Willows.

Holotype, male, (C. A. S., Ent., No. 3694) taken by Willows, May 7, 1932, on Indefatigable Island; one male paratype, taken June 17, 1932, at the same place; allotype, female, two male and two female paratypes taken May 21, 1932, on Albemarle Island.

5. *Chrysotus latifacies* Van Duzee, n. sp.

Face moderately wide, its sides nearly parallel but a little wider above, with a suture at the middle; face and palpi black with coarse white pollen, that nearly conceals the ground-color; proboscis black; front dark blue; antennae (Fig. 11) with first joint reddish brown, second and third black, third nearly straight below, a little oblique above, arista subapical; lateral and inferior orbital cilia white.

Dorsum of thorax blue with green and violet reflections and brown pollen; acrostichals in two rows; five pair of dorsocentrals. Abdomen green with bronze reflections, its hair largely black, but the hair on first and apical segments yellow; hypopygium mostly concealed, with a small black protuberance at lower posterior edge.

Fore coxae wholly yellow with long yellow hair; middle and hind coxae black, posterior pair with a large erect bristle on outer surface; femora and tibiae wholly yellow; tarsi yellow, more or less blackened toward their tips; all femora with small preapical bristles; fore tibiae above with a small bristle at basal fourth and one near tip; middle tibiae with three or four bristles above, the largest one near basal fourth and next at middle, none below; tip with three bristles; hind tibiae with four bristles above, the last one at tip, also two on anterior surface, one at basal fourth and the other beyond the middle; length of front tibiae as 32, middle as 34 and posterior pair as 50; joints of fore tarsi as 15-6-6-4-4; of middle pair as 22-5-4-5-4; posterior pair as 15-12-7-5-5. Calypters yellow with black cilia; halteres black.

Wings grayish; third and fourth veins parallel, fourth ending in apex of wing; last section of fifth vein as 33, cross-vein as 7; anal angle of wing prominent.

Holotype, male, (C. A. S., Ent., No. 3695) taken by Willows, May 7, 1932, on Indefatigable Island.

TABLE OF THE SPECIES OF CHRYSOTUS FROM THE GALAPAGOS ISLANDS

- 1. Face rather wide, its sides nearly parallel, but slightly wider above... *latifacies*
- Face narrow, eyes almost touching in the middle of the face..... 2
- 2. Hypopygial lamellae yellow; palpi blackish; bristles on lower surface of front femora of nearly equal length throughout..... *brevicornis*
- Hypopygial lamellae black; palpi whitish yellow; row of spines on lower surface of front femora rather short at base, longer at tip..... *brevispina*

6. *Dohrniphora willowsi* Van Duzee, n. sp.

Female: Length 1.2 mm. Head, dorsum of thorax and abdomen black; pleuræ, legs, feet, base of sixth abdominal segment, palpi, halteres and ovipositor yellow; antennæ, first abdominal segment and an elongated, narrow spot on each side at base of second abdominal segment reddish brown; front (Fig. 12) with a little gray pollen and three straight rows of four bristles and a pair of anterior frontal bristles about half as large, above and close to the antennæ, these last a little reclinate; palpi large, thick, somewhat cylindrical with four or five stout black spines at tip; third antennal joint large, rounded, arista black with white hair, longer than the front; pleuræ with one very small hair above middle coxæ. Abdomen (Fig. 13) with second, third, fourth and fifth segments very narrowly white on hind margin; sixth segment broadly yellow at base, but considerably blackened in the middle as far as the base, leaving two large yellow spots. Ovipositor slender, of one segment (visible) and with long hairs; below sixth segment there is about the same large brown sack-like portion as in *crockeri* (Fig. 20).

Coxæ, femora, tibiæ and tarsi yellow; middle tibiæ (Fig. 15) with a pair of large bristles near base and a very long spur at tip below, their basitarsi with a small spine near base below; fore tibiæ (Fig. 14) without bristles; hind tibiæ (Fig. 16) somewhat fusiform, with a slender bristle near base above, a very small one near tip above, a very small spur at tip below, and before this spur a larger curved rather short spine; length of front and middle tibiæ as 25, of posterior tibiæ 30; joints of front tarsi as 7-6-6-5-6; of middle tarsi 12-6-5-4-4; of posterior basitarsi as 10.

Wings (Fig. 17) grayish hyaline; costa reaching middle of wing, with short fringe of bristles, its sections as 25-6-3.

Holotype, female, (C. A. S., Ent., No. 3696) taken by Willows, July 11, 1932, on South Seymour Island, Galapagos Islands.

7. *Dohrniphora crockeri* Van Duzee, n. sp.

Female: Length 1.5 mm. Head, dorsum of thorax and abdomen black, pleuræ legs, feet, palpi, base of sixth abdominal segment, halteres and ovipositor yellow; antennæ and first abdominal segment reddish brown; front (Fig. 18) with three rows of four bristles each in straight lines and one pair of anterior frontal bristles placed close together, above and between the reclinate antennæ; antennæ reddish yellow with a blackish tip, slightly pear-shaped, arista apical, black with white hair and longer than the front; palpi yellow, large, somewhat cylindrical with stout black spines at tip; each cheek with two large spines.

Dorsum of thorax black, a little grayish pollinose, covered with dense, black minute hairs, one pair of dorsocentrals near the scutellum, which is a little reddish and has one pair of rather large marginal bristles and one pair of minute hairs. Abdomen (Fig. 19) colored and formed almost like that of *willowsi* new species, but second segment more wholly black and hind margins of all segments straight; ovipositor seen from above (Fig. 19) quite thick and showing two segments, viewed from the side (Fig. 20) still thicker and with a large sack-like portion on ventral side of sixth segment.

Coxæ, femora and tibiæ yellow, tarsi yellow but appearing darker because of the very black hairs on them; femora with fine hairs below; front tibiæ (Fig. 21) with four rather small bristles above, the last one at tip; their tarsi with a small spine at base below; middle tibiæ (Fig. 22) with two large bristles near base above, two hair-like ones below near tip and a very long spur at tip below; hind tibiæ (Fig. 23) long and curved, concave below, a little flattened and widened towards tip, without bristles, except the three large spurs at tip, their basitarsi long and thick, with two small slender bristles below near base; length of front tibiæ as 25,

middle as 31, and posterior as 43; joints of front tarsi as 13-5-5-4-6; of middle pair 18-9-9-7-6; and of posterior pair as 23-13-13-9-9. Halteres yellow.

Wings grayish hyaline, costa reaching the middle of the wing, fringed with short bristles, its sections as 35-6-3; fork of third vein slightly more divergent than in *willowsi* (Fig. 17) sixth vein scarcely reaching wing margin, being very thin towards tip. The wing is very much as figured for *willowsi* but is a little longer and of the same width, therefore appearing narrower.

Holotype, female, (C. A. S., Ent., No. 3697) taken by Willows, July 11, 1932, on South Seymour Island.

The two species of Phoridae described here are very much alike in general appearance, but have many structural characters to separate them. They both belong to the genus *Dohrniphora* Dahl. In Mr. Malloch's table of species, in the United States National Museum Proceedings, Vol. 43, number 1938, page 430, *crockeri* would run to *abbreviata* von Rosser, an European species found in North America, but differing from the character given in the table by having fourth, fifth and sixth veins reaching the wing margin; it also differs in many other points; *willowsi* would run to couplet 3, but has the dorsum of the thorax and most of the upper surface of the abdomen black.

These species differ from each other as follows: In *willowsi* the anterior frontal bristles are widely separated and placed above slight emarginations in the antennae and close to the antenna; the fore tibiae are without bristles; and the hind tibiae are slightly fusiform with a small bristle near base and a smaller one above close to tip; below with a very small spur at tip and a little before this a small curved bristle, their basitarsi slender, short, with one very small spine near base below. *Crockeri* has the pair of anterior frontal bristles placed close together, above and between the antennae; hind tibia without spines or bristles, except the three large spurs at tip, and are long, arched, widened, especially towards tip; their basitarsi thick, long and with two little bristles below on basal half. The ovipositor also shows two segments when viewed from above and is quite thick, while in *willowsi* the ovipositor is slender and the visible part has only one segment.

Both of these species have a large chitinized sack or capsule on the ventral side of sixth segment, a little like that figured by Dr. Lundbeck in *Diptera Danica*, part vi, page 99, for the female of *Chatoneurophora thoracica* Meigen but in this case it does not show when the abdomen is viewed from above.

EXPLANATION OF FIGURES

1, *Condylostylus dentaticauda*, antenna of male; 2, *same*, hypopygium of male; 3, *Chrysosoma latiapicatum*, antennæ of male; 4, *same*, hypopygium of male; 5, *same*, front tibiæ and tarsi of male; 6, *same*, last four joints of hind tarsi of male; 7, *Chrysotus brevicornis*, antenna of male; 8, *same*, front leg of male; 9, *Chrysotus brevispina*, antenna of male; 10, *same*, front leg of male; 11, *Chrysotus latifacies*, antenna of male; 12, *Dohrniphora willowsi*, frons of female; 13, *same*, abdomen of female; 14, *same*, front leg of female; 15, *same*, middle leg of female; 16, *same*, hind femora and tibia of female; 17, *same*, wing of female; 18, *Dohrniphora crockeri*, frons of female; 19, *same*, tip of abdomen of female, dorsal view; 20, *same*, apical part of abdomen of female, side view; 21, *same*, front tibiæ and tarsi of female; 22, *same*, middle tibiæ and tarsi of female; 23, *same*, posterior tibiæ and tarsi of female.

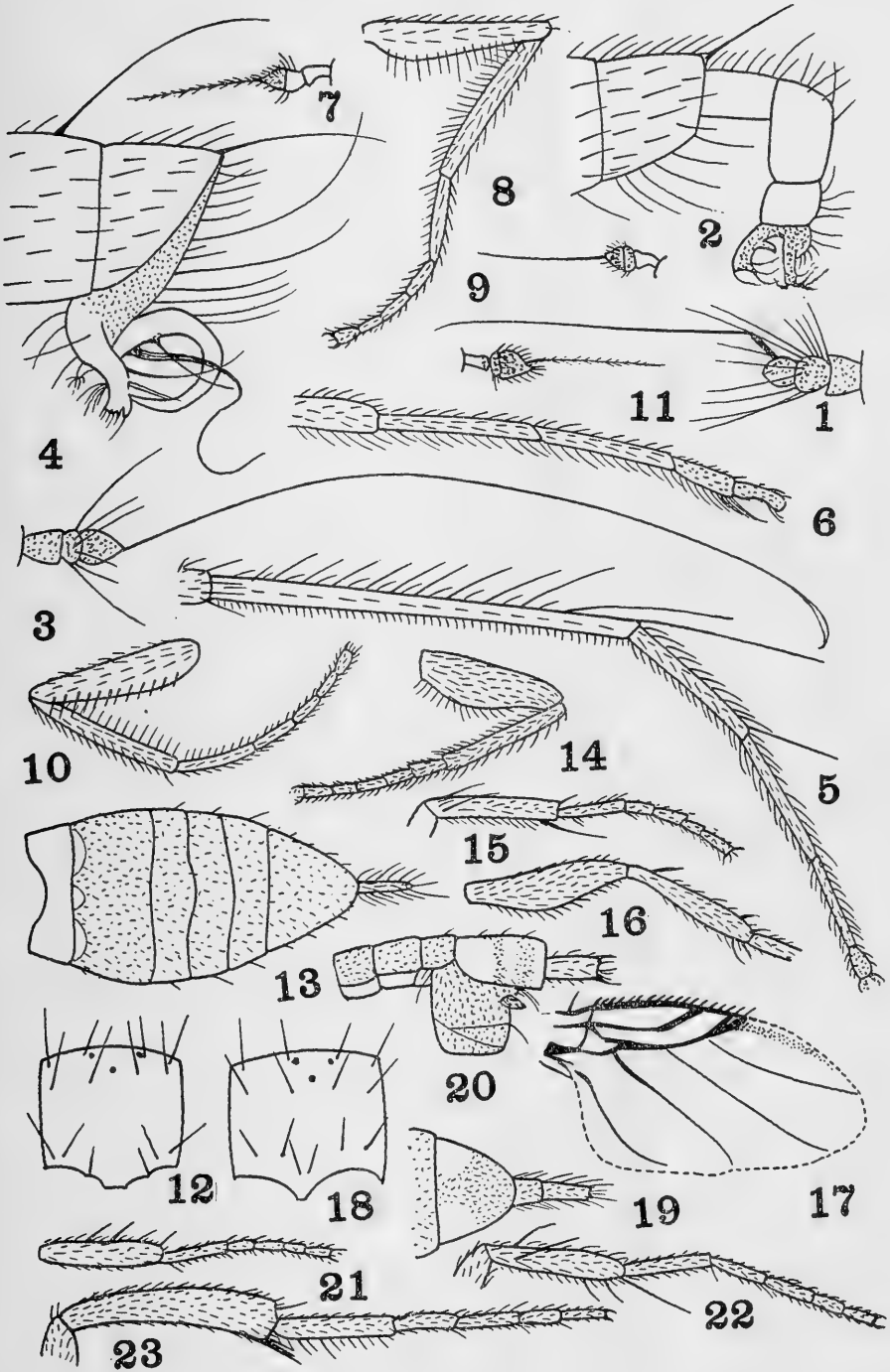


PLATE 4



C25

PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

VOL. XXI, No. 8, pp. 75-86, figs. 3

SEPTEMBER 20, 1933

**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 8

MOSESSES OF THE TEMPLETON CROCKER EXPEDITION

Collected by John Thomas Howell
and
Lists of the Mosses Known from the Galapagos
Islands and from Cocos Island

BY
EDWIN B. BARTRAM
Bushkill, Pennsylvania

Although Mr. Howell admittedly made no consistent effort to collect a complete series of mosses from the various localities in the Galapagos Islands and Cocos Island explored by the Expedition, his casual collections together with the scraps segregated from these and from the Hepatic collections make a surprisingly interesting record and add 17 species to the respective floras of these insular areas. This is a valuable addition to our meagre knowledge and suggests quite plainly that any thorough bryological exploration, especially in the Galapagos group, will surely increase the list of moss species by an appreciable number.

September 20, 1933

SAN NICOLAS ISLAND, CALIFORNIA

Barbula brachyphylla Sull.

March 13, 1932, No. 10.¹

Crossidium desertorum Holz. & Bartr.

March 13, 1932, No. 11. While this is a common species in southern Arizona, it does not seem to have been collected before in California.

Funaria Bolanderi (Lesq.) Holz.

March 13, 1932, No. 12.

GUADALUPE ISLAND, LOWER CALIFORNIA

Weisia viridula Hedw.

Slopes above Northeast Anchorage, Nov. 14, 1931, No. 51.

Pottia Fosbergii Bartr.

Mt. Augusta Trail, March 17, 1932, No. 4 in part. This unique little moss was described a few years ago² from a collection made near Los Angeles. The plants from Guadalupe Island agree perfectly with the original collection and are mixed with *Tortula atrovirens*.

Tortula atrovirens (Sm.) Lindb.

Slopes above Northeast Anchorage, Nov. 14, 1931, Nos. 44, 49 in part, 52 in part.

Tortula muralis Hedw.

Mt. Augusta Trail, March 17, 1932, No. 5; slopes above Northeast Anchorage, Nov. 14, 1931, Nos. 45, 46.

Tortula ruralis (Hedw.) Bry. Eur.

Mt. Augusta Trail, March 17, 1932, Nos. 2 in part, 41; slopes above Northeast Anchorage, Nov. 14, 1931, No. 43 in part.

Grimmia californica Sull.

Mt. Augusta Trail, March 17, 1932, No. 8.

¹ The numbers given to the different collections were assigned by the author as he worked up the material.—Ed.

² Bryologist 33: 18. 1930.

Grimmia leucophaea Grev.

North end of Island, Nov. 14, 1931, No. 47.

Grimmia pulvinata (Hedw.) Sm.

Mt. Augusta Trail, March 17, 1932, No. 7.

Funaria hygrometrica Hedw.

Mt. Augusta Trail, March 17, 1932, No. 3.

Bryum argenteum Hedw.

Mt. Augusta Trail, March 17, 1932, No. 1.

Bryum caespiticum Hedw.

Mt. Augusta Trail, March 17, 1932, No. 6 in part.

Anacolia Menziesii (Turn.) Par.

Slopes above Northeast Anchorage, Nov. 14, 1931, Nos. 42, 50.

Camptothecium arenarium (Lesq.) Jaeg.

Slopes above Northeast Anchorage, Nov. 14, 1931, No. 54.

I have collected this species on Santa Catalina Island but its occurrence on Guadalupe Island is an interesting extension of its geographical range.

Scleropodium illecebrum (Hedw.) Bry. Eur.

Slopes above Northeast Anchorage, Nov. 14, 1931, No. 53.

GALAPAGOS ISLANDS

Sphagnum erythrocalyx Hampe

Near the summit of Indefatigable Island on wet slope, May 10, 1932, No. 23.

Sphagnum cuspidatum Ehrh. var **serrulatum** Schlieph.

Near the summit of Indefatigable Island on wet slope, May 10, 1932, No. 22.

This variety seems to have a more austral distribution than the typical form. It has been recorded from South America but this seems to be the first record for the Galapagos Islands.

Fissidens (Semilimbidium) Howelli Bartr., spec. nov.

Figure No. 1.

Autoicous. Caulis procumbens, circa 1 cm. altus. Folia 20-30 juga, oblongo-lanceolata, acuminata, ad 1.5 mm. longa; lamina dorsali rotundata, inferne et superne immarginata, medio marginata, lamina apicali superne immarginata, inferne marginata, limbo laminae duplicatae e cellulis 4 seriatis composito; cellulis hexagonis, obscuris, papillosis; costa ante apicem evanescente. Seta rubella, 3-3.5 mm. longa; capsula inclinata.

Autoicous; male buds in the axils of the stem leaves; perigonal leaves few, 0.4 mm. long, abruptly contracted to a short stout point. Rather robust pale green plants growing in dense mats. Stems procumbent, up to 1 cm. or more long with 20-30 pairs of leaves, radiculose at base, 2 mm. wide with leaves, simple or innervating below the flowers. Leaves well spaced, not overlapping, slightly contorted with decurved points when dry, erect-spreading when moist, 1-1.5 mm. long by 0.4 mm. wide, oblong-lanceolate, sharply acuminate, duplicate blades ending obliquely about half way up, dorsal blade ending abruptly in a rounded lobe at the insertion, border of elongated cells about 4 rows wide on the duplicate blades, irregular and narrower on the apical blade and ending abruptly about half way to the apex, variable on the dorsal blade but confined to the median portion of the leaf and never extending to either the base or the apex; margin distantly denticulate on the bordered portion, erose-denticulate and crenulate with papillae on the

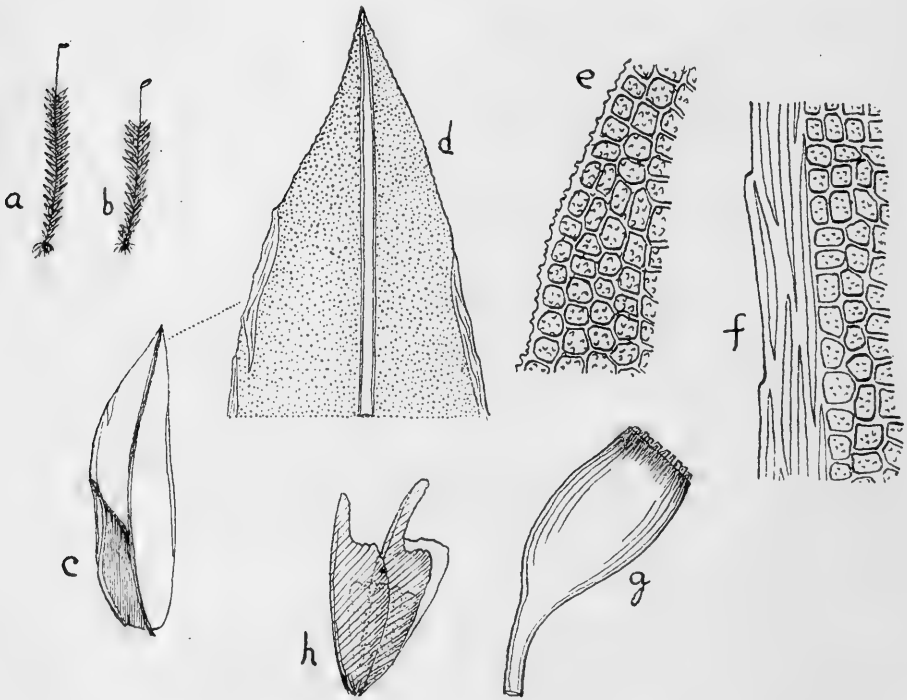


Fig. 1. *Fissidens Howelli* Bartr.; a, b, plants $\times 2$; c, leaf $\times 32$; d, apex of leaf $\times 160$; e, upper leaf cells and margin $\times 500$; f, margin of duplicate blade $\times 500$; g, capsule $\times 32$; h, 2 perigonal leaves $\times 80$.

unbordered parts; costa pale, ending a few cells below the apex; leaf cells hexagonal, up to 7 μ in diameter, thin walled, very dense and obscure, papillose. Perichaetial leaves scarcely differentiated; seta terminal, reddish, 3-3.5 mm. long; capsule inclined, ovoid-cylindric, reddish brown; urn about 0.7 mm. long.

Type: above Fortuna, in the rain forest, Indefatigable Island, May 9, 1932, collected by John Thomas Howell, No. 21 (C. A. S. Herb. No. 203284).

In spite of the fact that the apical and dorsal blades of this species are provided with a variable border of elongated cells I am inclined to think the dense, obscure, papillose areolation is a more weighty character and that the species belongs in the Section Semilimbidium near *F. Ravenelii* Sull. The border is quite variable, often entirely lacking on the apical and dorsal blades of the young leaves and when well developed is confined to the lower half or two thirds of the apical blade and to the middle portion of the dorsal blade.

Campylopus subleucogaster (C. M.) Jaeg.

First Camp, Mt. Crocker, Indefatigable Island, May 10, 1932, No. 104.

This species is recorded on the basis of a small tuft of plants that was segregated from a collection of Hepatics. The large, subquadrate, juxtacostal basal cells are characteristic of this species. It is a common moss in Costa Rica and the range might naturally be extended to include the Galapagos.

Campylopus Anderssonii (C. M.) Jaeg.

First Camp, Mt. Crocker, Indefatigable Island, May 10, 1932, No. 102; on ground and rocks, Floreana Peak, Charles Island, May 15, 1932, No. 103.

Through the kindness of Dr. Reimers I have been able to examine a part of the type collection of this species from the Muller Herbarium. The specimens cited above correspond exactly with the type material.

This species is readily identified by the short cells of the leaf base which are subquadrate or even transversely elongated and not at all narrower at the margins. This distinctive basal areolation is of infrequent occurrence in the genus and assists materially in identifying the species.

Campylopus (Eucampylopus) insularis Bartr., spec. nov.

Figure No. 2.

Caulis ad 6-7 cm. altus, simplex vel parce ramosus. Folia sicca et humida erectopatula, flexuosa, subsecunda, anguste lanceolata, longe subulata, canaliculata, integerrima, 6-7 mm. longa, 0.4-0.5 mm. lata, auriculis distinctis; costa basi circa 375 μ lata, dorso laevi; cellulis alaribus numerosis, fuscis, supra-alaribus rectangu-

laribus margines versus linearibus, caeteris minutis, oblongis vel subrhomboidalibus. Caetera ignota.

Sterile. Stems flexuose, tomentose, up to 6-7 cm. long, simple or sparingly branched. Leaves 6-7 mm. long by 0.4-0.5 mm. wide, narrowly lanceolate, subulate-acuminate, canaliculate, erect-spreading, flexuose, slightly secund; costa about $375\ \mu$ wide below, smooth on the back, in cross-section showing a ventral row of large, empty cells and a dorsal stereid band with the cells differentiated on both sides; margins erect, entire; alar cells reddish brown, conspicuously auricled, extending to the costa, supra-alar cells rectangular, narrower and linear at the margins, becoming gradually shorter and rhomboidal upward, the upper lamina cells small, chlorophyllose, oblong and rhomboidal.

Type: on ground and slopes at Second Camp, Mt. Crocker, alt. ca. 2000 ft., May 9, 1932, collected by John Thomas Howell, No. 101 (C. A. S. Herb. No. 203283); Duncan Island: Alban Stewart No. 3323, 1905-1906 [det. by R. S. Williams as *C. Anderssonii* (C. M.)].

This species is similar in gross appearance to *C. Anderssonii* (C. M.) but quite distinct in the entire leaves with the costa smooth on the back above and, especially, in the elongate basal cells which are narrower and linear at the margins.

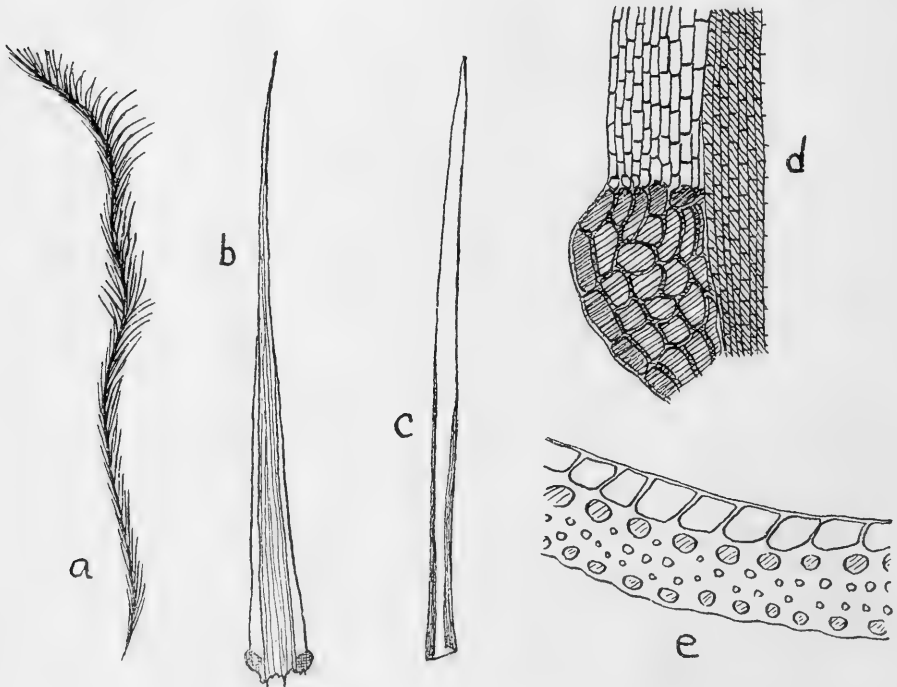


Fig. 2. *Campylopus insularis* Bartr.; a, plant $\times 1\frac{1}{2}$; b, leaf $\times 12$; c, apex of leaf $\times 80$; d, one side of leaf base $\times 160$; e, part of cross section of costa $\times 500$.

Campylopus introflexus (Hedw.) Mitt.

On rocks near Academy Bay, Indefatigable Island, May 14, 1932, No. 16.

Octoblepharum albidum Hedw.

Rain forest near Fortuna, Indefatigable Island, May 12, 1932, No. 17.

Syrrhopodon Guadichaudii Mont.

First Camp, Mt. Crocker, Indefatigable Island, May 10, 1932, No. 105.

Syrrhopodon parasiticus (Sw.) Besch.

First Camp, Mt. Crocker, Indefatigable Island, May 10, 1932, No. 106.

It is not surprising to find this species in the Galapagos Islands as Brotherus has recorded it from Ecuador. The plants average smaller than those from Florida and Yucatan, the narrow border of pale, elongated cells is better developed and extends further down the leaf but I doubt if these differences are either constant enough or of sufficient value to establish any distinct separation.

Hyophila Tortula (Schwaegr.) Hampe

On wet rocks at the spring east of Floreana Peak, Charles Island, April 25, 1932, No. 107.

Only a few plants of this widely distributed tropical American species were found but they are sufficient to establish its occurrence here for the first time.

Philonotis gracillima Aongstr.

On wet rocks at the spring east of Floreana Peak, April 25, 1932, No. 108.

Macromitrium mucronifolium (Hook. & Grev.) Schwaegr.

On rocks near the spring, Charles Island, April 25, 1932, No. 14; on ground, north side of Floreana Peak, Charles Island, May 15, 1932, No. 24.

Squamidium leucotrichum (Tayl.) Broth.

Rain forest above Fortuna, Indefatigable Island, No. 13.

Squamidium Caroli (C. M.) Broth.

From trees of Villamil Mt., above Santo Tomas, Albemarle Island, April 29, 1932, Nos. 18, 19; First Camp, Mt. Crocker, Indefatigable Island, May 10, 1932, No. 109.

Papillaria nigrescens (Sw.) Jaeg.

On ground and rocks, Floreana Peak, Charles Island, May 15, 1932, No. 110; near Fortuna, in rain forest, Indefatigable Island, May 12, 1932, No. 111.

Sematophyllum galipense (C. M.) Mitt.

Rain forest near Fortuna, Indefatigable Island, May 12, 1932, No. 20; on rocks near spring, Charles Island, April 25, 1932, No. 15.

Isopterygium tenerum (Sw.) Mitt.

First Camp, Indefatigable Island, May 10, 1932, No. 112.

These plants represent a rather robust form but they seem clearly to belong here. This species does not seem to have been collected before in either the Galapagos Islands or Cocos Island.

COCOS ISLAND

Calymperes Donnellii Aust.

Chatham Bay, June 28, 1932, No. 122; Wafer Bay, June 28, 1932, No. 37.

The range of this species is from Florida through the West Indies to northern South America but it does not seem to have been noted before from the west coast except in Panama. As far as I can see the plants from Cocos Island agree perfectly with specimens from other regions.

Rhizogonium spiniforme (Hedw.) Bruch.

Wafer Bay, June 28, 1932, No. 27.

Squamidium leucotrichum (Tayl.) Broth.

Wafer Bay, June 28, 1932, No. 30.

Meteoriopsis patula (Sw.) Broth.

Wafer Bay, June 28, 1932, Nos. 29, 32.

These collections are certainly inseparable from *M. patula*. I have seen no specimens of this species from the Galapagos Islands but it seems likely that *M. Anderssonii* (C. M.) Broth. will prove to be nothing more than a form of this widely distributed species.

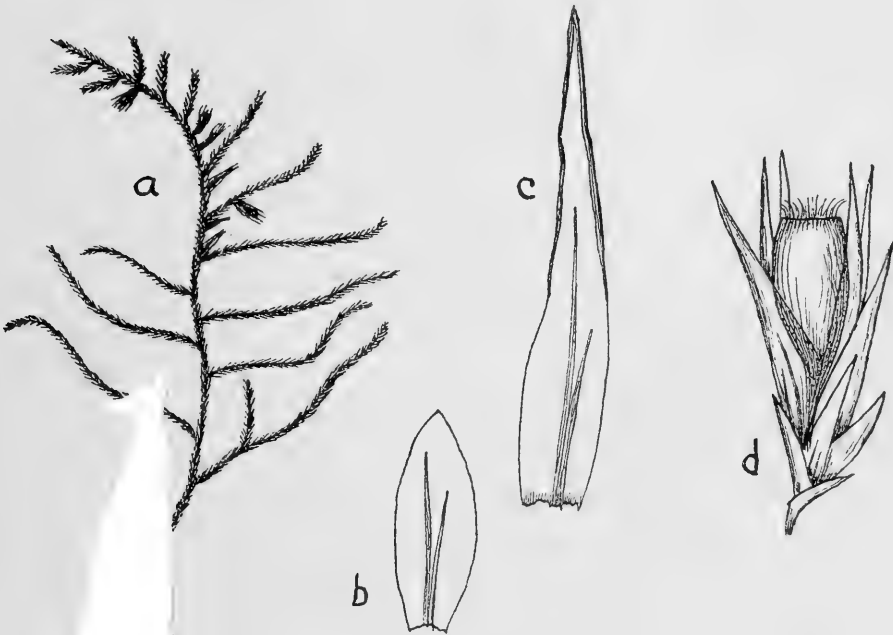
***Pilotrichum rugifolium* C. M.**

Wafer Bay, June 28, 1932; Nos. 34, 36. Figure 3.

These highly interesting collections seem to definitely establish the status of a moss that has never been recollected since the original gathering in 1794.

The species was described by Muller in 1849⁸ from a specimen in the Hooker Herbarium and the locality cited as "Insula Owyhee Australiae." One might infer that this is a phonetic spelling of Hawaii but in a recent critical study of the Hawaiian mosses I felt obliged to relegate this species to the list of "Uncertain Species." The genus *Pilotrichum* is an unusually compact one, confined exclusively to the American tropics, and the Hawaiian record seemed to be a rather dubious one.

These collections from Cocos Island have the capsules immersed in the perichaetial leaves and immediately suggested a comparison with *P. rugifolium*. The agreement was complete and convincing. The sporophyte characters correspond exactly to the original description and furthermore the vegetative features are in complete accord with a mount of several leaves taken from a scrap of the type col-



Pilotrichum rugifolium C. M.; a, upper part of plant $\times 1\frac{1}{2}$; b, leaf $\times 20$; c, capsule $\times 20$; d, capsule and perichaetium $\times 12$.

lection which was sent to me along with a sketch of the entire plant by Dr. A. W. Evans some years ago. The packet from Yale was labelled as follows: "Herb. Kew, Menzies, 1794." Did Menzies ever collect on Cocos Island?

This query is answered by the following extract from Mr. Howell's letter in response to inquiry. "It was of much interest to me to trace Vancouver, bound for home from his surveys in the Pacific Northwest, down the coast of North America until on Jan. 23, 1795, he sighted the Island of Cocos. The vessels, the *Discovery* and *Chatham*, were in need of both fuel and water, so they put in at Cocos, probably at Chatham Bay. By Jan. 27 refueling and watering the ships were accomplished and the two vessels sailed southward for Cape Horn. In this part of Vancouver's account no mention is given of Menzies, let alone word that he went ashore, but of course he was with the expedition at the time. However, to collect a moss, Menzies did not have to go ashore for wood was brought aboard for fuel and surely the wood was heavy with epiphytes."

The following transcript of the label on the type collection in the Hooker Herbarium was very kindly made by Mr. H. N. Dixon, "N. hypnoides. Owyhee 1794. A. M. No. 96."

As Menzies was notoriously rather careless about his localities I think we may safely assume that the collection was incorrectly labelled and that *P. rugifolium* is endemic to Cocos Island.

Another endemic species, *P. obtusatum* Williams, has rugose leaves but the apex is more obtuse, the capsule exerted on a longer seta and the perichaetial leaves scarcely longer than the stem leaves and not scabrous with spiculate papillae.

The accompanying sketch of some of the characteristic features of *P. rugifolium* may be useful as the species is unrepresented in most herbaria.

***Pilotrichum obtusatum* Williams**

Wafer Bay, June 28, 1932, No. 35.

***Crossomitrium Oerstedianum* C. M.**

Wafer Bay, June 28, 1932, No. 121.

This collection adds a new genus to Cocos Island. The s are robust for the group with stems about 3 mm. wide ves. The lateral leaves are not shrivelled when dry and th ters of the plants correspond very closely to the description of di-
anum from Costa Rica.

Thuidium involvens (Hedw.) Mitt.

Wafer Bay, June 28, 1932, No. 25.

Although meagre, the specimen is fortunately in fruit. The scabrous setae identify it clearly with this well known species of the mainland. It seems to be the only *Thuidium* reported so far from either Cocos Island or the Galapagos.

Sematophyllum galipense (C. M.) Mitt.

Wafer Bay, June 28, 1932, No. 31.

Taxithelium planum (Brid.) Mitt.

Wafer Bay, June 28, 1932, Nos. 28, 38.

Both of these collections are typical of this familiar species in all respects. I have seen a scrap of the type collection of *T. laxiusculum* R. & C. through the kindness of Mr. Williams and must confess my inability to separate it from the common *T. planum* which, like most widely distributed types, is subject to some variation within reasonable limits.

Isopterygium tenerum (Sw.) Mitt.

Wafer Bay, June 28, 1932, Nos. 33, 120.

NICARAGUA

Calymperes Richardi C. M.

Near the shore of the Gulf of Fonseca, Coseguina Volcano, July 7, 1932, No. 40.

Stereophyllum leucostegium (Brid.) Mitt.

East base of Coseguina Volcano on west shore of Gulf of Fonseca, July 6, 1932, No. 39.

A summary of the mosses of the Galapagos Islands and Cocos Island is given below. The additions to the flora found in Mr. Howell's collections are preceded by an asterisk.

GALAPAGOS ISLANDS

- | | |
|---|---|
| Sphagnum erythrocalyx Hampe | *Philonotis gracillima Aongstr. |
| *Sphagnum cuspidatum Ehrh. var. ser- rulatulum Schlieph. | Macromitrium mucronifolium (Hook. & Grev.) Schwaegr. |
| *Fissidens Howelli Bartr. | Macromitrium longifolium (Hook.) Brid. |
| Campylopus Anderssonii (C. M.) Jaeg. | Micromitrium fragile (Mitt.) Jaeg. |
| Campylopus introflexus (Hedw.) Mitt. (<i>C. lamellatus</i> Mont.) | Schlotheimia Jamesoni (W. Arn.) Brid. |
| *Campylopus subleucogaster (C. M.) Jaeg. | Squamidium nigricans (Hook.) Broth. |
| *Campylopus insularis Bartr. | Squamidium leucotrichum (Tayl.) Broth. |
| Campylopus Sprucei Mitt. | Squamidium Caroli C. M. |
| Octoblepharum albidum Hedw. | Meteoriopsis Anderssonii (C. M.) Broth. |
| Syrhropodon incompletus Schwaegr. | Papillaria nigrescens (Sw.) Jaeg. |
| Syrhropodon Guadichaudii Mont. | Daltonia longifolia Tayl. (<i>D. robusta</i> Aongstr.) |
| *Syrhropodon parasiticus (Sw.) Besch. | Daltonia Lindigiana Hampe (<i>D. Stew-</i> <i>artii</i> Williams) |
| Tortella caespitosa (Schwaegr.) Limp. | Cyclodictyon albicans (Sw.) Broth. |
| *Hyophila Tortula (Schwaegr.) Hampe | *Sematophyllum galipense (C. M.) Mitt. |
| Funaria calvescens Schwaegr. | *Isopterygium tenerum (Sw.) Mitt. |
| Orthodontium confine Hampe | |
| Brachymerium imbricatum Schp. | |

COCOS ISLAND

- | | |
|---|--|
| Fissidens Garberi S. & L. | *Crossomitrium Oerstedianum C. M. |
| Octoblepharum albidum Hedw. | Leucomium cuspidatifolium (C. M.) Mitt. |
| Syrhropodon Bernoullii C. M. | *Thuidium involvens (Hedw.) Mitt. |
| *Calymperes Donnellii Aust. | Sematophyllum galipense (C. M.) Mitt. |
| Rhizogonium spiniforme (Hedw.) Bruch. | *Taxithelium planum (Brid.) Mitt. (<i>T.</i> <i>laxiusculum</i> Ren. & Card.) |
| Philonotis gracillima Aongstr. | Glossadelphus cocoensis (Williams) Bartr., comb. nov. ⁵ . (<i>Hookeriopsis</i> <i>cocoensis</i> Williams; <i>Glossadelphus</i> <i>longisetus</i> Bartr.) |
| *Squamidium leucotrichum (Tayl.) Broth. | *Isopterygium tenerum (Sw.) Mitt. |
| *Meteoriopsis patula (Sw.) Broth. | Vesicularia vesicularis (Schwaegr.) Broth. |
| Pilotrichum obtusatum Williams | |
| *Pilotrichum rugifolium C. M. | |
| Callicostella depressa (Sw.) Jaeg. | |
| Hookeriopsis diffusa (Wils.) Jaeg. ⁴ | |
| Lepidopilum crassisetum Williams | |

⁴ Collected by Mr. H. K. Svenson, in connection with the Astor Expedition, along brook flowing into Wafer Bay, alt. approx. 1000 ft., April 19, 1930. A rare species previously known only from Panama.

⁵ I have seen a part of the type collection of *Hookeriopsis cocoensis* through the courtesy of Mr. Williams. It is evidently a *Glossadelphus* and seems to be identical with the plant I described from Costa Rica as *G. longisetus*. As Mr. Williams' name has priority the new combination will stand as noted above. This species will be readily separated from *G. truncatulus* (C. M.) by the nearly smooth leaf cells with minute papillae over the upper ends. In *G. truncatulus* the leaf cells show several sharp salient papillae over the lumens giving the surface of the leaf a peculiar rasp-like appearance under the microscope.

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**THE TEMPLETON CROCKER EXPEDITION OF THE
 CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 9

THE AMARANTHACEAE OF THE GALAPAGOS ISLANDS

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INTRODUCTION

Several months have been spent in the study of the *Amaranthaceae* of the Galapagos Islands; and, because of the difficulty encountered in the limitation of many of the species and because in nearly all of the genera new names are being proposed, it has appeared best to present the results in a synoptical study of the family as it occurs in the archipelago. Moreover, a special interest attaches itself to this family because of its highly endemic development in the islands. The study was begun when a determination of the extensive collections made by the writer on the Templeton Crocker Expedition of the California Academy of Sciences was attempted. This collection and the material obtained by the expedition of the Academy to the Galapagos Islands in 1905 and 1906 formed the basis for the study. From the Gray Herbarium of Harvard University, critical specimens of Galapagian *Amaranthaceae*, including numerous types and isotypes from the collections of Andersson, Baur, and Snodgrass and Heller, were available for study. From the United States National

Herbarium and from the Field Museum, specimens of *Amaranthus* were borrowed; and from the Herbarium of the University of California specimens of *Alternanthera ficoidea* from South America were studied. Specimens obtained in the Galapagos Islands by Snodgrass and Heller on the Hopkins-Stanford Galapagos Expedition were available from the Dudley Herbarium of Stanford University. To the officers of these institutions, the writer expresses grateful appreciation for the privileges he has enjoyed in studying the specimens. Particular thanks are due to Dr. B. L. Robinson and to Mr. C. A. Weatherby of the Gray Herbarium who have been helpful in many ways, to Dr. Paul C. Standley of the Field Museum who determined several species of *Amaranthus* and answered questions concerning others, to Dr. H. K. Svenson of the Brooklyn Botanic Garden who loaned specimens and notes on *Alternanthera*, and to Miss Ruth D. Sanderson, Librarian, Gray Herbarium, who has sent transcripts of early descriptions and photographs of figures. Distributional data for species extending beyond the Galapagos Islands have been obtained almost entirely from Standley's work on the *Amaranthaceae* in the North American Flora (21: 95-169. 1917). Except in the genus *Alternanthera* in which only type collections and specimens examined are cited, all collections that have been reported from the island for the family are listed. An exclamation point follows the collector's name if a specimen has been examined.

KEY TO THE GENERA

- a. Leaves alternate; anthers 4-celled.
 - b. Shrub, about 1 m. tall; fruit a many-seeded berry...1. **PLEUROPETALUM**
 - bb. Annual herbs; fruit a 1-seeded utricle.....2. **AMARANTHUS**
- aa. Leaves opposite; anthers 2-celled; perennials.
 - c. Perianth-segments distinct or nearly so, not becoming modified in fruit.
 - d. Heads numerous and small, disposed in an open panicle; perianth terete; anthers 5; stigma 2-3-lobed....3. **IREGINE**
 - dd. Heads fewer and larger, these solitary or glomerate, terminal or axillary; perianth generally compressed.
 - e. Leaves mostly basal, more or less crowded on the crown of the thick vertical root; anthers 2, staminodia 3, pseudostaminodia lacking; stigma 2-lobed.....4. **LITHOPHILA**
 - ee. Leaves cauline; stamens with anthers 5.
 - f. Leaves rigid, pungently mucronate; pseudostaminodia none; stigma 2-lobed.....5. **PHILOXERUS**
 - ff. Leaves herbaceous or coriaceous, not pungently mucronate; pseudostaminodia 5; stigma capitate.....6. **ALTERNANTHERA**
 - cc. Perianth-segments united at least to the middle into a tube, the tube becoming hardened and variously modified in fruit.....7. **FROELICHIA**

1. PLEUROPETALUM Hook. f.

Pleuropetalum Darwinii Hook. f.,
London Jour. Bot. 5: 108 (1846)

Type locality. James Island.

Insular distribution. ALBEMARLE: Iguana Cove, *Snodgrass & Heller*; Villamil, *Stewart!* JAMES: *Darwin; Stewart!*

Endemic.

2. AMARANTHUS L.

KEY TO THE SPECIES

- a. Perianth-segments 1-5, generally 3, oblong to oblanceolate, never spatulate-expanded, rarely corky-thickened at base.
 - b. Utricle dehiscent (*Amaranthus* proper).
 - c. Spines lacking.
 - d. Sepals shorter than utricle; bracts usually shorter than the sepals.
 - e. Stems erect; flowers nearly confined to terminal inflorescence.....1. *A. dubius*
 - ee. Stems diffuse; flowers common in axillary clusters below the terminal inflorescence..2. *A. celosioides*
 - dd. Sepals longer than utricle; bracts longer than the sepals.....3. *A. quitensis*
 - cc. Spines present at nodes and in inflorescence.....4. *A. spinosus*
 - bb. Utricle indehiscent (*Euxolus*).
 - f. Stems mostly erect or spreading; leaves broad.
 - g. Utricle smooth; stems spreading.....5. *A. viridis*
 - gg. Utricle rugulose; stems erect.....6. *A. gracilis*
 - ff. Stems prostrate, rarely ascending; leaves linear.
 - h. Sepals 3-5; utricle buff or brown.....7. *A. sclerantoides*
 - hh. Sepal 1; utricle black-brown.....8. *A. furcatus*
- aa. Perianth-segments spatulate, the blade largely scarious, in fruit becoming indurated at the base or coalescing below into a thickened spongy cushion (*Amblogyna*).
 - i. Stems erect, glabrous; leaves linear to narrowly lanceolate; cy-mules becoming elongate; base of bracts becoming thickened in fruit; base of perianth-segments scarcely spongy-coalescing, more indurated and nearly distinct.....9. *A. squamulatus*
 - ii. Stems spreading or erect, villous; leaves elliptic to obovate; cy-mules condensed, not elongating; bracts unchanged in fruit; base of perianth-segments coalescing to form an enlarged spongy base in fruit.....10. *A. Andersson*

1. **Amaranthus dubius** Mart.,
Pl. Hort. Erlang. 197 (1814)

A. caracasanus of reports on the Galapagian flora, perhaps
A. caracasanus HBK., Nov. Gen. & Sp. 2: 195 (1817).

The species was named from cultivated plants originating in tropical America.

Insular distribution. ALBEMARLE: southern part, *Baur*; Tagus Cove, *Snodgrass & Heller*; Villamil, *Stewart!*, *Howell!*; Cowley Bay, *Stewart!* CHARLES: *Darwin*; *Andersson*; *Snodgrass & Heller*; *Stewart!* CHATHAM: *Andersson*; *Snodgrass & Heller*; Wreck Bay, *Stewart!*, *Howell!* HOOD: Gardner Bay, *Howell!* INDEFATIGABLE: *Andersson*; Academy Bay, *Stewart!*; Conway Bay, *Howell!* JAMES: James Bay, *Howell!*

Further distribution. Widespread as a weed in tropical America.

2. **Amaranthus celosioides** HBK.,
Nov. Gen. & Sp. 2: 194 (1817)

This can be distinguished from *A. dubius* Mart. by the spreading habit, the stouter terminal inflorescence, and the axillary flower-clusters which extend to the base of the plant. In the Galapagos Islands, *A. celosioides* was reported by Hooker f. and by Andersson from Charles Island (*Darwin*, *Andersson*) and from Chatham Island (*Andersson*). No specimen of this species has been seen in the collections of *Amaranthus* from the islands, but, since the plant is one of the common species of northern South America, it is to be expected on the islands as a weed about dwellings and in cultivated ground. *Amaranthus celosioides* was first described from plants collected at Cumana, Venezuela.

3. **Amaranthus quitensis** HBK.,
Nov. Gen. & Spec. 2: 194 (1817)

Type locality. Near Quito, Ecuador.

Insular distribution. ALBEMARLE: Iguana Cove, *Snodgrass & Heller!*, *Stewart!*, *Howell!* CHARLES: *Stewart!*; Post Office Bay, *Howell!*; Black Beach, *Howell!* INDEFATIGABLE: Sierra la Jacres, *Rorud*; Turtle Bay, *Rorud*.

Further distribution. Northern South America; introduced into Europe.

Standley, who examined the specimens collected by the writer, and Blom, who examined the specimens collected by Rorud, refer the plants to a form of *A. quitensis* HBK. as that species is interpreted by Thellung in Ascherson and Graebner's Synopsis der Mit-

teleuropaischen Flora, a form with bracts shorter than in the type. The collections by Snodgrass and Heller (*No. 77* and *108*) and by Stewart (*No. 1355*) are placed here, but the specimens are very immature and possibly should be referred to *A. dubius* Mart.

4. **Amaranthus spinosus** L.,
Sp. Pl. 991 (1753)

Type locality. India.

Insular distribution. ALBEMARLE: Villamil, *Howell!* CHARLES: in cultivated ground, *Andersson*.

Further distribution. Tropical and subtropical Asia, Africa, and North and South America.

5. **Amaranthus viridis** L.,
Sp. Pl., ed. 2, 1405 (1763)

Type locality. Jamaica.

Insular distribution. ALBEMARLE: Villamil, *Stewart!*

Further distribution. Widespread in tropical and subtropical lands, occasionally adventive in temperate countries.

6. **Amaranthus gracilis** Desf.,
Tabl. Bot. 43 (1804)

Type locality. Guinea.

Insular distribution. BARRINGTON: *Snodgrass & Heller!* CHATHAM: Wreck Bay, *Stewart!* INDEFATIGABLE: Academy Bay, *Howell!*

Further distribution. Common in tropical regions around the world, occasionally adventive in temperate regions.

Here, too, probably belongs the collection of Snodgrass and Heller, made on Chatham Island and reported by Robinson as *A. viridis* L. The determination of the specimen from Academy Bay was confirmed by Standley.

7. **Amaranthus sclerantoides** (Ands.) Ands.,
Om Galap.-öarnes Veg. 59 (1857)

This *Amaranthus* is one of the plants characteristic of the lowlands of the Galapagos Islands in the vicinity of the shore, commonly growing in the higher reaches of bright calcareous beaches or a bit farther inland on sandy coastal flats. Only rarely was the species seen in the interior away from the sea.

Amaranthus sclerantoides presents several marked aspects because of the variation in leaf-shape, the leaves varying from linear and scarcely expanded at the apex to cuneate and rather widely dilated at the apex. When names were originally proposed for these forms, they were believed to be variants geographically isolated and were named for the islands where they were first collected. More recent and extensive field studies and collections have not only shown that the several forms are not confined to certain islands, but that they are dispersed through the archipelago and that occasionally several forms grow together in one colony. Thus at Academy Bay a form with gray-green, linear leaves grew with one marked by red-purple, cuneate leaves; on Tower Island the same pair occurred not far distant from each other, and at each locality no intergrades were seen.

There is also considerable variation in the development of spongy tissue at the base of the fruiting sepals and in the wrinkling of the utricle, variations which tend to be correlated. While all of the forms that have been named heretofore have been based on the striking foliar variations in the different plants, the form *rugulosus* is here proposed to take care of plants with sepals spongy at the base and with much-wrinkled utricles. There is some variation also in the length and width of the sepals, but generally the sepals equal or slightly exceed the utricle.

The seemingly artificial and deliberate segregation of the forms of this species in the key that follows belies the naturalness of the arrangement and the distinctive appearance of the segregates. As always in a key of this sort, care must be taken to distinguish between senescent plants and mature plants, and between puny starved seedlings and vigorous robust seedlings. The measurements in the key have been taken from the primary leaves of plants just reaching maturity.

KEY TO THE FORMS OF *A. sclerantoides*

- a. Sepals not prominently corky-thickened at the base; utricle not prominently rugulose.
 - b. Leaves dilated at the apex, the primary leaves more than 1 mm. wide at apex, frequently emarginate, obcordate, or truncate.
 - c. Leaves 1-2 mm. wide, emarginate or obcordate.7a. f. *typicus*
 - cc. Leaves 2-3 mm. wide, truncate or angularly obcordate.7b. f. *chathamensis*
 - bb. Leaves not dilated at apex, the primary leaves mostly 1 mm. or less wide at apex, generally obtuse or truncate, rarely emarginate.7c. f. *abingdonensis*
- aa. Sepals in fruit rather prominently corky-thickened at the base; utricle rugulose.7d. f. *rugulosus*

7a. *Amaranthus sclerantoides* f. *typicus* Howell, nom. nov.

Euxolus sclerantoides Ands., Stock. Akad. Handl. 163 (1854).
Amaranthus sclerantoides Ands., Om Galap.-öarnes Veg. 59
 (1857). *A. sclerantoides* f. *hoodensis* Rob. & Greenm., Amer.
 Jour. Sci. 50: 140 (1895).

Type locality. Charles Island.

Insular distribution. ALBEMARLE: Villamil, *Howell!*; southwestern coast, *Howell!* CHARLES: *Andersson!*, the original collection; *Stewart!*; Post Office Bay, *Howell!*; Black Beach, *Howell!* CHATHAM: Wreck Bay, *Howell!* GARDNER (near Hood): *Snodgrass & Heller!*; *Stewart!* HOOD: *Baur!*, the original collection of f. *hoodensis*; *Snodgrass & Heller!* INDEFATIGABLE: Academy Bay, *Svenson!*, *Howell!*; Conway Bay, *Howell!* NARBOROUGH: east side, *Snodgrass & Heller!* SOUTH SEYMOUR: *Svenson!*; *Howell!*

Endemic.

It does not appear that f. *hoodensis* can be well separated from the typical form, although f. *hoodensis* represents a variant with shorter and hence more obviously cuneiform leaves.

7b. *Amaranthus sclerantoides* f. *chathamensis* Rob. & Greenm.,
Amer. Jour. Sci. 50: 140 (1895)

A. sclerantoides f. *albemarlensis* Stewart, Proc. Calif. Acad. Sci., ser. 4, 1: 55, pl. 2, fig. 2 (1911).

Type locality. Southwestern end of Chatham Island.

Insular distribution. ALBEMARLE: Turtle Cove, *Stewart!*, type collection of f. *albemarlensis*. CHATHAM: southwestern end, *Baur!*, original collection of f. *chathamensis*; Wreck Bay, *Stewart!*, *Howell!* HOOD: Gardner Bay, *Howell!* INDEFATIGABLE: Academy Bay, *Svenson!*, *Howell!* TOWER: *Svenson!*; *Wheeler*; *Rose & Beebe!*; Darwin Bay, *Howell!*

Endemic.

From an examination of the original collection of this form, it is believed to be a plant past maturity which in a younger state would be marked by leaves broadly dilated at the apex. The collections of the form obtained at Wreck Bay at the western end of Chatham Island add to the probability of this view. Stewart's form *albemarlensis* represents the extreme aspect of leaf-dilation in the species, but can scarcely be segregated from the series of variations referred to f. *chathamensis*.

7c. *Amaranthus sclerantoides* f. *abingdonensis* Stewart,
Proc. Calif. Acad. Sci., ser. 4, 1: 54 (1911)

Type locality. Abingdon Island.

Insular distribution. ABINGDON: *Stewart!*, type collection. DAPHNE: *Wheeler, Rose & Beebe!* INDEFATIGABLE: Seymour Bay (north side), *Wheeler, Rose & Beebe!* TOWER: *Wheeler, Rose & Beebe!*; near Darwin Bay, *Howell!*, intergrade to f. *rugulosus*.

Endemic.

In the type collection the sepals are unchanged in fruit and the utricle is smooth; but, in the other specimens seen, there is a tendency for the sepals to become thickened at the base and for the utricles to become wrinkled.

7d. *Amaranthus sclerantoides* f. *rugulosus* Howell, f. nov.

Foliis linearibus, vix dilatatis apice, truncatis emarginatisve, ad 3 cm. longis, 0.5–1 mm. latis; sepalis basi suberoso-crassiusculis; utriculis rugulosis.

Leaves linear, scarcely widened at the apex, truncate or emarginate, to 3 cm. long, 0.5–1 mm. wide; sepals becoming corky-thickened at the base; utricle rugulose.

Type: Academy Bay, Indefatigable Island, *Howell No. 9062* (C. A. S. Herb. No. 203292). Other collections. BARRINGTON: *Snodgrass & Heller!* TOWER: Arcturus Lake, *Howell!*

This form is a nominal indication of a variable tendency found in *A. sclerantoides*. In those forms characterized by leaves broadened at the apex, the tendency is not marked; but, in the forms with linear leaves, the tendency reaches a development which, in other parts of the genus, is used as an indicator of specific limits.

8. *Amaranthus furcatus* Howell, spec. nov.

Annuus; caulibus prostratis, angularibus, 1–2 dm. longis, glabris; foliis distichis, cineraceo-viridibus, 1–3.5 cm. longis, ad 3 mm. latis, basi sensim attenuatis, apice dilato, furcato, lobis divergentibus, costa prominenti infra, costis lateralibus tenuibus vel nullis; floribus monoeciis, in brevibus axillaribus spicis, rachibus suberoso-crassiusculis curvatisque fructu; bracteis lineari-lanceolatis, 1.5 mm. longis, longioribus quam flores; sepalo 1, 1 mm. longo, lineari-oblongo, brevioris quam utriculus, viride, albo-marginato, acuto, immutabili fructu; stamine 1; stigmatibus 3; utriculis compressis, obovatis, rugulosis, fuliginosis, indehiscentibus, rostris acutis vel 3-dentatis; semine biconvexo, rotundo, nigro, nitido, circa 1 mm. diametro.

Annual; stems prostrate, angled, 1–2 dm. long, glabrous; leaves distichous, gray-green, 1–3.5 cm. long, to 3 mm. wide at the dilated apex, shallowly cleft with the lobes somewhat divergent, gradually attenuate below, midrib prominent below, the lateral veins inconspicuous or none; flowers monoecious, in short axillary spikes, the axes of which become corky-thickened and curved in fruit; bracts linear-lanceolate, 1.5 mm. long, exceeding the flowers; sepal 1, 1 mm. long, linear-oblong, shorter than the utricle, green, white-margined, acute; stamen 1; stigmas 3; utricle compressed, obovate, rugulose, dark brown, indehiscent, with pointed or shortly 3-toothed beak; seed biconvex, round, black, shining, about 1 mm. in diameter.

Type: Academy Bay, Indefatigable Island, *Howell No. 9063* (C. A. S. Herb. No. 203294).

This species is clearly related to *A. sclerantoides* Ands. which it resembles in its prostrate habit and linear leaves. From that species it differs not only in the flowers with single sepals and stamens, but also in the peculiar divergent lobes at the ends of the leaves, the dark colored, much wrinkled utricles, and the thickened curved axes of the axillary flower-clusters. The fruit is not readily deciduous; it is frequently held fast in the enlarged curved axis which breaks off with the fruit and which might serve as a buoyant means for dispersal. The species is known from two plants collected on a sandy flat near the shore of Academy Bay.

9. *Amaranthus squamulatus* (Ands.) Rob.,
Proc. Amer. Acad. 43: 22 (1907)

Scleropus squamulatus Ands., Stock. Akad. Handl. 162 (1854).
S. squarrulosus Ands. acc. Gray, Proc. Amer. Acad. 5: 169 (1861).
Amblogyne squarrulosa Gray, loc. cit.
Amaranthus squarrulosus Uline & Bray, Bot. Gaz. 19: 270 (1894).

Type locality. Chatham Island.

Insular distribution. ALBEMARLE: Tagus Cove, *Snodgrass & Heller!*, *Stewart!*, *Howell!* CHARLES: *Snodgrass & Heller!*; Black Beach Road, *Howell!* CHATHAM: *Andersson.* DUNCAN: *Snodgrass & Heller!*; *Howell!* INDEFATIGABLE: northern part, *Snodgrass & Heller!*, *Howell!*; northeast side, *Stewart!*; Conway Bay, *Howell!* JAMES: Sullivan Bay, *Howell!* JERVIS: *Baur!*; *Howell!* NORTH SEYMOUR: *Snodgrass & Heller!*

Endemic.

10. *Amaranthus Anderssoni* Howell, nom. nov.

KEY TO THE FORMS OF *A. Anderssoni*

- a. Stems spreading; bracts 1-2 mm. long; flowers about 2 mm. long,
almost as broad, strongly urceolate.....10a. *f. typicus*
aa. Stems erect; bracts 1.5-2 mm. long; flowers 2-2.5 mm. long, tubular.
.....10b. *f. erectus*

10a. *Amaranthus Anderssoni f. typicus* Howell, nom. nov.

Scleropus urceolatus Ands., Stock. Akad. Handl. 162 (1854). *Amblogyna urceolata* Ands., not Moq., Om. Galap.-öarnes Veg. 59 (1857). Not *Amaranthus urceolatus* Benth., Bot. Sulph. 158 (1844).

Type locality. Indefatigable Island in the vicinity of Conway Bay.

Insular distribution. INDEFATIGABLE: *Andersson*. HOOD: Gardner Bay, *Howell!* JAMES: James Bay, *Howell!*; Sullivan Bay, *Howell!*
Endemic.

This plant, which was described as an endemic Galapagian species by Andersson, was considered by subsequent workers in the flora of the islands as synonymous with *A. urceolatus* Benth., a species described from Guayaquil, Ecuador. The island plant is even more distinct from the mainland species than is *A. squamulatus* (Ands.) Rob. which has always been considered endemic. The peculiar spongy cushion developing in fruit at the base of the pistillate calyx at once separates *A. Anderssoni* from the mainland plant in which the base of the calyx becomes indurated (ex char.); and a further essential difference between the two is found in the male flowers which are two-staminate in the island plant and five-staminate in the one on the mainland (ex char.). The misinterpretation of the island plant has resulted largely from the lack of material, the collections made on the Templeton Crocker Expedition being the only ones known of the island plant aside from Andersson's original collection.

10b. *Amaranthus Anderssoni* f. *erectus* Howell, f. nov.

Caulibus erectis; bracteis 1.5–2 mm. longis; floribus 2–2.5 mm. longis, tubulato-urceolatis, longioribus quam latiores.

Stems erect; bracts 1.5–2 mm. long; flowers 2–2.5 mm. long, tubular-urceolate, longer than wide.

Type: Duncan Island, *Howell No. 9837A* (C. A. S. Herb. No. 203293).

This form was believed to be *A. squamulatus* (Ands.) Rob. when it was collected because in its erect slender habit it represents a marked change from typical *A. Anderssoni*. The flowers and bracts are also somewhat more elongated. The plant might represent a hybrid between the two species; but it can be properly placed in *A. Anderssoni* because of the hairy stem, broader leaves, and spongy tissue at the base of the fruiting perianth.

3. IRESINE L.

Iresine Edmonstonei Hook. f.,
Trans. Linn. Soc. 20: 190 (1847)

This plant, which with *I. elatior* Rich. is referred to the section *Rosea* of *Iresine* by both Moquin (DC. Prodr. 13, pt. 2: 313) and Schinz (Natur. Pflanz. III. 1a: 117), is known in the Galapagian flora only from a collection made by Darwin on Charles Island, the only collection cited by Hooker with the original description. Ac-

ording to Robinson (Proc. Amer. Acad. 38: 137), there is a specimen in the Gray Herbarium labelled "*Iresine Edmonstonei* Hook. f. Guayaquil? Mr. Edmonston," a specimen which agrees well with the description of the species. Hence, it is doubtful if the species is endemic to the Galapagos Islands, and there might be expressed some doubt as to the locality of the first collection.

4. LITHOPHILA Sw.

KEY TO THE SPECIES

- a. Basal leaves rush-like and subterete.....1. *L. radicata*
 aa. Basal leaves linear-oblongate, foliaceous.....2. *L. subscaposa*

1. *Lithophila radicata* (Hook. f.) Standl., Jour. Wash. Acad. Sci. 5: 396 (1915)

Alternanthera radicata Hook. f., Trans. Linn. Soc. 20: 261, 262 (1847).

A. acaulis Ands., Stock. Akad. Handl. 164 (1854).

Iresine radicata (Hook. f.) Kuntze, Rev. Gen. Pl. 542 (1891).

Type locality. Chatham Island.

Insular distribution. CHARLES: *Stewart!*; Black Beach, *Howell!*
 CHATHAM: *Darwin; Andersson!*, the type collection of *Alternanthera acaulis* Ands. HOOD: *Snodgrass & Heller!*

Endemic.

This striking plant inhabits very dry rocky places in the lowlands. It bears a generic resemblance to the species of *Lithophila* in northern South America and the West Indies, *L. muscoides* Sw., but differs in the larger size of all its parts as well as in other details. By Schinz (Die Natur. Pflfam. III. 1b: 117), the genus *Lithophila* is merged with *Iresine*; but the plants are incongruous in *Iresine* and can be properly separated from that genus by the two fertile stamens and the three staminodia and by the compressed perianth.

2. *Lithophila subscaposa* (Hook. f.) Standl., Jour. Wash. Acad. Sci. 5: 396 (1915)

Alternanthera subscaposa Hook. f., Trans. Linn. Soc. 20: 189 (1847).

Iresine subscaposa (Hook. f.) Kuntze, Rev. Gen. Pl. 542 (1891).

Type locality. Charles Island.

This endemic species is either very rare or else it is not easily detected as it grows in the moist uplands amid the abundant vegetation of the wet zone. It is known from only two collections, the original one made by Darwin and a second one made by Stewart near the summit of Duncan Island at 1250 ft. The second collection

differs in one or two minor details of inflorescence and flower from the original description by Hooker and from the description by Moquin (DC. Prod. 13, pt. 2: 353); but, until the original collection can be compared, the differences are scarcely noteworthy.

5. **PHILOXERUS** R. Br.

Philoxerus rigidus (Rob. & Greenm.) Howell, comb. nov.

Alternanthera rigida Rob. & Greenm., Amer. Jour. Sci. 50: 143 (1895).

Lithophila rigida (Rob. & Greenm.) Standl., Jour. Wash. Acad. Sci. 5: 396 (1915).

Type locality. Orchilla Bay, James Island.

Insular distribution. JAMES: Orchilla Bay, *Baur!*; northeastern side, *Stewart!*

This remarkable Galapagian endemic is readily placed in the genus *Philoxerus* by its compressed perianth with the base of sterile tissue, by the five fertile stamens united at the base to form a short tube, by the absence of interstaminal appendages, and by the two elongate-triangular stigmas. The two-lobed stigma and the unappendaged stamen-tube separate the plant from *Alternanthera*, and the five fertile stamens and the modified base of the perianth separate the plant from *Lithophila*. Schinz (Die Natur. Pffam. III. 1b: 117) merges *Philoxerus* and *Lithophila* in his section *Philoxerus* of *Iresine*; but it would seem that things are represented more nearly in the proper proportion to treat both *Philoxerus* and *Lithophila* as distinct genera: for not only are these several groups habitually dissimilar but they are rather readily distinguished by characters of the perianth and androecium.

The development of a low shrubby habit and shortened hardened leaves in *P. rigidus* marks an abrupt departure from the more usual type of plant found in *Philoxerus*. This sclerocauly and sclerophylly are the result of the direct influence of the desert conditions of the Galapagos Islands, as these conditions would affect a mesophytic prototype. The same end has been effected in *Mollugo Snodgrassii* Rob., a remarkable switch plant of the islands, also believed to be rather closely allied to herbaceous annuals of the mesophytic type. But in *P. rigidus* certain vegetative peculiarities of the group are still discernible beneath the strange aspect, such as the disposition of the pubescence in the axils of the leaves and in the inflorescence and the attachment of the opposite leaves by broad bases which completely surround the stems at the nodes.

6. *ALTERNANTHERA* Forsk.

The genus *Alternanthera*, which has received the most critical attention in this study, has a particularly high development in the Galapagos Islands, a development that is almost entirely endemic. Of the twenty species, subspecies, and forms that are accepted here, only one is considered not endemic, although there is a question about yet another. Most of the species are well marked and easily limited; but some of the species, especially those of the arid lowlands which have scoparious stems and linear leaves, are more intimately related and are not readily distinguished because of the variability of the plants. In the species of *Alternanthera* in the Galapagos Islands there are few instances where the morphology of the flower and the size of the flower-parts have been available for purposes of specific segregation. The type of foliage and its vesture and the position assumed by the flowers in the capitate inflorescences have been considered the most valuable structural features for a general grouping of species, and habit, as a character of secondary importance, has been very helpful. Some students may consider these characters too trivial to indicate acceptable species, but, nevertheless, they lend to the entities that they delimit a distinctive and specific aspect that is well correlated with insular distribution. It is believed that a much more accurate picture of the taxonomic status of the Galapagian *Alternantheras* is given, not by combining these groups into broad aggregates where nice distinctions are lacking and where geographic distribution is of no significance, but by treating these entities as species, some of which are more complex and variable within themselves, others of which are very distinctive in appearance and local in occurrence.

The generic name *Alternanthera* is taken for the group, replacing *Telanthera* to which most of the Galapagian species have been referred heretofore. *Telanthera*, established mainly on the relative lengths of the stamen-tube, filaments, and pseudostaminodia, is scarcely distinct from *Alternanthera* as a genus. *Achyranthes*, to which Standley referred most of the species, is to be returned to its generally accepted application with the designation of *Achyranthes aspera* L. as the type species, according to the list of standard species of Linnean genera proposed at the International Botanical Congress at Cambridge in 1930. This fixes *Alternanthera* as the name of the genus for which Standley, under the then existing American Code of Botanical Nomenclature, assumed *Achyranthes repens* L. as type.

Because of the confusion that has existed in the determination of many of the collections in the genus and because of differences of opinion on specimens, no specimens other than original collections have been cited unless they have been examined.

KEY TO THE SPECIES

- a. Leaves narrowly linear to linear-oblong or linear-oblongate, 0.5–3 mm. wide (or 5 mm. wide in *A. glaucescens* and *A. flavicoma*).
- b. Stems and leaves glabrous or if minutely pubescent soon glabrate.
- c. Flowers closely and smoothly imbricated, densely covered with pale yellow hairs.....1. *A. nudicaulis*
- cc. Flowers loosely imbricated or even subsquarrose, or if more closely adpressed, the head not smooth.
- d. Leaves not fleshy or glaucescent (except in *A. filifolia glauca*); flowers frequently erect or spreading at the top of the head, the tips standing free, the flowers whitish to straw-color.....2. *A. filifolia*
- dd. Leaves somewhat fleshy when fresh, glaucescent; flowers more closely imbricated, the tips incurved at the top of the head or subadpressed, pale yellowish.....3. *A. glaucescens*
- bb. Stems and leaves densely or conspicuously pubescent, the pubescence subsistent.
- e. Leaves linear-oblongate or linear-oblong, 2–5 mm. wide or rarely wider; heads 4–5 mm. wide; flowers 3–3.5 mm. long, roughly imbricated, the tips free. 4. *A. flavicoma*
- ee. Leaves narrowly linear, 1–2 mm. wide; heads 3 mm. wide; flowers 2–2.5 mm. long, closely imbricated, the tips subadpressed.....5. *A. flosculosa*
- aa. Leaves oblanceolate and elliptic to ovate or round, generally more than 5 mm. broad (the upper leaves of *A. Snodgrassii* are usually narrower and the smaller leaves of *A. nesiotis* are less than 5 mm. wide).
- f. Flowers more or less adpressed or closely imbricated.
- g. Stems and leaves glabrous and glaucous.....6. *A. galapagensis*
- gg. Stems and leaves not glaucous, hirsutulose to tomentulose or subsericeous.
- h. Leaves at least twice as long as broad, oblong or elliptic to oblanceolate.
- i. Hairs on the stems much-branched, the pubescence hirsutulose and fulvous.....7. *A. vestita*
- ii. Hairs on the stems nearly or quite simple, the pubescence subsericeous and pale straw-color.....8. *A. Snodgrassii*
- hh. Leaves nearly as broad as long to broader than long, broadly ovate to round and even transversely elliptical.
- j. Bushy plants with erect or spreading stems; leaves to 4.5 cm. long.....9. *A. Helli*
- jj. Mat-like plant with stems prostrate from the top of a thick woody tap-root; leaves to 0.8 cm. long.....10. *A. nesiotis*
- ff. Flowers loosely imbricated to arcuate-spreading or squarrose.

- k. Sepals subequal and similar, generally more than 5 mm. long; stamen-tube and pseudostaminodia 5-6 mm. long; anthers 2 mm. long; shrubs to 2.5 m. tall... 11. *A. echinocephala*
- kk. Sepals not equal, dissimilar, less than 5 mm. long; stamen-tube and pseudostaminodia 3 mm. long; anthers 1 mm. long or less.
1. Arborescent shrub or low tree, 3-4 m. tall; leaves oblong, rounded at the apex; heads terminal, oblong.....12. *A. rugulosa*
- 1l. Trailing or bushy perennials to 1.5 m. tall, becoming woody at the base; leaves elliptic or lanceolate to ovate, generally acute, sometimes obtuse; heads axillary, about as broad as long.
- m. Leaves elliptic to ovate-oblong, to 5.5 cm. long, 3-5-nerved; outer sepals spinose-acuminate.....13. *A. ficoidea*
- mm. Leaves broadly elliptic to ovate, to 10 cm. long, 5-8-nerved; outer sepals acute to acuminate.....14. *A. halimifolia macrophylla*

1. *Alternanthera nudicaulis* (Hook. f.)

E. Christophersen, *Nyt Mag. Naturvid.* 70: 73 (1931)

Bucholtzia nudicaulis Hook. f., *Trans. Linn. Soc.* 20: 191 (1847).

Telanthera nudicaulis Moq. in DC., *Prodr.* 13, pt. 2: 369 (1849).

Achyranthes nudicaulis Standl., *Jour. Wash. Acad. Sci.* 5: 74 (1915).

Type locality. Charles Island.

Insular distribution. ABINGDON: *Stewart!* CHARLES: *Darwin; Stewart!*; Post Office Bay, *Crocker!, Howell!*; Black Beach, *Howell!*
Endemic.

Andersson's collection from Charles Island (Gray Herb.) which has been referred to this species has been examined and is not typical because the flowers are not closely adpressed in the heads. Hence, the plant may be more closely related to *A. glaucescens* as the species are limited here. In fact, a critical comparison of this specimen and Andersson's type collection of *Telanthera strictiuscula* discloses no essential difference; and the suggestion is made here that there might have been a confusing of labels or specimens, and that Andersson's specimen labelled *T. nudicaulis* from Charles Island is actually *T. strictiuscula* from Chatham Island, at least as far as the specimen in the Gray Herbarium is concerned.

Also in the material in the Gray Herbarium is an excellent specimen of *A. nudicaulis* from the "Galapagos Islands" with mature heads, but the specimen is without definite locality or name of collector. The heads are 4-5 mm. wide and as much as 2 cm. long, and the flowers are closely and evenly adpressed and imbricated. Al-

though in young heads the bracts and sepals are densely yellowish-hairy, in these matured heads they are glabrate and light brown.

Stewart's collection (*No. 1405*) from Abingdon Island is not typical in that the ends of the branches are pubescent and the leaves are broad, but the heads and flowers correspond almost exactly to those of typical *A. nudicaulis* from Charles Island. It is probable that the Abingdon plant will be recognized later as a distinct form of *A. nudicaulis* when better vegetative specimens are obtained.

2. *Alternanthera filifolia* (Hook. f.) Howell, comb. nov.

Bucholtzia filifolia Hook. f., Trans. Linn. Soc. 20: 192 (1847).

Telanthera filifolia Moq. in DC., Prodr. 13, pt. 2: 368 (1849).

Achyranthes Hookeri Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

KEY TO THE SUBSPECIES OF *A. filifolia*

- a. Heads 3–6 mm. wide, generally 3–7-glomerate at the ends of branchlets or sometimes only 1 or 2; leaves mostly 1–2 mm. wide.
 - b. Stems not glaucous.
 - c. Heads 3–4 mm. wide; flowers erect, the tips free but scarcely divergent. 2a. *typica*
 - cc. Heads 4–6 mm. wide; flowers spreading or subsquarrose. 2b. *subsquarrosa*
 - bb. Stems glaucous. 2c. *glauca*
- aa. Heads 2.5–3 mm. wide, generally solitary, sometimes 2–3-glomerate.
 - d. Leaves 1.5–4 mm. wide; heads 2.5–3 mm. wide, generally pearly-white; bracts and sepals acute. 2d. *margaritacea*
 - dd. Leaves 3 mm. wide; heads 3 mm. wide, straw-color; bracts and sepals subacuminate. 2d. *sylvatica*

2a. *Alternanthera filifolia typica* Howell, nom. nov.

Bucholtzia filifolia Hook. f., l. c. *Telanthera filifolia* Moq., l. c.

Achyranthes Hookeri Standl., l. c.

Type locality. James Island.

Insular distribution. ALBEMARLE: southern part (?), *Baur No. 293!*; 5 miles ne. of Webb Cove, *Howell!*; Cowley Bay, *Baur!*, *Stewart!*; Tagus Cove Mt., *Stewart!*, *Howell!* INDEFATIGABLE: south-eastern side, *Stewart!*; Academy Bay, *Howell!* JAMES: *Darwin!*; Orchilla Bay, *Baur!*; James Bay, *Howell!*; Sullivan Bay, *Howell!*

Endemic.

In localities not of the most arid sort, where the plants are shaded by brush or trees, the typical form with heads glomerate-congested

is frequently replaced by a form in which solitary heads are not infrequent. Since the aspect of such plants and the character of the leaves and heads are more like the typical form, such plants are referred here. The following specimens are of this character. Albemarle: southern part, *Baur No. 302!*; Villamil, *Stewart!*, *Howell!* Indefatigable: Academy Bay, *Howell!* Narborough: southern side, *Stewart!*

2b. *Alternanthera filifolia subsquarrosa* Howell, subspec. nov.

Caulibus divaricatis; foliis usque ad 5 cm. longis, 1–2.5 mm. latis; capitulis fere 3–7-glomeratis, 4–6 mm. latis; floribus subpatentibus vel subsquarrosis; longioribus sepalis 3–3.5 mm. longis; staminibus 2.5 mm. longis.

Stems divergently branched; leaves to 5 cm. long, 1–2.5 mm. wide; heads generally 3–7-glomerate, 4–6 mm. wide; flowers somewhat spreading or subsquarrose; longer sepals 3–3.5 mm. long, stamens 2.5 mm. long.

Type: James Bay, James Island, *Stewart No. 1413* (C. A. S. Herb. No. 132894; isotype in Gray Herb.). Stewart notes that the plant was "fairly abundant to 1200 ft." A second collection was made by Stewart at James Bay, *No. 1397* (!), and was reported as an occasional bush, 12 to 18 inches high, growing to an elevation of 2150 ft. A foliose specimen with very young heads from relatively moist slopes above the southeastern end of James Bay, *Howell No. 9685*, may belong here.

2c. *Alternanthera filifolia glauca* Howell, subspec. nov.

Caulibus ligneis, glaucis, multiramosis supra, internodis brevibus; foliis crassiusculis, subcoriaceis, leve pubescentibus, demum glabrescentibus, glaucescentibus, lineari-oblongeolatis, usque ad 2.5 cm. longis, 3 mm. latis, margine vix revolutis; capitulis 2–4-glomeratis, 8 mm. longis, 4 mm. latis, oblongo-conoideis, floribus inaequaliter imbricatis; bracteis 2 mm. longis; longioribus sepalis circa 3 mm. longis; staminibus 2 mm. longis.

Stems woody, glaucous, much-branched above, the internodes short; leaves thickish, subcoriaceous, lightly pubescent, becoming glabrate, glaucescent, linear-oblongeolate, to 2.5 cm. long, 3 mm. wide, margins scarcely revolute; heads generally 2–4-glomerate, 8 mm. long, 4 mm. wide, the flowers roughly imbricated; bracts 2 mm. long; the longer sepals about 3 mm. long; stamens 2 mm. long.

This distinctive plant, which is nearly specifically distinct as the species are accepted here, is known from only a single collection made on Brattle Island by Stewart, *No. 1408* (type, C. A. S. Herb. No. 132898; isotype in Gray Herb.). The character of the heads definitely relates *A. filifolia glauca* to *A. filifolia* rather than to *A. glaucescens* or *A. galapagensis*, the other glaucescent species in

the Galapagos Islands. It appears to be a development resulting from maritime influence in the variable series here placed in *A. filifolia*.

2d. *Alternanthera filifolia margaritacea* Howell, subspec. nov.

Caulibus divaricatis; foliis linearibus ad lineari-oblongatis, 1.5-4 mm. latis; capitulis globosis ad conicis, solitariis vel 2-3-glomeratis, margaritaceis, 2.5-3 mm. latis; floribus erectis, apicibus non adpressis; bracteis 1.5 mm. longis; longioribus sepalis circa 2 mm. longis; staminibus 1-1.5 mm. longis.

Stems divergently branched; leaves linear to linear-oblongate, 1.5-4 mm. wide, heads solitary or 2-3-glomerate, pearly-white, 2.5-3 mm. wide; flowers erect, the tips not adpressed; bracts 1.5 mm. long; the longer sepals about 2 mm. long; stamens 1-1.5 mm. long.

Type: Iguana Cove, Albemarle Island, *Howell No. 9416* (C. A. S. Herb. No. 203288). Other collections have been made at Iguana Cove by Snodgrass & Heller (!) and by Stewart (!). A young specimen was collected by Snodgrass & Heller (!) from southern Narborough Island at 2000 ft. and is perhaps referable here. In this the heads are a bit larger and the leaves broader than in the specimens from Iguana Cove.

2e. *Alternanthera filifolia sylvatica* Howell, subspec. nov.

Caulibus divaricatis; foliis angustato-oblongatis, 3-3.5 cm. longis, 3 mm. latis; capitulis fere solitariis, 3 mm. latis, stramineis; floribus primo patentibus, tandem subadpressis; bracteis 1.5-2 mm. longis; longioribus sepalis 2.5 mm. longis; staminibus 1.5 mm. longis.

Stems divergently branched; leaves slender-oblongate, 3-3.5 cm. long, 3 mm. wide; heads generally solitary, 3 mm. wide, straw-color; flowers spreading at first, later subadpressed; bracts 1.5-2 mm. long; the longer sepals 2.5 mm. long; stamens 1.5 mm. long.

Type: trail to Fortuna from Academy Bay, Indefatigable Island, *Howell No. 9140* (C. A. S. Herb. No. 203289). This was a much-branched shrub about 1 m. tall growing on a rocky slope in partial shade in the region between the dry lowlands and wet uplands. A collection by Svenson (!) from the shore of Academy Bay is referred here as a puberulent variant. In this collection, as in the type, the bracts and sepals are nearly acuminate.

3. *Alternanthera glaucescens* (Hook. f.) Howell, comb. nov.

Bucholtzia glaucescens Hook. f., Trans. Linn. Soc. 20: 191 (1847).

Telanthera glaucescens Moq. in DC., Prodr. 13, pt. 2: 369 (1849).

Achyranthes glaucescens Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

KEY TO THE FORMS OF *A. glaucescens*

- Leaves 2-3 (or 5) mm. wide, linear-oblancoelate.....3a. f. *typica*
 Leaves 1-1.5 mm. wide, linear.....3b. f. *strictiuscula*

3a. *Alternanthera glaucescens* f. *typica* Howell, nom. nov.

Bucholizia glaucescens Hook. f., l. c. *Telanthera glaucescens* Moq.,
 l. c. *Achyranthes glaucescens* Standl., l. c.

Type locality. Chatham Island.

Insular distribution. CHATHAM: *Darwin*; *Andersson!*; Wreck Bay,
Stewart!, *Howell!*; Sappho Cove, *Stewart!*

Endemic.

Stewart's collections from Wreck Bay were reported by him as
Telanthera flavicoma Ands. because of the pubescence on the branch-
 lets and young leaves. In spite of the emphasis placed on the char-
 acter of pubescence in *A. flavicoma*, it would seem that these speci-
 mens are more properly considered puberulent variants of *A. glau-
 cescens*, with which species they seem allied by the more rhombic-
 linear or elliptic-linear leaves, subcoriaceous in texture, and sparse
 on the branchlets. Baur's collection from the northern part of
 Chatham Island (!) is a specimen without leaves, but it is referred
 here on the character of the mature heads in which the flowers are
 not very closely and evenly adpressed.

3b. *Alternanthera glaucescens* f. *strictiuscula* (Ands.) Howell,
 comb. nov.

Telanthera strictiuscula Ands., Stock. Akad. Handl. 166 (1854).
T. angustata Ands., Om. Galap.-öarnes Veg. 61, pl. 4, fig. 2
 (1857). *Achyranthes strictiuscula* Standl., Jour. Wash. Acad.
 Sci. 5: 75 (1915).

Type locality. Chatham Island.

Insular distribution. CHATHAM: *Andersson!*, original collection of
Telanthera strictiuscula Ands.; *A. Agassiz!*; *Snodgrass & Heller!*,
 intergrading to typical *A. glaucescens*.

Endemic.

Telanthera strictiuscula Ands., interpreted from a specimen of the
 original collection in the Gray Herbarium, appears to be a narrow-
 leaved form of *A. glaucescens*, and it can be connected to that species
 by a series of intergrading specimens. In fact, if the material in the
 pocket on the sheet in the Gray Herbarium is from the same plant
 as the mounted specimen, there is no doubt of the close relationship
 of the two species because of the greater width of the leaf-fragments
 and the character of the more mature heads enclosed therein. Even

if the pocket-material originated from a collection of typical *A. glaucescens*, wholly or in part, the mounted specimen with its narrow leaves would still appear best treated as a form of *A. glaucescens* because of the similarity of the heads in the two forms.

Alternanthera glaucescens through f. *strictiuscula* is closely related to *A. filifolia*. In fact, many of the collections cited in this work under *A. filifolia* have been referred by earlier students of the Galapagian flora to *Telanthera strictiuscula* Ands. Typical *A. filifolia* has the flowers more or less spreading in the head, and even in less typical forms the flowers have an unaddressed or uneven appearance. The flowers in *A. glaucescens* f. *typica* and f. *strictiuscula* are more evenly addressed and the heads have a different aspect from those of the more atypical forms of *A. filifolia*. Further study and more extensive collections of *A. glaucescens* will determine whether it can be maintained distinct from *A. filifolia*.

After a critical study of the diagnoses of *Telanthera strictiuscula* Ands. and *T. angustata* Ands., names which Andersson considered synonymous, and after an examination of Andersson's figure of *T. angustata*, a question arose as to whether the names had been applied by Andersson to plants nearly enough alike to be considered the same, or whether two taxonomic entities were involved. The specimen of *T. strictiuscula* in the Gray Herbarium corresponds closely to the original description of the species as given by Andersson in Stock. Akad. Handl. p. 66; but this specimen, principally the leaves and inflorescence, does not correspond to the figure of *T. angustata* Ands. in Andersson's second work on the flora of the Galapagos Islands, Om Galap.-öarnes Veg. pl. 4, fig. 2, nor to the statement, l. c., p. 61, that the leaves are to 3 inches in length. On the mounted specimen referred to, there is no leaf over one inch in length and the heads are not on elongated "peduncles" as shown in the figure. Undoubtedly two collections from Chatham Island were used by Andersson, specimens unlike in appearance but probably representing merely extremes of branching and of leaf variation. The collection from Chatham Island by A. Agassiz (Gray Herb.) represents the form with more open branching and longer leaves. For a time it was thought that *T. angustata* Ands. might be *A. flosculosa* Howell, but the absence of pubescence in the former species (ex char., as far as *T. angustata* Ands. is concerned) and its abundance in the latter species led to the conclusion that *T. strictiuscula* Ands. and *T. angustata* Ands. are very nearly related forms, if not identical, and that to neither is *A. flosculosa* referable.

In his second work, Andersson was in undoubted error when he cites his collection from James Island instead of from Chatham Island (cf. Robinson, Fl. Galap. Is., p. 140). No reason for changing the name of the species from *strictiuscula* to *angustata* is given.

4. ***Alternanthera flavicoma*** (Ands.) Howell, comb. nov.

Telanthera flavicoma Ands., Stock. Akad. Handl. 166 (1854).

Achyranthes flavicoma Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

Type locality. Charles Island.

Insular distribution. ALBEMARLE: Villamil, *Stewart!* CHARLES: *Andersson; Stewart!* CHATHAM: Bassa Point, *Stewart!* DUNCAN: *Snodgrass & Heller!* GARDNER (near Hood): *Snodgrass & Heller!; Howell!* HOOD: *Baur!; Snodgrass & Heller!; Stewart!* INDEFATIGABLE: Academy Bay, *Stewart!* JERVIS: *Stewart!*

Endemic.

This species is closely related to *A. filifolia* and might be considered a pubescent variant of it. However, besides the commonly golden hairs which envelope the young growth, there is a tendency for the leaves to be wider and for the tips of the flowers to be less sharply acute. It is not always easy to distinguish between the two species but usually specimens can be rather readily placed.

Among the specimens that have been examined from the Gray Herbarium is a collection of *Alternanthera* labelled "S. Chili, J. G. Reynolds." Undoubtedly, it represents a plant closely related to the narrow-leaved species of *Alternanthera* of the Galapagos Islands and seems nearest to the present species. It is very improbable that a plant with the xerophytic characters which are found in this plant would occur in southern Chile, and it seems not impossible that the collection originated in the Galapagos Islands and has been mislabelled. This plant has been determined as *Telanthera nudicaulis* but it cannot be that species because the flowers are not smoothly adpressed in the heads and the leaves and branchlets are rather conspicuously pubescent.

From Abingdon Island come the collections most divergent from the usual type, *Snodgrass & Heller No. 826, Stewart No. 1387, and Stewart No. 1386*. In the first two specimens the leaves vary to 1 cm. wide, the flowers are a little more adpressed in the heads, and the anthers are only about 0.5 mm. long. In *Stewart No. 1386* the stems are noted as prostrate and there are roots at the nodes; and, although the leaves are as broad as in the other collections from Abingdon Island, the heads and flowers are more like the usual type and the anthers are 1 mm. long. For the present these are placed as atypical forms of *A. flavicoma* although they might be considered nearer to *A. Snodgrassii*.

5. ***Alternanthera flosculosa*** Howell, spec. nov.

Frutex multiramis, 1-2 m. altus; ramulis pubescentibus; foliis angustato-linearibus, 1-6 cm. longis, 1-2 mm. latis, subsessilibus, dense et persistente flavescenti-pubescentibus subtus, subglabrescentibus supra; capitulis albidis, solitariis vel 2-3-glomeratis, oblongo-ovatis, 4-7 mm. longis, 3 mm. latis, dense pilosis; bracteis 1.5 mm. longis; longioribus sepalis circa 2 mm. longis, apicibus florum subadpressis; staminibus 1 mm. longis, breviter excedentibus pseudostaminodia.

Much-branched shrub, 1-2 m. tall; branchlets pubescent; leaves narrowly linear, 1-6 cm. long, 1-2 mm. wide, subsessile, densely and persistently yellowish-hairy below, subglabrescent above; heads whitish, solitary or 2-3-glomerate, oblong-ovate, 4-7 mm. long, 3 mm. wide, densely pilose; bracts 1.5 mm. long; longer sepals 2 mm. long, the tips of the flowers subadpressed; stamens 1 mm. long, barely exceeding the pseudostaminodia.

Collections. CHATHAM: Wreck Bay near the shore, *Howell No. 8604* (type, C. A. S. Herb. No. 203290); southwestern end, *Baur!* (seedling); Wreck Bay at 500 ft., *Stewart!*

Alternanthera flosculosa is most nearly related to *A. flavicoma* but appears amply distinct for specific recognition. Not only does the plant differ from *A. flavicoma* in its more slender heads and smaller flowers, but it is a definite shrub 1 to 2 m. tall instead of a scoparious herb from a woody base as is *A. flavicoma*.

6. ***Alternanthera galapagensis*** (Stewart) Howell, comb. nov.

Telanthera galapagensis Stewart, Proc. Calif. Acad. Sci., ser. 4, 1: 57 (1911).

Achyranthes galapagensis Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

This distinct species with its broad glaucous leaves is known only from the type specimen, collected on Gardner Island near Charles Island by J. R. Slevin (!), herpetologist on the Expedition of the California Academy of Sciences of 1905-1906.

7. ***Alternanthera vestita*** (Ands.) Howell, comb. nov.

Telanthera vestita Ands., Stock. Akad. Handl. 169 (1854).

Achyranthes vestita Standl., Jour. Wash. Acad. Sci. 5: 75 (1915).

Type locality. Indefatigable Island.

Insular distribution. INDEFATIGABLE: dry places in the middle regions, *Andersson*; south of Conway Bay, *Baur!*; north side, *Stewart!*; Academy Bay, *Stewart!*

Endemic.

In his original account of the species, *Andersson* reported it from Charles Island, but in his second work the locality was changed to Indefatigable Island, on which the plant has been recollected and to which its distribution appears to be restricted. Without doubt, *Andersson's* collection was made in the vicinity of Conway Bay at the northwest side of the island.

8. *Alternanthera Snodgrassii* (Rob.) Howell, comb. nov.

Telanthera Snodgrassii Rob., Proc. Amer. Acad. 38: 140 (1902).

Achyranthes Snodgrassii Standl., Jour. Wash. Acad. Sci. 5: 75 (1915).

Type locality: North Seymour Island.

Insular distribution. INDEFATIGABLE: Seymour Bay, *Wheeler, Rose & Beebel*; north side, *Howell!* NORTH SEYMOUR: *Snodgrass & Heller!*, original collection; *Howell!* SOUTH SEYMOUR: *Howell!*, only one plant seen.

Endemic.

Alternanthera Snodgrassii was very abundant on the grassy flats of northern Indefatigable Island and North Seymour Island, and was not unattractive as it formed broad, loosely spreading, much-branched bushes. The species is closely related to *A. vestita* in the character of inflorescence and flowers, but the two can be readily distinguished by the very different types of vestiture with which the young shoots are clothed. It is not always easy to distinguish *A. Snodgrassii* from *A. flavicoma*, especially in those forms of the latter where the leaves are somewhat broader than usual. But in *A. flavicoma* the flowers usually end abruptly and the heads have a thatched appearance; in *A. Snodgrassii* the flowers are more closely adpressed and the heads are relatively smooth. Moreover, *A. Snodgrassii* is usually widely and loosely branched and bears many more heads.

9. *Alternanthera Helleri* (Rob.) Howell, comb. nov.

Telanthera Helleri Rob., Proc. Amer. Acad. 38: 138 (1902).

Achyranthes Helleri Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

KEY TO THE FORMS OF *A. Helleri*

- Leaves ovate, acute.....9a. f. *typica*
 Leaves ovate to broadly ovate, obtuse.....9b. f. *obtusior*

9a. *Alternanthera Helleri* f. *typica* Howell, nom. nov.

Telanthera Helleri Rob., l. c. *Achyranthes Helleri* Standl., l. c.

The typical form of this species is known only from Culpepper Island where it was originally collected by Snodgrass and Heller (!) and subsequently by F. X. Williams (!), entomologist on the California Academy of Sciences Expedition of 1905-1906.

9b. *Alternanthera Helleri* f. *obtusior* (Rob.) Howell, comb. nov.

Telanthera Helleri var. *obtusior* Rob., Proc. Amer. Acad. 38: 139 (1902).

This form is readily distinguished from the typical form by the broader obtuse leaves. It is known only from Wenman Island where two collections have been made, the first by Snodgrass and Heller (!), the second by Stewart (!).

10. *Alternanthera nesiotis* Johnston,
Contrib. Gray Herb. n. s. 68: 83 (1923)

This rock-dweller, with its low trailing stems, small roundish leaves, and diminutive heads, is one of the most distinctive developments in *Alternanthera*. It was originally mistaken for a *Coldenia* and was reported as *C. fusca* (Stewart, Proc. Calif. Acad. Sci., ser. 4, 1: 126) so similar were the habitual resemblances of the two plants. This remarkable species is known only from a single collection made by Stewart (!) at Cormorant Bay, Charles Island.

11. *Alternanthera echinocephala* (Hook. f.)
E. Christophersen, Nyt Mag. Naturvid. 70: 73 (1931)

Brandesia echinocephala Hook. f., Trans. Linn Soc. 20: 189 (1847).
Telanthera echinocephala Moq. in DC., Prodr. 13, pt. 2: 373 (1849).
T. argentea Ands., Stock. Akad. Handl. 168 (1854). *T. argentea robustior* Ands., l. c. 168. *T. argentea nudiflora* Ands., l. c. 169. *T. argentea bracteata* Ands., l. c. 169.
T. echinocephala robustior Ands., Om Galap.-öarnes Veg. 63 (1857).
T. echinocephala nudiflora Ands., l. c. 63. *T. echinocephala bracteata* Ands., l. c. 63.
Achyranthes echinocephala Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

Type locality. Charles Island.

Insular distribution. ABINGDON: *Baur!*; *Snodgrass & Heller!*; *Stewart!* ALBEMARLE: southern part, *Baur!*; *Villamil, Stewart!*; trail to Santo Tomas, *Howell!*; Iguana Cove, *Snodgrass & Heller!*, *Stewart!*; Cowley Bay, *Stewart!* BARRINGTON: *Snodgrass & Heller!* CHARLES: *Darwin!*; *Snodgrass & Heller!*; Black Beach, *Howell!*; Post Office Bay, *Howell!* CHATHAM: *Andersson!*; *Snodgrass & Heller!*; southwestern end, *Baur!*; Wreck Bay, *Stewart!*, *Howell!* DUNCAN: *A. Agassiz!*; *Baur!*; *Snodgrass & Heller!*; *Howell!* GARDNER (near Hood): *Snodgrass & Heller!*; *Howell!* HOOD: *Baur!*; *Stewart!*; *Gardner Bay, Howell!* INDEFATIGABLE: northern part, *Snodgrass &*

Heller!; Seymour Bay, Wheeler, Rose & Beebel; Conway Bay, Howell!; southeastern side, Stewart!; Academy Bay, Stewart!, Howell!
JAMES: Stewart!; James Bay, Baur!, Snodgrass & Heller!, Stewart!, Howell!

Endemic.

12. *Alternanthera rugulosa* (Rob.) Howell, comb. nov.

Telanthera rugulosa Rob., Proc. Amer. Acad. 38: 139 (1902).

Achyranthes rugulosa Standl., Jour. Wash. Acad. Sci. 5: 74 (1915).

Aside from its remarkable habit which is that of a low tree, *A. rugulosa* has excellent characters of foliage, inflorescence, and flowers which distinguish it from related species. It is known to us from only two collections, the original collected by Baur (!) and the second by Stewart (!), both from Chatham Island, the former from the southwestern end in the middle region, the latter from 1800 ft. above Wreck Bay.

13. *Alternanthera ficoidea* (L.) R. Br., Prodr. 1: 417 (1810)

Gomphrena ficoidea L., Sp. Pl. 225 (1753).

Telanthera ficoidea Moq. in DC., Prodr. 13, pt. 2: 363 (1849).

A plant, undoubtedly referable to this species, was collected by Svenson (!) on Indefatigable Island, about 3 miles west of Academy Bay, at an elevation of 300 ft. The plant was so different from other species in the islands that it was tentatively named as new by Svenson, but he later referred it to *A. ficoidea*. In a letter regarding the plant, he points out that the main difference between his plant and the continental forms is found in the length of the stamens and the relative length of the stamens and the pseudostaminodia. The anthers of the island plant are 0.5 to 0.75 mm. long and the pseudostaminodia are a little shorter than the tips of the anthers; in the continental material that has been examined the anthers are about 1 mm. long and the pseudostaminodia equal the stamens or exceed them by as much as 0.5 mm. These differences can probably be considered within the range of specific variation of *A. ficoidea*. Svenson notes his collection as "somewhat dimorphic" but the two specimens mounted on the sheet which has been examined are not believed to be the same species. The small-leaved, flowering plant is what is here referred to *A. ficoidea*; the large-leaved, budding plant is what is placed with the lowland variants of *A. halimifolia macrophylla*. Further critical field study must be made to determine whether these two types of plants should be referred to the same or to two different species.

Alternanthera ficoidea was originally described from tropical America, and is widely distributed from the West Indies and Mexico to Argentina.

14. *Alternanthera halimifolia* (Lam.) Standl.
macrophylla Howell, subsp. nov.

Herba perennis, caulibus repentibus et radicantibus vel erectis suffruticosis, 0.5–1.5 m. altis, hirsutulosis trichomis stellatis, glabrescentibus; foliis ellipticis ad ovatis, fere 2–10 cm. longis, 1–6 cm. latis, subhirsutulosis utrinque, densius infra, glabrescentibus supra, obtusis acutisve, nervis fere prominentibus, nervis lateralibus 5–8, petiolis 0.3–2.5 cm. longis; capitulis axillaribus, saepe solitariis vel interdum glomeratis, 4–8 mm. longis, circa eodem latitudine, floribus laxè imbricatis vel subdivergentibus, non arcuatis, subfuscis, bracteis 3–3.5 mm. longis; sepalis exterioribus 4–5 mm. longis, glabris vel pubescentibus; staminibus 2.5–4 mm. longis, antheris 1 mm. longis, pseudostaminodiis filamentis vix longioribus vel staminibus longitudine fere aequalibus, laciniatis.

Stems spreading and rooting or erect and forming bushes 0.5–1.5 m. tall, hirsutulose with stellate hairs, becoming glabrate; leaves elliptic to ovate, generally 2–10 cm. long, 1–6 cm. wide, subhirsutulose on both sides at first but denser below, above soon glabrate, obtuse or acute, the nerves generally prominent, the lateral nerves mostly 5–8, petioles 0.3–2.5 cm. long; heads frequently solitary or sometimes glomerate, nearly as broad as long, 4–8 mm. long, the flowers loosely imbricated or subdivergent, not arcuate, grayish-brown; bracts 3–3.5 mm. long; outer sepals 4–5 mm. long, the pseudostaminodia equalling the filaments or nearly equalling the stamens, lacinate.

Type: Villamil Mt. above Santo Tomas, Albemarle Island, *Howell* No. 8985 (C. A. S. Herb. No. 203286).

Insular distribution. ALBEMARLE: Villamil Mt., *Stewart!*, *Howell!* CHATHAM: *Stewart!* INDEFATIGABLE: southeastern side, *Stewart!*; northwestern side, *Stewart!*; above Academy Bay, *Stewart!*, *Svenson!*, *Howell!*; summit of Mt. Crocker, *Howell!*

Endemic.

After a critical comparison of the Galapagian material that has been referred to *A. halimifolia* with a number of specimens from the west coast of South America, it has appeared best to treat the island plant as a variable subspecies of the mainland plant. The leaves on the island plant average much larger, the stems are less branched, and the heads are always axillary. The flowers are more loosely arranged in the heads of the island plant although there is considerable variation in the compactness of the inflorescence in the continental forms. The most constant difference is found in the pseudostaminodia which in the mainland plant usually exceed the stamens by a considerable margin; in the island plant the pseudostaminodia equal the filaments but rarely reach the tips of the stamens.

The variation of habit and aspect found in subspecies *macrophylla* is considerable, seemingly in direct response to the immediate environ-

onment and available water supply. In the rain forests on the windward side of the higher islands, where the plant is especially abundant and characteristic, it becomes bushy and 1 to 1.5 m. tall and bears large ovate or ovate-lanceolate leaves with the blades as much as 10 cm. long and 6 cm. wide. The flower-parts are also larger in specimens from the rain forests. Above the rain forest in the more arid grassland of the island summits, the plant assumes a trailing habit, growing along the ground or clambering among low shrubs and bushy herbs. The stems and leaves of these plants are generally more densely pubescent and the leaves are not so large as those of the plants from the rain forest. The flowers are also smaller. The greatest reduction in leaf-size occurs along the lower edge of the forest belt where it approaches the lowland deserts or on the lee-side of the islands where the rainfall of the dry season tends to be intermittent. It is here that forms occur which in aspect and leaf-size most nearly correspond to the material which has been studied from the west coast of South America. The leaves are generally less than 4 cm. long and about half as wide, and the dense pubescence of the young shoots is relatively persistent. Just as in the summit regions, the flowers of these lowland plants are smaller than are those of plants in the rain forest. These ranging variations, seemingly so dependent on edaphic and climatic factors and so evenly connected with one another in the series of island specimens which has been studied, have appeared best treated as a single variable entity.

From the higher slopes of James Island above James Bay, Stewart obtained plants of this relationship with leaves narrower than is usual and somewhat elongated (*Stewart Nos. 1396 and 1416!*). The leaves are reminiscent of the wider type of leaves found in *A. flavicoma*; but the heads and flowers of these specimens are not like those in *A. flavicoma*, nor are they like the heads and flowers in *A. ficoidea* which also has leaves narrower than those of typical *A. halimifolia macrophylla*.

Although the name *Alternanthera halimifolia* (Lam.) Standl. is taken for the species, the concept is not believed to be identical with *Achyranthes halimifolia* Standley of the N. A. Fl. (21: 139) or with *Alternanthera halimifolia* Standley in Pittier's Man. Pl. Usual. Venez. (145. 1926), where the combination was first made. If *Telanthera Crucis* (Vahl) Moq. and *Telanthera flavogrisea* Urb. (which are probably synonymous) of the West Indian region are properly interpreted by the writer, there would seem to be no place for them in *Alternanthera halimifolia* as the species is here accepted.

7. **FROELICHIA** Moench

KEY TO THE SPECIES

- a. Inflorescence rather strictly branched, the flowers in dense rounded or oblong clusters, the rhachis long-woolly.
 - b. Inflorescence not interrupted; perianth 4 mm. long, the perianth-segments exceeding the stamen-tube by at least 1 mm.; lobes of the stamen-tube broadly oblong, more than half as broad as long, rounded at apex; in fruit the perianth-tube developing wings at least half as broad as the tube.....1. *F. nudicaulis*
 - bb. Inflorescence frequently interrupted; perianth 3-3.5 mm. long, the perianth-segments nearly equalled by the stamen-tube; lobes of the stamen-tube oblong, about half as broad as long, at the apex rounded or emarginate; in fruit the perianth-tube nearly or quite without wings2. *F. lanigera*
- aa. Inflorescence loosely branched, spicate, the flowers more or less scattered or if congested the end of the inflorescence acute, the rhachis not woolly or sparsely woolly in subspecies *alata*. .3. *F. juncea*

1. **Froelichia nudicaulis** Hook. f.,
Trans. Linn. Soc. 20: 192 (1847)

KEY TO THE SUBSPECIES OF *F. nudicaulis*

- a. Stems subglabrous or weakly lanate; spike to 3 cm. long; longer bractlet 3-4 mm. long; perianth densely lanate.
 - b. Stems slender, elongate, divergently branched, glabrous or nearly so; spike oblong, 1-3 mm. long; longer bractlet 3-3.5 mm. long.....1a. *typica*
 - bb. Stems lower and stouter, more strictly erect and broom-like, somewhat lanate; spike capitate, about 0.5 cm. long; longer bractlet 4 mm. long.....1b. *curta*
- aa. Stems pilose; spike to 6 cm. long; bractlets 2-2.5 mm. long; perianth almost glabrous.....1c. *longispicata*

1a. **Froelichia nudicaulis typica** Howell, nom. nov.

F. nudicaulis Hook. f., 1. c.

Type locality. Charles Island.

Insular distribution. CHARLES: Darwin; Andersson. CHATHAM: Andersson. JAMES: James Bay, Stewart!

Endemic.

1b. **Froelichia nudicaulis curta** Howell, subspec. nov.

Caulibus ad 3 dm. altis, substrictis erectis et scopariis, sublanatis; spica capitata, circa 0.5 cm. longa; longiore bracteola 4 mm. longa.

Stems to 3 dm. tall, substrictly erect, broom-like, sublanate; spike capitate, about 0.5 cm. long; longer bractlet 4 mm. long.

Type: from the sides and top of Duncan Island, *Stewart No. 1366* (C. A. S. Herb. No. 133009).

The superficial aspect of this plant is that of *F. lanigera* Ands., under which name it was reported by Stewart (Proc. Calif. Acad. Sci. ser. 4, 1: 56. 1911); but the technical characters of the flower and of the wings developed on the fruiting perianth-tube relate the plant definitely to *F. nudicaulis*.

1c. **Froelichia nudicaulis longispicata** (Christophersen)
Howell, comb. nov.

F. nudicaulis var. *longispicata* Christophersen, *Nyt Mag. Naturvid.* 70: 74 (1930).

This distinctive *Froelichia* is known only from the original collection which was made by Miss Rorud at Turtle Bay, Indefatigable Island. Material has not been seen, the characters on which it is based in this work being taken from the original description.

2. **Froelichia lanigera** Ands.,
Om Galap.-öarnes Veg. 63 (1857)

KEY TO THE SUBSPECIES OF *F. lanigera*

- a. Stems lower and stouter, erect and broom-like; spikes oblong-capitate or shorter, the flowers usually 10 or more.....2a. *typica*
- aa. Stems more elongate and slender; spikes capitate, less than 10-flowered, mostly about 5-flowered.....2b. *scoparia*

2a. **Froelichia lanigera typica** Howell, nom. nov.

F. lanigera Ands., l. c. *F. lanata* Ands., l. c., pl. 3, fig. 1.

Type locality. Albemarle Island, probably in the vicinity of Tagus Cove.

Insular distribution. ALBEMARLE: *Andersson*; Tagus Cove, *Snodgrass & Heller*; Tagus Cove Mt., *Stewart!*, *Howell!*; Cowley Bay, *Stewart!*

Endemic.

2b. **Froelichia lanigera scoparia** (Rob.) Howell, comb. nov.

F. scoparia Rob., Proc. Amer. Acad. 38: 136 (1902).

Type locality. Narborough Island, southern part at 2000 ft. Insular distribution. NARBOROUGH: southern part, *Snodgrass & Heller!*; northern side, *Stewart!*, perhaps nearer the typical subspecies because of the more numerous flowers in the spikes.

Endemic.

3. **Froelichia juncea** Rob. & Greenm.,
Amer. Jour. Sci. 50: 143 (1895)KEY TO THE SUBSPECIES OF *F. juncea*

- a. Stems and rhachis sparsely hairy or subglabrous; perianth 2-3 mm. long, the lobes about 1.5 mm. long, glabrous or nearly so; stamen-tube 2 mm. long; in fruit the perianth-tube without wings or with thick narrow wings.....3a. *typica*
- aa. Stems and rhachis somewhat hairy or subtomentulose; perianth 4 mm. long, the lobes about 2 mm. long, tomentulose; stamen-tube 3 mm. long; in fruit the perianth-tube developing wings about 1 mm. broad.....3b. *alata*

3a. **Froelichia juncea typica** Howell, nom. nov.

F. juncea Rob. & Greenm., l. c.

Type locality. Southern part of Albemarle Island.

Insular distribution. ALBEMARLE: southern part, *Baur*; Cowley Bay Mt., *Snodgrass & Heller*; Tagus Cove Mt., *Snodgrass & Heller, Howell!*; Villamil near sea level, *Stewart!*; trail to Santo Tomas, *Howell!*

Endemic.

The type was said to have been "collected on South Albemarle and Barrington Islands," but the occurrence of the species on Barrington Island is probably to be considered an error. Barrington Island is omitted by Robinson from his list of localities for *F. juncea* in his Flora of the Galapagos Islands.

3b. **Froelichia juncea alata** Howell, subspec. nov.

Caulibus et rachibus subpubescentibus vel subtomentulosis; perianthio 4 mm. longo, lobis circa 2 mm. longis, tomentulosis; tubo staminum 3 mm. longo; fructu tubo perianthii alato, alis circa 1 mm. latis.

Stems and rhachis somewhat hairy or subtomentulose; perianth 4 mm. long, the lobes about 2 mm. long, tomentulose; stamen-tube 3 mm. long; in fruit the perianth-tube developing wings about 1 mm. broad.

Type: southeastern side of Indefatigable Island at 450 ft., *Stewart No. 1363* (C. A. S. Herb. No. 203291).

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PROCEEDINGS

OF THE

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**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 10

**MARINE MOLLUSCA FROM ACAPULCO, MEXICO
WITH NOTES ON OTHER SPECIES**

BY

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The following pages contain a list of the marine mollusca dredged in Acapulco Bay, Mexico, by the Templeton Crocker Expedition of the California Academy of Sciences in 1932.¹ Several species of special interest secured by the Expedition at other places are included. A report upon the collection as a whole will require a considerable amount of additional time for completion because of the very large number of species and specimens obtained.

This fine collection of shells, together with that made by the Hancock Expedition to the Galapagos Islands and the various expeditions of the Academy to west Mexican waters forms an

¹ For a general account of the Expedition see: Grunsky, C. E. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. Foreword. Proc. Calif. Acad. Sci. ser. 4, vol. 21, no. 1, March 14, 1933, pp. 1-2. Introductory statement by Templeton Crocker, pp. 3-9, pl. 1.

excellent series for a study of the tropical American marine fauna. Many species secured by Mr. Crocker are new or little known to conchologists. The rare *Xenophora robusta* Verrill has heretofore been known only from the two original specimens and is one example of the nature of the collection as a whole.

Much time is required for the research necessary to prepare a comprehensive report on all of the tropical American mollusca now available because of the lack of illustrations, poor descriptions and the many scattered references in the literature.

List of Species from Acapulco, Mexico, Loc. 27,527 (C. A. S.)

| | |
|--|---|
| Arca cf. <i>aviculoides</i> Reeve | <i>Dentalium oerstedii</i> Mörch |
| Arca <i>labiosa</i> Sowerby | <i>Architectonica granulata</i> Lamarck |
| Arca <i>nux</i> Sowerby | <i>Bursa albifasciata</i> Sowerby |
| Arca, (2 additional species) | <i>Calliostoma bonita</i> Strong, Hanna & Hertlein, new species |
| <i>Callocardia citharia</i> Dall | <i>Calliostoma leanus</i> C. B. Adams |
| <i>Chione compta</i> Broderip | <i>Calliostoma rema</i> Strong, Hanna & Hertlein, new species |
| <i>Chione kelletii</i> Hinds | <i>Cancellaria bullata</i> Sowerby |
| <i>Corbula ovulata</i> Sowerby | <i>Cancellaria indentata</i> Sowerby |
| <i>Cyclinella subquadrata</i> Hanley | <i>Cancellaria ventricosa</i> Hinds |
| <i>Cardium (Laevicardium) cumingii</i> Sowerby | <i>Cantharus pallidus</i> Broderip & Sowerby |
| <i>Cardium (Fragum) graniferum</i> Broderip & Sowerby | <i>Cantharus vibex</i> Broderip |
| <i>Cardium (Fragum) obovale</i> Broderip | <i>Cerithium stercus-muscarum</i> Valenciennes |
| <i>Crassatellites gibbosus</i> Sowerby | <i>Clathrodrilla nautica</i> Pilsbry & Lowe |
| <i>Glycymeris tessellata</i> Sowerby | <i>Clathurella adria</i> Dall |
| <i>Macoma panamensis</i> Dall | <i>Clava gemmata</i> Hinds |
| <i>Macrocallista squalida</i> Sowerby | <i>Clavatula (Knefastia) tuberculifera</i> Broderip & Sowerby |
| <i>Mactra goniocyma</i> Pilsbry & Lowe | <i>Clavus (Clathrodrillia) alcestis</i> Dall |
| <i>Modiolus pallidus</i> Dall | <i>Clavus (Clathrodrillia) alcestis</i> Dall var. |
| <i>Nuculana acapulcensis</i> Pilsbry & Lowe | <i>Clavus (Clathrodrillia) callianira</i> Dall |
| <i>Nuculana costellata</i> Sowerby | <i>Clavus (Clathrodrillia) heliplexa</i> Dall |
| <i>Nuculana gibbosa</i> Sowerby | <i>Clavus (Cymatosyrinx) ianthe</i> Dall |
| <i>Nuculana (Adrana) sowerbyana</i> d'Orbigny | <i>Clavus (Brachytoma) nigerrimus</i> Sowerby |
| <i>Nuculana</i> sp. | <i>Clavus (Cymatosyrinx) pallida</i> Sowerby |
| <i>Ostrea conchaphila</i> Carpenter | <i>Clavus (Cymatosyrinx) pudica</i> Hinds |
| <i>Pecten circularis</i> Sowerby | <i>Clavus (Cymatosyrinx) rosea</i> Sowerby |
| <i>Pecten sericeus</i> Hinds | <i>Clavus (Cymatosyrinx) rugifera</i> Sowerby |
| <i>Pecten tumbezensis</i> d'Orbigny | <i>Crepidula nummaria</i> Gould |
| <i>Pitar callicomata</i> Dall | <i>Crepidula</i> cf. <i>onyx</i> Sowerby |
| <i>Pitar lenis</i> Pilsbry & Lowe | <i>Conus archon</i> Broderip |
| <i>Semele incongrua</i> Carpenter | <i>Conus comptus</i> Gould |
| <i>Tagelus violescens</i> Carpenter | <i>Conus emarginatus</i> Reeve |
| <i>Tellina (Eurytellina) panamaensis</i> Li ² | |
| <i>Tellina pristiphora</i> Dall | |
| <i>Tellina rubescens</i> Hanley | |

² *Tellina panamaensis* Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 262, pl. 5, fig. 32. "Gatun formation." Miocene. [Recent, according to Pilsbry, 1931.]

Tellina (Eurytellina) panamaensis Li, Pilsbry, Proc. Acad. Nat. Sci. vol. 83, 1931, p. 436, pl. 41, figs. 4, 5, 6. "Panama Bay, about 1 mile from mainland, off mouth of the Rio Grande, 10-40 ft." Also from Quarantine Island, Panama.

| | |
|---|---|
| Conus ximines Gray | Natica broderipiana Recluz |
| Conus sp. | Oliva spicata Balten |
| Coralliophila hindsii Carpenter | Phyllonotus bicolor Valenciennes |
| Cosmiocncha palmeri Dall | Polinices uber Valenciennes |
| Crassispira erebus Pilsbry & Lowe | Phos gaudens Hinds |
| Crucibulum imbricatum Sowerby | Phos veraguensis Hinds |
| Crucibulum spinosum Sowerby | Recluzia insignis Pilsbry & Lowe |
| Distortio decussata Valenciennes | Strombina edentula Dall |
| Enaeta barnesii Gray | Strombina dorsata Sowerby |
| Eupleura muriciformis Broderip | Strombina gibberula Sowerby |
| Fusinus dupetit-thouarsii Kiener | Strombina recurva Sowerby |
| Harpa crenata Swainson | Terebra armillata Hinds |
| Latirus sp. | Terebra aspera Hinds |
| Hindsia acapulcana Pilsbry & Lowe | Terebra ligyrus Pilsbry & Lowe |
| Lioglyphostoma acapulcanum Pilsbry & Lowe | Terebra lingualis Hinds |
| Malea ringens Swainson | Terebra panamensis Dall |
| Metula amosi Vanatta | Terebra paphia Bartsch |
| Mitra attenuata Reeve | Terebra varicosa Hinds |
| Mitra zaca Strong, Hanna & Hertlein, n. sp. | Terebra sp. |
| Mitra sp. | Turricula maura Sowerby |
| Murex rectirostris Sowerby | Turricula (Pleurofusua) militaris Hinds |
| Nassarius gemmulosus C. B. Adams | Turricula sowerbyi Reeve |
| Nassarius miser Dall | Turris oxytropis Sowerby |
| Nassarius pagodus Reeve | Turris picta Reeve |
| Nassarius versicolor C. B. Adams | Turris sp. |
| | Turritella mariana Dall |
| | Turritella nodulosa King |

Cancellaria bullata Sowerby

Plate 5, figure 7

Cancellaria bullata SOWERBY, Proc. Zool. Soc. London, 1832, p. 51. "*Hab.* ad littora Americae Meridionalis et Centralis. (Payta and Gulf of Nocoia.)" —SOWERBY, Conch. Illustr. *Cancellaria*, Dec. 7, 1832, p. 6, pl. 12, fig. 35. "Dredged in mud at a depth of twelve fathoms, at Payta, and in the Gulf of Nocoioy. Mr. Cuming." —REEVE, Conch. Icon. vol. 10, 1856, *Cancellaria*, sp. 5, pl. 2, figs. 5a, 5b. Earlier record from Gulf of Nocoia cited. —SOWERBY, Thes. Conch. vol. 2, 1855, p. 457, pl. 94, fig. 56. "Found in the Gulf of Nocoia." —TRYON, Manual Conch. vol. 7, 1885, p. 78, pl. 5, fig. 78.

This species was dredged off Acapulco, Mexico. Tryon³ united it with *Cancellaria tuberculosa* Sowerby⁴ but Reeve's⁵ figure of that species shows a heavier, lighter colored shell with stronger sculpture. Both species are characterized by the very wide, open umbilicus.

³ Manual Conch. vol. 7, 1885, p. 78, pl. 5, figs. 76, 77 (*C. tuberculosa*), fig. 78 (*C. bullata*). "Iquiqui, Peru, 7 fms. (Cuming); Gulf of Nocoia, Central America, 12 fms. (Cuming)."

⁴ *Cancellaria tuberculosa* Sowerby, Proc. Zool. Soc. London, 1832, p. 51. "*Hab.* ad littora Americae Meridionalis. (Iquiqui)." —Sowerby, Conch. Illustr., *Cancellaria*, December 7, 1832, p. 6, pl. 13, fig. 36. "Dredged in sandy mud, at a depth of seven fathoms, at Iquiqui. Mr. Cuming."

Cancellaria tuberculata Sowerby, Thes. Conch. vol. 2, 1855, p. 457, pl. 94, fig. 52. "From Iquiqui, in sandy mud, six to twelve fathoms water."

⁵ Conch. Icon. vol. 10, 1856, *Cancellaria*, sp. 36, pl. 8, figs. 36a, 36b. Iquique, Peru. Dredged in seven fathoms; Cuming.

Centrifuga leeana Dall

Plate 5, figure 11

Murex (chicoreus) leeanus DALL, Proc. U. S. Nat. Mus. vol. 12, 1889, p. 329, pl. 7, fig. 1. "Off Cerros Island, Lower California, in 44 fathoms, mud."—ARNOLD, Mem. Calif. Acad. Sci., vol. 3, 1903, p. 243, pl. 7, fig. 1. Pleistocene at San Pedro, Calif.

Purpura (Centrifuga) leeana (Dall), GRANT & GALE, Mem. San Diego Soc. Nat. Hist. vol. 1, 1931, p. 707. Arnold's record from the Pleistocene cited; living from Guadalupe Island to Cedros Island, Lower California.

Five young specimens were dredged near Cedros Island, off Lower California. This species seems to be closer to *Trophon* than to either *Murex* or *Purpura*; therefore we have considered *Centrifuga* as a separate genus in the present paper. The species, *C. leeana*, seems to be very restricted in its range. The type was dredged in 44 fathoms off Cedros Island, and most of the few specimens in California collections are from Scammon Lagoon and San Ignacio Lagoon, presumably collected by Captain Porter.

Mitra zaca Strong, Hanna & Hertlein, new species

Plate 5, figure 10

Shell fusiform, heavy, very large, covered with a thin, blackish epidermis; whorls with a narrow, rounded shoulder occupying about one eighth of the width between the sutures, below which they are very slightly convex; surface smooth except for a few faint spiral threads on the shoulder and about 15 slightly stronger threads on the base; aperture long and narrow, about half the length of the shell, white within; outer lip not thickened; inner lip with a broad, slightly tinted callus covering the body of the shell; columella with three strong plaits and a smaller spiral ridge at the base; canal short, slightly recurved, forming a distinct fasciole. The type has nine whorls without the nucleus and measures: length, 130; maximum diameter, 34 mm.

Holotype: No. 6061 (C. A. S. type coll.) from Loc. 27594 (C. A. S.) dredged in Santa Maria Bay, Lower California. Templeton Crocker, collector, August 11, 1932. Additional specimens were secured in the same place.

This species probably reaches the largest size of any *Mitra* known from the west coast. In shape and color it is quite similar to the well-known *Mitra (Strigatella) idae* Melvill from the California coast but it is much larger, the epidermis is much thinner and it entirely lacks the finely pitted spiral lines characteristic of that species. The unfigured *Mitra (Strigatella) mexicana* Dall⁶ dredged off Guaymas is also similar but the type is only 72 mm. in length and is said to

⁶ Proc. U. S. Nat. Mus., vol. 56, 1919, p. 309. "Off Guaymas, Mexico, in 71 fathoms, sand."

have moderately rounded whorls, sculptured with feeble, flattened, spiral cords. The new species can be referred to the subgenus *Strigatella* and to the section *Atrimitra*.

The species is named for Mr. Crocker's yacht, *Zaca*.

***Calliostoma bonita* Strong, Hanna & Hertlein, new species**

Plate 5, figures 5, 6

Shell conical, brilliantly polished and highly colored; body whorl with two sharp spiral keels, one on the periphery and the other at about one third the distance between the periphery and the suture, angulating the whorls of the spire; in addition to these spiral keels the entire surface is marked with smooth spiral threads, of which, on the body whorl, there are eight between the suture and the upper keel, three between the keels, and twelve on the base; ground color of the shell white, the spiral threads with irregularly spaced bright brown dots, much closer on the spire than on the base, although not arranged in any definite pattern; the wider spacing at irregular intervals gives the appearance of white axial flames; umbilical region excavated, purple, bounded by a rounded carina, ending in a tooth-like projection at the base of the columella; aperture subquadrate, pearly within. The type has eight whorls and measures: height, 21.5; maximum diameter, 22 mm.

Holotype: No. 6044 (C. A. S. type coll.) from Loc. 27527 (C. A. S.), dredged in Acapulco Bay, Mexico. Twenty-one additional specimens were secured at the same place; Templeton Crocker, collector, April 4, 1932.

This species is very similar in shape to *Calliostoma palmeri* Dall⁷ from the Gulf of California, which also has the excavated, purple umbilical region. The present species is more highly colored, with a different number of spiral threads, which are smooth instead of granular.

***Calliostoma rema* Strong, Hanna & Hertlein, new species**

Plate 5, figures 3, 4

Shell depressed, polished but with the colors rather dull; body whorl with two broad, spiral keels, one on the periphery and the other at about one third the distance between the periphery and the suture, angulating the whorls of the spire; in addition to the keels the entire surface is marked with granular spiral threads, of which on the body whorl there are three between the suture and the upper keel, one between the keels, and eight on the base, with, on the spire, faint indications of very fine intercalary threads; ground color of the shell pale brown, with the spiral threads dotted here and there with

⁷ Dall, Amer. Jour. Conch., vol. 7, pt. 2, November 2, 1871, p. 125, pl. 15, fig. 15. "Guaymas, ten specimens. Dr. Palmer."

darker spots, most noticeable on the base; the surface also painted with broad, indistinct, whitish patches and axial lines; umbilicus open, bordered by a rounded carina, the end of which forms a tooth-like projection at the base of the columella; columella curved, white, in the adult somewhat reflected over the umbilicus; aperture subquadrate, pearly. The type has $4\frac{1}{2}$ whorls and measures: height, 11 mm.; maximum diameter, 16.6 mm.

Holotype: No. 6045 and paratype no. 6046 (C. A. S. type coll.) from Loc. 23779 (C. A. S.), dredged in from 10 to 25 fms. off the penal settlement on Maria Madre Island of the Tres Marias Group, Mexico by G. D. Hanna and E. K. Jordan in 1925. Several additional specimens, mostly young, were secured at the same place and a single specimen was dredged by the Crocker Expedition at Loc. 27527 (C. A. S.) in Acapulco Bay, Mexico.

This species is quite different from all the known west coast forms in the depressed shape and in the umbilicus, which in the young shells is entirely open and in the adult only partly covered by the reflected columella.

Metula amosi Vanatta

Plate 5, figure 12

Metula amosi VANATTA, Proc. Acad. Nat. Sci. Philadelphia, vol. 65, January, 1913, p. 22, figs. 1, 2. "Panama."

Specimens dredged in Acapulco Bay agree in all the details shown in the figures given by Vanatta of the type of *Metula amosi*. *Metula clathrata* Adams & Reeve⁸ has been reported from Western Panama by Tomlin, but Tryon has given Cape of Good Hope, South Africa as the locality for the species. The name *Metula hindsii* H. & A. Adams⁹ has been definitely stated by Tryon¹⁰ to represent the same species as *Buccinum metula* Hinds,¹¹ from western Panama. From the facts at hand, we see no reason for abandoning the name given by Hinds to the Panamanian species which would then be *Metula metula* (Hinds). A species doubtfully referred to the genus is "*Fusus*" *bellus* C. B. Adams.¹² Carpenter¹³ considered that this species might belong to *Metula* but Tryon stated that he was inclined to think that it should be placed in *Columbella*. Woodring¹⁴ has given a discussion of the genus *Metula* and the problems connected with the selection of the type species.

⁸ *Buccinum clathratum* Adams & Reeve, Voy. Samarang, Moll. 1850, p. 32, pl. 11, fig. 12. — Tryon, Manual Conch. vol. 3, 1881, p. 152, pl. 72, fig. 238. "Cape of Good Hope: 136 fathoms."

⁹ *Metula hindsii* H. & A. Adams, Genera Rec. Moll. vol. 1, 1858, p. 84. — Tryon, Manual Conch. vol. 3, 1881, p. 153, pl. 72, fig. 240. "West Coast of Veragua; in mud, at a few fathoms' depth."

¹⁰ Manual Conch. vol. 3, 1881, p. 251. "*Hindsii* (*Metula*), H. & A. Adams' Genera, 1, 84. = *Buc. metula*, Hinds."

¹¹ *Buccinum metula* Hinds, Zool. Voy. Sulphur, no. 7, (Moll. pt. 2), October 1844 [Date given on cover], p. 31, pl. 16, figs. 13, 14. "Inhab. west coast of Veragua. Obtained at a depth of a few fathoms, among mud."

¹² *Fusus bellus* C. B. Adams, Ann. Lyceum Nat. Hist. New York, vol. 5, 1852, p. 353, 531. "Panama." — Tryon, Manual Conch. vol. 3, 1881, p. 153 (as *Metula bella*).

¹³ Proc. Zool. Soc. London, 1863, p. 9. Reprint in Smithsonian Miscell. Coll. no. 252, 1872, p. 183.

¹⁴ Carnegie Inst. Washington, Publ. no. 385, 1928, pp. 285-287.

Turritella mariana Dall

Plate 6, figures 1-4

Turritella mariana DALL, Bull. Mus. Comp. Zool. vol. 43, no. 6, October, 1908, p. 327, pl. 11, fig. 14. "Near the Tres Marias Islands, in 80 fathoms, rocky bottom, temperature 51.2° F."

Many specimens of this interesting species were dredged at the following localities; Loc. 27527 (C. A. S.), Acapulco Bay, Mexico; Loc. 27571 (C. A. S.), 20-45 fathoms in Lat. 16° 39' N, Long. 99° 24' 30" W., to Lat. 16° 38' N., Long. 99° 27' 30" W.; Loc. 27573 (C. A. S.), Lat. 18° 14' N., Long. 103° 23' W., in 60 fathoms; Loc. 27584 (C. A. S.) Lat. 23° 03' to 23° 06' N., Long. 109° 36' to 109° 31' W., in 20-220 fathoms.

The original specimen was only 25 mm. in length; large series of adults from the localities listed above show the pronounced tendency of the shell to develop two large spiral ridges on each whorl. These are sometimes noded and sometimes not on the later whorls. A selection has been made for illustration to show some of the variation in sculpture and shape.

It is obvious from a study of this excellent series that the form described as *Turritella imperialis* from the Pliocene beds at Coyote Mountain, Imperial County, California¹⁵ is exceedingly close and may fall into synonymy. The similarity between the Pliocene and living forms is far greater than between the Pliocene and lower Miocene species.

Woodring's¹⁶ recent attempt to place the Imperial formation in the lower Miocene because of this last mentioned relationship might not have been made had it been recognized how closely the fossils are related to the living fauna of the Gulf of California and the waters to the southward.

Mansfield¹⁷ has shown the great similarity which exists between some of the fossils of the Imperial formation and those of certain Pliocene deposits of southern Florida. In view of the fact that the most trustworthy evidence furnished by paleontology indicates a comparatively late epoch of deposition in the region of Coyote Mountain, something far more convincing than has thus far been disclosed will need to be brought forward before a lower Miocene age can be accepted.

¹⁵ Hanna, G. D. Paleontology of Coyote Mountain, Imperial County, California. Proc. Calif. Acad. Sci. ser. 4, vol. 14, no. 18, Mar. 23, 1926, pp. 427-503, pls. 20-29.

¹⁶ Woodring, W. P. Distribution and age of the marine Tertiary deposits of the Colorado Desert. Carnegie Inst. Wash. Publ. no. 418, (Cont. to Palaeo. I) Jan. 1931, pp. 1-25.

¹⁷ Mansfield, W. C. Pliocene fossils from limestone in southern Florida. U. S. Geol. Surv. Prof. Ppr. 170-D, 1932, pp. 43-56, pls. 14-18.

Turritella radula Kiener

Plate 6, figures 7, 8

Turritella radula KIENER, Spec. General et Icon. Coq. Viv., *Turritella*, p. 13, 1873, pl. 2, fig. 1 (two figures). [No locality cited.]—REEVE, Conch. Icon. vol. 5, *Turritella*, sp. 30, pl. 7, fig. 30. "*Hab.* Isle of Muerte, Bay of Guayaquil (found at the depth of eleven fathoms in sandy mud); Cum-
ing."—TRYON, Manual Conch. vol. 8, 1886, p. 201, pl. 63, fig. 77. "Bay of Guayaquil."—TOMLIN, Jour. Conch. vol. 18, no. 6, December, 1927, p. 168. "Jicarón I. and Isla del Rey, on shore; Coiba, dredged in 10-12 f.; Gargona, very common in 15 f.; James I."

Excellent specimens were dredged at Loc. 27573 (C. A. S.), Lat. 18° 14' N., Long. 103° 23' W., off Acapulco, Mexico, 60 fms. The species is characterized by a strong, noded spiral ridge at the base of the whorl. The suture in the specimens available is not as deeply impressed as is shown in Reeve's figure but otherwise agreement seems sufficiently close to justify the identification.

Xenophora robusta Verrill

Plate 5, figures 8, 9; plate 6, figures 5, 6

Xenophora robusta VERRILL, Amer. Jour. Sci. & Arts, ser. 2, vol. 49, no. 146, March, 1870, p. 226. "Near La Paz, J. Pedersen. Two fresh specimens."

Five living specimens were dredged by Mr. Crocker in Lat. 23° 02' N., Long. 109° 32' W., in 25 fathoms; and one living and two dead specimens from Lat. 15° 40' N., Long. 93° 49' W., 28 fathoms. The species, previously unfigured, has been heretofore known only from the description and the two original specimens. It is the only living representative from the eastern Pacific and must be very locally distributed as well as rare. Four fossil species have been reported from the Tertiary of western North America.¹⁸

The type of the species is No. 8882, Peabody Museum, Yale University and the label bears the following information: "La Paz, Lower Calif. Coll. James Pedersen, 1885." The date is an obvious error. We have been permitted to study and photograph the speci-

¹⁸ *Xenophora hawleyi* Loel & Corey, Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 22, no. 3, 1932, p. 269, pl. 63, fig. 12. "From the green conglomerate near the base of the Vaqueros horizon, about 2.5 miles southwest of Buelton, western Santa Ynez Mountains, Santa Barbara County, Calif." Vaqueros, lower Miocene.

Xenophora simiensis Nelson, Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 15, no. 11, 1925, p. 422, pl. 55, figs. 7 a-c. From Loc. 422 (Calif. Acad. Sci.) "three miles west of Santa Susana; near base of Martinez, just north of contact." Martinez, lower Eocene.

Xenophora stocki Dickerson, Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 9, no. 17, 1916, p. 502, pl. 37, figs. 4 a-b. Loc. 2226 (Univ. Calif.), Tejon group, Rose Canyon, San Diego County, Calif.—Hanna, M. A., Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 16, no. 8, 1927, p. 306. La Jolla formation, San Diego County Calif. B. L. Clark is cited as authority that the species occurs in the Domengine formation in Simi Valley and near Coalinga, Calif. Upper or middle Eocene.

Xenophora ziteli Weaver, Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 4, no. 5, 1905, p. 118, pl. 12, fig. 8. "Found southwest of Martinez on the west side of the Del Hambre Cañon road. This species occurs only in the lower beds of the Martinez group."—Dickerson, Univ. Calif. Publ. Bull. Dept. Geol. Sci. vol. 8, no. 6, 1914, pp. 111, 151. "Martinez north of Mount Diablo." "Type locality, Benicia, Selby." "*Solen stantoni* zone." "*Meretrix dalli* zone."

men through the kindness of Dr. Stanley C. Ball, Curator, Department of Zoology of the Peabody Museum. The specimen is a fresh but dead shell, with the apertural margin somewhat broken but with the basal characters well preserved. Diam., 56 mm., alt., 45 mm. Most of the erratics have been dislodged but there remain several pebbles, mostly encrusted with corallines, and a few fragments of *Glycymeris* and *Chione*. The sides of the spire are slightly dome shaped at the apex and approximately six whorls can be made out. The erratics were mostly attached in a row, close to the suture line but numerous grains of coarse quartz and shell sand were indiscriminately scattered over the outer surface. The shell has once been attached to a brown paper card with glue and fragments of these materials adhere to one side.

The specimens dredged by Mr. Crocker are in excellent state of preservation and agree in all essential respects with the type. *Pecten*, *Glycymeris* and *Arca* are the most abundant erratics. The operculum is brown, horny, pyriform in shape and with the nucleus completely worn away from the side on which it was situated.

PLATE 5

Fig. 1. *Calliostoma palmeri* Dall. Alt., 24.5 mm., diam., 28 mm. Plesiotype, no. 6043 (C. A. S. type coll.), from Loc. 27665, San Felipe at the head of the Gulf of California; H. N. Lowe, coll. Specimen illustrated for comparison with *Calliostoma bonita*, n. sp. P. 121.

Fig. 2. *Calliostoma palmeri* Dall. Basal view of specimen shown in fig. 1.

Fig. 3. *Calliostoma rema* Strong, Hanna & Hertlein, n. sp. Alt., 11 mm., diam., 16.4 mm. Paratype, no. 6046 (C. A. S. type coll.), from Loc. 23779 (C. A. S.) along east shore of Maria Madre Island, Revillagigedo group, west coast of Mexico. Dredged in 5 to 10 fathoms by G. D. Hanna and E. K. Jordan, 1925. P. 121.

Fig. 4. *Calliostoma rema* Strong, Hanna & Hertlein, n. sp. Alt., 8.9 mm., diam., 12.5 mm. Holotype, no. 6045 (C. A. S. type coll.), from same locality as fig. 3. P. 121.

Fig. 5. *Calliostoma bonita* Strong, Hanna & Hertlein, n. sp. Alt., 21.1 mm., diam. 21.6 mm. Holotype, no. 6044 (C. A. S. type coll.), from Loc. 27527 (C. A. S.), Acapulco Bay, Mexico. Dredged by Templeton Crocker, 1932. P. 121.

Fig. 6. *Calliostoma bonita* Strong, Hanna & Hertlein, n. sp. Basal view of specimen shown in fig. 5. P. 121.

Fig. 7. *Cancellaria bullata* Sowerby. Alt., 32.8 mm., diam., 26 mm. Plesiotype, no. 6057 (C. A. S. type coll.), from Loc. 27596 (C. A. S.) in channel near Cedros Island, off Lower California, Templeton Crocker, Coll., Aug. 15, 1932. P. 119.

Fig. 8. *Xenophora robusta* Verrill. Alt., 45 mm., diam., 56 mm. Holotype, no. 8882 (Peabody Museum, Yale University), plasto-holotype, no. 6054 (C. A. S. type coll.), from near La Paz, Lower California. P. 124.

Fig. 9. *Xenophora robusta* Verrill. Basal view of specimen shown in figure 8. P. 124.

Fig. 10. *Mitra zaca* Strong, Hanna & Hertlein, n. sp. Alt. 132.2 mm., diam., 36 mm. Holotype, no. 6061 (C. A. S. type coll.), from Loc. 27594 (C. A. S.) Santa Maria Bay, Lower California, below Cape San Lazaro. Templeton Crocker, coll., 1932. P. 120.

Fig. 11. *Centrifuga leana* Dall. Alt., 34 mm., diam., (including spines), 29 mm. Plesiotype, no. 6056 (C. A. S. type coll.), from Loc. 27596 (C. A. S.) in channel near Cedros Island, off Lower California, Templeton Crocker, coll., Aug. 15, 1932. P. 120.

Fig. 12. *Metula amosi* Vanatta. Alt., 24.2 mm., diam., 9.5 mm. Plesiotype, no. 6058 (C. A. S. type coll.), from Loc. 27527 (C. A. S.), Acapulco Bay, Mexico. Dredged by Templeton Crocker, April, 1932. P. 122.

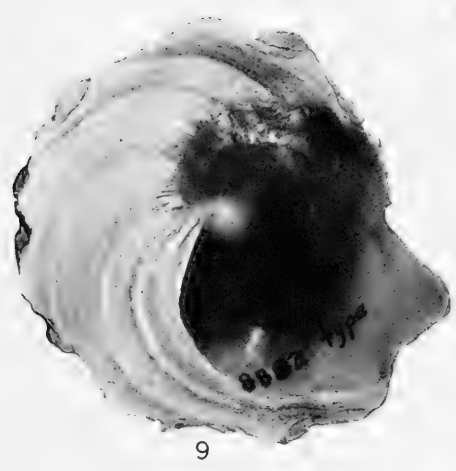
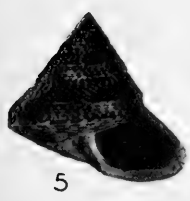
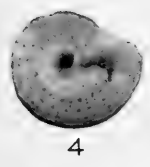
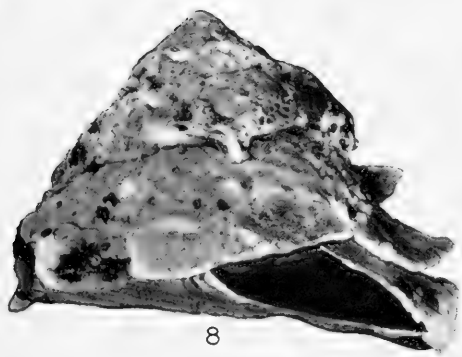
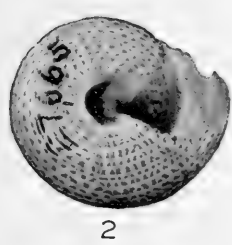
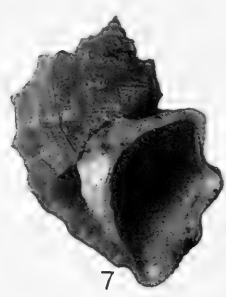
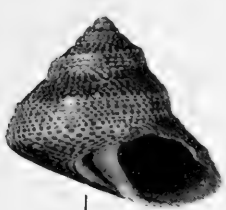


PLATE 6

Fig. 1. *Turritella mariana* Dall. Alt., 66.6 mm., diam., 13 mm. Plesiotype, no. 6050 (C. A. S. type coll.), from Loc. 27571 (C. A. S.), Lat. $16^{\circ} 39' N.$ to $16^{\circ} 38' N.$, Long. $99^{\circ} 24' 30'' W.$ to $99^{\circ} 27' 30'' W.$, in 20 to 45 fathoms. Templeton Crocker, coll., July 15, 1932. P. 123.

Fig. 2. *Turritella mariana* Dall. Alt., 77.8 mm., diam., 12.8 mm. Plesiotype, no. 6051 (C. A. S. type coll.), from Loc. 27584 (C. A. S.) Lat. $23^{\circ} 03' N.$ to $23^{\circ} 06' N.$, Long. $109^{\circ} 36' W.$ to $109^{\circ} 31' W.$ in 20 to 220 fathoms. Templeton Crocker, coll., Aug. 4, 1932. P. 123.

Fig. 3. *Turritella mariana* Dall. Alt., 68 mm., diam., 11 mm. Plesiotype, no. 6052 (C. A. S. type coll.), from same locality as specimen shown in fig. 1. P. 123.

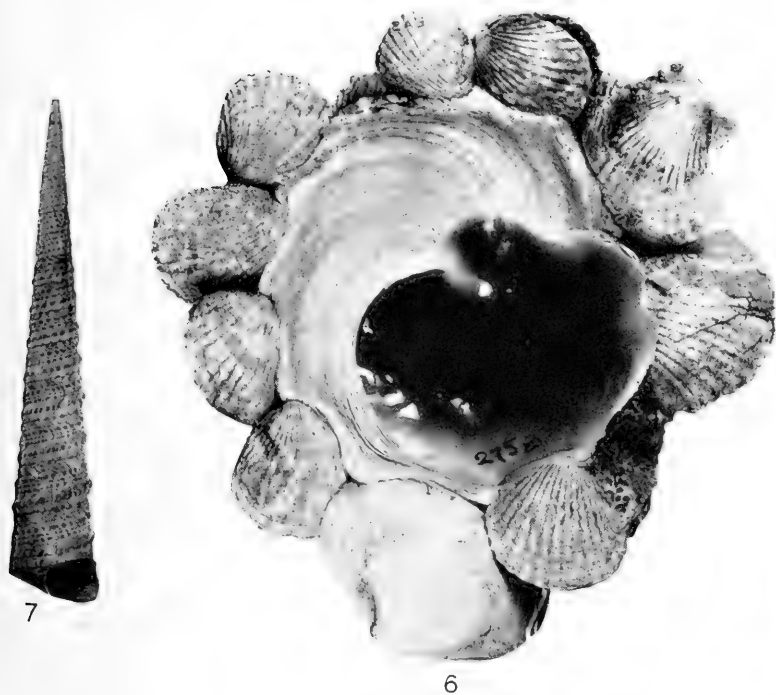
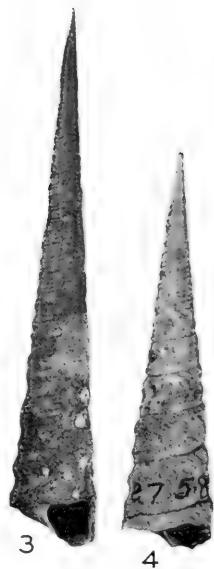
Fig. 4. *Turritella mariana* Dall. Alt., 50.2 mm., diam., 12 mm. Plesiotype, no. 6053 (C. A. S. type coll.), from the same locality as specimen shown in fig. 2. P. 123.

Fig. 5. *Xenophora robusta* Verrill. Alt. approximately 59 mm., diam. approximately 105 mm. Plesiotype, no. 6055 (C. A. S. type coll.), from Loc. 27585 (C. A. S.), Lat. $23^{\circ} 02' N.$, Long. $109^{\circ} 32' W.$, in 25 fathoms, Templeton Crocker, coll., Aug. 5, 1932. P. 124.

Fig. 6. *Xenophora robusta* Verrill. Basal view of specimen shown in fig. 5. P. 124.

Fig. 7. *Turritella radula* Kiener. Alt., 64.1 mm., diam., 12.1 mm. Plesiotype, no. 6048 (C. A. S. type coll.), from Loc. 27573 (C. A. S.), Lat. $18^{\circ} 14' N.$, Long. $103^{\circ} 45' W.$, in 60 fathoms, Templeton Crocker, coll., July, 1932. P. 124.

Fig. 8. *Turritella radula* Kiener. Alt. 61.1 mm., diam., 10 mm. Plesiotype, no. 6049 (C. A. S. type coll.), from same locality as specimen shown in fig. 7. P. 124.





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PROCEEDINGS

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THE TEMPLETON CROCKER EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES, 1932

No. 11

THE HIPPOBOSCIDAE OF THE GALAPAGOS ARCHIPELAGO (NOTES ON THE HIPPOBOSCIDAE. 8.) WITH AN APPENDIX ON THE TABANIDAE.

BY

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The Templeton Crocker Expedition obtained three of the six species of Hippoboscidae known to occur in the Galapagos Islands. Since the status of some of the names applied to these flies is as yet open to discussion, while I have had the opportunity to study material from the Galapagos from several sources, a review of the entire fauna may be useful. Three genera are represented thus far, viz., Olfersia, Lynchia, and Microlynchia, the first by three, the second by two, and the third by one species.¹

Olfersia Wiedemann

(Feronia Leach; Pseudolfersia Coquillett)

The genus is reviewed in a paper now being printed in Psyche (1933, XL.) The three species known from the Galapagos may be separated as follows:

¹ I am much indebted to Mr. J. L. Peters, Assistant Curator of Ornithology, Museum of Comparative Zoölogy, for valuable information concerning several of the birds mentioned in this paper.

1. Posterior orbits (above eyes) much shorter than the greatest width of the inner orbits; occipital margins of posterior orbits and of postvertex scarcely produced and separated by shallow curves. Second basal cell long, the second section of the fourth longitudinal vein at most one and one-third times the length of the first section of the fifth (the two sections usually of about the same length). Third longitudinal vein bare or at most with a few minute setæ on apical portion. Postvertex forming one, undivided smooth plate from occiput to frontoclypeus. *O. fossulata* Macquart.
 Posterior orbits about as long as the greatest width of the inner orbits; occipital margins of posterior orbits and of postvertex strongly produced behind and separated from one another by deep curved notches. Postvertex divided by a slight transverse depression into two areas. 2.
2. Occipital margin of postvertex somewhat more produced behind than the posterior orbits. Third longitudinal vein setulose throughout. Cross-vein closing second basal cell very oblique, the upper outer angle of the cell acute. *O. spinifera* (Leach).
 Occipital margins of postvertex and of posterior orbits about equally produced behind. Third longitudinal vein bare or at most with a few setæ toward apex. Cross-vein closing second basal cell nearly vertical, the upper outer angle of the cell almost square. *O. erythroptis* Bigot.

Olfersia fossulata Macquart

Olfersia fossulata Macquart, 1843, Mém. Soc. Sci. Lille, (1842), p. 434 (no sex; Brazil, no host); 1843, Dipt. Exot., II, pt. 3, p. 277; C. W. Johnson, 1924, Zoologica, New York, V. No. 8, p. 91 (Daphne Major Island, off *Pelecanus fuscus occidentalis*); Curran, 1932, Nyt Mag. Naturvidenskab., LXXI, p. 366; J. Bequaert, 1933, Psyche, XL.

Pseudolfersia fossulata Coquillett, 1901, Proc. Washington (D. C.) Ac. Sci., III, p. 379 (Wenman Island, no host).

I have not seen the specimens recorded by Johnson and by Coquillett from the Galapagos, but there is no reason to doubt the identifications.

O. fossulata is a common species along the coasts of western South America, where it is sometimes found in large numbers on young birds, especially on the Guanay, the White Gannet, Belcher's Gull, and Pelicans.

Olfersia spinifera (Leach)

Feronia spinifera Leach, 1817, On the Genera and Species of Eproboscideous Insects, p. 11, Pl. XXVI, figs. 1-3 (no sex, no locality, no host).

Olfersia spinifera C. W. Johnson, 1924, Zoologica, New York, V. No. 8, p. 91 (Tower Island, off *Fregata aquila*); Curran, 1932, Nyt Mag. Naturvidenskab., LXXI, p. 366 (Floreana or Charles Island, off Man-o'-war bird); J. Bequaert, 1933, Psyche, XL.

Darwin Bay, Tower Island, without host, one specimen (M. Willows Jr. Coll.—Templeton Crocker Expedition, Calif. Acad. Sci.); Tower Island, off Frigate Bird, *Fregata minor ridgwayi*

Mathews, April 15, 1930 (J. P. Chapin Coll.—Astor Galapagos Exp., Am. M. N. H.), and off Frigate Bird, two males, April 15, 1928 (W. S. Brooks Coll.—Mus. Comp. Zoöl.) In addition, I have seen three females and one male, part of the material recorded by C. W. Johnson from Tower Island, and some of the specimens recorded by C. H. Curran from Post Office Bay, Floreana (Charles) Island.

O. spinifera is a common and widespread parasite of Frigate or Man-o'-war birds (species of *Fregata*), in the Pacific and Atlantic oceans. I have seen also a few specimens taken off Pelicans and Cormorants.

Two specimens, collected by Dr. J. P. Chapin, bear interesting parasitic mites of the genus *Myialges* (see G. F. Ferris, 1928, Ent. News, XXXIX, pp. 137-140, Pl. III). In one fly a female mite is fixed in the first longitudinal vein, on the upper side and close to the base of the left wing. In the other specimen, a female mite, surrounded by numerous stalked eggs, is attached to the left mesopleuron immediately behind the articulation of the fore leg.

Olfersia erythroptis Bigot

Olfersia erythroptis Bigot, 1885, Ann. Soc. Ent. France, (6) V, p. 239 (no sex, New Caledonia, no host); J. Bequaert, 1933, Psyche, XL.

Pseudolfersia diomedæ Coquillett, 1901, Proc. Washington (D. C.) Acad. Sci., III, p. 379 (no sex, Albemarle Island, off Albatross, *Diomedea irrorata*).

Olfersia diomedæ Curran, 1932, Nyt Mag. Naturvidenskab., LXXI, p. 366.

Pseudolfersia spinifera Ferris and Cole, 1922, Parasitology, XIV, pt. 2, p. 196 (in part), figs. 13 and 14 A-C (drawings of male paratype of *P. diomedæ*). Not of Leach.

Indefatigable Island, without host, one specimen (M. Willows Jr. Coll.—Templeton Crocker Exp., Calif. Acad. Sci.); Hood Island, off *Diomedea irrorata*, one specimen (F. X. Williams.—Calif. Acad. Sci.). I have also studied the types of *P. diomedæ*, from Albemarle Island, at the U. S. National Museum and in Professor G. F. Ferris' collection.

O. erythroptis I have seen also from the Bahamas, Desecheo Island (near Porto Rico), Clarion Island (off the western coast of Mexico), Laysan Island, the Marquesas, the Tahiti Islands, and the Caroline Islands. The hosts known to me are the Albatross, *Diomedea irrorata* Salvin, the Red-tailed Tropic-bird, *Phaëton rubricauda* Boddaert, the White-bellied Booby, *Sula leucogaster* (Boddaert), the Small Noddy, *Anous minutus* Boie, the Wedge-tailed Shearwater, *Puffinus cuneatus* Salvin, and the Sooty Tern, *Sterna fuscata* Linnæus.

Lynchia Weyenbergh(Olfersia of Authors; *Icosta* Speiser; *Ornithoponus* Aldrich)

The two species of the Galapagos are very readily separated as follows:

1. Large species. Wing 7.5 to 8.5 mm. long. Posterior fourth to third of anal cell (Cu+1st An) bare on the upper side. Inner orbital bristles of frons very numerous. Postvertex without anterior pit-like depression.....*L. nigra* (Perty).

Small species. Wing 5 to 5.5 mm. long. Anal cell (Cu+1st An) entirely covered with setulæ on the upper side. Inner orbital bristles of frons moderately numerous. Postvertex anteriorly with a more or less pronounced pit-like depression...*L. albipennis* (Say).

Lynchia nigra (Perty)

Hippobosca nigra Perty, 1833, Delectus Anim. Artic. Brasil., III, p. 190, Pl. XXXVII, fig. 15 (no sex, no host, State of Piauhy, Brazil).

Lynchia nigra J. Bequaert, 1933, Psyche, XL, pp. 70 and 79.

Ornithomyia intertropica Walker, 1849, List Dipt. Brit. Mus., IV, p. 1144 (no sex, no host, Galapagos).

Ornithoponus americanus C. W. Johnson, 1924, Zoologica, New York, V, No. 8, p. 91 (off *Buteo galapagoensis*; Seymour Bay, Indefatigable Island); Curran, 1932, Nyt Mag. Naturvidenskab., LXXI, p. 366 Santa Cruz, (Indefatigable Island). Not of Leach.

Indefatigable Island, three females, off *Buteo galapagoensis* (Gould) (J. P. Chapin Coll.—Astor Exp., Am. M. N. H.). I have also seen two of the specimens, from Indefatigable, erroneously referred to *O. americanus* by Johnson. I assume that the specimen recorded by Curran belongs to the same species, but I have not studied it. I have never yet seen true *L. americana* (Leach) from south of Mexico.

L. nigra probably occurs over most of North and South America, since I have seen it also from Quebec, British Columbia, Colorado, Montana, New Mexico, Texas, Mexico, Republic of Honduras, Panama, Brazil, and Bolivia, as well as from the Hawaiian Islands. The hosts are various diurnal birds of prey. I have fully discussed this species in a recent paper (1933).

Lynchia albipennis (Say)

Olfersia albipennis Say, 1823, Jl. Acad. Nat. Sci. Philadelphia, III, p. 101 (no sex, off Great Blue Heron, *Ardea herodias* Linnaeus, no locality); Swenk, 1916, Jl. New York Ent. Soc., XXIV, p. 126.

Ornithoponus intertropicus C. W. Johnson, 1924, Zoologica, New York, V, No. 8, p. 91 (off *Butorides sundevalli* Reichenow, Seymour Bay, Indefatigable Island); Curran, 1932, Nyt Mag. Naturvidenskab., LXXI, p. 366. Not of Walker.

Narborough Island, seven specimens, off *Ardea herodias cognata* Bangs, May 28, 1932 (M. Willows Jr. Coll.—Templeton Crocker

Exp., Calif. Acad. Sci.); James Island, one specimen, without host, June 4, 1932 (M. Willows Jr. Coll.—Templeton Crocker Exp., Calif. Acad. Sci.); North Seymour Island, two specimens, without host, June 12, 1932 (M. Willows Jr. Coll.—Templeton Crocker Expedition, Calif. Acad. Sci.). Tower Island, one specimen, off Yellow-crowned Night Heron, *Nyctanassa violacea pauper* (Sclater and Salvin), April 15, 1928 (W. S. Brooks Coll.—Mus. Comp. Zoöl.). I have also seen one of the specimens recorded by Johnson from Indefatigable as "*Ornithoponus intertropicus*."

The Galapagos flies listed above agree in every respect with North American specimens of *L. albipennis*. I have also seen the species from the Republic of Honduras. It is, moreover, an open question whether this species is really distinct from the Old World *L. ardeæ* (Macquart), which I have seen from Sicily (the type locality), the Island of Rhodus, and the Belgian Congo. A most careful comparison of Old World specimens of *ardeæ* and New World specimens of *albipennis*, fails to disclose reliable differences.

In America, *L. albipennis* is a frequent parasite of wading birds, especially of Herons.

Microlynchia Ad. Lutz, Neiva and da Costa Lima

Microlynchia agrees with *Pseudolynchia* in most particulars, except the following. (1) The sides of the scutellum are rounded off, not produced into flattened, strongly ciliate, right angles. (2) The second longitudinal vein ends freely in the costa, while in *Pseudolynchia* its apical portion runs for a long stretch side by side with the costa, the two veins gradually coalescing. (3) Ocelli are usually more or less developed, one, two, or three being visible; but they may be entirely lacking, so that this character has not the value that was originally given it.

Only one species was known with certainty in the genus, but I have seen a second one, as yet undescribed.

Microlynchia pusilla (Speiser)

Lynchia pusilla Speiser, 1902, Zeitschr. Syst. Hym. Dipt., II, p. 157 (no sex, no host, Cuba); 1907, Ent. News, XVIII, p. 104.

Microlynchia pusilla Ad. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, VII, p. 185, Pl. XXVII, fig. 6, and Pl. XXVIII, fig. 6; Ad. Lutz, 1928, Est. Zoöl. Paras. Venezolanas, p. 9; Ferris, 1930, Can. Ent., LXII, p. 66, figs. 3-4 (♀ ♂).

Hood Island, one specimen, off *Buteo galapagoensis* (Gould), April 5, 1929 (W. S. Brooks Coll.—Mus. Comp. Zoöl.)

The specific characters of *M. pusilla* will be discussed elsewhere. Meanwhile it will be readily recognized from Ferris' excellent drawings. This parasite seems to be very widely distributed in the New World. I have seen it also from Arizona and Texas, and there are

published records from Cuba, Venezuela, and Brazil (Rio de Janeiro, Minas Geraes, and Espirito Santo). In the United States it has been found on Domestic Pigeon, on Quail, *Callipepla squamata pallida* Brewster (in Arizona), and on Roadrunner, *Geococcyx californianus* (Lesson) (in Texas). In South America it is recorded more particularly from wild pigeons, *Scardafella squammata* (Lesson) (= *squamosa* Temminck), *Columbigallina talpacoti* (Temminck), and *Leptotila rufaxilla* (Richard and Bernard).

APPENDIX: TABANIDÆ

So far as known, only one species of horse-fly occurs in the Galapagos Archipelago.

***Tabanus (Neotabanus) vittiger* Thomson**

Tabanus vittiger C. G. Thomson, 1868, Svensk. Freg. Eugenies Resa, Vet. Iakttag., II, Zoöl., Pt. 1, Insekter, Heft 12, p. 451 (♀; Galapagos Islands); Hunter, 1901, Trans. Amer. Ent. Soc., XXVII, p. 144; Kertész, 1900, Cat. Taban., p. 77; 1908, Cat. Dipt., III, p. 292; Coquillett, 1901, Proc. Washington (D. C.) Acad. Sci., III, p. 373 (James Island, Indefatigable Island, Albemarle Island); Surcouf, 1921, Gen. Insect., Taban., p. 88; C. W. Johnson, 1924, Zoologica, New York, V, No. 8, p. 87 (Conway and Seymour bays, Indefatigable Island); Curran, 1932, Nyt Mag. Naturvidenskab., LXXI, p. 349 (♀, Floreana or Charles Island).

Five females from Chatham Island, April 18, 1932 (M. Willows Jr. Coll.—Templeton Crocker Expedition, Calif. Acad. Sci.) I have also seen some of the specimens recorded by C. W. Johnson in 1924 from Indefatigable, and in 1932 by Curran from Floreana. The species seems to be found throughout the Archipelago. Since the known dates of capture fall in January, April, August, October and November, this fly is probably on the wing most of the year. The male is as yet undescribed.

T. vittiger belongs to the group of trivittate species, of which *T. tæniola* is a common North American representative. If one wishes to segregate these species in a subgenus, the name *Neotabanus* Ad. Lutz should be used for the group. *Neotabanus* was validly established in 1909 by Ad. Lutz (in a publication entitled "Instituto Oswaldo Cruz em Manguinhos," Rio de Janeiro, p. 29), two years before the homonym *Neotabanus* Ricardo (1911, Records Indian Mus., IV, p. 363, for an Indian species, *Neotabanus ceylonicus* Ricardo, 1911). In 1927 (Konowia, VI, pt. 1, p. 50), Enderlein designated as type of *Neotabanus* Ad. Lutz, *Tabanus triangulum* Wiedemann, one of the species originally included. The subgeneric name *Tæniotabanus* Kröber (1932, Rev. de Entomologia, S. Paulo, II, pt. 2, p. 201, without species) is a synonym of *Neotabanus* Ad. Lutz, 1909.

In the group of trivittate *Tabanus*, *T. vittiger* may be recognized by the following combination of characters: Frons very wide, about

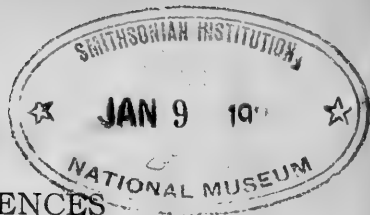
two and a half times as long as wide at vertex, with the inner orbits markedly converging below, where the frons is about three-fourths the width of the vertex; frontal callosity russet, broad and short, pyriform or square, narrowly separated from inner orbits, connected with a fine, barely raised median line which reaches to about midway the frons; no trace of ocelli or ocellar callosity; subcallus pruinose. Antennæ and palpi shaped and colored almost exactly as in *T. carneus* Bellardi. Fore femora blackish brown, mid and hind femora pale ferruginous or yellowish brown with infuscate bases; fore tibiæ blackish brown with yellowish white basal third; mid and hind tibiæ pale ferruginous; tarsi all black. Abdominal pattern much as in *T. modestus* Wiedemann or *T. lineola* Fabricius. Wings uniformly subhyaline with a slight grayish tinge, not darker nor yellowish along the costa; stigma narrow, amber-yellow; upper branch of third longitudinal vein without appendix (in all six specimens seen). Length 14 to 15 mm. The eyes appear to be banded like those of *T. carneus*.

T. vittiger is evidently a near ally of *T. carneus* Bellardi, of Mexico and Central America; but it differs in the much wider frons, quite conspicuously narrowed toward the subcallus.

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PROCEEDINGS
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CALIFORNIA ACADEMY OF SCIENCES
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Vol. XXI, No. 12, pp. 139-146 DECEMBER 21, 1933

**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 12

THE DIURNAL LEPIDOPTERA OF THE EXPEDITION

BY
E. P. VAN DUZEE
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No special effort was made to secure Galapagos Lepidoptera on the Templeton Crocker Expedition of 1932 as that order of insects had been systematically collected by F. X. Williams while on the Academy Expedition of 1905-06. However a few interesting things were taken, including three still undetermined. The present paper records the Diurnal Lepidoptera of the expedition, numbering 42 species. All were taken under Mr. Crocker's direction by his secretary, Mr. Maurice Willows, Jr.

PAPILIONIDÆ

1. *Papilio philenor* Linnæus

One male of the typical form of this species was taken at Acapulco, Mexico, April 5, and one female was found on Clarion Island.

2. *Papilio photinus* Doubleday

Another Central America butterfly of which one individual was taken on Coseguina Slope, Nicaragua, July 6.

December 21, 1933

3. **Papilio thoas autocles** Rothschild and Jordan

Three specimens of the Central American form of *thoas* were taken on Coseguina Slope, Nicaragua, July 6-7.

4. **Papilio epidaus** Doubleday

One of the most beautiful of the white papilios. Two fresh specimens were taken on the Costa Rica coast July 2.

PIERIDÆ

5. **Ascia monuste** Linnæus

This large white butterfly was taken at Mazatlan, Mexico, July 28, at Puerto Vallarta, Jalisco, Mexico, July 21, and on Isabel Island, Mexico, July 27. The latter a dark female.

6. **Itaballia calydonia** Boisduval

Costa Rica, July 3. This is a Central American form of the South American *demophila* Linn.

7. **Catopsilia eubule** Linnæus

Indefatigable Island, May 3-8; Chatham Island, April 7; Iguana Cove, Albemarle Island, May 21; Villamil, Albemarle Island, April 28. Apparently common on the Galapagos Islands as it is in North and South America. Here we call it the cloudless sulphur.

8. **Catopsilia stetira** Cramer

Puerto Vallarta, Jalisco, Mexico, July 27. The paler outer half of the wings will serve to distinguish this from the preceding.

9. **Catopsilia argante** Fabricius

Two examples of this large bright orange butterfly were taken with the preceding.

10. **Gonepteryx mæricula** Fabricius

Banderas Bay, Mexico, July 22. A large orange yellow butterfly with a conspicuous black dot on the wings.

11. **Gonepteryx chlorinde** Godart

Two individuals of this large white butterfly with a square lemon-yellow spot on the forewing, were taken in Costa Rica, July 2, and one on Isabel Island, Mexico, July 27.

12. **Terias westwoodi** Boisduval

Coseguina Slope, Nicaragua, July 7, four specimens.

13. **Terias lydia** Felder

Coseguina Slope, Nicaragua, July 6.

DANAIDÆ

14. **Danais berenice** Cramer

Coseguina Slope, Nicaragua, July 7. A common species in tropical America.

15. **Mechanitis lycidice** Bates

Coseguina Slope, Mexico, July 7-8.

SATYRIDÆ

16. **Eupytcha hermes** Fabricius

Coseguina Slope, Nicaragua, July 6.

HELICONIDÆ

17. **Heliconius petiverena** Doubleday

Acapulco, Mexico, April 5. The broad orange band on the forewing and narrow lemon-yellow one on hind wing will distinguish this insect.

NYMPHALIDÆ

18. **Colænis delila** Fabricius

Coseguina Slope, Nicaragua, July 7. A bright orange narrow-winged butterfly.

19. **Agraulis vanillæ galapagensis** Holland

Albemarle Island, April 28. This is a small dark form of our common *vanillæ* that well deserves subspecific distinction. It seems to be common on the islands.

20. **Euptoita claudia** Cramer

Costa Rica, July 1; Puerto Vallarta, Jalisco, Mexico, July 21; Isabel Island, Mexico, July 27. Common in the southern United States.

21. **Chlosyne**, sp.

Puerto Vallarta, Jalisco, Mexico, July 21, two examples. This insect in wing form and style of marking seems nearest to *tellias* as figured in Seitz, but it is a narrower winged form and both specimens lack the white spot behind the cell of the forewing, while one wants the red on the hind wing above.

22. **Melitæa theona** Menetres

Acapulco, Mexico, April 3, one damaged specimen.

23. **Microtia elva** Bates

Costa Rica, July 2, one female.

24. **Vanessa caryæ** Hubner

San Martin Island, Lower California, August 19. This is our common western painted lady.

25. **Anartia jatrophæ** Linnæus?

One small pale specimen, probably not distinct, was taken at Acapulco, Mexico, April 28.

26. **Anartia venusta** Fruhstorfer

Puerto Vallarta, Jalisco, Mexico, July 27. In this specimen the red band on the hind wings consists of about seven intervenular spots.

27. **Eunica modesta** Bates

Isabel Island, Mexico, July 27. A small black butterfly with about five white subapical spots on forewings.

28. **Victorina steneles biplagiata** Fruhstorfer

Puerto Vallarta, Jalisco, Mexico, July 21.

29. **Megalura chiron** Fabricius

Puerto Vallarta, Jalisco, Mexico, July 27, three examples; Punta Arenas, Costa Rica (H. S. Swarth).

30. *Megalura peleus* Sulzer

Puerto Vallarta, Jalisco, Mexico, July 21, one male.

31. *Chlorippe kallima* Staudinger

Coseguina Slope, Nicaragua, July 7, one example.

32. *Zaretas ellops* Menetres

Coseguina Slope, Nicaragua, July 7, one large female much resembling Seitz' figure of *strigosa* female.

LIBYTHIDÆ

33. *Libythea carinenta* Cramer

Banderas Bay, Mexico. July 22, one specimen.

ERYCINIDÆ

34. *Nymphidium mycone* Hewiston

Acapulco, Mexico, April 5, one female.

LYCÆNIDÆ

35. *Leptotes parrhasioides* Wallengren

Indefatigable Island, June 8, five examples. These are smaller and darker than our *marina* which they much resemble. Williams gives an interesting account of this insect in Proc. Calif. Acad. Sci., (Ser. 4) I, p. 300, 1911.

36. *Thecla melinus clarionensis* Heid, n. subsp.

At my request Mr. Graham H. Heid has studied this insect. Two specimens were taken by the Templeton Crocker Expedition. The types, however, are selected from a series taken by Mr. H. H. Keifer on the Academy expedition to the Revillagigedo Islands in 1925, as some of these are in more perfect condition. Mr. Heid's description follows.

Thecla melinus clarionensis Heid. Subsp. new

Resembles *melinus* Hbn. except in following particulars:

Ground color of both wings dorsally black-brown; ground color of both wings ventrally light cinnamon-brown.

Secondaries dorsally with a large, orange-red submarginal spot in area 2, this spot being carried over into area 3 as a red suffusion, often forming a distinct spot.

Secondaries ventrally with a row of spots in the discal area forming a transverse line, as in typical *melinus* Hbn. However, with the row of red spots along the basal edge of this line, always broad and distinct. The spot in area 6 never nearer to the base than the others, so the line is nearly straight from vein 4 to vein 8. Submarginal red spots in areas 1a, 1b, 2 and 3; those in 2 and 3 large and confluent. The spot in area 2 extends basally to meet the transverse line, which it partially obscures.

The general appearance of the insect is more brownish than in typical *melinus*, with the red marking greatly exaggerated and tending toward confluence.

Holotype, male (No. 3749, Mus. Calif. Acad. Sci.) Clarion Island, Mexico, April 30, 1925, collector, H. H. Keifer. Allotype, female (No. 3750, Mus. Calif. Acad. Sci.) Clarion Island, April 29, 1925, H. H. Keifer, collector. Paratype 1 ♂ (author's collection) Clarion Island, April 30, 1925. Paratype 2 ♀ (author's collection) Clarion Island, April 29, 1925, H. H. Keifer, collector. Paratypes 3-9, all males, April 29 to May 1st, 1925, collector, H. H. Keifer. Paratypes 10-11, females, Clarion Island, April 29-30, H. H. Keifer, collector. Paratype 12, female, Clarion Island, March 24, 1932, Templeton Crocker Expedition, M. Willows, Jr., collector. The characters mentioned in the description above are constant throughout the entire series.

HESPERIDÆ

37. *Eudamus galapagensis* Williams

Post Office Bay, Charles Island, April 24; Black Beach Road, Charles Island, April 25; Chatham Island, April 15-18; Tower Island, June 15; Tagus Cove, Albemarle Island, May 21; Summit Mt. Crocker, 2000 ft., Indefatigable Island, May 10, nineteen specimens in all.

In his description of this insect (Proc. Calif. Acad. Sci., Ser. 4, I, p. 303, 1911) Williams reports this as common, especially on Chatham and Albemarle islands.

38. *Heteropia* sp. near *imalena* Butler

Albemarle Island, April 28, 1 pair. This species has the blue blush on the base of the forewings found in *imalena* but the white markings consist of but two quadrate white spots representing the transverse band, one other distad of the second, and three minute white points near the apex. The female is labeled Puerto Vallarta, Jalisco, Mexico, July 21. One of these labels undoubtedly is wrong, but there is no way now of deciding which until more material has been secured.

39. **Thanaos persius** Scudder

Chatham Island, April 15, one rubbed example. It is possible that this label is also in error. The determination of this and the following two species is subject to some uncertainty until fuller series have been secured.

40. **Thanaos** sp. near **funeralis**

Clarion Island, March 22, three examples.

41. **Camptopleura theramenis** Mabe

Coseguina Slope, Nicaragua, July 6, one example.

42. **Pellicia licisca** Platz.

Coseguina Slope, Nicaragua, July 6; Puerto Vallarta, Jalisco Mexico, July 21.



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PROCEEDINGS
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**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 13

DIPTERA

BY

C. H. CURRAN

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The Diptera collected by the Crocker Expedition to the Galapagos form a noteworthy addition to our knowledge of the insects from this interesting group of islands and it has been a pleasure to prepare this report on the collection. In 1932 a report on the Diptera of the Wollebæk Expedition¹ was published and a list of all species known from the Islands included. In this report the Tipulidæ and Culicidæ were omitted and references to three species were overlooked. In April, 1933, Mr. M. C. Van Duzee² published a report on the Dolichopidæ and Phoridæ of the Crocker Expedition, but all of the specimens of these families were not included, and additional records are included in the present report, together with references to the original descriptions of species from the Galapagos. Owing to the fact that I have so recently presented a review of the Diptera from this region I have not repeated all of the records and the student will find it necessary to use my two reports together in order to obtain a complete survey of the known Dipterous fauna of the Galapagos Islands.

¹ Curran, *Nyt Mag. f. Naturvidens.*, lxxi, pp. 347-366, 1932.

² Van Duzee, *Proc. Calif. Acad. Sci.*, xxi, pp. 65-74, 1933.

While the Crocker Expedition secured a large number of specimens a glance at the present report will acquaint the reader with the fact that additional material in the California Academy of Sciences, the collection made by Dr. F. X. Williams in 1905 and 1906, constitutes no little part of the material studied. Dr. Williams secured a number of species not obtained by the Crocker Expedition, including two of the species described as new. Most of the material is in good condition and as a result I am able to correct some errors in my previous report.

I must express my appreciation to Mr. E. P. Van Duzee for the privilege of examining the collections upon which this report is based, to Messrs. Marston Bates and H. G. Barber for bringing to my notice descriptions of species which had been overlooked, and to Miss Daphne Aubertin and Mr. Tams for their assistance in the identification of *Oxya asia* Walker.

The types of the new species and all uniques are in the California Academy of Sciences. Paratypes and duplicate specimens, where available, are in the American Museum of Natural History.

FAMILY TIPULIDÆ

I am indebted to Dr. C. P. Alexander for the identification of the specimens belonging to this family.

1. *Limonia* (*Geranomyia*) *tibialis* (Loew)

Aporosa tibialis Loew, Linn. Ent., v, p. 397, 1851.

Seven specimens of both sexes: Black Beach Road, Charles Island, April 25 and May 14, 1932, and Chatham Island, April 18, 1932 (M. Willows Jr.).

According to Dr. Alexander this species has a wide range in the Neotropical region. Evidently the specimens reported by Coquillett and Johnson belong to this species.

FAMILY CHIRONOMIDÆ

Two species belong to this family.

2. *Galapagomyia longipes* Johnson

Galapagomyia longipes Johnson, Zoologica, v, p. 86, 1924 (f).

Female, Indefatigable Island, May 6, 1932 (M. Willows Jr.).

This specimen is much smaller than any of the others I have seen.

3. *Chironomus* sp.

A single male specimen in poor condition, Chatham Island, April 17, 1932 (M. Willows Jr.).

A species of *Chironomus* has been recorded from the Island but no material in sufficiently good condition to be named has been secured.

FAMILY CULICIDÆ

Only one species is represented in the collection and this has been identified by Dr. Stanley Freeborn.

4. *Aedes tæniorhynchus* (Wiedemann)

Culex tæniorhynchus Wiedemann, Dipt. Exot., p. 43, 1821.

Nine females, Chatham Island, April 17, 1932; five females, Charles Island, April 23, 25, 1932; one female, Indefatigable Island, May 5, 1932; one female, James Island, June 4, 1932, and one female, Jervis Island, June 6, 1932 (M. Willows Jr.). Also two females, Charles Island, October 3, 1905 (F. X. Williams).

In addition to the specimens enumerated above the Academy has additional material from Indefatigable, Charles and Chatham islands which was not forwarded.

FAMILY CERATOPOGONIDÆ

One species has been described from the Islands.

5. *Dasyhelea galapagensis* (Coquillett)

Ceratopogon galapagensis Coquillett, Proc. Wash. Acad. Sci., iii, p. 372, 1901.

Nine males and three females, Gardner Island, April 22, 1932; one male, Indefatigable Island, May 7, 1932 (M. Willows Jr.).

FAMILY SCIARIDÆ

This family is represented by four females of a very small species of *Sciara*. Since the identification of females in this genus is very difficult, and little is known about the Neotropical species I have made no effort to name the specimens.

The specimens are from South Seymour Island, July 11, 1932 (M. Willows Jr.).

FAMILY STRATIOMYIDÆ

Two species were taken on the Islands by F. X. Williams, one of them undescribed.

6. *Pelagomyia dubia* Curran

Pelagomyia dubia Curran, *Nyt Mag. Naturvidens.*, lxxi, p. 348, 1932.

Two females, Chatham Island, February 8, 1906; female, Tagus Cove, Albemarle Island, March, 1906; female, Indefatigable Island, November, 1905; female, South Seymour Island, July 25, 1906; female, Hood Island, October 1905; male, James Island, July 28, 1906; male, Charles Island, October, 1905, all collected by F. X. Williams.

The female from Hood Island was reared from pupa in cactus and a male from James Island is labelled "cactus fly."

7. *Merosargus insularis* Curran, new species

Related to *elatus* Curran but differs in having the posterior femora and tibiæ wholly reddish. Length, 7 mm.

Male.—Head black, the front and vertex metallic green; front yellow anteriorly, darker immediately above the antennæ; hair black, yellowish on the vertex, whitish on the occiput. Proboscis and palpi yellow. Antennæ reddish, black haired; arista, black.

Thorax metallic green, the upper border of the sternopleura and most of the pteropleura yellowish; humeri, posterior calli and upper edge of the mesopleura yellow. Hair yellow, rather tawny on the disc of the mesonotum, becoming whitish on the pectus.

Legs reddish, the apical four segments of the posterior tarsi brownish and bearing black hair; middle and posterior femora and the upper surface of the posterior tibiæ with very short black hair, the hair otherwise yellow.

Wings cinereous hyaline. Squamæ pale yellowish. Halteres reddish yellow.

Abdomen black, the incisures broadly yellowish, the first segment green laterally, the hair black, yellow on the apices of the segments and on the sides. Venter wholly reddish yellow. Genitalia reddish, the cerci brown.

Holotype, male, No. 3795, C. A. S. Ent., Cocos Island, September 3, 1905 (F. X. Williams).

FAMILY TABANIDÆ

Representatives of the single species known from the Islands were secured by F. X. Williams.

8. *Tabanus vittiger* Thomson

Tabanus vittiger Thomson, *Eugenies Resa*, p. 451, 1868.

Four females, Chatham Island, January 24, 1906, and October 12, 1906; female, Charles Island, October 3, 1905; two females, Albe-

marle Island, March and April 24, 1906; four females, Indefatigable Island, November, 1905, and July 11, 1906.

One of the specimens bears a label "feeding on turtles."

FAMILY BOMBYLIIDÆ

One species was collected by the Crocker Expedition and another by Dr. F. X. Williams.

9. *Lepidanthrax tincta* (Thomson)

Anthrax tincta Thomson, *Eugenies Resa*, p. 483, 1868.

Female, Bartholomew Island, June 14, 1932.

The specimen is in fairly good condition and there can be no doubt that the species belongs to *Lepidanthrax*. It is possible that *Anthrax brachialis* Thomson also belongs to this genus.

10. *Villa primitiva* (Walker)

Anthrax primitiva Walker, *List. Dipt. Brit. Mus.*, ii, p. 257, 1849.

Five specimens collected by F. X. Williams on Barrington Island, October 20, 1905.

FAMILY EMPIDÆ

11. *Drapetis zonalis* (Curran)

Drapetis zonalis Curran, *Nyt Mag. Naturvidens.*, lxxi, p. 351, 1932.

Female, Indefatigable Island, May 5, 1932.

The female differs from the male in having the basal three segments reddish yellow with brown lateral spots, the apical segments black.

FAMILY DOLICHOPIDÆ

Most of the material belonging to this family has been examined and reported upon by Mr. M. C. Van Duzee (*Proc. Calif. Acad. Sci.*, xxi, pp. 65-69, 1933). However, the collection contains two species, one of them new to the Islands: A list of the species known from the Galapagos is given for the convenience of students.

Condylostylus dentaticauda Van Duzee (1933).

Anchineura tibialis Thomson (1868).

Chrysotus brevicornis Van Duzee (1933).

Chrysotus brevispina Van Duzee (1933).

Chrysotus latifacies Van Duzee (1933).

- Asyndetus versicolor* Johnson (1924).
Asyndetus interruptus (Loew) (1861).
Aphrosylus setosus Curran (1932).
Paracleius pusillus (Macquart ?) Coquillett (1901).

12. *Chrysotus brevispina* Van Duzee

Chrysotus brevispina Van Duzee, Proc. Calif. Acad. Sci. xxi, p. 68, 1933.

One male, Chatham Island, April 18, 1932 (M. Willows Jr.).

13. *Asyndetus interruptus* (Loew)

Diaphorus interruptus Loew, Wien. Ent. Monatschr., v, p. 37, 1861.

One male, Abingdon Island, September 18, 1906 (F. X. Williams).

FAMILY PHORIDÆ

One specimen was overlooked when the material was sent to Mr. M. C. Van Duzee. In his report on this family Mr. Van Duzee described *Dohrniphora willowsi* and *crockeri*. The specimen in the collection agrees perfectly with *crockeri* Van Duzee and it also agrees perfectly with specimens of *venusta* Coquillett taken on my office windows in New York City. The venation is identical and I do not think there can be any doubt about the synonymy.

14. *Dohrniphora venusta* (Coquillett)

Phora venusta Coquillett, Can. Ent., xxvii, p. 107, 1895.

Phora divaricata Aldrich, Trans. Ent. Soc. London, p. 437, 1896.

Dohrniphora crockeri Van Duzee, Proc. Calif. Acad. Sci., xxi, p. 70, 1933.

Female, South Seymour Island, July 11, 1932 (M. Willows Jr.).

This specimen was taken at the same time as the type of *crockeri*. The species varies in color, the mesonotum and abdomen varying from reddish brown to black. I have previously recorded the species from the Galapagos.

FAMILY PIPUNCULIDÆ

15. *Pipunculus galapagensis* Curran, new species

A small, black species with partly yellowish legs, yellow third antennal segment and cleft hypopygium. Length, 2.25 mm.

Male.—Face, frontal triangle and posterior orbits silvery white pollinose; vertical triangle and vertex shining black, the occiput thinly pale pollinose; labellæ and palpi yellowish. Eyes touching for a distance equal to half the length of the frontal triangle. Basal antennal segments brown, the third yellow, acutely pointed below.

Thorax black, the humeri yellow in ground color. Mesonotum and scutellum thinly brownish pollinose, the pleura with cinereous pollen; scutellum with fine, dark hair.

Legs black; tips of femora and broad bases of the tibiæ yellow, the apices of the tibiæ and the tarsi reddish, the tarsi becoming brown apically; posterior four tibiæ silvery in front from basal view.

Wings cinereous hyaline, without stigma; fourth vein without appendage. Squamæ whitish. Halteres yellow.

Abdomen greenish black, thinly brown pollinose, the first segments and sides of the apical ones with rather thin whitish pollen, the bristly hairs on the sides of the first segment whitish, the hair otherwise inconspicuous. Genitalia rather small from dorsal view, broadly cleft toward the right, half as long as the abdomen from ventral view.

Female.—Front moderately wide, shining black on the upper half; anterior eye facets very large; sixth abdominal segment almost all whitish pollinose, the genitalia small, the piercer about as long as the basal section and reddish in color.

Holotype, male, No. 3796, C. A. S. Ent., Tagus Cove, Albemarle Island, May 25, 1932; allotype, female, No. 3797, C. A. S. Ent., Gardner Island, near Hood Island, April 22, 1932. Paratypes: two males, Charles Island, April 24 and May 14, 1932, and male, James Island, June 4, 1932 (M. Willows Jr.).

This species is perhaps related to *acuticornis* Malloch, from Panama, but the absence of pale abdominal fasciæ will distinguish it.

FAMILY SYRPHIDÆ

The Crocker Expedition obtained three species, all previously recorded from the Islands. One of these is undescribed while a second has been erroneously placed in *Sphærophoria*.

KEY TO GENERA

1. Abdomen elongate and spatulate. *Baccha* Fabricius.
Abdomen not spatulate, never narrowed basally. 2.
2. Face wholly black. *Xanthandrus* Verrall.
Face partly yellow. 3.
3. Mesonotum with a median cinereous or metallic vitta; face strongly produced in the middle. *Mesogramma* Loew.
Mesonotum shining black, without median vitta; face weakly tuberculate below the middle, almost straight to the tip of the tubercle *Allograpta* Osten Sacken.

16. *Allograpta splendens* (Thomson)

Syrphus splendens Thomson, Eugenes Resa, p. 501, 1868.

Sphærophoria splendens Coquillett, Proc. Wash. Acad. Sci., iii, p. 374, 1901.

Four females, Chatham Island, April 17, 18, 1932 (M. Willows Jr.). One female, James Island, July 3, 1906 (F. X. Williams).

This species agrees with *obliqua* Say in having a continuous yellow band on the pleura, the hypopleura being crossed by a yellow spot.

It differs greatly from *obliqua* in the abdominal markings, the black vittæ being absent, the pale fasciæ arched and more or less tridentate behind on the fourth and following segments, as well as in having a black vittate face.

17. *Baccha clavata* (Fabricius)

Syrphus clavatus Fabricius, Ent. Syst., iv, p. 298, 1794.

Female, Chatham Island, April 17, 1932 (M. Willows Jr.). Male, Albemarle Island, April 24, 1906 (F. X. Williams).

This species is common over the whole of tropical America and is easily recognized.

18. *Mesogramma crockeri* Curran, new species

Mesogramma duplicata Coquillett, Proc. Wash. Acad. Sci., iii, p. 374, 1901 (not Wiedemann).

Related to *duplicata* Wiedemann but with the mesonotum wholly black pilose and the black abdominal fasciæ in the female strongly produced forward laterally. Differs from *producta* Curran in having the face much less strongly produced and in the shape of the abdominal fasciæ in the female. Length, 5 to 6 mm.

Male.—Face and frontal triangle yellowish; vertical triangle very long, black, thinly brownish pollinose in front of the ocelli, the pile black. Vertex brown pollinose, the occiput yellowish pollinose on the upper half, white pollinose and pilose on the lower half. Cheeks black. Face rather strongly produced. Antennæ reddish yellow, the third segment somewhat darkened above; arista blackish.

Mesonotum dark in ground color, reddish brown pollinose, the sides broadly yellow on their whole length; a median vitta and one at either side bordering the yellow bright bluish or steel-blue. Scutellum yellowish, sometimes a little darkened basally. Pleura bluish black, with large yellow spots on the mesopleura and sternopleura and a small one above the front coxæ. Pile black on the dorsum, yellow on the pleura.

Legs yellowish; apical segment of the middle tarsi and the posterior tarsi brown, the posterior tarsi sometimes paler on the intermediate segments. Black hair on under surface of posterior femora extending almost to the base.

Wings cinereous hyaline. Squamæ whitish. Halteres yellow.

Basal abdominal segment bluish black with the sides yellow. Second segment black with a little more than the median third reddish yellow or yellow. Third segment reddish, with a little less than the apical third black, the black expanding laterally to occupy about half the length of the segment, vary narrowly interrupted in the middle and emitting a pair of slender black vittæ which are rather triangularly expanded in front. Fourth segment with similar markings to those on the third, the fifth with an oval or roundish opaque black spot in the middle basally. Genitalia reddish with a large shining black spot on the right side. Pile black, yellow ventrally. The lateral margins are wholly pale or nearly so and the dark markings vary greatly, often being almost absent on the third and following segments.

Female.—Front black or steel blue, the sides rather narrowly yellow to above the middle, thinly brownish pollinose, in some lights the median black stripe appears yellowish pollinose; pile black. Occiput cinereous yellow pollinose. Pale fascia on second abdominal segment more than half as wide as the length of the segment, the black on the following segments much more strongly produced forward at the sides and reaching the basal fourth of the segment, apex of fifth segment more or less blackish, the sixth shining brown.

Holotype, No. 3798, and allotype, No. 3799, C. A. S. Ent., Charles Island, April 25, 1932. Paratypes, six males and four females, Charles Island, April 25 and May 14, 17, 1932; two females, Chatham Island, April 17, 1932; two males and two females, Tagus Cove, Albemarle Island, May 25, 1932; two males, James Island, June 4, 1932, and one male, Indefatigable Island, May 7, 1932, all collected by Mr. M. Willows Jr. Also two males, Albemarle Island, March, 1906 (F. X. Williams).

One of the specimens collected by Dr. Williams is very dark, the yellow fasciæ are mostly separated from the lateral margins and the posterior femora are brown apically.

19. *Xanthandrus* species

A single female of a small, undescribed species belonging to this genus was collected by Dr. F. X. Williams on Abingdon Island, September 8, 1906. The head is missing so it must remain nameless until perfect specimens are available. It cannot be the same as the following species.

20. *Syrphus albomaculatus* Smith

Syrphus albomaculatus Smith, Proc. Zool. Soc. London, 1877, p. 84.

Originally described from Charles Island.

This species evidently does not belong to *Syrphus* but I am unable to place it from the brief description although it appears to belong to the genus *Xanthandrus*. The name is preoccupied by *albomaculatus* Loew, which was attributed to Wiedemann, stated to be the same as *pyrastri* Linnæus. Unfortunately, I was unaware of the description of this species until long after I had sent specimens of *Paroxyna crockeri* to the British Museum and for this reason I have no definite information as to the generic position.

FAMILY PLATYSTOMIDÆ

The collection contains two species of *Euxesta*, one of them undescribed.

Genus **Euxesta** Loew

The following key separates the species recorded from the Islands.

TABLE OF SPECIES

- | | |
|---|------------------------------|
| 1. Femora blackish..... | 2. |
| Femora reddish..... | <i>nitidiventris</i> Loew. |
| 2. Costal border with two blackish spots..... | <i>notata</i> Wiedemann. |
| Costal border brown on the whole length..... | <i>galapagensis</i> , n. sp. |

21. **Euxesta nitidiventris** Loew

Euxesta nitidiventris Loew, Mon. N. Amer. Dipt., ii, p. 157, 1873.

Female, Indefatigable Island, May 6, 1932 (M. Willows Jr.).

22. **Euxesta galapagensis** Curran, new species

Blackish green, the parafacials and front reddish; wings broadly brown along the anterior border. Length about 3.5 mm.

Front reddish, the vertex blackish green, the dark color extending more than one-third the distance along the orbits and also over the ocellar triangle; hair moderately abundant. Vertex and occiput rather thinly cinereous pollinose. Cheeks, face and clypeus cinereous white pollinose. Palpi opaque black. Antennæ dull black, the third segment only a little longer than wide; arista black. Frontal lunule dull brown, a dark triangle lying between the antennæ.

Thorax blackish green, thinly pale pollinose, black haired.

Legs black; front coxæ mostly reddish; trochanters, knees, tips of the tibiæ and the tarsi reddish, the anterior tarsi becoming brown apically.

Wings cinereous hyaline, brown in front of the second vein and on the broad apex in front of the fourth vein. Anal cell moderately produced posteriorly.

Abdomen blackish green, thinly pale pollinose. The apical abdominal segments are missing so it is impossible to determine the color of the apical segments and the sex of the specimen.

Holotype No. 3800, C. A. S. Ent., Hood Island, October 1905 (F. X. Williams).

This species is so distinct from any described that I do not hesitate to describe it despite the condition of the abdomen.

FAMILY TRYPANEIDÆ

23. *Paroxyna crockeri* Curran, new species

Black, thickly pale pollinose, the head and legs mostly yellowish. Length, about 3 mm.

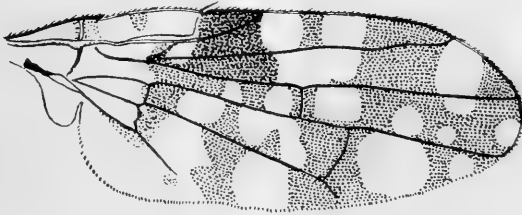


Figure 1

Male.—Head reddish yellow, the occiput blackish on the upper half; parafrontals, parafacials, cheeks and lower half of the occiput white pollinose, the upper half of the occiput with cinereous pollen; bristles of the front black, the upper pair of reclinate frontals white; bristles of occiput and cheeks white. Proboscis and palpi reddish. Antennæ reddish yellow, the arista black.

Mesonotum rather yellowish pollinose, with three brownish yellow vittæ which coalesce on the posterior half; scutellum brownish yellow, with darker border. Pleura cinereous pollinose. Hair whitish, the bristles black. Scutellum with one pair of strong marginals and a very weak apical pair.

Legs reddish, the posterior four coxæ and all the femora black, the femora cinereous pollinose and with the apices broadly reddish; apical tarsal segment somewhat brownish.

Wings brown with about twenty clear spots as shown in the figure, the color somewhat variable; third vein bare. Squamæ and halteres yellowish.

Abdomen cinereous pollinose, the dorsum with two rows of very large, brownish spots which may cover most of the dorsum and form almost entire, narrowly separated, vittæ, or the spots may be more or less orbicular and separated. Hair yellow. Genitalia brown.

Female.—Brown abdominal vittæ usually narrower; ovipositor shining black.

Holotype, male, No. 3801, and allotype, female, No. 3802, C. A. S., Ent., Indefatigable Island, June 8, 1932.

In the male the third and fourth abdominal segments have rather weak marginals laterally, in the female these are stronger and extend across the fourth segment.

Three specimens, Tagus Cove, Albemarle Island, May 24, 25, 1932; eleven specimens, Charles Island, May 14, 1932; seven specimens, James Island, June 4, 1932; female, South Seymour Island, July 11, 1932; four specimens, Jervis Island, June 6, 1932; four specimens, Duncan Island, June 7, 8, 1932; eleven specimens, Indefatigable Island, Conway Bay, June 8, Sullivan Bay, June 13, 1932, all collected by M. Willows Jr.

24. *Paroxyna* ? *æsia* Walker

Oxya æsia Walker, List. Dipt. Brit. Mus., iv, p. 1006, 1849.

This species was described from the Galapagos and the type is in the British Museum (Natural History). It is in poor condition and Miss Daphne Aubertin, who compared specimens of *crockeri* with it, was unable to decide the genus to which it belongs, so its exact



Figure 2

position must remain in doubt until additional material is obtained. It seems probable that *æsia* is a true *Paroxyna* and it is at once evident that it differs markedly from the species described as *crockeri*. I am indebted to Mr. Marston Bates for the reference to the species and to Miss Aubertin and Mr. Tams for examining the type and furnishing a photograph of the wing.

FAMILY BORBORIDÆ

In my report on the Diptera of the Wollebæk Expedition I reported *Leptocera discalis* Malloch from St. Charles Island. This is the only species of Borboridæ recorded up to the present time, but the collection contains an undescribed species of *Sphærocera*.

25. *Sphærocera galapagensis* Curran, new species

Related to *binotata* Williston but with the femora extensively black. Length, 2.25 mm.

Female.—Head black, thinly pale pollinose; hair and bristles absent. Antennæ situated in oval depressions, transverse, reddish, the depressions with thinned margins below and laterally. Face receding, the clypeus large and on a level with the posterior edge of the antennal pits. Proboscis brownish red. Eye-facets rather large.

Thorax black, thinly yellowish brown pollinose; mesonotum with tiny brownish setulæ forming two acrostical rows, dorsocentral rows and a wide row above the wings. Disc of scutellum with tiny setulæ and a small tubercle on either side.

Pleura without hairs. Hypopleura produced and terminating in a mammiform process.

Legs reddish; coxæ, basal two-thirds of the anterior and basal half of the posterior four femora black; tibiæ darkened toward the apex. Hair pale and very short.

Wings cinereous hyaline, the veins yellowish basally; fifth vein reaching the wing margin; anal vein short. Squamæ yellowish. Halteres yellow.

Abdomen black, thinly brown pollinose, the dorsum with two large, yellow, membranous areas, that on the second segment subrectangular, widest behind, the corners rounded, the spot lying between the second and third segments, fully as large as the preceding one but more oval and with sharp outer ends. Venter yellowish, with only the apical sternites black and chitinized.

Holotype, female, No. 3803, C. A. S. Ent., Chatham Island, April 15, 1932 (M. Willows Jr.).

S. galapagensis belongs to a group of neotropical species in which the antennæ are horizontal and situated in well defined pits. The abdomen in most of the species is black with yellow, membranous markings above and the sternites quite small or partly missing. The yellow markings on the dorsum of the abdomen vary in size and shape in *bimaculata* Williston and perhaps in all the species. *S. pallipes* Malloch, from Panama, differs from the remaining species in the group in lacking the yellow markings. *S. bimaculata* is widely distributed in the American tropics.

FAMILY CHLOROPIDÆ

This family is represented in the Islands by four species. The genera are separable as follows.

- | | |
|---|-------------------------------|
| 1. Posterior tibiæ with a long, ventral terminal spine | 2. |
| Posterior tibiæ without apical spine | <i>Oscinella</i> Becker. |
| 2. Scutellum long and flattened; frontal bristles strong | <i>Prohippelates</i> Malloch. |
| Scutellum shorter and convex; frontals hair-like, very poorly developed | <i>Hippelates</i> Loew. |

26. *Prohippelates pallidus* (Loew)

Hippelates pallidus Loew, Berl. Ent. Zeit., ix, p. 184, 1865.

Four males and twelve females, South Seymour Island, June 11, 1932 (M. Willows Jr.).

There is some variation in the color of the tarsi. In some specimens the posterior tarsi are black below or clothed with black hair, while the anterior tarsi may be brown and the tip of the anterior tibiæ also darkened.

FAMILY CANACEIDÆ

Coquillett described a species belonging to this family, of which there are two described genera. Before me is a third genus represented by a species from the Panama Canal Zone and one from Albemarle Island. The genera are separable as follows.

KEY TO GENERA

1. Antennæ fully as long as the short, slightly convex face (Europe)
 *Dinomyia* Becker.
 Antennæ much shorter than the face 2.
2. Face convex *Canace* Haliday.
 Face concave below the middle *Procanace*, new genus.

Genus *Procanace* Curran, new genus

Front wide, the ocellar triangle dull but extending practically to the anterior margin of the front; three or four pairs of strong, divergent frontals with quite weak ones between; frontal vitta with a strong bristle toward either side opposite the anterior ocellus; ocellars strong, divergent; postocellars weak, parallel or slightly divergent; outer verticals divergent; cheeks about one-third as wide as eye-height, with two or three strong upturned bristles; face convex above, concave at or below the middle, the oral margin slightly projecting; clypeus prominent. Acrostical bristles and hairs absent; four pairs of dorsocentrals and an irregular row of hairs immediately inside each row; two pairs of marginal scutellars; one or two sternopleurals, the mesopleura with a downwardly directed bristle below the middle. Wings normal. Ovipositor of female with the apical lamellæ diverging and with short, erect bristles apically. Genotype, *P. panamensis*, new species.

I have named *panamensis* the genotype because the species should be more easily secured than *galapagensis*, the coast near Panama City being more accessible than the Galapagos Islands. I found the species in tide pools in the lava formation east of Panama City during low tide. Unfortunately the rising tide made further collecting impossible at the time but additional material should be secured without difficulty.

27. *Procanace galapagensis* Curran, new species

Black; wings brownish; face and cheeks gray pollinose. Length, 3 mm.

Female.—Front almost half as wide as the head anteriorly, greatly widening posteriorly; three pairs of strong, divergent frontals and weak ones between them; postocellars parallel; front and occiput dull blackish. Occiput with black hairs. Cheeks with a strong, upcurved bristle near the middle and another one anteriorly toward the oral margin, the vibrissæ scarcely weaker than these. Face concave a little below the middle, prominent above; clypeus narrow but distinctly protruding. Proboscis thinly grayish pollinose. Palpi brown, with apical bristle. Antennæ black; third segment somewhat longer than wide, rounded apically; arista pubescent.

Thorax dull black, in some lights with pale brown tinge; scutellum bare except for the marginals; two pairs of sternopleurals; mesopleura with scattered short bristly hairs, with a strong bristle near the middle below and another near the posterior margin.

Legs wholly black.

Wings brownish. Squamæ and halteres brown.

Abdomen black, with dull greenish tinge; lamellæ of the ovipositor moderately long and with three short, stout bristles on the outer side apically.

Holotype, female, No. 3804, C. A. S. Ent., Tagus Cove, Albemarle Island, May 27, 1932 (M. Willows Jr.).

28. *Procanace panamensis* Curran, new species

Differs from *galapagensis* in its smaller size, lighter color, pale halteres, etc. Length, 1.75 mm.

Male.—Front pale brownish, but in some lights appearing mostly dark grayish, the anterior border more or less gray pollinose; frontals between the strong bristles rather strong; ocellars long; postocellars gently diverging; outer verticals strong. Cheeks with three strong upwardly curved bristles. Face and cheeks whitish pollinose; face concave well below the middle, the clypeus moderately projecting. Proboscis grayish pollinose; palpi yellowish, the apical bristle rather weak. Antennæ black; third segment about as wide as long, obtusely rounded apically; arista pubescent.

Thorax black, cinereous pollinose, the dorsum brownish. Scutellum with a pair of discal hairs. Mesopleura with a single downwardly directed bristle; only one sternopleural.

Legs blackish, the femora rather paler and cinereous pollinose.

Wings tinged with brown. Squamæ brown. Halteres yellow.

Abdomen greenish black, with pale brownish pollen, the hair appressed but moderately long. Genitalia small.

Holotype, male, Patilla Point, Canal Zone, January 15, 1929 (Curran), in American Museum of Natural History.

FAMILY EPHYDRIDÆ

There is a single representative of this family in the collection, representing an apparently undescribed species of *Scatella*. The only other species recorded from the Islands is *Ephydra gilvipes* Coquillett.

29. *Scatella galapagensis* Curran, new species

Related to *stagnalis* but with four pairs of dorsocentral bristles, the anterior two pairs much weaker than the others; front polished metallic black. Length, 3 mm.

Male.—Face yellowish brown pollinose; the lowest and a median bristle in the facial rows strong and directed outward. Front shining metallic black, the lowest fourth with brown pollen, the middle very lightly and finely punctured; ocellars

rather strong. Cheeks about one-sixth as wide as the eye-height, rather thickly pollinose and with the usual strong bristle behind the middle. Antennæ black, the third segment obtusely rounded apically; arista pubescent.

Thorax black, moderately brown pollinose, the pollen becoming grayish on the pectus, the dorsum somewhat shining. Two pairs of strong dorsocentrals and two much weaker pairs in front of the suture, the presutural acrosticals only a little stronger than the third pair of dorsocentrals. Four scutellars, the basal pair about half as long as the apicals.

Legs blackish; femora grayish pollinose basally and brown pollinose on about the apical half. Coxæ with grayish pollen.

Wings light brown, with five whitish spots on the disc as in *stagnalis*. Squamæ whitish. Halteres reddish yellow.

Abdomen greenish basally and bronzed on the apical half and sides, rather thinly yellowish brown and cinereous pollinose. Venter blackish.

Holotype, male, No. 3805, C. A. S. Ent., Chatham Island, April 17, 1932 (M. Willows Jr.).

FAMILY PHYLLOMYZIDÆ

This family has not been recorded from the Islands. One specimen is in the collection.

30. *Desmometopa M-nigrum* (Zetterstedt)

Agromyza M-nigrum Zetterstedt, Dipt. Scand., vii, p. 2743, 1848.

Female, South Seymour Island, July 11, 1932 (M. Willows Jr.).

This species occurs in Europe, North America and the West Indies.

FAMILY DROSOPHILIDÆ

The two specimens in the collection represent species previously recorded from the Islands.

31. *Drosophila immigrans* Sturtevant

Drosophila immigrans Sturtevant, N. Amer. Sp. Drosophila, p. 83, 1921, (f).

One specimen, James Island, June 4, 1932 (M. Willows Jr.).

32. *Diastata costalis* (Coquillett)

Rhinoëssa costalis Coquillett, Proc. Wash. Acad. Sci., iii, p. 378, 1901.

Male, Hood Island, October, 1905 (F. X. Williams).

FAMILY AGROMYZIDÆ

The collection contains two species belonging to this family.

33. *Cerodontha dorsalis* (Loew)

Odontocera dorsalis Loew, Berl. Ent. Zeit., vii, p. 54, 1863.

Two specimens, Charles Island, April 25, 1932, and Indefatigable Island, May 1, 1932 (M. Willows Jr.).

34. *Odinia williamsi* Johnson

Odinia williamsi Johnson, Zoologica, v, p. 90, 1924.

Male, Indefatigable Island, May 7, 1932; male, Jervis Island, June 6, 1932 (M. Willows Jr.). Male and two females, Barrington Island, November 20, 1905, and female, Abingdon Island, April 8, 1906 (F. X. Williams), the last recorded as "ovipositing on cactus."

FAMILY MUSCIDÆ

Six species have previously been recorded from the Islands, and three additional ones are contained in the material before me. A key to the genera is presented.

KEY TO GENERA

1. Arista pectinate; proboscis long and strongly broadened basally.*Stomoxys* Geoffroy.
Arista bare, pubescent or plumose; proboscis shorter and not broadened basally. 2.
2. One presutural dorsocentral.*Xenocænosia* Malloch.
Two presutural dorsocentrals. 3.
3. Prosternum haired. 4.
Prosternum bare. 5.
4. Arista bare.*Synthesiomyia* Brauer & Bergenstamm.
Arista with long rays.*Musca* Linnaeus.
5. Anal vein short, the following vein curved so as to cut across its apex
.*Fannia* Desvoidy.
Anal vein long. 6.
6. Pteropleura bare. 7.
Pteropleura with hair.*Lispe* Latreille.
7. Body shining blackish.*Ophyra* Desvoidy.
Body pollinose and dull.*Limnophora* Desvoidy.

35. *Xenocænosiæ devia* Curran, new species

Agrees with *ovata* Stein in having a median anteroventral bristle on the posterior tibiæ but the base of the abdomen is broadly yellow. Length, 3.5 to 4 mm.

Male.—Front rather wide, brownish, the orbits, a median vitta and the vertex dull yellowish; ocellars long; occiput, face and cheeks cinereous pollinose, the upper part of the occiput and face with yellowish tinge. Palpi reddish yellow; proboscis brown. Antennæ blackish with almost the basal half of the second segment reddish; arista black, with moderately long rays.

Thorax black, densely cinereous pollinose, the dorsum more or less brownish in the middle or almost wholly tinged with brownish yellow. Acrostical hairs paired, in four rows behind the suture. Scutellum with four equally strong bristles.

Legs reddish yellow, the tarsi brownish. Anterior and middle tibiæ with posterior bristle near the middle, the middle tibiæ with anterior median bristle. Posterior femora with an entire row of anterodorsal bristles, three posteroventrals, three or four strong anteroventrals and as many very poorly differentiated ones basally, a preapical posterodorsal and another on the posterior surface. Posterior tibiæ with a strong anterodorsal near the middle, a weak anteroventral below it, a strong dorsal bristle on the apical fourth and a slightly weaker anterodorsal near the apex. Apex of hind femora with brown spot.

Wings cinereous hyaline; veins brownish, becoming reddish basally. Squamæ white. Halteres pale yellow.

Abdomen brownish in ground color, yellowish on about the basal half except in the middle, densely covered with cinereous pollen ventrally and cinereous yellow pollen above; dorsum with a narrow, median brown vitta on the apical three segments and a round spot at the lateral third of the posterior border. First segment entirely yellow, the second with a broad black triangle extending to the base in the middle. Fourth segment with row of discals and marginals, third with marginals only, the basal two with only lateral bristles.

Female.—Yellowish median vitta of the front in the form of a triangle extending two-thirds the distance from the ocelli to the anterior border of the front. Dorsal bristle on posterior tibiæ situated half way between the anterodorsal and apex. Median dark vitta on abdomen less distinct.

Holotype, male, No. 3806, and allotype, female, No. 3807, C. A. S. Ent., Chatham Island, April 17, 1932. Paratypes, three females, Chatham Island, April 17, and male and female, James Island, June 4, 1932 (M. Willows Jr.).

36. *Fannia* species

Two females, Chatham Island, April 17, 1932 (M. Willows Jr.).

As there is no male available I am unable to identify these specimens but think they are probably *pusio* Wiedemann. I have female examples of the same species from British Guiana and Panama Canal Zone, but have no males associated with them.

37. *Ophyra ænescens* Wiedemann

Anthomyia ænescens Wiedemann, Aussercur. Zweifl., ii, p. 435, 1830.

Two females, South Seymour Island, June 11, 1932 (M. Willows Jr.).

38. *Lispe* species

A single female, in only fair condition, belongs to this genus. It is impossible to identify the species without a male and it is to be hoped that this sex may be secured. The specimen was taken by F. X. Williams on Charles Island, October, 1905.

39. *Musca domestica* Linnæus

Musca domestica Linnæus, Syst. Nat., 10th ed., i, p. 596, 1758.

One female, South Seymour Island, June 11, 1932 (M. Willows Jr.).

40. *Stomoxys calcitrans* (Linnæus)

Conops calcitrans Linnæus, Syst. Nat., 10th ed., i, p. 604, 1758.

Two females, South Seymour Island, June 11, 1932, and one female, Chatham Island, April 17, 1932 (M. Willows Jr.).

41. *Morellia ochricornis* (Wiedemann)

Musca ochricornis Wiedemann, Aussereur. Zweifl., ii, p. 408, 1830; F. Smith, Proc. Zool. Soc. London, p. 84, 1877.

This species was collected on Charles Island during the visit of H. M. S. "Peterel" in 1875.

FAMILY METOPIIDÆ

I employ this name for the group which has been known as the Sarcophagidæ, Calliphoridæ, Miltogramminæ, and Muscidæ (Townsend), since *Metopia* is the oldest included generic name. The family is fairly well represented on the Islands.

KEY TO GENERA

1. Arista plumose 2.
Arista long pubescent above, very short below *Opsophytopsis* Townsend.
2. Suprasquamal ridge bare 3.
Suprasquamal ridge with long hairs *Viridinsula* Shannon.
3. Palpi long and more or less swollen apically 4.
Palpi short and wholly slender; face and cheeks yellow in ground color
. *Cochliomyia* Townsend.
4. Two sternopleurals; female with a single proclinate orbital 5.
At least three sternopleurals; female with two proclinate orbitals . . .
. *Sarcophaga* Meigen.
5. Posterior crossvein situated more than its length from the bend of
the fourth vein *Sarcophagula* Wulp.
Posterior crossvein situated much less than its length from the bend of
the fourth vein *Prosthetocirca* Townsend.

42. **Cochliomyia macellaria** (Fabricius)

Musca macellaria Fabricius, Syst. Ent., p. 776, 1775.

Three females, Chatham Island, April 17, 18, 1932 (M. Willows Jr.). Six females, Charles Island, October, 1905; female, Barrington Island, October 20, 1905; two males and six females, Hood Island, October, 1905 (F. X. Williams).

Genus **Viridinsula** Shannon

At the time I examined the Diptera of the Wollebæk Expedition I had only alcoholic specimens belonging to this genus and I was misled into placing the material studied under the name *pionia* Walker. There are two species belonging to the genus and I am now describing the dark colored form. They are separable as follows.

Bright green; eyes of male approximate above..... *pionia* Walker.
Blackish with bronze and dull greenish reflections and rather thickly
pollinose; eyes of male widely separated..... *deceptor*, n. sp.

43. **Viridinsula pionia** (Walker)

Musca (Lucilia) pionia Walker, List, Dipt. Brit. Mus., iv, p. 880, 1849.

Female, Indefatigable Island, May 6, 1932 (M. Willows Jr.).
Female, Charles Island (F. X. Williams).

44. **Viridinsula deceptor** Curran, new species

Viridinsula pionia Curran, Nyt Mag. Naturvidens., lxxi, p. 361, (not of Walker).

Dark green and bronzed but so thickly grayish pollinose that the insect appears blackish to the naked eye; front of male moderately wide. Length, 5 to 8 mm.

Male.—Head black in ground color, thickly cinereous pollinose, the frontal pollen with brownish tinge. Front one-fifth of the head-width, the frontal vitta dull reddish on the anterior half; seven or eight pairs of rather weak frontals; ocellars long; outer verticals moderately long. Occipital cilia black, the pile with yellowish tinge. Cheeks almost one-third as wide as the eye-height, yellowish haired below and posteriorly, with coarse black hair above and anteriorly. Parafacials about as wide as the antennæ; oral margin produced. Palpi reddish yellow, the apices infuscated. Antennæ brownish, the apex of the second segment and base of the third more or less reddish; arista black, with long rays above and short ones below.

Thorax densely gray pollinose, the mesonotum with three poorly defined dark vittæ, the ground color dull green beneath the pollen, on the mesonotum somewhat bronzed. Acrosticals 2-2; dorsocentrals 3-3; posterior sublateral absent; two intralars; sternopleurals 2-1; four pairs of marginal scutellars and a discal pair. Hair black.

Legs blackish, the femora gray pollinose. Anterior femora with a row of strong posterodorsal bristles, a slightly weaker row immediately below them and a row of very strong posteroventral bristles; middle femora with three or four anteroventral bristles on the basal half, a row of strong posteroventral bristles on the basal two-thirds and short fine bristles on the apical third; posterior femora with row of antero- and posteroventral bristles and a row on the anterodorsal surface. Anterior tibiae with a posterior bristle near the middle, the middle tibiae with two short posterodorsal bristles, the posterior tibiae with a row of very short anterodorsal bristles.

Wings cinereous hyaline. Squamæ yellowish. Halteres reddish yellow.

Abdomen mostly green in ground color, the dorsum bronzed, the apices of the segments and a median vitta on the second and third segments blackish, the cinereous pollen quite thick. Hair black, yellow on the venter. Third and fourth segments each with a row of marginals, the fourth with erect bristly hairs. Fifth sternite divided on practically its whole length, the lobes very broadly separated, long and conspicuous, with bristles apically. Genitalia blackish, grayish pollinose.

Female.—Front about two-fifths as wide as the head; basal antennal segments sometimes reddish. Sternopleura with yellowish pile. Hair of fourth abdominal segment shorter and appressed; venter with black hair except basally.

Holotype, male, No. 3808, North Seymour Island, June 12, 1932; allotype, female, No. 3809, C. A. S. Ent., Tagus Cove, Albemarle Island, May 27, 1932 (M. Willows Jr.). Paratypes, male and female, Hood Island, October, 1905, January, 1906; two females, Cocos Island, September 3, 1905 (F. X. Williams); four males and ten females, Floreana or Charles Island (Wollebæk Exp.).

45. *Opsophytopsis inoa* (Walker)

Sarcophaga inoa Walker, List. Dipt. Brit. Mus., iv, p. 832, 1849.

Opsophytopsis insularis Townsend, Ins. Ins. Mens., v, p. 163, 1917.

Wohlfahrtia inoa Johnson, Zoologica, v, p. 88, 1924.

Female, James Island, July 28, 1906; female, Chatham Island, October 14, 1905, and female, Indefatigable Island, November, 1905, all collected by F. X. Williams.

46. *Sarcophagula occidua* (Fabricius)

Musca occidua Fabricius, Ent. Syst., iv, p. 315, 1794.

Male and female, Charles Island, April 23 and May 14, 1932; female, James Island, June 4, 1932; seven males and the same number of females, Chatham Island, April 17, 1932. All the specimens were collected by Mr. M. Willows Jr.

The synonymy of this species is given in my previous paper on the Galapagos Diptera.

47. *Prosthetocirca cana* Townsend

Prosthetocirca cana, Townsend, Proc. Biol. Soc. Wash., xxx, p. 196, 1917.

Sarothromyiops cincta Townsend, Proc. Biol. Soc. Wash., xxx, p. 196, 1917.

Male, Hood Island, January, 1906 (F. X. Williams). Female, Indefatigable Island, May 5, 1932 (M. Willows Jr.).

I am not certain that the female belongs here as it has black palpi while the male has these organs brownish red. However, it is not likely that there are two species on the Islands. The posterior forceps of the male are peculiar: basally there is a pair of transverse, foliate appendages, the basal half is thick while the apical half is in the form of a slender, tapering, slightly curved, cylinder. Despite its shape the forceps are not united and the lower edges of the thickened part bears abundant very short, fine hairs on the inner surface.

Genus *Sarcophaga* Meigen

1. Fourth abdominal segment with golden yellow pollen. *taitensis* Schiner.
Fourth abdominal segment without yellowish pollen. 2.
2. Males. 3.
Females. 7.
3. Genital segments blackish. *williamsi*, n. sp.
At least the second genital segment reddish. 4.
4. Palpi mostly reddish; posterior forceps with four arms. *plinthopyga* Wiedemann.
Palpi blackish; posterior forceps with only a single arm on either side. 5.
5. First genital segment blackish; posterior forceps with stout, short setulæ in the middle behind. *violenta* Walker.
First genital segment brownish only on apical half. 6.
6. Posterior forceps with tiny setulæ on most of their length and without yellow pubescence on their inner margin. *reversa* Aldrich.
Posterior forceps without setulæ, their inner margins with dense yellow pubescence on the basal half. *isla*, n. sp.
7. Fifth abdominal segment brownish, cinereous pollinose. *violens* Walker.
Fifth abdominal segment reddish. 8.
8. Bristles on fifth tergite almost equally strong and almost contiguous along the whole apex. *isla*, n. sp.
Bristles not all equally strong, those in the middle quite weak.
. *plinthopyga* Wiedemann ?.

48. *Sarcophaga taitensis* Schiner

Sarcophaga taitensis Schiner, Novara Reise, Dipt., p. 314, 1868.

Four males, Charles Island, April 17 and 25, 1932 and May 14, 1932; male, James Island, June 1, 1932; two females, Chatham Island, April 17, 1932; female, Iguana Cove, Albemarle Island, May 21, 1932; female, Duncan Island, May 7, 1932, all collected by Mr. M. Willows Jr. Two females, Albemarle Island, March, 1906 (F. X. Williams).

49. *Sarcophaga plinthopyga* Wiedemann

Sarcophaga plinthopyga Wiedemann, Aussereuropäische Zweiflügelige Insecten, ii, p. 360, 1830.

S. robusta Aldrich, Sarc. & Allies., p. 207.

S. quadriforceps Curran, Nyt Mag. Naturwissen., lxxi, p. 363, 1932.

A female collected by F. X. Williams on San Martin Island, off the coast of Lower California, July 2, 1905, is referred here with some doubt as I do not have available authentic females of this species.

50. *Sarcophaga violenta* Walker

Sarcophaga violenta Walker, List. Dipt. Brit. Mus., iv, p. 826, 1849.

Gigantotheca galapagensis Townsend, Proc. Biol. Soc. Wash., xxx, p. 195, 1917.

S. violenta Aldrich, Proc. U. S. N. M., lxxviii, Art. 12, p. 16, 1930, (fig.).

Two males and one female, Indefatigable Island, November, 1905; male, Barrington Island, October 20, 1905 (F. X. Williams).

51. *Sarcophaga isla* Curran, new species

Resembling *violenta* Walker but the first genital segment is red with brownish apex and the genitalia are very different. Length, 9 to 11 mm.

Male.—Head white pollinose; front one-fifth as wide as the head; frontals diverging below; ocellars weak; outer verticals scarcely developed; an incomplete row of black hairs behind the occipital cilia; pile of occiput white; cheeks with fine

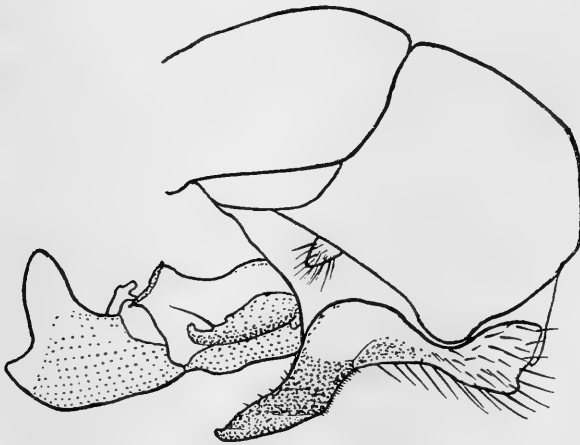


Figure 3

black hair; hair of parafacials rather fine. Palpi brown. Antennæ brown, the basal segments reddish; arista brown, its rays of moderate length.

Thorax cinereous pollinose, the three black vittæ of moderate width. Prescutellar acrosticals weak; presutural dorsocentrals weak, the posterior series with only the posterior one strong, the anterior three or four very weak; apical scutellars absent; sternopleurals 1-1-1; propleura bare in middle.

Legs black, the femora with cinereous pollen; middle femora with comb of short, stout bristles apically on posteroventral surface and with two preapical postero-dorsal bristles, villous on the basal half below; posterior femora villous below, their tibiæ short villous on the apical half of ventral surface; claws and pulvilli elongate.

Wings cinerèous hyaline. Squamæ white. Halteres mostly brownish.

Abdomen cinereous pollinose, a median vitta and the apices of the segments black or brown, each segment toward the side with a blackish spot in some lights; no marginals except on the fourth segment and sides of the others. Genitalia reddish, the basal segment with the apex brown above; posterior forceps expanded and red on the basal half, black and curved on the apical half, outer forceps narrow; posterior claspers long and rather narrow, the anterior claspers not developed; penis robust, the end expanded and very thin.

Female.—Front one-fourth the head-width; normally two pairs of proclinate orbitals; ocellars rather weak; outer verticals weak. Dorsocentrals not longer but more conspicuous. Abdomen more tessellate, the median vitta narrower, the apices of the segments not clearly black or brown. Fifth tergite reddish, with a row of strong, almost contiguous apical bristles, its sternite bright red, with an irregular row of rather short, appressed bristles near the apical third, its apex rather transverse with a shallow U-shaped median emargination, the basal two-thirds convex; apex of ovipositor yellowish and with black bristles.

Holotype, male, No. 3810, and allotype, female, No. 3811, C. A. S. Ent., Gardner Island, September, 1905. Paratypes, two males, Gardner Island, September, and four males and four females, Hood Island, October, 1905, all collected by F. X. Williams.

52. *Sarcophaga williamsi* Curran, new species

Hind tibiæ villous; genitalia wholly blackish; two strong post-sutural dorsocentrals. Length, about 7.5 mm.

Male.—Front two-elevenths of head-width; frontals diverging below; ocellars and outer verticals absent; two partial rows of black hairs behind the occipital cilia; occipital pile white; cheeks with black hairs, almost one-third as wide as the eye-height; parafacial hairs sparse; head white pollinose. Palpi brownish red, dark below. Antennæ brownish, the basal segments brownish red.

Thorax black, cinereous pollinose, the mesonotum with four moderately wide blackish vittæ. Dorsocentrals weak, the two posterior pairs strong; sternopleurals 1-1-1; no apical scutellars.

Legs black, the femora with grayish pollen. Middle and posterior femora with long hair below, the middle pair with weak, comb-like row of bristles apically. Middle tibiæ with the hair on the apical half of the lower surface hardly as long as the tibial thickness, the posterior tibiæ villous.

Wings cinereous hyaline. Squamæ whitish. Halteres yellowish with the base of the knob brownish.

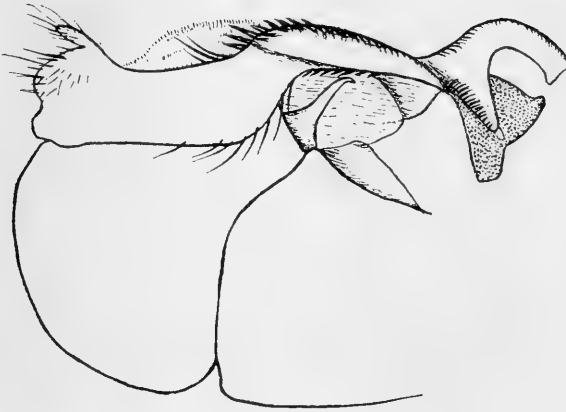


Figure 4

Abdomen black, with cinereous pollen, rather strongly tessellate; the black median vitta narrow. Lobes of fifth sternite very broadly separated, with very short black bristles along their inner edges, the base perpendicular and with a deep U-shaped incision in the middle. Posterior forceps reddish on the basal half, black apically, near their middle with short, coarse setulæ along the inner side, and for some distance beyond the base with dense yellow pubescence on the inner margin.

Holotype, male, No. 3812, C. A. S. Ent., Charles Island (F. X. Williams).

FAMILY TACHINIDÆ

This family has not been recorded from the Islands and the single specimen in the collection represents an apparently undescribed genus.

Genus *Galapagosia* Curran, new genus

In Townsend's Key to Genera traces to *Stomatodexia* Brauer and Bergenstamm but the palpi are smaller, the arista quite bare, cheeks somewhat narrower, etc.

Front almost one-fifth as wide as the head; with six pairs of frontals, the upper pair reclinate, the lower two pairs situated below the base of the antennæ; ocellars of moderate length; verticals rather weak. The occipital cilia extend to the cheeks and the occiput is pale haired. Cheeks about one-seventh as wide as the eye-height, with coarse, sparse hairs. Face almost as long below as at the base of the antennæ, gently receding, the oral margin somewhat produced; facial ridges bare; parafacials about half as wide as the third antennal segment, bare. Proboscis blackish, the apical section about three-fourths as long as the head-height; palpi rather slender, gently enlarged apically, of moderate length and bearing a few short, black bristly hairs below. Antennæ reaching almost to the vibrissæ, the third segment scarcely twice

as long as the second, with parallel sides, the apex obtusely rounded; arista practically bare, thickened on the basal fifth. Eyes bare. Acrosticals wholly absent although two of the presutural hairs are somewhat stronger than the others; dorso-centrals 3-3, although the anterior pair is very weak; posterior sublateral absent; posthumeral weak; two weak intra-alars; two pairs of marginal scutellars; three sternopleurals, the lower one very weak. Propleura and prosternum bare; infra-squamal setulæ absent. Legs normal, the tibial bristles short. Wings with the apical cell ending a little in front of the wing tip, narrowly open; bend of fourth vein without appendage; base of third vein with one or two weak basal bristles; costal spine very short. Abdomen long, narrow, subcylindrical and tapering; first segment without dorsal bristles, the second with a pair of marginals, the third and fourth each with a row; discals absent; genitalia small, wholly concealed from dorsal view. Genotype: *G. minuta*, n. sp.

53. *Galapagosia minuta* Curran, new species

Black, the antennæ, legs and abdomen partly yellowish or reddish. Length, 3.5 mm.

Male.—Head white pollinose; frontal vitta narrower than either parafrontal and brown in color. Antennæ black with the basal segments yellowish; palpi yellow.

Thorax cinereous pollinose, the mesonotum with four brown vittæ, the median pair approximate, replaced a little behind the suture by a single median vitta, the outer ones short and broadly interrupted at the suture; behind the outer ends of the suture a short, brownish black stripe. Scutellum brown, with the base and broad sides cinereous.

Legs brown; trochanters and tips of the femora reddish, the tibiæ more or less broadly reddish basally.

Wings cinereous hyaline; squamæ large, with yellowish tinge. Halteres yellow.

First abdominal segment brown with the sides very broadly yellow except apically and basally on the dorsum, wholly yellow on the under side; second segment broadly brown in the middle and posteriorly, the yellow in the form of large basal triangles and occupying the whole of the under side of the tergites; fourth segment much less extensively yellow, the posterior two-fifths black on the under side, the yellow triangles extending onto the dorsum narrow and reaching only about one-fourth the distance across; fourth segment wholly black. Basal half of the tergites thickly cinereous pollinose, the apical portion brownish, the brown extending slightly forward on the median portion; on the fourth segment the gray pollen is more extensive and the apex is shining black. Genitalia quite small, brownish behind, reddish anteriorly, the brown area thickly cinereous pollinose.

Holotype, male, No. 3813, C. A. S. Ent., Indefatigable Island, May 5, 1932 (M. Willows Jr.).

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No. 14

FORMICIDAE OF THE TEMPLETON CROCKER
EXPEDITION, 1933¹

BY

WILLIAM MORTON WHEELER

Professor of Entomology, Harvard University

The following ants collected by Mr. Maurice Willows Jr. in the Solomon, Santa Cruz and Danger islands comprise several forms not hitherto recorded from the Papuan region. One of the species represents a new and very interesting genus, *Willowsiella*, quite unlike any known Myrmicine ant.

FAMILY FORMICIDÆ

SUBFAMILY PONERINÆ

Odontomachus hæmatoda (Linn.)

Solomon Islands: Northwest end of Bellona Island (VI.9.33; VI.19.33; VI.23.33) ♀.

Santa Cruz Islands: Nupani Island (V.8.33) ♀ — Mohawk Bay, Matema Island (VII.9.33; VII.10.33) ♀ — Anuda Island (VII.15.33) ♀ — Tevia Bay, Vanikoro Island (V.6.33) ♀.

¹ NOTE: Vol. XXI of Proceedings was originally planned to contain only the results of the Crocker Expedition of 1932. However, his expedition of 1933 (not solely in the interest of the Academy) has added more new material from places in the Pacific Ocean to the Academy's collections. It has seemed but natural to incorporate the reports upon this later material with the reports on that collected on the Expedition of 1932. Consecutive numbering has been adhered to.—*Editor*.

Odontomachus hæmatoda var. **fuscipennis** Forel

Solomon Islands: Kungava Bay, Rennel Island (VI.14.33) ♂ ♀.

Numerous workers and three females, two of which are dealated. In this variety, originally described from Ceylon and Sumatra, the female has deeply infuscated wings, but the worker is indistinguishable from that of the typical *hæmatoda*. Perhaps, therefore, some or all of the workers above referred to the typical form of the species may really belong to this variety, which is not recorded by Mann from the Solomon Islands.

SUBFAMILY MYRMICINÆ

Pheidole megacephala (Fabr.)

Santa Cruz Islands: Anuda Island (VII.18.33) ♂ — Mohawk Bay, Matema Island (VII.8.33) ♂.

Danger Islands: Puka Puka Island (IV.9.33) ♂.

This pantropical ant is not recorded by Mann from the Solomon Islands.

Willowsiella Wheeler, gen. nov.

Worker. Monomorphic; integument smooth, hard and thick. Head rather large; eyes well-developed, near the middle of the sides; ocelli absent. Mandibles rather small, triangular, with oblique masticatory border bearing a well-developed apical tooth and a few poorly developed basal teeth. Palpi very short, the maxillary pair apparently 3-jointed. Clypeus with a raised plate-like median portion which is marginate on each side, extending forward as a subrectangular lobe and backward between the frontal carinæ as a blunt point. Posterior clypeal suture distinct; lateral portions of clypeus short and much depressed so that the anterior prolongations of the antennal foveæ are very deep. Frontal carinæ well-developed but short, rather far apart and feebly diverging posteriorly. There are no scrobes for the antennæ. Frontal area and groove absent. Antennæ stout, 11-jointed; first funicular joint well-developed, joints 2-7 short and transverse, 8-10 forming an enlarged and very distinct 3-jointed club, which is longer than the remainder of the funiculus. Thorax high, evenly arcuate above, without any traces of promesonotal and mesoepinotal sutures. Epinotum sloping without distinct base and declivity, armed with a pair of broad spines which are placed very low; metasterna well-developed, auriculate and compressed. Petiole very large, with a short, stout peduncle provided on each side with a blunt rectangular protuberance. Postpetiole very small compared with the petiole, very broad and very short. Gaster lenticular, consisting very largely of the first segment which is as broad as long and constitutes the whole dorsal surface; remaining segments very small and retracted; sting very long, exerted. Legs stout, hind tibiæ with delicate, hair-like, vestigial spurs; hind metatarsi as long as the tibiæ.

Genotype: *Willowsiella dispar* sp. nov.

Willowsiella dispar Wheeler, sp. nov. (Fig. 1)

Worker. Length very nearly 2.5 mm.

Head trapezoidal, slightly longer than broad, with nearly straight, anteriorly converging sides and feebly and evenly convex posterior border; in profile moderately convex above and subtruncate behind, with concave occipital border. Eyes slightly in front of the middle of the sides, moderately large, convex, semi-circular, with straight inferior orbit. Mandibles with straight external borders and two or three blunt teeth in addition to the acute apical tooth. Antennal scapes reaching to the posterior fourth of the head, curved at their bases; first funicular joint one and one-half times as long as broad; joints 2-7 fully twice as broad as long; eighth nearly as long as the three preceding joints together; the ninth as long as broad, the terminal distinctly longer than the combined eighth and ninth. Thorax in profile convex and evenly rounded above; seen from above slightly more than twice as long as broad, broader in front than behind, with broadly arcuate anterior border, subrectangular humeri and straight sides which gradually converge posteriorly to the epinotal region where they become subparallel. Epinotal spines as broad at the base as long, acute, strongly compressed, subparallel, directed backward and slightly upward, the space between them sloping and feebly concave. Petiolar node in profile higher than long, truncated anteriorly and posteriorly and

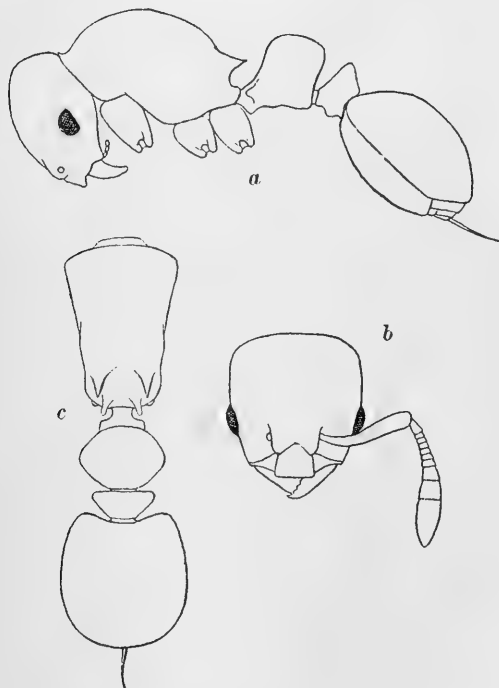


Fig. 1. *Willowsiella dispar* gen. et sp. nov.
a, lateral aspect; *b*, head, dorsal aspect;
c, thorax and abdomen, dorsal aspect.

rounded dorsally; seen from above transversely subelliptical, broader than the epinotum, with very bluntly angulate sides, nearly one and one-half times as broad as long. The peduncle bears on each side a blunt rectangular projection and at its anteroventral border a blunt tooth. Postpetiole anteroposteriorly compressed and cuneate in profile, with straight anterior and posterior surfaces and blunt superior border; from above much narrower than the petiolar node, broadly trapezoidal, fully twice as broad as long, its anterior and lateral borders straight, the latter strongly converging posteriorly. First gastric segment subquadrate, with broadly rounded anterior and posterior corners and deeply excised anterior border.

Shining; body and legs regularly, very finely and delicately reticulate, with sparse umbilicate punctures, distinctly coarser on the mandibles, head, thorax and petiole than on the postpetiole and gaster, which are smoother and more minutely and sparsely punctate. Frontal carinae and clypeus granular, the raised median portion of the latter with a few longitudinal rugae on each side. Cheeks coarsely reticulate-rugose; lower portion of epinotal declivity with several transverse rugae.

Hairs yellowish, very short, erect only on the clypeus and tip of the gaster, elsewhere appressed and arising from the umbilicate punctures. Pubescence short, even, appressed, confined to the antennae and legs.

Black; mandibles, antennae, legs and terminal segments of gaster yellowish brown; femora dark brown, except at their bases and tips; median portion of antennal scapes somewhat infuscated.

Described from a single specimen taken by Mr. Maurice Willows Jr. at the northwestern end of Bellona Island, Solomons (VI. 23.33).

The genus *Willowsiella* evidently belongs to Emery's tribe Meranoplini, which has hitherto included only five genera: *Promeranoplus* Emery, *Prodicroaspis* Emery, *Mayriella* Forel, *Calyptomymex* Emery (with the subgenus *Dicroaspis*) and *Meranoplus* F. Smith. *Mayriella*, *Calyptomymex* and *Meranoplus* have deep scrobes for the accommodation of the antennae and a different number of antennal joints, except in certain species of *Calyptomymex*. *Willowsiella* is more closely related to *Promeranoplus* and *Prodicroaspis*, which are known only from New Caledonia, but both have 12-jointed antennae and a very differently shaped thorax and pedicel. The new genus is therefore more specialized than these two but much less so than the three other genera. Emery (*Les Fourmis de la Nouvelle-Calédonie et des îles Royalty*, 1914, p. 14, *nota*) expressed the following opinion concerning the phylogeny of the Meranopline genera: "The two genera *Promeranoplus* and *Prodicroaspis* are apparently very closely allied. They arose from an unknown primitive type of the tribe Meranoplini and suggest transitions to two existing groups, one of which is represented by the single genus *Meranoplus*, the other by the genera *Calyptomymex*, *Dicroaspis* and *Mayriella*. The mesonotum is very prominent and armed with appendages in *Promeranoplus* and *Meranoplus* but unarmed in the others, and, since the epinotum tends to become abbreviated, the basal surface is very short and the spines (if present) are at half the height on

the declivity." Willowsiella in all probability departed from the unknown ancestral Meranopline along a third independent line of phylogenetic development in which the head failed to develop antennal scrobes, the thorax acquired no appendages and the antennæ retained a more primitive number of joints (eleven) than Mayriella, which has ten, and Meranoplus, which has only nine joints.

Tetramorium guineense (Fabr.)

Solomon Islands: Tai Lagoon, Malaita (V.30.33) ♀.

Santa Cruz Islands: (Anuda Island (VII.15.33) ♀.

Danger Islands: Puka Puka Island (IV.9.33) ♀.

Palmyra Island (IV.1.33) ♀.

This ant is now widely distributed throughout tropical and subtropical countries.

Tetramorium pacificum Mayr

A single worker from the northwestern end of Bellona Island, Solomons (VI.23.33). Though common in Indonesia and Oceania this species is not recorded by Mann from the Solomons.

Tetramorium melanogyna Mann var. **pallidiventre** Wheeler, var. nov.

Worker. Differing from the typical *melanogyna* in having the gaster yellow instead of fuscous. The mandibles and legs are of the same yellow color as the gaster, the knees, however, are infuscated. The petiolar and postpetiolar nodes are as coarsely reticulate-rugose as the thorax and their lateral marginations are less distinct.

A single specimen from the northwestern end of Bellona Island, Solomons (VI.19.33).

Xiphomyrmex costatus Emery subsp. **willowsi** Wheeler, subsp. nov.

Worker. Resembling the subspecies *flavescens* Emery but the femora and abdomen are yellow and paler than the rufotestaceous head and thorax, the antennal scrobes are not continued beyond the eyes, there are six rather sinuous longitudinal rugæ between the frontal carinæ and the thoracic rugæ are irregular and vermiculate. Antennal scapes extending fully one-fourth their length beyond the posterior corners of the head; funicular joints 3-5 as broad as long; epinotal spines shorter than in the typical *costatus* and either straight or slightly curved upward; metasternal spines two-fifths as long as the epinotal spines; petiolar peduncle only slightly longer than the node; postpetiole nearly twice as broad as long.

Two workers; one from Uras Cove, Malaita Island, Solomons (type locality, V.28.33) and one from Star Harbor, Cristoval Island (VII.1.33) in the same group. Mann records only the subsp. *flavescens* from the Solomons and states that it lives in hollow twigs.

SUBFAMILY DOLICHODERINÆ

Iridomyrmex myrmecodiæ Emery

Solomon Islands: Uras Cove, Malaita Island (V.28.33) ♀ ♂—Ugi Island (VI.28.33) ♀.

Iridomyrmex anceps Roger subsp. **papuanus** Emery

Santa Cruz Islands: Matema Island (VII.7.33) ♀ —Mohawk Bay, Matema Island (VII.8.33) ♀.

Turneria pacifica Mann

A single worker from Matema Bay, Santa Cruz Island (VII.8.33). This species was originally described from a single specimen taken by Dr. Mann at Graciosa Bay on the same island. Only four other species of the singular genus *Turneria* are known, *frenchi* Forel and *bidentata* Forel from Queensland, Australia, *dahli* Forel from the Bismarck Archipelago and *butteli* Forel from Sumatra. These, too, seem to be known from very few worker specimens.

Tapinoma melanocephalum Fabr.

A single worker from Anuda Island, in the Santa Cruz group (VII.15.33). A widely distributed pantropical species.

SUBFAMILY FORMICIDÆ

Anoplolepis longipes (Jerdon)

Solomon Islands: Santa Catalina Island (VII.2.33) ♀ —Kau Kau Plantation, Guadalcanar Island (V.20.33; V.23.33) ♀ ♀ —Star Harbor, San Cristoval Island (VII.3.33) ♀.

Santa Cruz Islands: Nupani Island (V.8.33) ♀ —Mohawk Bay, Matema Island (VII.10.33) ♀ —Matema Island (VII.7.33) ♀.

A well-known species widely distributed in Southern Asia, Indonesia and Oceania. It has even established itself in Mexico.

Oecophylla smaragdina Fabr. subsp. **subnitida** Emery

Solomon Islands: Star Harbor, San Cristoval Island (VII.1.33)
♂ —Kau Kau Plantation, Guadalcanar Island (V.20.33) ♂.

A rather smooth variety of the common East Indian "red tree ant," which uses its larvæ in spinning the silken webs that form the sutures of its leafy nests.

Camponotus (Myrmamblys) reticulatus Roger subsp.
bedoti Emery

Solomon Islands: Malaita Island (V.28.33) ♂ —northwestern end of Bellona Island (V.28.33) ♂ —Santa Catalina Island (VII.2.33) ♂ —Kau Kau Plantation, Guadalcanar Island (V.20.33) ♂ —Kungava Bay, Rennell Island (VI.14.33) ♂.

Sikaiana Island, east of Solomons (V.15.33) ♂.

Santa Cruz Islands: Nupani Island (V.8.33) ♂ —Anuda Island (VII.18.33) ♂.

All the numerous specimens are minor workers and vary somewhat in the sharpness of the fine striolation of the body. This ant was recorded by Mann from many localities in the Solomons and by Emery from Ternate, the Sula and Morty Islands. It also has a wide distribution in Indonesia (Borneo, Java, Sumatra).

Polyrhachis (Myrma) relucens (Latr.) subsp. **andromache**
F. Smith var. **nesiotis** Mann.

Eight workers from Tevia Bay, Vanikoro Island, Santa Cruz group (V.6.33). This variety was originally described from Graciosa Bay, Santa Cruz.

Polyrhachis (Myrma) relucens subsp. **ithonus** F. Smith

A single worker from Mohawk Bay, Matema Island, Santa Cruz Islands (VII.2.33). Hitherto recorded only from the Moluccas.

Polyrhachis (Myrma) labella F. Smith var. **brunneipes** Wheeler,
var. nov.

Worker. Like the var. *obliqua* Stitz from Bougainville Island, Solomons, in the shape of the epinotum which has a more oblique declivity than in the typical *labella*. The pubescence on the thorax

is grayish and not very long, abundant only on the pleuræ, finer and rather sparse on the gaster. Legs, excluding the coxæ, castaneous, the tibiæ scarcely paler than the femora and not yellow as in the typical *labella* and the var. *obliqua*.

A single worker from the northwestern end of Bellona Island, Solomons (VI.21.33).

Polyrhachis (Chariomyrma) rere Mann

Six workers from Anuda Island in the Santa Cruz group (VII.18.33). Originally described from Rere, on Guadalcanar Island, Solomons.

Polyrhachis (Chariomyrma) kaipi Mann

A single worker from Anuda Island (VII.15.33). Originally described from Malaita Island, Solomons.

Polyrhachis (Chariomyrma) arcuata Le Guillou
var. **acutinoda** Forel

One worker from the Kau Kau Plantation, Guadalcanar Island, Solomons (V.23.33). This variety was originally described from the Bismarck Archipelago.

Polyrhachis (Hedomyrma) annæ Mann

Solomon Islands: Northwestern end of Bellona Island (VI.23.33)
♂ —Kau Kau Plantation, Guadalcanar Island (V.20.33) ♀ —Kun-
gava Bay, Rennell Island (VI.14.33; VI.16.33) ♂ ♀.

Santa Cruz Islands: Mohawk Bay, Matema Island (VII.9.33)
♂ ♀.

Female (undescribed): Length 6–6.5 mm.

Resembling the worker; pronotal teeth shorter than broad at their bases and less acute; epinotal spines shorter and subparallel, petiolar spines straight and less divergent. Mesonotum as long as broad, semicircular in front. The dense golden pubescence covering the body the same as in the worker but somewhat less silvery on the head and thorax, the pale erect hairs slightly more numerous on the thorax and gaster.

Graciosa Bay, Santa Cruz Island is the type locality of this beautiful species, which was taken by Mann also in several localities in the Solomons.

***Polyrhachis (Myrmatopa) osæ* Mann**

A single worker from the Kau Kau Plantation, Guadalcanar Island, Solomons (V.20.33). The species was originally described from Ugi Island and recorded from three localities on San Cristoval.

***Paratrechina longicornis* (Latr.)**

A single worker from Puka Puka Island in the Danger group (IV.19.33). Mann found this pantropical species in all the localities which he visited in the Solomons.

***Nylanderia vaga* (Forel)**

Solomon Islands: Sikaina Island (V.15.33) ♀—Santa Catalina Island (VII.2.33) ♀—eastern end of Bellona Island (VI.19.33) ♀. Nupani Reef Island, east of Solomons (V.8.33).

Santa Cruz Islands: Matema Island (VII.7.33) ♀—Mohawk Bay, Matema Island (VII.8.33) ♀—Anuda Island (VII.15.33) ♀.

The large number of specimens are rather uniform in color and pilosity and close to the form which Santschi has recently called subsp. *crassipilis* from Samoa, Fiji and Tahiti.

***Nylanderia obscura* (Mayr) var.**

A single worker from Kungava Bay, Rennell Island, Solomons (VI.14.33), which agrees well with the Australian type of the species except in its somewhat less robust stature and deep black coloration. Mandibles, antennæ and legs reddish yellow, with the apical halves of the scapes and the femora and tibiæ, except their bases and tips, black. I hesitate to introduce a new name for this form without additional material.

***Nylanderia dichroa* Wheeler, sp. nov.**

Worker. Length about 2.7 mm.

Closely resembling *N. rosæ* Forel of Australia in form and sculpture but of very different color. Head broader, with more convex eyes and distinctly concave posterior border; antennal funiculi longer and more slender; base of epinotum more convex and rounded. Petiolar node with more rounded and less truncated superior border, inclined forward as in *rosæ*. Gaster anteriorly with a deep concavity for the accommodation of the petiole. Yellow, with jet black gaster; anal segment reddish. Smooth and shining. Pilosity much as in *rosæ*, with the erect hairs long and coarse, but longer and more numerous on the mesonotum and sides of the pronotum. The hairs are dark brown but appear partially pale in some lights. Pubescence on epinotum and legs rather conspicuous, white and appressed.

A single specimen from the Kau Kau Plantation, Guadalcanar Island, Solomons (V.20.33).

THE UNIVERSITY OF CHICAGO

PHILOSOPHY DEPARTMENT

PHILOSOPHY 101

LECTURE NOTES

BY [Name]

DATE

CHAPTER 1

101

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PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

VOL. XXI, No. 15, pp. 183-188

OCTOBER 16, 1934

**THE TEMPLETON CROCKER EXPEDITION TO WESTERN
POLYNESIAN AND MELANESIAN ISLANDS, 1933**

No. 15

**NOTES ON THE REPTILES AND AMPHIBIANS, WITH THE
DESCRIPTION OF A NEW SPECIES OF SEA-SNAKE**

BY
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The following paper is based on a collection of reptiles and amphibians made on the Templeton Crocker Expedition to the Solomon Islands on board the yacht *Zaca* in 1933 and very generously donated by Mr. Crocker to the California Academy of Sciences. While the bulk of the collection is from the Solomon Islands the Santa Cruz Islands, Palmyra Island, lying to the south and west of the Hawaiians, and Danger or Pukapuka Island, lying to the north and east of the Samoans, are also represented.

The thanks of the author are due Mr. Crocker and the crew of the *Zaca* for the privilege of studying this interesting collection, and especially to Mr. Maurice Willows Jr. upon whom fell the work of caring for and preserving the specimens.

The collections of Guppy and Woodford first brought to the notice of herpetologists the unique character of the reptile and amphibian fauna of the Solomons. At various times collectors have visited the group, the Whitney South Sea Expedition making investigations on some thirty-five islands. Since the collections made by the Crane Pacific and the Whitney South Sea expeditions no new species have been discovered until the Templeton Crocker Expedition secured a new species of sea-snake from Lake Tungano, Rennell Island. Several islands, from which there seem to be no records, in

both the Solomon and Santa Cruz groups were visited, thus increasing our knowledge of the distribution of the reptiles and amphibians of this most interesting region.

Like the previous collections made in the Solomon Islands the present one substantiates the theory that the reptile and amphibian fauna shows a Papuan rather than an Australian origin.

List of species from the SOLOMON and SANTA CRUZ groups, including additional records in distribution.

Hyla thesaurensis Peters

Malaita, 1 specimen.

Ceratobatrachus guentheri Boulenger

Malaita, 65 specimens.

Rana bufoniformis Boulenger

Ugi, 1 specimen.

Rana guppyi Boulenger

Malaita, 19 specimens.

Rana solomonis (Boulenger)

Malaita, 1 specimen.

Rana krefftii Boulenger

Guadalcanar, 1 specimen; Malaita, 4 specimens.

Gonocephalus godeffroyi (Peters)

Ugi, 2 specimens; Santa Anna, 1 specimen.

Gehyra oceanica (Lesson)

Bellona, 3 specimens; Guadalcanar, 1 specimen; Lomlom, 1.

Gekko vittatus Houttuyn

Bellona, 1 specimen; San Cristoval, 1; Ugi, 1; Rennell, 2 specimens.

Lepidodactylus guppyi Boulenger

Rennell, 1 specimen.

Cryptoblepharus boutonii poecilopleurus (Wiegmann)

Rennell, 5 specimens.

Dasia smaragdina perviridis Barbour

Lomlom, 1 specimen; Nupani, 1; Nalago, 1.

Emoia cyanogaster (Lesson)

San Cristoval, 5 specimens; Lomlom, 3; Malaita, 4; Anuda 2; Santa Anna, 1 specimen; Ugi, 1.

Emoia cyanura (Lesson)

Guadalcanar, 5 specimens; Bellona, 14; San Cristoval, 14; Ugi, 3; Rennell, 7; Malaita, 8; Anuda, 3; Matema, 6; Lomlom, 2; Vanikoro, 1 specimen.

Emoia nigra (Hombron and Guichenot)

Guadalcanar, 7 specimens; Bellona, 16; Rennell, 14; Lomlom, 14; Malaita, 14; Anuda, 2; Matema, 13; Vanikoro, 2; Nupani, 2; Nalago, 1 specimen.

Emoia atrocostata (Lesson)

Bellona, 1 specimen.

Emoia weneri (Vogt)

San Cristoval, 2 specimens.

Leiopisma anolis (Boulenger)

Ugi, 1 specimen.

Leiopisma noctua (Lesson)

Guadalcanar, 1 specimen.

Sphenomorphus concinnatus (Boulenger)

Malaita, 3 specimens.

Varanus indicus (Daudin)

Rennell, 2 specimens; Guadalcanar, 1 specimen; Malaita, 1.

Enygrus australis (Montrouzier)

Lomlom, 10 specimens.

Enygrus carinatus (Schneider)

Malaita, 8 specimens; Bellona, 1 specimen.

Boiga irregularis (Merrem)

Guadalcanar, 2 specimens.

Laticauda colubrina (Schneider)

Malaita, 2 specimens; Lomlom, 1 specimen.

Laticauda crockeri Slevin, new species.

Diagnosis.—Body compressed, markedly so posteriorly; head scarcely distinct from neck; snout elongate, rounded at tip; nasal large, occupying most of the posterior part of the nasal plate; no azygous prefrontal present; tip of third labial touching the eye, the fourth broadly in contact; rostral as high as broad; genials equal in length, the posterior ones not broadly in contact; gastrosteges two and one-half times as broad as long, with lateral keel anteriorly.

Scales smooth, in 21 rows; gastrosteges 199; urosteges 39; anal divided; upper labials 7-7; lower labials 8-8; preoculars 1-1; postoculars 2-2; sex ♂. Color uniform dark-brown, with yellowish anal plate. Total length 479 mm.; tail 64 mm.

Type: No. 72001 Mus. Calif. Acad. Sci., **Lake Tungano, Rennell Island, Solomon Islands.** Collected by the crew of the yacht *Zaca* June 8, 1933 and named for Mr. Templeton Crocker, Patron of the Academy.

This species may be readily distinguished from the other members of the genus by the elongate head, the uniform coloration and the more rounded snout.

Lake Tungano, situated about two miles inland from the east point of Rennell Island, is described as a body of water about ten miles in length and entirely separated from the sea. Visitors to the island found the water too salty for drinking purposes though it is used for drinking by the natives. Soundings taken have shown no bottom at thirty fathoms. The elevation of the lake is supposed to be about sea-level. Mr. L. A. Penn, of the Associated Oil Company, very kindly examined a water sample from the lake and gives the following analysis:

| <i>Radicles</i> | <i>Parts per Million</i> |
|-----------------------|--------------------------|
| Sodium..... | 1870.0 |
| Calcium..... | 110.0 |
| Magnesium..... | 230.0 |
| Sulphate..... | 460.0 |
| Chloride..... | 3400.0 |
| Bicarbonate..... | 110.0 |
| <i>Colloids</i> | |
| Silica..... | 10.0 |
| Iron and Alumina..... | 20.0 |
| Mineral Content..... | 6210.0 |
| Total Solids..... | 6650.0 |

Hydrophis ornatus (Gray)

Guadalcanar, 1 specimen; Malaita, 1.

Hydrophis faciatus atriceps (Smith)

Malaita, 1 specimen.

DANGER AND PALMYRA ISLANDS

DANGER ISLAND

Gehyra oceanica (Lesson)

7 specimens.

Peropus mutilatus (Wiegmann)

1 specimen.

Lepidodactylus lugubris (Duméril and Bibron)

2 specimens.

Emoia cyanura (Lesson)

21 specimens.

Leiopisma noctua (Lesson)

4 specimens.

PALMYRA ISLAND

Lepidodactylus lugubris (Duméril and Bibron)

5 specimens.

Those who are interested in the herpetology of the Solomon Islands should refer especially to the following papers:

Barbour, T.

1921. Reptiles and Amphibians from the British Solomon Islands. Proc. New England Zool. Club, Vol. VII, pp. 91-112, pls. 2-6.

Kinghorn, J. R.

1928. Herpetology of the Solomon Islands. Records of the Australian Museum, Vol. XVI, No. 3, pp. 123-178, figs. 1-35, pls. 13-15.

Burt, Charles E. and May Danheim.

1932. Herpetological Results of the Whitney South Sea Expedition. VI. Bull. Amer. Mus. Nat. Hist., Vol. LXIII, Art. 5.

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PROCEEDINGS
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OCTOBER 16, 1934

**THE TEMPLETON CROCKER EXPEDITION TO WESTERN
POLYNESIAN AND MELANESIAN ISLANDS, 1933**

No. 16

NOTES ON THE BIRDS

BY

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In the year 1933, Mr. Templeton Crocker, in his yacht *Zaca*, visited several groups of western Polynesian and Melanesian islands for the purpose of acquiring collections of natural history and ethnological material. The natural history specimens were destined for the California Academy of Sciences, and included ornithological representations from several rarely visited islands.

Bird skins secured by the expedition were taken on the following islands:

SOLOMON ISLANDS:

| | |
|---------------|----------------|
| Malaita | Santa Catalina |
| Guadalcanar | Santa Ana |
| San Cristoval | Rennell |
| Ugi | Bellona |

SWALLOW GROUP, SANTA CRUZ ISLANDS:

| | |
|--------|--------|
| Lomlom | Nupani |
| Anuda | Matema |

PALMYRA

October 16, 1934

Adequate collections from certain of the more interesting of the Solomon Islands have not been available until recently. Material secured in recent years by the Whitney South Sea Expedition has aided in the consolidation of the work previously accomplished by Tristram, Ramsay, Rothschild, Hartert, Stresemann, and others, and made possible Mayr's several studies¹ in distribution and differentiation. The avifauna of Rennell Island has been shown to be an important link in the distribution chain, and, although the material under examination appears to include no new forms, the California Academy of Sciences is fortunate in having such a valuable representation in its collections.

Sula dactylatra personata Gould

Nos. 38261-63: male and females, April 2; Palmyra Island.

The bills of these specimens yield the following measurements:

| | <i>Length of culmen</i> | <i>Breadth of culminicorn at base</i> | <i>Depth of bill at base</i> |
|--------------|-------------------------|---|----------------------------------|
| Male..... | 107.0 mm. | 26.5 | 38.5 |
| Females..... | 101.5-104.0 | 25.5-30.0 | 36.5-38.0 |

Butorides striatus macrorhynchus (Gould)

No. 38264: male, July 10; Mohawk Bay, Lomlom, Swallow Group, Santa Cruz Islands.

From this example, a bird in fresh adult plumage, the following measurements were obtained: Wing, 180.0 mm.; tail, 63.0; culmen, 64.0; tarsus, 48.5; middle toe, 42.0.

White tips are absent from the primary coverts, and only faintly indicated on the inner primaries and secondaries. The elongated dorsal plumes are strongly suffused with gray.

Demigretta sacra (Gmelin)

Nos. 38265-66: male and female, July 19; Bellona Island, Solomon Islands.

Both birds are in white plumage and lack any indication of dark color. Plumage renewal is in progress in both examples, contour and flight feathers being involved. Much of the body plumage is new, but partially developed feathers are present on all the feather tracts. All the rectrices are newly acquired, and all but the second and third primaries have been replaced.

The measurements are: Male.—Wing, 308.0 mm.; tail, 111.0; culmen, 88.0; tarsus, 79.0; middle toe, 61.0. Female.—Wing, 292.0; tail, 110.0; culmen, 83.5; tarsus, 76.0; middle toe, 58.5.

¹ Am. Mus. Novit. Nos. 469, 486, 488, 502, 504, 516, 522, 531.

Threskiornis æthiopicus pygmæus Mayr

Nos. 38267-70: males and females, June 18; Rennell Island, Solomon Islands.

Unworn rectrices are Cinnamon Buff (Ridgway, XXIX)², and the ruff feathers are also tinted with the same color. Elsewhere the white plumage is strongly suffused with Light Vinaceous-Cinnamon (Ridgway, XXIX). In all the examples the dark tips of the inner secondaries are much varied with white.

The measurements of the series are:

| | <i>Male</i> | <i>Male</i> [<i>Female?</i>] | <i>Female</i> | <i>Female</i> |
|-----------------|-------------|-----------------------------------|---------------|---------------|
| Wing..... | 336.0 mm. | 316.0 | 311.0 | 330.0 |
| Tail..... | 119.0 | 116.0 | 117.0 | 116.0 |
| Culmen..... | 132.0 | 90.0 | 112.0 | 115.0 |
| Tarsus..... | 83.0 | 65.0 | 72.0 | 79.0 |
| Middle toe..... | 67.0 | 57.0 | 62.0 | 67.0 |

Sterna bergii cristata Stephens

No. 38271: male, July 1; Star Harbor, San Cristoval, Solomon Islands.

The example is that of an immature bird, passing into adult plumage. The primaries have been newly acquired. The bird measures, as follows: Wing, 336.0 mm.; tail, worn; tarsus, 28.0; culmen, 59.0.

Megalopterus minutus minutus (Boie)

Nos. 38272-73: females, July 15; Anuda Island, Santa Cruz Islands.

In both birds feather renewal is nearly complete.

Heteractitis incanus (Gmelin)

No. 38274: female, July 8; Nupani Island, Swallow Group, Santa Cruz Islands.

The bird, in worn summer dress, is acquiring some of the feathers of winter plumage on the back and wings.

Cirrepidesmus mongolus mongolus (Pallas)

No. 38275: female, July 8; Mohawk Bay, Lomlom, Swallow Group, Santa Cruz Islands.

² Ridgway's *Color Standards and Nomenclature*, 1912.

Ptilinopus rhodostictus rhodostictus (Tristram)

No. 38278: immature male, June 30; Santa Ana, Solomon Islands.

Ptilinopus rhodostictus cyanopterus (Mayr)

Nos. 38276-77: adult and immature males, June 18 and 19; Rennell Island, Solomon Islands.

The older bird is just acquiring adult plumage. The measurements of this specimen are: Wing, 137.0 mm.; tail, 79.0; culmen, 13.5.

Coryphænas crassirostris (Gould)

No. 38279: male, July 1; Star Harbor, San Cristoval, Solomon Islands.

Eos grayi Mathews & Iredale

Nos. 38280-82: males, May 21; Kau Kau Harbor, Guadalcanar Island, Solomon Islands.

Trichoglossus hæmatodus cæruleiceps D'Albertis & Salvadori

Nos. 38286-89: males and female, July 8; female, July 10; Mowhawk Bay, Lomlom, Swallow Group, Santa Cruz Islands.

Birds from the Swallow Group are tentatively placed under this head. The blue of the forehead and crown covers but a slightly greater area than in *aberrans*, and there is little more blue on the cheeks.

A renewal of the contour and flight feathers is complete or nearly so in all the individuals.

Trichoglossus hæmatodus aberrans Reichenow

Nos. 38283-85: males and female, May 21; Kau Kau Harbor, Guadalcanar Island, Solomon Islands.

The plumage of the adult male and female is greatly abraded, but replacement has begun on the feather tracts of the head, and in the flight feathers.

Eclectus pectoralis salomonensis Rothschild & Hartert

No. 38290: female, June 16; Tai Bay, Malaita, Solomon Islands.

The plumage is greatly worn, especially the flight feathers, but inner primaries and outer secondaries are fresh and many new feathers are present among the interscapulars and on the rump.

Collocalia fuciphaga vaukorensis (Quoy & Gaimard)

No. 38291: female, May 31; Tai Bay, Malaita, Solomon Islands.
This example is in almost fresh feather.

Hemiprocne mystacea woodfordiana (Hartert)

No. 38292: female [male], May 31; Tai Bay, Malaita, Solomon Islands.

This bird wears the plumage of the male and probably has been incorrectly sexed.

Halcyon chloris solomonis Ramsay

No. 38299: male, July 6; Star Harbor, San Cristoval, Solomon Islands.

This individual lacks any indication of the pale occipital spot which is present in a specimen, received previously, from Guadalcanar.

Halcyon chloris amœna Mayr

No. 38298: unsexed, June 20; Bellona Island, Solomon Islands.
This is probably an example of a female not quite fully adult.

Halcyon sancta Vigors & Horsfield

Nos. 38293-97: males, June 20; Rennell Island, Solomon Islands.
Males and one unsexed, June 21; Bellona Island, Solomon Islands.

Two immatures are in badly abraded plumage, and feather renewal is only just commenced on the body feather tracts. Two older birds are in almost fresh feather. One example has newly acquired central rectrices, and the next pair and the outermost are not fully grown.

Coracina luneata gracilis Mayr

Nos. 38414-17: female, June 18; male, July 21; Rennell Island, Solomon Islands. Female and unsexed bird, July 21; Bellona Island, Solomon Islands.

In all the examples the rectrices are narrowly fringed with white, and the lateral ones tipped with that color. In one female the outer rectrix has a white shaft line extending 11 mm. from the apex.

The measurements obtained from these specimens are:

| | <i>Male</i> | <i>Female</i> | <i>Female</i> | <i>Unsexed</i> |
|-----------------|-------------|---------------|---------------|----------------|
| Culmen..... | 20.5 mm. | 21.0 | 20.0 | 20.0 |
| Wing..... | 141.0 | 143.0 | 138.0 | 140.0 |
| Tail..... | 109.0 | 107.0 | 99.0 | 105.0 |
| Tarsus..... | 25.0 | 24.0 | 24.0 | 22.0 |
| Middle toe..... | 20.0 | 21.0 | 20.0 | 20.0 |

Mino dumontii sanfordi Hartert

No. 38299: female, May 31; Tai Bay, Malaita, Solomon Islands.

This specimen measures: Length of culmen, 33.0 mm.; breadth of bill at nostril, 10.0; wing, 151.0; tail, 100.0; tarsus, 35.0; middle toe, 28.5.

Aplonis cantorides cantorides (Gray)

Nos. 38304-05: unsexed, May 26; Auki Bay, Malaita, Solomon Islands. Female, July 6; Star Harbor, San Cristoval, Solomon Islands.

The museum is fortunate in having acquired specimens of this rather uncommon bird. The birds are in unworn plumage, and the second primary in the unsexed example is only partially developed. The wing formula of the female is $3 > 4 > 2 > 5 > 6$.

The measurements of the specimens are:

| | <i>Culmen</i> | <i>Wing</i> | <i>Tail</i> | <i>Tarsus</i> | <i>Middle toe</i> |
|--------------|---------------|-------------|-------------|---------------|-------------------|
| Female..... | 19.25 mm. | 94.25 | 61.50 | 21.50 | 19.00 |
| Unsexed..... | 19.75 | 96.00 | 65.25 | 23.50 | 19.00 |

Aplonis tabuensis fortunæ Layard

Nos. 38306-09: female and males, July 7; Matema Island, Swallow Group, Santa Cruz Islands.

The measurements obtained from this series are: Males.—Length of culmen, 20.0-21.0 (av. 20.5) mm.; breadth of bill at base, 7.0-7.5 (7.25); wing, 109.5-112.5 (110.6); tail, 64.0-70.0 (66.3); tarsus, 25.0-28.5 (27.0); middle toe, 20.0-20.0 (20.0). Female.—Length of culmen, 20.0; breadth of bill at base, 7.0; wing, 106.0; tail, 60.0; tarsus, 27.5; middle toe, 20.0.

Aplonis metallica nitida (Gray)

Nos. 38301-03: female, May 31; Tai Bay, Malaita, Solomon Islands. Males, June 28; Ugi Island, Solomon Islands.

The moult of the two males is practically complete. The female wears the dress of an immature.

Pinarolestes hamlini Mayr

Nos. 38314-16: female, June 18; unsexed bird, June 20; male, June 21; Rennell Island, Solomon Islands.

The examples are in fresh plumage. They seem to measure rather less than those in Mayr's³ series.

³ Am. Mus. Novit. No. 486, 1931, p. 24.

| | <i>Male</i> | <i>Female</i> | <i>Unsexed</i> |
|---------------------------|-------------|---------------|----------------|
| Culmen, from nostril..... | 20.5 | 19.0 | 21.5 |
| Culmen, exposed..... | 28.5 | 26.5 | 29.0 |
| Wing..... | 93.5 | 86.0 | 89.5 |
| Tail..... | 77.5 | 75.5 | 76.5 |
| Tarsus..... | 23.5 | 22.0 | 20.0 |
| Middle toe..... | 16.5 | 16.0 | 16.5 |

***Monarcha ugiensis* (Ramsay)**

Nos. 38310-11: male and female, June 30; Santa Ana Island, Solomon Islands.

These specimens measure:

| | <i>Culmen</i> | <i>Wing</i> | <i>Tail</i> | <i>Tarsus</i> | <i>Middle toe</i> |
|-------------|---------------|-------------|-------------|---------------|-------------------|
| Male..... | 20.75 mm. | 83.25 | 77.5 | 20.5 | 14.0 |
| Female..... | 21.00 | 83.00 | 74.5 | 21.5 | 12.5 |

The female has the feathers of the lower abdomen and crissum narrowly tipped with rusty.

This species has not been recorded previously save from Ugi Island.

***Monarcha vidua* (Tristram)**

No. 38313: female, June 30; Santa Ana Island, Solomon Islands.

The measurements are: Culmen, 14.5 mm.; wing, 74.0; tail, 67.0; tarsus, 18.0; middle toe, 11.5.

This species is known from San Cristoval, but has not been reported before from Santa Ana Island.

***Myiagra ferrocyanea malaitæ* Mayr**

No. 38312: female, May 31; Tai Bay, Malaita, Solomon Islands.

The specimen measures: Culmen, 15.0 mm.; wing, 72.5; tail, 62.5; tarsus, 15.5; middle toe, 12.5.

***Rhipidura leucophrys melaleuca* (Quoy & Gaimard)**

Nos. 38317-18: female, June 28; Ugi Island, Solomon Islands. Male, July 3; Star Harbor, San Cristoval, Solomon Islands.

Both birds are in somewhat worn plumage, but have a few undeveloped feathers present on the occiput and nape.

The measurements are as follows: Male.—Culmen, 17.0 mm.; wing, 102.0; tail, 101.5; tarsus, 26.5; middle toe, 15.5. Female.—Culmen, 16.5; wing, 98.0; tail, 99.0; tarsus, 25.5; middle toe, 14.75.

***Rhipidura rennelliana* Mayr**

Nos. 38319, 38410-11: females, June 20 and 21; Rennell Island, Solomon Islands.

The measurements of the two adult birds are: Culmen, 13.50-13.75 mm.; wing, 76.0-88.0; tail, 91.0-100.5; tarsus, 19.5-20.0; middle toe, 11.0-12.0

One adult is in almost fresh feather, the other is nearly so, but one lateral rectrix is still in the sheath.

***Rhipidura rufifrons kuperi* Mayr**

Nos. 38412-13: male, July 2; Santa Catalina Island, Solomon Islands. Male, July 3; Santa Ana Island, Solomon Islands.

The Santa Ana specimen is in almost fresh feather, but that from Santa Catalina has feather replacement still in progress on nearly all areas.

The birds measure: Santa Ana.—Culmen, 11.75 mm.; wing, 70.5; tail, 81.0; tarsus, 19.0; middle toe, 11.0. Santa Catalina.—Culmen, 11.5; wing, 66.0; tail, 77.5; tarsus, 19.0; middle toe, 10.5.

In coloration both individuals appear to conform to Mayr's⁴ description of his new subspecies.

***Pachycephala pectoralis feminina* Mayr**

No. 38418: male, June 18; Rennell Island, Solomon Islands.

The specimen is a bird in unworn plumage, and yields the following measurements: Culmen, 18.0 mm.; wing, 85.5; tail, 57.0; tarsus, 25.0; middle toe, 16.0.

***Pachycephala pectoralis ornata* Mayr**

No. 38419: female, July 8; Mohawk Bay, Lomlom, Swallow Group, Solomon Islands.

This bird appears to correspond very closely to Mayr's⁵ description, save that the middle of the abdomen is more nearly Buff-Yellow (Ridgway, IV) than Lemon Yellow. The edge of the wing is Lemon Yellow.

The measurements are: Wing, 88.0 mm.; tail, 64.0; tarsus, 26.0; middle toe, 14.0

***Myzomela cardinalis sanfordi* Mayr**

Nos. 38420-22: male, June 6; Kungava, Rennell Island, Solomon Islands. Male and female, June 20; Rennell Island, Solomon Islands.

***Myzomela cardinalis pulcherrima* Ramsay**

Nos. 38423-24: males, June 28; Ugi Island, Solomon Islands.

⁴ Am. Mus. Novit. No. 502, 1931, p. 18.

⁵ Am. Mus. Novit. No. 531, 1932, p. 8.

Myzomela cardinalis sanctæcrucis Sarasin

Nos. 38425-28: male May 8; Nupani Island, Swallow Group, Santa Cruz Islands. Male, July 7; Matema Island, Swallow Group, Santa Cruz Islands. Males, July 8; Mohawk Bay, Lomlom, Swallow Group, Santa Cruz Islands.

Although the nomenclature employed by Mayr has been followed here, specimens of *Myzomela cardinalis* from Rennell, Ugi, and the Swallow Group fail to conform to his descriptions⁶ of the subspecies *sanfordi*, *pulcherrima*, and *sanctæcrucis*. Birds in the Crocker collection from Ugi have the reddish color of the under parts Scarlet (Ridgway, I), the scarlet margins are broader than those of the Swallow Group and Rennell Island birds, and the reddish areas are quite as extended as those of *sanfordi*. In coloration, the reddish parts of the Rennell Island and Swallow Group series approach quite closely. The adult bird from Rennell Island is in worn plumage. In consequence, the reddish margins are somewhat narrow and the bird appears rather darker than the actual coloration of the feathers warrants. A specimen of *sanctæcrucis*, in fresh plumage, has broad Scarlet-Red (Ridgway, I) margins to the feathers, the basal black not being evident in the under parts. A female *sanfordi* has some of the interscapulars margined with reddish, and the bases of the feathers of the head slaty, not olive gray.

The measurements of the birds under examination are as follows:

| <i>M. c. pulcherrima</i> (Ugi Island) | | | | | |
|---|---------------|-------------|-------------|---------------|-------------------|
| | <i>Culmen</i> | <i>Wing</i> | <i>Tail</i> | <i>Tarsus</i> | <i>Middle toe</i> |
| Males..... | 18.00-18.25 | 68.0-68.5 | 45.0-46.0 | 17.0-18.5 | 13.0-13.0 |
| <i>M. c. sanfordi</i> (Rennell Island) | | | | | |
| Male, adult..... | 18.25 | 69.0 | 47.5 | 19.00 | 13.5 |
| Male, immature..... | 18.00 | 61.5 | 42.5 | 19.00 | 12.5 |
| Female, adult..... | 18.00 | 64.0 | 43.0 | 19.25 | 12.5 |
| <i>M. c. sanctæcrucis</i> (Mohawk Bay, Lomlom, Swallow Group) | | | | | |
| Males..... | 20.0-20.5 | 74.0-77.5 | 50.0-54.0 | 20.0-20.0 | 13.25-14.00 |
| <i>M. c. sanctæcrucis</i> (Nupani Island, Swallow Group) | | | | | |
| Male..... | 20.5 | 75.25 | 53.5 | 20.75 | 13.0 |
| <i>M. c. sanctæcrucis</i> (Matema Island, Swallow Group) | | | | | |
| Male..... | 19.0 | 71.0 | 50.0 | 20.0 | 13.5 |

Myzomela nigrita tristrami Ramsay

No. 38429: male, July 3; Santa Ana Island, Solomon Islands.

From this specimen were obtained measurements, as follows: Culmen, 20.0 mm.; wing, 68.0; tail, 48.5; tarsus, 18.25; middle toe, 12.0.

⁶ Am. Mus. Novit. No. 486, 1931, p. 27; No. 516, 1932, pp. 22-24.

Woodfordia superciliosa North

Nos. 38430-33: male and female, June 6; Kungava Bay, Rennell Island, Solomon Islands. Male and female, June 6; Rennell Island, Solomon Islands.

| | <i>Culmen</i> | <i>Wing</i> | <i>Tail</i> | <i>Tarsus</i> | <i>Middle toe</i> |
|-----------------------|---------------|-------------|-------------|---------------|-------------------|
| Males | 21.0-21.0 | 75.50-76.25 | 50.00-50.25 | 21.25-22.00 | 13.5-14.0 |
| Female, adult | 20.5 | 77.25 | 48.75 | 23.0 | 15.0 |
| Female, immature.. | 21.0 | 73.0 | 47.75 | 23.5 | 14.0 |

The immature female is just commencing to moult, but replacement in the adult is practically complete.

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No. 17

THE HEPATICAE (CHIEFLY RICCIA AND ANTHOCERO-
TACEAE) OF THE GALAPAGOS ISLANDS AND THE
COAST AND ISLANDS OF CENTRAL AMERICA
AND MEXICO

BY
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In a list of eighteen Hepaticae from the Galapagos Islands (including two referred to genus only), determined by Professor A. W. Evans and published in Dr. B. L. Robinson's "Flora of the Galapagos Islands"¹, one was a *Riccia*, "sterile and indeterminable" from Iguana Cove, Albemarle Island, and another from Tagus Cove, Albemarle Island, was referred to the North American *Notothylas orbicularis* (Schwein.) Sulliv. Of the 36 numbers of supposed *Ricciae* (including 3 collected on Guadalupe Island by Mr. John Thomas Howell in November, 1931) and Anthocerotaceae sent to the present writer for determination, one turned out to contain a sterile *Plagiochasma*. Following is the list of species collected:

RICCIACEAE

Riccia sorocarpa Bisch.

North end of Guadalupe Island, *Howell No. 160; No. 145* (sterile), from slopes above N. E. Anchorage, Guadalupe Island, may be a very reduced condition of this species.

¹ Proc. Am. Acad. Arts and Sci. 38: 100, 101. Oct. 1902.

Riccia nigrella DC.

Guadalupe Island, *Howell Nos. 142, 146, 164, and 168*; Ensenada, Lower California, *Howell No. 181*.

Riccia trichocarpa M. A. Howe

Slopes above N. E. Anchorage, Guadalupe Island, *Howell No. 138*; Ensenada, Lower California, *Howell No. 183*.

Riccia Elliottii Steph.

Puerto Vallarta, State of Jalisco, Mexico, *Howell No. 236*. On moist shaded soil, Braxilito Bay, Costa Rica, *Howell No. 238*; same locality, *Howell No. 239*; on soil among rocks on steep bank, on largest island in Murcielago Bay, Costa Rica, *Howell No. 240*.

Riccia sp.

Three collections (*Howell Nos. 174, 175, and 177*) were made on Socorro Island, March 26, 1932, two of them in stream-bed above Braithwaite Bay. No spores have been found. The occasional or rather numerous purple papillae or short cilia on the thallus margins suggest affinity with a species of the Galapagos Islands and Mexico described below as new under the name *Riccia iodocheila*, but the thalli are usually broader, both actually and in relation to height, and the superficial cells are larger.

Riccia sp.

Howell No. 259, Camp 1, Indefatigable Island, Galapagos Islands, alt. 1700 ft., growing on decaying fragments of wood, presumably moist. The plants belong in the *Ricciella* section of the genus and bear some resemblance to the terrestrial condition of *Riccia fluitans* L., but are probably not referable to that species. They are apparently sterile and for that reason are not accurately determinable.

Riccia iodocheila M. A. Howe, sp. nov.

Thallis parvis, 3-6 mm. longis, plerumque 1-3-plo dichotomis, irregulariter gregariis aut radiantibus, viridibus, firmis, levibus, nigro-violaceis in marginibus et plus minusve infra; segmentis primariis oblongis aut oblongo-ellipticis, 0.4-1.2 mm. (saepius 0.6-0.8 mm.) latis; segmentis apicalibus similibus aut obovatis, obtusis; marginibus acutis aut subobtusis, erectis vel paullum inflexis, papillas paucas violaceo-purpureas aut hyalinas vel ciliis breves obtusas 25-60 μ longas

ferentibus; papillis apicali-dorsalibus raris; sulco in apice manifesto; squamis parvis, violaceis, cellulis paucis formatis; sectionibus transversalibus semiorbicularibus, plano-convexis, aut concavo-convexis, tam altis quam latis ad bis latioribus, in partibus mediis 18-25 cellulis crassis; epidermide dorsali e cellularum seriebus duobus contexta, cellulis primariis mammiformi-hemisphericis, cito collapsis, nullis eminentiis conspicuis relictis, cellulis subjacentibus 15-25 μ in diam. max.; monoica; ostiolis antheridiorum laeviter aut haud elevatis; sporis nigro-brunneis, cito opacis, 70-105 μ in diam. max., rotundati-subangulatis vel interdum plane angulatis, non-alatis, facie exteriori lineis permultis irregularibus anastomosantibus notata, eis aliquando areolas parvas irregulares 3-5 μ latas formantibus, faciebus interioribus similibus aut paulum minus fortiter notatis, marginibus laevibus aut subtiliter submammillatis.

In solo argillaceo, in loco "Wreck Bay, Chatham Island" dicto, Insularum Galapagensium, Oceani Pacifici, specimen typicum (n. 201) John Thomas Howell, Apr. 18, 1932, legit. Species *Ricciae violaceae* M. A. Howe affinis est, sed in sporarum sculptura, probabiliter in characteri monoico, thalli ciliis marginalibus paucioribus, etc., differt.

Typus: Herb. Calif. Acad. Sci. No. 215005.

Thallus small, 3-6 mm. long, mostly 1-3 times dichotomous, irregularly gregarious or forming rosettes, green above, compact, firm, smooth, deep violet on margins and the higher ventral parts; main segments oblong or oblong-elliptic, 0.4-1.2 mm. (mostly 0.6-0.8 mm.) wide; terminal segments similar or obovate, obtuse; margins acute or subobtuse, erect or slightly inflexed, bearing occasional violet-purple or hyaline papillae or short obtuse cilia 25-60 μ long, rarely with papillae on dorsal surface in younger parts; median sulcus obscure except near apex; scales small, violet, few-celled; transverse sections as high as broad to one half as high, semi-orbicular, plano-convex, or concavo-convex, 18-25 cells thick in median parts; dorsal epidermis 2-stratose, the cells of the primary stratum mammiform-hemispheric, soon collabent, leaving no conspicuous cusps, the cells of the succeeding stratum 15-25 μ in maximum diameter, rather obscurely defined when seen from above; monoicous; antheridial ostioles slightly or not at all elevated; spores dark brown, soon opaque, obscurely or sometimes distinctly angled, destitute of margins, 70-105 μ in maximum diameter, the outer face marked with very numerous low irregularly anastomosing ridges, these sometimes forming small irregular areolae 3-5 μ wide, the inner faces similarly but a little less strongly marked, the spores appearing smooth or very minutely mammillate in profile.

On moist clay flat, Wreck Bay, Chatham Island, Galapagos Islands, *Howell No. 201* (holotype), April 18, 1932.

Riccia iodocheila is evidently allied to *Riccia violacea* M. A. Howe, of the West Indies, type from Mona Island, off Porto Rico, but it differs in being apparently monoicous rather than dioicous, in having fewer and smaller marginal papillae or cilia, and in the smoother more angular spores, which have smaller and much less perfect areolae. The areolae of the spores of *R. violacea*, as stated by the present writer in *The Bryologist* (20: 36. 1917) are 7-11 μ wide, while those of *R. iodocheila*, when formed, are 3-5 μ wide. In the writer's treatment of *R. violacea* in *North American Flora* (14: 20, 21. 1923), the measurements were reduced to include two Mexican collections (Lerdo, *Jared G. Smith*, Jan. 2, 1892, and Magdalena, Sonora, *David Griffiths*, Aug. 18, 1904). These two Mexican collections are now identified with *Riccia iodocheila*, described above, with type from the Galapagos Islands.

Riccia Howellii M. A. Howe, sp. nov.

Thallis parvis vel mediocribus, 3-10 mm. longis, plerumque 2-4-plo dichotomis, irregulariter gregariis aut aliquando radiantibus, pallidi-viridibus, glaucescentibus, vel albescentibus, supra minute reticulatis, in siccitate saepe aliquanto papyraceis aut rugulosis, infra pallidi-viridibus, saepius (marginibus quoque) violacei-brunneis; segmentis primariis oblongis aut obovatis, 0.75-3 mm. (saepius 1-2 mm.) latis; segmentis primariis oblongis aut obovatis, 0.75-3 mm. (saepius 1-2 mm.) latis; segmentis apicalibus similibus, 0.6-1.5 mm. latis, obtusis aut subacutis; marginibus tenuibus et acutis aut latis membranaceis vel subpapyraceis, saepe albescentibus, ascendentibus aut aliquando deflexis, integris aut cellulis marginalibus saepe papilliformibus; sulco in partibus junioribus profundo et acuto; squamis parvis, hyalinis aut brunnei-violaceis marginem attingentibus; sectionibus transversalibus semiorbicularibus, planoconvexis, aut arcuati-subfusiformibus, aliquando tam altis quam latis, saepius duplo-triplo (-sextuplo) latioribus quam altis, in partibus mediis 12-20 cellulas crassis; epidermide dorsali e cellularum seriebus duobus contexta, cellulis primariis plerumque mammiformi-hemisphericis, cito collapsis, parietibus plerumque persistentibus et parietes exteriores cellularum subjacentium fortiores facientibus, rarius fugacibus et calyces humiles reliquentibus, cellulis subjacentibus 25-30 μ (-50 μ) in diam. max., a superficie visis; monoica; ostiolis antheridiorum 40-70 μ altis aut aliquando aegre elevatis; capsulis plerumque multis; sporis brunneis, interdum violaceis tinctis, deinde saepe fuscis et opacis, 75-130 μ (plerumque 95-120 μ) in diam. max., rotundati-subangulatis, ubique paene uniformiter foveolati-areolatis, faciei exterioris areolis plerumque 10-15 μ latis, saepe papillas obtusas humiles vel trabeculas truncatas 3-5 μ altas ostendentibus.

In loco "Iguana Cove, Albemarle Island" dicto, Insularum Galapagensium, Oceani Pacifici, specimen typicum (n. 209) John Thomas Howell, Jun. 4, 1932, legit. Quoque in insulis alteris Archipelagi Galapagensis Howell legit. Species *Ricciae Elliottii* Steph. affinis est, sed in characteribus epidermalibus, etc. differt.

Typus: Herb. Calif. Acad. Sci. No. 215008.

Thalli small to medium-sized, 3-10 mm. long, mostly 2-4 times dichotomous, irregularly gregarious or sometimes forming imperfect rosettes, light green, glaucescent, or albescent, minutely reticulate above, often somewhat wrinkled or papyraceous when dried, concolorous or more often violet-brown below and on margins; main segments oblong or obovate, 0.75-3 mm. (mostly 1-2 mm.) wide; terminal segments similar, 0.6-1.5 mm. wide, rounded-obtuse or subacute; margins thin and acute or rather broadly membranous, subpapyraceous, or scarious-albescent, ascending or the edge sometimes deflexed, entire or marginal cells often papilliform; median sulcus deep and acute in younger parts; scales small, obscure, hyaline or brownish violet, reaching the margin; transverse sections semi-orbicular, planoconvex, to arcuate-subfusiform, sometimes as high as broad, more often 2-3 (-6) times as broad as high, 12-20 cells thick in median parts; dorsal epidermis 2-stratose, the cells of the primary stratum mammiform-hemispheric to cylindric-domeshaped, soon collabent, their walls usually persistent and reinforcing the outer walls of the subjacent layer (secondary epidermis), rarely fugacious and leaving obscure cups, the cells of succeeding stratum 25-35 μ (-50 μ) in maximum diameter in surface view; monoicous; antheridial ostioles 40-70 μ high or sometimes scarcely elevated; capsules moderately abundant; spores brown, sometimes tinged with violet, often becoming opaque, 75-130 μ (mostly 95-120 μ) in maximum diameter, obscurely angled, margins commonly wanting, outer and inner faces almost equally foveolate-areolate, the areolae mostly 10-15 μ wide, commonly showing in profile obtuse or truncate processes or lamellae 3-5 μ high.

GALAPAGOS ISLANDS: Iguana Cove, Albemarle Island, *Howell Nos. 199* and *209* (holotype); shaded by rocks, west base of Tagus Cove Mountain, Albemarle Island, *Howell Nos. 219* and *220*; James

Bay, *Howell No. 187* (p. p. max.), June 4, 1932; on moist earth, James Bay, *Howell No. 188*; on moist surfaces of shaded rocks, Hood Island, *Howell No. 184*; Wreck Bay, Chatham Island, *Howell Nos. 203, 204* and *205*; on clay-gravel soil, about 500 ft. elevation, along trail, Charles Island, *Howell No. 247*. Type and cotypes divided between the California Academy of Sciences and The New York Botanical Garden.

Riccia Howellii is closely allied to the West Indian, Mexican, and Central American *R. Elliottii* Stephani² but seems distinguishable by the closely reticulate rather than coarsely alveolate character of the dorsal epidermis, which shows itself in a cross section of the thallus by the essential absence of thickened cusps representing the walls of the collapsed cells of the primary epidermal layer. The cells of the final (secondary) epidermis average considerably smaller than those of *Riccia Elliottii*; and the plants themselves average smaller. The Galapagos Islands plants cited above vary in vegetative characters, but are remarkably uniform in size, form, color, and markings of their spores and it is believed that they represent only one species. A peculiar feature of some of the specimens with conspicuous albescent margins is that these margins become fuscous after being soaked out with New York tap-water.

MARCHANTIACEAE

Plagiochasma sp.

Socorro Island, *Howell No. 176*—apparently sterile and undeterminable.

ANTHOCEROTACEAE

Notothylas galapagensis M. A. Howe, sp. nov.

Planta olivacea, parva, radianti, 5-10 mm. in diam., aliquanto tenui et levi, lobis paucis rotundatis aut truncatis instructa; cellulis paginae dorsalis irregulariter 5- vel 6-gonis, oblongis, aut quadrati-suborbicularibus, 25-65 μ in diam. max.; involucris 0.8-1.5 mm. altis, in longitudinem plicatis vel alatis, alis plus minusve cristatis aut ciliati-denticulatis, ore lacinulati-fimbriatulo vel irregulariter ciliato; capsulis brevi-cylindricis, 1.5-2 mm. longis, parietibus cellularum exteriorum maxime incrassatis; sporis pallidi-flavis, deinde paulum fuscis, levibus, 40-50 μ diam. max.; elateribus ca. 40-50 μ diam., aliquando obscure spira notatis; columella bene evoluta et persistenti.

Cum *Riccia Howellii* in loco "James Bay" dicto, Insularum Galapagensium, Oceani Pacifici, John Thomas Howell (n. 187, p. p. min.) Jun. 4, 1932, legit. Species fortasse *N. dissectae* Steph. affinis, sed in sporis majoribus, elateribus paene sine spiris, etc., differt.

Typus: Herb. Calif. Acad. Sci. No. 215004.

² Type from Dominica, B. W. I. *Riccia Elliottii* appears to be the legal name for a group of somewhat variable plants, including *R. Breutelii* Hampe, type from St. Jan, *R. Brittonii* M. A. Howe, type from Mona Island, and *R. Gaumeri* Underwood Ms., type from Yucatan.

Thalli small, olivaceous, forming rosettes 5-10 mm. in diameter, rather thin and smooth, with a few truncate or rounded-obtuse marginal lobes; cells of dorsal surface irregularly 5- or 6-sided, oblong, or quadrate-suborbicular, 25-65 μ in maximum diameter; involucre 0.8-1.5 mm. high, longitudinally plicate or alate, the wings more or less cristate or ciliate-denticulate, the mouth lacinulate-fimbriate or irregularly ciliate; capsule short-cylindric, 1.5-2 mm. long, abruptly constricted below to a pedicel 75-150 μ long, bivalved, the exterior cells very thick-walled, their walls (at least of the more elongated cells) mostly 10-16 μ thick (i. e., the two collateral walls) commonly wider than the lumen of the cell, the valve-margins reddish brown; spores pale yellow, becoming more or less fuscous, 40-50 μ in maximum diameter, with cell wall finally 2-3 μ thick, smooth or very nearly so; elaters of about the same size, with traces of very irregular spiral thickening; columella well developed and persistent.

Growing with *Riccia Howellii* at James Bay, *Howell No. 187* (p. p. min.), type, June 4, 1932. Also, James Bay, *Howell Nos. 193* and *195*, and Charles Island, *Howell No. 197*.

Notothylas galapagensis is closely allied to *N. dissecta* Steph., from Guatemala, in the thick-walled cells of its capsule and its essentially smooth spores, but its spores are larger (40-50 μ vs. "27 μ "), its elaters are nearly devoid of any spiral thickening instead of being trispiral, and its smaller thallus is sparingly round-lobed instead of being profoundly dissected.

From the North American *Notothylas orbicularis*, it differs chiefly in the much thickened walls of the exterior cells of the capsule. There is considerable range in the thickness of the cell-walls in *N. orbicularis*, but no such thickness as is shown in our photograph of the valve surface of *Notothylas galapagensis* has ever been observed in the North American species. The specimen collected by the Hopkins-Stanford Expedition, at Tagus Cove, Albemarle Island, and referred by Evans to *N. orbicularis*, the writer has not been able to examine, but it is assumed that it would now be identified in *N. galapagensis*.

***Anthoceros simulans* M. A. Howe, sp. nov.**

Thallis parvis, caespitosis, cavernosis, profunde laciniati-lobulatis, crispatis, superficie lamellati-cristata vel irregulariter proliferante, cellulis superficialibus plerumque 35-85 μ in diam. max., marginalibus saepe mammiformi-hemisphericis; monoica (?); involucris cylindricis truncatis, 1-1.5 mm. altis, 0.3-0.45 mm. latis, levibus, aut sublevibus; capsulis numerosis, 1-3 cm. altis, fusco-nigris, valvis siccitate laeviter tortis aut rectis, stomatiferis; sporis fuscis, demum opacis, 44-51 μ in diam. max., facie exteriori dense muricati-papillata, papillis conico-acutis aut subtruncatis, 1.5-3 μ longis, faciebus interioribus sublaevibus aut papillis valde humilioribus praeditis; pseudo-elateribus fuscis, 40-150 μ longis, 5-16 μ latis, plerumque 1-3 cellulis constitutis, raro furcatis; columella levi.

Terricola in loco umbroso humido, alt. 1,000 m., in monte "Tagus Cove" dicto insulae "Albemarle" Insularum Galapagensium, Oceani Pacifici, specimen typicum (n. 213) John Thomas Howell Maio 26, 1932, legit.

A. fusiformis Aust. involucris brevibus cylindricis (1-1.5 mm. longis et 0.3-0.45 mm. latis vs. 2-9 mm. longis et 0.35-1.2 mm. latis), capsulis brevioribus tenuioribus (1-3 cm. longis et 0.12-0.175 mm. latis vs. 2-9 cm. longis et 0.25-0.5 mm. latis),

et papillis sporarum plus opacarum longioribus crassioribus minus acicularibus differt.

A. A. punctato L. et *A. crispulo* (Mont.) Douin, *A. simulans* capsulis tenuioribus et papillis sporarum plus opacarum valde congestis, minus acutis, plerumque brevioribus differt.

Typus: Herb. Calif. Acad. Sci. No. 215006.

Thalli small, cespitose, terricolous, cavernous, deeply laciniate-lobulate, crispate, the surface lamellate-cristate or very irregularly proliferate, the surface cells mostly 35-80 μ in maximum diameter, the marginal often dome-shaped or hemispheric-protuberant; monoicous³; involucre cylindric, truncate, 1-1.5 mm. high, 0.3-0.45 mm. broad, smooth or nearly so, truncate; capsules numerous, 1-3 cm. long, 0.12-0.175 mm. broad, dark brown or black, the valves very slightly, if at all, twisted on drying, freely provided with stomata; spores fuscous, becoming opaque, 44-51 μ in maximum diameter, outer face densely muricate-papillate, the papillae conic-acute or subtruncate, 1.5-3 μ long, the inner faces with much lower irregular papillae; pseudo-elaters fuscous, 40-150 μ long, 5-15 μ wide, mostly of 1-3 cells, rarely branched; columella smooth.

On ground in a moist shady spot, Tagus Cove Mountain, at elevation of 3,300 feet, Albemarle Island, Galapagos Islands, *Howell No. 213* (holotype), May 26, 1932.

Anthoceros simulans is perhaps most nearly allied to *A. fusiformis* Aust., of the Pacific Coast of North America, from which it differs in its short-cylindric involucre (1-1.5 mm. long and 0.3-0.45 mm. wide vs. 2-9 mm. long and 0.35-1.2 mm. wide), in the shorter and slenderer capsules (1-3 cm. long and 0.12-0.175 mm. wide vs. 2-9 cm. long and 0.25-0.5 mm. wide), and in the longer stouter less acicular papillae of the more opaque spores.

From *Anthoceros punctatus* L. and *A. crispulus* (Mont.) Douin, *A. simulans* differs in the more slender capsules and especially in the much more crowded, less acute, and usually shorter papillae of the more opaque spores.

Of the numerous species from tropical America described by F. Stephani, *Anthoceros turbinatus* of Mexico, if we may judge by description alone, may appear to be the most closely allied to the Galapagos plant, but there is nothing turbinate or carnosose about the thallus of *A. simulans*.

Anthoceros vegetans M. A. Howe, sp. nov.

Thallo mediocri, olivaceo, cavernoso, terricola, aliquanto carnososo, dissecto vel laciniati-lobulato, lobis plerumque flabelliformibus aut sublinearibus, saepe lobulis pyriformibus vel subglobosis marginalibus, deinde ut propagulis disjunctis, praeditis; superficie vulgo rugosa vel canaliculata, cellulis paginae dorsalis plerumque 30-50 μ in diam. max.; monoica; androeciis saepe involucris approximatis; involucris brevi-cylindricis, interdum geminatis, carnosis, 1.4-2.1 mm. altis, 0.75-1.1 mm. latis, rotundati-truncatis, ore subintegro vel subcrenato, superficie fere cristas vel lamellas humiles ferente; capsulis paucis, 5.5-8 mm. longis, 0.2-0.35 mm. latis,

³ Antheridia have not been identified with certainty, but cavities, looking as if they had been occupied by antheridia occur on the same plant as the capsules.

olivaceis, deinde brunneis, stomatibus passim paucis, oblongo-ellipticis; plerumque 52-65 μ longis, 31-47 μ latis; sporis pallidi-flavis, translucetibus, 26-40 μ in diam. max., facie exteriori dense et minute papillati-muriculata, papillis interdum lineas irregulares aut areolas imperfectas formantibus, faciebus interioribus similiter sed minus fortiter notatis aut paene levibus; pseudo-elateribus paucis et inconspicuis, plerumque cellula una constitutis; columella conspicue filis pluri-cellularibus ramentaceis fibrillata, eis fortasse officii pseudo-elaterum fungentibus.

In ripis humidis in loco "Wafer Bay, Cocos Island" dicto specimen unicum (n. 234) John Thomas Howell, Jun. 28, 1932, legit.

Anthoceros vegetans *A. laevi* affinis est, sed habitu propagulifero, capsulis brevibus (5.5-8 mm. vs. 10-35 mm.), columella fibrillata, sculptura sporarum, defectu pseudo-elaterum veri simili, etc., facile distinguitur.

Species fortasse *A. propagulifero* Steph. chilensi sterili affinis est, sed thallo non lamellifero. A *Anthoceroi bulbifero* Steph. peruviano in sculptura sporarum *A. vegetans* longe distat.

Typus: Herb. Calif. Acad. Sci. No. 215007.

Thallus medium-sized, olivaceous, cavernous, terricolous, rather carnosae, dissected or lacinate-lobulate, the lobes commonly flabelliform or sublinear, often with pyriform or subglobose marginal lobules detachable as propagula; surface commonly rugose or canaliculate, the surface cells mostly 30-50 μ in maximum diameter; monoicous; androecia often at base of involucre; involucre short-cylindric, sometimes geminate, carnosae, 1.4-2.1 mm. high, 0.75-1.1 mm. broad, rounded-truncate, the mouth subentire or somewhat crenate, the surface commonly bearing low crests or lamellae; capsules few, 5.5-8 mm. long, 0.2-0.35 mm. broad, olivaceous, becoming brown, rather few, oblong-elliptic, mostly 52-65 μ long, 31-47 μ wide; spores pale yellow, translucent, 26-40 μ in max. diam., the outer face densely and minutely papillate-muriculate, the papillae sometimes forming irregular ridges or imperfect areolae, the inner faces similarly and less strongly marked or nearly smooth; pseudo-elaters few and inconspicuous, mostly 1-celled; columella conspicuously fringed with pluricellular branching filaments, these perhaps taking the place of pseudo-elaters.

On moist steep banks of a stream, Wafer Bay, Cocos Island, Howell No. 234 (holotype), June 28, 1932.

Anthoceros vegetans belongs to the *A. laevis* group, but is easily distinguished from those species by its propaguliferous habit, its short capsules (5.5-8 mm. vs. 10-35 mm.), its fibrillate columella, its apparently almost deficient pseudo-elaters, and by the spore-markings, the papillae often showing a pronounced tendency to be confluent into ridges and imperfect areolae. The capsules as found are not dehiscing and it is probable that they are not fully mature.

Of the numerous American species of this group proposed by Stephani, *Anthoceros vegetans* is possibly allied to the sterile *A. propaguliferus* from Chile but the thallus in that species is said to be "antice lamellifera, lamellis confertis", while in the Cocos Island plant, lamellae are very weakly developed or wanting. *Anthoceros bulbiferus* Steph., from Peru, has spores that are "grosse remoteque spinosae", words that could never be applied to the spores of *A. vegetans*.

Dendroceros crispus (Sw.) Nees

On decaying wood, with foliose Hepaticae, lichens, etc., Indefatigable Island, *Howell No. 255*.

The specimens have not the long smooth involucre attributed to this species by Stephani (Sp. Hep. 5: 1015), but in this respect they are very similar to West Indian specimens referred to *D. crispus* (type from Jamaica) by Evans and others. The involucre are 4-4.5 mm. long and bear a moderate number of small irregular appendages. In West Indian specimens seen, the involucre are 3-5 mm. long, although Stephani describes them as 8 mm. long. The capsules of the Indefatigable Island plant are about 1 cm. long, the spores are 40-50 μ in maximum diameter and minutely granulate, and the elaters are about 300 μ long. Possibly the capsules average shorter than in typical *D. crispus*, but the writer does not find any reliable characters for specific distinction. Many species have been described in this genus without satisfactory diagnostic characters.

In the Mitten Herbarium, now in the possession of The New York Botanical Garden, is a fragment of the type of *Monoclea crispata* Hook. [*Dendroceros crispatus* (Hook.) Nees], from the island of St. Vincent, and also what is apparently a part of the original of *Anthoceros brasiliensis* Raddi [*Dendroceros brasiliensis* (Raddi) Nees]. The Raddi plant has immature capsules included in the involucre (which are about 6 mm. long), though Raddi's figures show mature dehiscent capsules. Stephani makes *Dendroceros crispatus* a synonym of *D. brasiliensis* and describes the involucre of the composite as 10 mm. long, the spores 72 μ , and the elaters 360 μ long. In the authentic specimen of *Monoclea crispata* Hook., the involucre are 4-5 mm. long ("vix duas lineas longus", according to Hooker), the spores are 45-65 μ in maximum diameter and minutely muriculate, and the elaters are 160-300 μ long. The species of *Dendroceros* are in need of critical revision, with a reexamination of the type specimens, beginning with *Anthoceros crispus* Swartz.

PLATE 7

FIGURES 1-4, *Riccia Howellii* M. A. Howe, sp. nov.

1. Plants (James Bay, no. 187, p. p.), natural size.
2. Cross section of holotype (Albemarle Island, no. 209), showing spores, etc., $\times 38$.
3. Cross section of holotype (Albemarle Island, no. 209), showing epidermis, etc., $\times 70$.
4. Outer face of spore of holotype (Albemarle Island, no. 209), $\times 246$.

FIGURE 5, *Riccia iodocheila* M. A. Howe, sp. nov.

5. Outer face of spore of holotype (Wreck Bay, Chatham Island, no. 201), $\times 246$.

FIGURES 6 and 7, *Anthoceros vegetans* M. A. Howe, sp. nov.

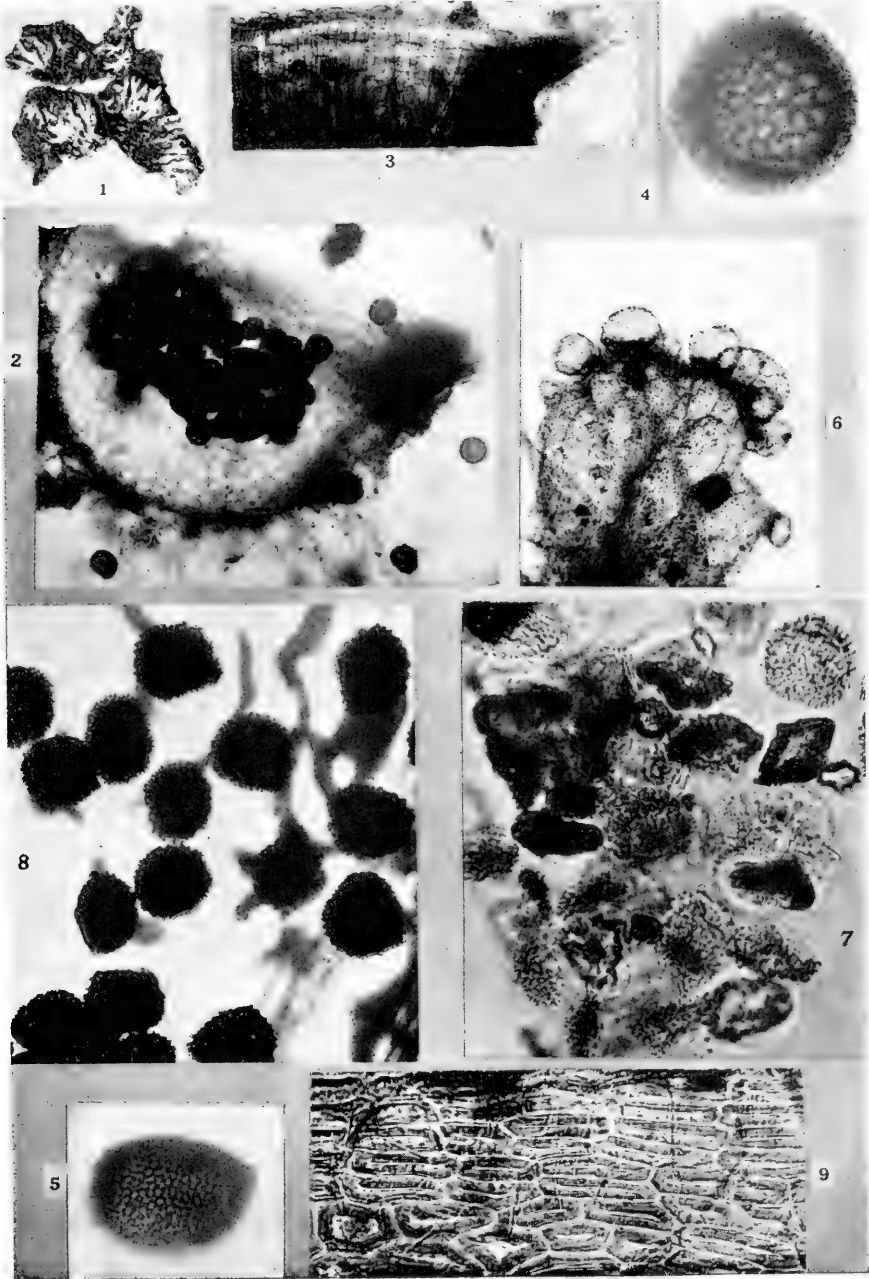
6. A lobe of the thallus of holotype (Cocos Island, no. 234), somewhat more bulbiferous than is normal, $\times 25$.
7. Spores of holotype, $\times 319$. Pseudo-elaters are scarcely recognizable.

FIGURE 8, *Anthoceros simulans* M. A. Howe, sp. nov.

8. Spores and pseudo-elaters of holotype (Albemarle Island, no. 213), $\times 246$.

FIGURE 9, *Notothylas galapagensis* M. A. Howe, sp. nov.

9. A part of the capsule wall of holotype (James Bay, no. 187, p. p.), showing thickenings, $\times 246$.





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THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932

No. 18

LICHENS¹

BY
DAVID H. LINDER
Curator, Farlow Herbarium

During the course of an expedition to the Galapagos Islands in 1932 and to Guadalupe Island in 1931, Mr. John Thomas Howell, botanist of the expeditions, made incidental collections of lichens to the extent of a little over fifty numbers, for the most part from the Guadalupe Island off the coast of Lower California and from the islands of the Revillagigedo group.

Among the families represented, excluding the *Rocellaceae* which are being studied by Professor O. V. Darbishire, members of the *Usneaceae* appear to be dominant. The family is represented by sixteen numbers which include eleven different species and among them are one species of *Alectoria*, seven species, one variety and one form of *Ramalina*, and two species of *Usnea*. The next largest family, so far as the number of species is concerned, is the *Physiaceae* which includes one new species of *Anaptychia* and six species of *Physcia*, in which genus one species is described as new. The third largest family is the *Parmeliaceae*, represented by eight numbers but with only one species of *Cetraria* and four species of *Parmelia*.

The remainder of the families are represented by from one to three species. Among these is the interesting species *Pertusaria bispora* (Farlow) Linder which, originally named *Pertusaria leioplara* f.

¹ Contribution from the Laboratories of Cryptogamic Botany of Harvard University, No. 130.

bispora by Farlow² but without a description, was listed from Tower Island of the Galapagos group. This second collection was made on Socorro Island, off the west coast of Mexico, nearly twenty degrees north of the type locality.

The systematic portion of this paper, which follows immediately, is arranged according to the system of Zalbruckner in the "Natürlichen Pflanzenfamilien."³

SPHAEROPHORACEAE

Sphaerophorus coralloides Pers.

Pine forest, Guadalupe Island, Lower California, November 15, 1931, *J. T. Howell* (34)⁴. Determined by Dr. D. N. Voigtlaender-Tetzner.

PYRENOPSISIDACEAE

Psorotichia squamulosa Zalbr.

Summit of Clarion Island, June 28, 1932, *J. T. Howell* (20).

COLLEMACEAE

Leptogium mollucanum (Pers.) Wainio

Wafer Bay, Cocos Island, June 28, 1932, *J. T. Howell* (7). Determined by Dr. J. Lowe.

Leptogium sp.

Lower limits of forest above Braithwaite Bay, Socorro Island, March 27, 1932, *J. T. Howell* (8).

This specimen is sterile. The thallus, however, would seem to place the species near *L. mollucanum*.

LECIDEACEAE

Lecidea (Psora) **crenata** (Taylor) Nyl.

On cypress, Guadalupe Island, Lower California, March 17, 1932, *J. T. Howell* (5).

Although it is stated on the label that this specimen was growing "on cypress," the substratum is, in fact, reddish volcanic earth. There is apparently some doubt about the differences between this species and *L. decipiens*; for there is a fairly large series of both species which intergrade to such an extent as to cause Dr. Farlow to make a notation questioning the status of the species.

² Farlow, W. G. in A. Stewart, Notes on the lichens of the Galapagos Islands. Proc. Calif. Acad. Sci. Ser. IV. 1:431-446. 1912.

³ Zalbruckner, A. Lichens (Ascolichens, Hymenolichens), in Engler & Prantl, Die Natürlichen Pflanzenfamilien, 2nd ed. 8:61-263. fgs. 32-127. 1926.

⁴ The numbers cited in parentheses are those assigned by the writer.

Lecidea (Psora) globifera Ach.

Socorro Island, Revillagigedo Islands, March 26, 1932, *J. T. Howell* (6, 45). Although the collection is sterile, number 45 is tentatively assigned to this species.

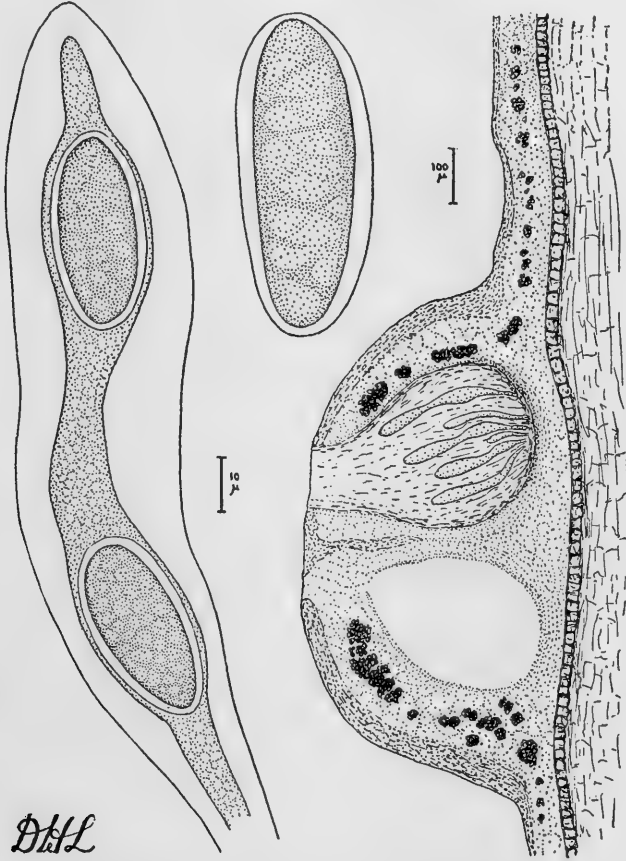


Fig. 1. *Pertusaria bispora* (Farlow) Linder. On the left an ascus with two immature ascospores. Note the extreme thickening of the ascus wall. Upper middle: a mature ascospore with definitely thickened lateral walls. On the right a section through a verruca showing two locules, the distribution of the algal symbionts, and the thin cortex which becomes thicker above the verruca.

PERTUSARIACEAE

***Pertusaria bispora* (Farlow) Linder, comb. nov.**

Fig. 1; Plate 8, figs. 1 and 2.

Pertusaria leioplaca f. *bispora* Farlow (l. c.)

Thallus "Sea foam green" (Ridgway), laevis, demum parce fissuratus, KOH± laeviter lutescens; cortice supero exili; apotheciis 1-5 in verrucis irregulariter hemisphaericis, disculis parvis, punctiformibus, indistinctis; paraphysibus tenuissimis,

ramosis; ascis $150 \mu \pm$ longis, $30-38 \mu$ latis; hyalinis, parietibus crassis, bisporis vel interdum unisporis; sporis $47-65 \mu$ longis, $18.5-25.5 \mu$ latis, ellipsoidalibus, laevibus hyalinisque.

Thallus "Sea foam green" (Ridgway), smooth, becoming sparsely fissured, KOH \pm faintly yellowish, only the upper surface corticate and the cortex poorly developed; apothecia 1-5 in irregularly hemispherical elevated verrucae, the disc small, punctiform, indistinct; paraphyses slender (less than 1μ), branching; ascis thick-walled, hyaline, about 150μ long, $30-38 \mu$ wide, 2-spored, occasionally 1-spored; spores $47-65 \mu$ long, $18.5-25.5 \mu$ wide, hyaline, smooth, ellipsoidal.

Galapagos Islands: Tower Island, on trunks and branches of *Bursera graveolens*, *Alban Stewart*, 153, type, in the Farlow Herbarium, and cotype in the Herbarium of the California Academy of Sciences, No. 119734. Revillagigedo Islands: Socorro Island, March 27, 1932, *J. T. Howell* (17).

In contrast with *P. leioplaca* which produces from four to eight spores in an ascus, and of which the thallus, according to Hasse⁵, reacts positively to KOH, changing to yellow and then to pale violet, this species produces two spores, or occasionally one, in an ascus and gives but a faint yellowish reaction with KOH. The extended range of the plant would also indicate that this lichen is more than a local variant of *P. leioplaca*.

LECANORACEAE

Lecanora Hageni Ach.

On rocks, summit of Clarion Island, Revillagigedo Islands, March 23, 1932, *J. T. Howell* (38).

The apothecia of this specimen are larger than are those of the majority of the specimens in the Farlow Herbarium, especially of those occurring on rock, but it agrees with material occurring on wood. The spore sizes agree with those given for the species. The reaction with KOH is positive, the thallus turning yellow.

PARMELIACEAE

Cetraria scutata Poetsch

Pine forest, Guadalupe Island, Lower California, November 15, 1931, *J. T. Howell* (3).

Parmelia conspersa (Ehrb.) Ach.

South end of Guadalupe Island, Lower California, November 16, 1931, *J. T. Howell* (9).

⁵ Hasse, H. E. The lichen flora of Southern California. Contrib. U. S. Nat. Herb. 17(1):1-132. 1913.

***Parmelia perforata* (Wulf.) Ach.**

Socorro Island, Revillagigedo Islands, March 27, 1932, *J. T. Howell* (10).

***Parmelia perlata* (L.) Ach.**

Socorro Island, Revillagigedo Islands, March 26, 1932, *J. T. Howell* (13).

***Parmelia physodes* (L.) Ach.**

Pine forest, Guadalupe Island, November 15, 1931, *J. T. Howell* (11, 14, 15); on cypress, Guadalupe Island, March 17, 1932, *J. T. Howell* (12); on the ground, Guadalupe Island, March 17, 1932, *J. T. Howell* (16). In specimen number 15, the laciniae are inflated and thus approach those of *P. enteromorpha* Ach.

USNEACEAE

***Alectoria sarmentosa* Ach.**

Near the village, Chatham Island, Galapagos Islands, April 18, 1932, *M. Willows* (1).

***Ramalina calicaris* (L.) Fr.**

Socorro Island, Revillagigedo Islands, March 27, 1932, *J. T. Howell* (21).

***Ramalina calicaris* var. *canaliculata* Fr.**

Socorro Island, Revillagigedo Islands, March 27, 1932, *J. T. Howell* (22).

***Ramalina ceruchis* (Ach.) DeNot.**

Pine forest, Guadalupe Island, Lower California, November 15, 1931, *J. T. Howell* (23, 24). Collection number 24 was mixed with *R. homalea* and was apparently growing with that species.

Ramalina ceruchis forma **cephalota** Tuck.

South end of Guadalupe Island, Lower California, November 16, 1931, *J. T. Howell* (25).

Ramalina combeoides Nyl.

South Bay, Cedros Island, August 17, 1932, *Templeton Crocker*, (26).

This specimen, which is fertile, shows variations in the thallus from smooth to shallowly concave-pitted, and from terete to slightly flattened. According to Howe⁶, the southernmost range of this species is San Diego. This specimen therefore represents a southerly extension of the range.

Ramalina complanata (Sw.) Ach.

Summit of Clarion Island, Revillagigedo Islands, March 23, 1932, *J. T. Howell* (27).

Ramalina farinacea (L.) Ach.

On oak above Northeast Anchorage, Guadalupe Island, Lower California, November 14, 1931, *J. T. Howell*, (32).

So far as the writer has been able to ascertain, this species has not been reported south of Santa Monica, and Santa Cruz Island, California, hence it would appear that this specimen represents another southern extension of species range.

Ramalina homalea Ach.

San Nicolas Island, California, March 13, 1932, *J. T. Howell* (31, 33); pine forest, Guadalupe Island, November 15, 1931, *J. T. Howell*, (28, 29); south end of Guadalupe Island, November 16, 1931, *J. T. Howell*, (24, 30).

According to Howe (*l. c.*), Santa Barbara and San Diego are listed as the southernmost stations for this species.

Ramalina usneoides Fr.

Socorro Island, March 27, 1932, *J. T. Howell* (48).

⁶ Howe, R. H. North American Species of the genus *Ramalina*. *The Bryologist* 16:65-74. 1913.

Usnea duriuscula J. Motyka

Pine forest, Guadalupe Island, Lower California, November 15, 1931, *J. T. Howell* (36).

Although this specimen is sterile, it agrees in thallus characters with material from Mexico which was determined by J. Motyka, and accordingly is so listed.

Usnea florida (L.) Web.

On oak above Northeast Anchorage, Guadalupe Island, Lower California, November 14, 1931, *J. T. Howell* (37).

CALOPLACACEAE

Caloplaca cirrochroa T. Fr.

On rocks, Clarion Island, Revillagigedo Islands, March 22, 1932, *J. T. Howell* (2).

This specimen, growing with *Physcia stellaris* (which see) and the following species, is sterile but its general appearance and the reaction of the thallus to KOH would indicate that it belongs here.

Caloplaca murorum (Hoffm.) T. Fr.

On rocks, Clarion Island, Revillagigedo Islands, March 22, 1932, *J. T. Howell* (2).

THELOSCHISTACEAE

Theloschistes flavicans Norm.

Pine forests, Guadalupe Island, Lower California, November 15, 1931, *J. T. Howell* (35). Determined by Dr. D. N. Voigtlaender-Tetzner.

PHYSICIACEAE

Anaptychia ciliatomarginata Linder, sp. nov.

Plate 8, figs. 3 and 4.

Thallus applanatus apice assurgens, usque 2-3 cm. radio, sursum albidus vel cinereo-albidus, infra albidus, laxe ramosus; laciniis angustis, raro 1.5 mm. latis, KOH + luteis, utrinque corticatis, margine ciliatis, ciliis albis apice nigrescentibus;

apotheciis usque 3 mm. diametro, breve stipitatis, discis planis vel concavis, atris vel pruinosis, excipulis albis integris, externe longe ciliatis, hypotheciis hyalinis; paraphysibus 72-108 μ longis, 3-3.5 μ latis, simplicibus vel interdum apice breve ramosis, sursum fuscis, sensim inflatis et epithecium formantibus; ascis 48.5-75.5 μ longis, 9-14.5 μ latis, clavatis, monostichis vel irregulariter distichis, octosporis; sporis 14.5-16.5 μ longis (vel raro 12-18 μ longis), 7-8 μ latis, fuscis, ellipsoidalibus vel subinaequilateraliter ellipsoidalibus bilocularibus, parietibus crassis.

Thallus up to 2-3 cm. in radius, spreading, the tips ascending, whitish to grayish-white above, whitish below, loosely branching, the laciniae narrow, seldom more than 1.5 mm. broad, KOH+ yellow, corticate on both sides, the medulla KOH-, the margin ciliate with long fibrils which are white but become dark at the ends; apothecia up to 3 mm. in diameter, short-stipitate, the disc flat or concave, black or pruinose, the thalline exciple white and entire, the outer periphery long-ciliate; hypothecium hyaline; paraphyses 72-108 μ long, 3-3.5 μ wide, simple or occasionally short-branched at the apex where they are slightly inflated and fuscous; ascii clavate, 48.5-75.5 μ long, 9-14.5 μ wide, 8-spored, monostichous or irregularly distichous; the spores 14.5-16.5 μ long (or rarely 12-18 μ long), 7-8 μ wide, ellipsoidal or subinequilaterally ellipsoidal, biloculate, thick-walled.

Type: Herb. Calif. Acad. Sci. No. 215010, co-type in Farlow Herb., Harvard University; south end of Guadalupe Island, Lower California, November 16, 1931, *J. T. Howell* (47).

This beautiful species resembles and is closely related to *A. erinacea* in its general lacy appearance, but differs from that species in its consistently lighter thallus, the narrower laciniae, and the long ciliations on the outer edge of the exciple, the last character suggesting the specific name. The spores also are somewhat smaller than those of *A. erinacea* since Herre⁷ states that those of the latter species measure 15-23 μ long and 7.5-11 μ wide, and Hasse (l. c.) that they measure 16-32 μ long and 7.5-15 μ wide. *Anaptychia comosa*, although resembling this species in the ciliate margins of the thallus, lacks the ciliations on the outer periphery of the exciple. It may also be readily separated from this species by its much broader thallus which is conspicuously gray above.

***Physcia adscendens* Fr.**

Physcia hispida var. *adscendens* Fr.

On oak above Northeast Anchorage, Guadalupe Island, Lower California, November 14, 1931, *J. T. Howell*.

***Physcia aegilata* (Ach.) Nyl.**

Summit of Clarion Island, Revillagigedo Islands, March 23, 1932, *J. T. Howell* (18).

⁷ Herre, A. W. C. T. The lichen flora of the Santa Cruz Peninsula, California. Proc. Washington Acad. Sci. 12(2):27-269. 1910.

Physcia aipolia (Ach.) Nyl.

On twigs and bark, Socorro Island, Revillagigedo Islands, March 27, 1932, *J. T. Howell* (44).

This specimen appears to be young and poorly developed. The margins of the few apothecia that are present in the specimen are minutely crenulate, and the thallus is colored below and gives rise to dark rhizoids, hence the specimen would appear to belong in this species.

Physcia (Euphyscia) **Howellii** Linder, sp. nov.

Plate 8, fig. 3.

Thallus parvus, usque 1-2 cm. radio, applanatus, sursum laevis, esorediatus, KOH+ luteus, irregulariter paucè ramosus, extremis rotundatis vel lobatis, infra albidus paucè rhizoidigerus, medulla KOH-; apotheciis usque 2.5 mm. diametro, sessilibus vel subsessilibus, discis planis vel laeviter concavis, atris; excipulis distincte crenatis; hypotheciis hyalinis; paraphysibus 60-70 x 2 μ , apice inflatis, 3.6 μ diam., fuscis et epithecium fuscum formantibus; ascis clavatis, 90 μ vel 99-128 μ longis, 27-35 μ latis, 2-8 sporis, monostichis vel irregulariter distichis; sporis ellipsoidibus vel late rotundato-biconicis, 25 μ vel 28-32.5 μ longis et 12-14.5 μ latis (vel raro 11-16.5 μ latis) in ascis octosporis vel 29-34 μ longis et 18-20 μ latis in ascis bi- vel quadrisporis, uniseptatis raro unicellularibus, fuscis, parietibus crassis.

Thallus small, up to 1-2 cm. in radius, adnate, the upper surface smooth, esorediate, greenish or greenish-gray, KOH+ yellow, irregularly few-branched, the ends rounded or lobate, the under side whitish with few concolorous rhizoids, medulla KOH-; apothecia up to 2.5 mm. in diameter, sessile or subsessile, the disc flat or slightly concave, black, the margin distinctly crenate; hypothecium hyaline; paraphyses 60-70 μ long, 2 μ wide, inflated and 3.6 μ in diameter at the tips where they are colored, forming a dark epithecium; asci clavate (90 μ or) 99-128 μ long, 27-35 μ wide, 2-8-spored, irregularly distichous or monostichous; spores ellipsoidal or broadly rounded, biconical, nonseptate or 1-septate, in the eight-spored asci 28-32.5 μ long, 12-14.5 μ wide, or rarely 25 μ long and 11-16.5 μ wide, or in the two or four-spored asci the spores 29-34 μ long and 18-20 μ wide.

Type: Herb. Calif. Acad. Sci. No. 215009, co-type in Farlow Herb., Harvard University; growing on bark among hepatics, lower limits of forest above Braithwaite Bay, Socorro Island, March 27, 1932, *J. T. Howell* (a).

The dimensions of the spores of this species immediately separate it from the related species such as *P. stellaris*, *P. aipolia*, *P. Leana*, and *P. crispa*. Because of its broad thallus it resembles the last three species, and because of the crenate margin of the exciple, the second and last species. From *P. aipolia*, it is separated by the pale under surface and the concolorous rhizoids, while only the large spores separate *P. Howellii* from *P. crispa*. There are other characters to be found in the thallus, but the writer hesitates to stress them, since the scanty type material does not allow sufficient observations on the range of variation to be found in this new species. Nevertheless, because of the spore-size and the distinctly crenate margin of the apothecium, the specimen is worthy of recognition under the new name.

Physcia picta (Sw.) Nyl.

Summit of Clarion Island, Revillagigedo Islands, March 22, 1932, J. T. Howell (19).

The reaction of the thallus to KOH is positive, the color changing to yellow and then to yellowish-green. The hypothallus is black, and the spores are 10-15 μ long and 5-7 μ wide.

Physcia stellaris Nyl.

Clarion Island, Revillagigedo Islands, March 22, 1932, J. T. Howell (2).

This specimen, growing on rock with *Caloplaca cirrochroa* and *C. murorum*, is somewhat doubtfully referred to this species since the thallus is somewhat broader than the usual forms and is less well developed. In contrast to these characters, which appear to be more or less variable in the species, the reaction to KOH is positive, and the spores measure 13.5-16 μ long and 5-7.5 μ wide.

HYMENOLICHENS

Dictyonema sericeum (Fr.) Mont.

Dichonema sericeum (Fr.) Mont.

On wet slope near the summit of Indefatigable Island, Galapagos Islands, May 10, 1932, J. T. Howell (4).

This species has not hitherto been reported from the Galapagos Islands although it is not uncommon in tropical or subtropical countries.

The distribution and occurrence of the lichens of the Galapagos Islands has already been summarized by Stewart (l. c.) and hence little can be added by the writer, since among those specimens already listed above, only *Alectoria sarmentosa* from Chatham Island and *Dictyonema sericeum* from Indefatigable Island were collected in the Galapagos group. However, in order that the lichen flora of the more northern islands may be compared with that of the Galapagos, there follows a tabulated list of species arranged alphabetically according to genus and without regard to families.

| | <i>Guadalupe Island</i> | <i>Cedros Island</i> | <i>Clarion Island</i> | <i>Socorro Island</i> |
|--|-----------------------------|--------------------------|---------------------------|---------------------------|
| <i>Anaptychia ciliatomarginata</i> | + | - | - | - |
| <i>Caloplaca cirrochroa</i> | - | - | + | - |
| <i>Caloplaca murorum</i> | - | - | + | - |
| <i>Cetraria scutata</i> | + | - | - | - |
| <i>Lecanora Hageni</i> | - | - | + | - |
| <i>Lecidea crenata</i> | + | - | - | - |
| <i>Lecidea globifera</i> | - | - | - | + |
| <i>Leptogium mollucanum</i> ? | - | - | - | + |
| <i>Parmelia conspersa</i> | + | - | - | - |
| <i>Parmelia perforata</i> | - | - | - | + |
| <i>Parmelia perlata</i> | - | - | - | + |
| <i>Parmelia physodes</i> | + | - | - | - |
| <i>Pertusaria bispora</i> | - | - | - | - |
| <i>Physcia adscendens</i> | + | - | - | - |
| <i>Physcia aegilata</i> | - | - | + | - |
| <i>Physcia aipolia</i> | - | - | - | + |
| <i>Physcia Howellii</i> | - | - | - | + |
| <i>Physcia picta</i> | - | - | + | - |
| <i>Physcia stellaris</i> | - | - | + | - |
| <i>Psorotichia squamulosa</i> | - | - | + | - |
| <i>Ramalina calicaris</i> | - | - | - | + |
| <i>R. calicaris</i> v. <i>canaliculata</i> | - | - | - | + |
| <i>Ramalina ceruchis</i> | + | - | - | - |
| <i>R. ceruchis</i> f. <i>cephalota</i> | + | - | - | - |
| <i>Ramalina combeoides</i> | - | + | - | - |
| <i>Ramalina complanata</i> | - | - | + | - |
| <i>Ramalina farinacea</i> | + | - | - | - |
| <i>Ramalina homalea</i> ? | + | - | - | - |
| <i>Ramalina usneoides</i> | - | - | - | + |
| <i>Sphaerophorus corralloides</i> | + | - | - | - |
| <i>Theloschistes flavicans</i> | + | - | - | - |
| <i>Usnea duriuscula</i> | + | - | - | - |
| <i>Usnea florida</i> | + | - | - | - |

? Also collected on San Nicolas Island.

PLATE 8

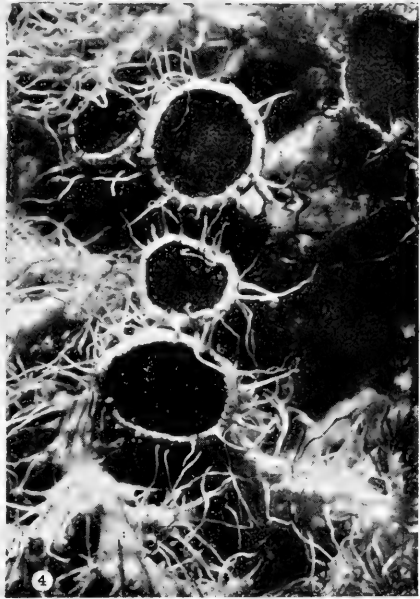
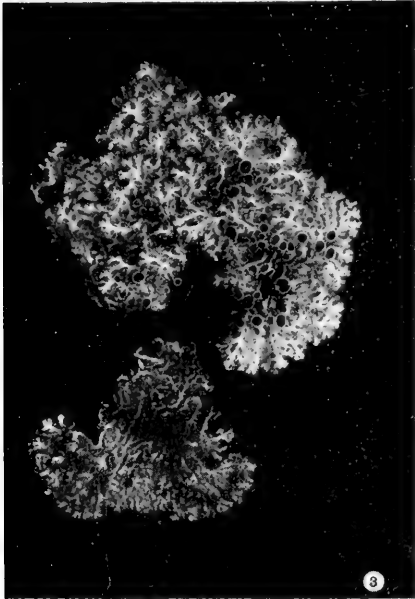
Fig. 1. *Pertusaria bispora* (Farlow) Linder. Photomicrograph to show the one- to four-pored hemispherical verrucae, and the slightly fissured thallus. $\times 9.2$.

Fig. 2. *Pertusaria bispora* (Farlow) Linder. Photograph to show the relatively even thallus and the distribution of the verrucae. $\times \frac{3}{4}$.

Fig. 3. *Anaptychia ciliatomarginata* Linder, spec. nov. Photograph to show the manner of branching of the thallus and the elongate-ciliate margin of the slender laciniae. The under surface of the plant is shown by the lower specimen. $\times \frac{3}{4}$.

Fig. 4. *Anaptychia ciliatomarginata*. Linder, spec. nov. Photomicrograph to show more clearly the elongate cilia on the margins of the apothecia, and the black, slightly granulose surface of the disc. $\times 9.2$.

Fig. 5. *Physcia Howellii* Linder, spec. nov. The upper specimen illustrates the characteristic type of branching of the thallus with its broad, inconspicuously lobed laciniae. $\times 2.5$. The lower figure is a photomicrograph of a fruiting body to illustrate the crenulate margin of the apothecium. $\times 10.2$.





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THE TEMPLETON CROCKER EXPEDITION OF THE
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No. 19

A REVISION OF TWO SPECIES OF VINCIGUERRIA,
A GENUS OF DEEP SEA FISHES

BY
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The genus *Vinciguerria* comprises at present six generally accepted species, namely, *V. poweriae* (Cocco); *attenuata* (Cocco); *nimbaria* (Jordan and Williams); *lucetia* (Garman); *raoulensis* (Waite); and *sanzoi* Jespersen and Tåning. Of these, the first four species appear to be valid. On the other hand, *V. raoulensis* is somewhat doubtful, McCulloch suggesting its identity with *V. lucetia*. It was described from a single specimen, checking in all details with the latter species with the exception of the number of dorsal and anal rays. Considering the fragility of these structures it is possible that an injury caused the loss of a few of the rays. Furthermore, *V. sanzoi* is identical with *V. nimbaria*, as will be demonstrated.

In distinguishing the various species of this genus, a number of features have been used. A pronounced short-coming of most of these characters is that they exhibit wide ranges of variation and a striking degree of overlapping. Two exceptions to this general rule were apparently formed by the number of gill rakers on the first branchial arch, and by a pair of photophores occurring on the chin

of certain species. These two characters have been carefully examined in the course of the present investigation. The result of this study shows the former character to be an excellent and reliable differentiating feature, while the latter is of questionable systematic value. These photophores are evidently the anterior members of the upper lateral rows of organs, separated by a relatively wide space from the second organs, but still an integral part of these rows. Therefore, no great importance can be attached to the presence or absence of these members, but such inconstancy must rather be considered as a simple numerical variation at the anterior end of a linear series. No comparable systematic significance has been attributed to similar variations commonly found posteriorly in these rows. The presence or absence of any single organ in such a varying series cannot be taken as a non-intergrading difference of any appreciable importance. This conclusion is based upon the fact that among the specimens of *Vinciguerria lucetia* examined, one individual had but one photophore, on the right side of the symphysis with no indication of any such member on the left, while an additional two specimens entirely lacked these photophores at the symphysis. These three specimens were mature individuals and were identical in every other respect with the other members of the species.

Because of lack of material of *Vinciguerria poweriae* and *V. attenuata* it is impossible to venture a discussion of the status of these two forms. However, it was deemed advisable to give a redescription of *V. lucetia* and *V. nimbaria* to clarify their relationships and status in the genus. It will be noticed in the following descriptions that *V. nimbaria* possesses fewer gill rakers, a slightly greater number of photophores in the upper lateral row, and a slightly greater body depth than *V. lucetia*.

For convenience the two lateral rows of photophores are divided into the following natural series: symphysis to pectorals, (S-P); isthmus to pectorals, (I-P); pectorals to ventrals, (P-V); ventrals to anal, (V-A); anal to caudal base, (A-C).

Vinciguerria lucetia (Garman)

Maurolicus lucetius Garman, Mem. Mus. Comp. Zool., 24, 1899, p. 242, pl. J, fig. 2.

Zalarges lucetius Brauer, Wiss. Ergebnisse Deutsch. Tiefsee-Exp. "Valdivia," 1906, 1, p. 96, fig. 40; 2, p. 186, taf. 36, fig. 9; Gilbert, Mem. Mus. Comp. Zool., 26, 1908, p. 237; Weber and Beaufort, Fish. Indo-Austral. Arch., 2, 1913, p. 119, fig. 44; Weber, "Siboge" Fische, 1913, p. 21; Regan, Larval Fish. "Terra Nova," 1916, p. 137, figs. 6, 7; Jespersen and Tåning, Vid. Medd. Dansk. Nat. For., 70, 1919, p. 219; McCulloch, Rec. Austral. Mus., 14, 1923, p. 115; Jespersen and Tåning, Rep. Danish Ocean. Exped. 1908-10, 2A, 12, 1926, pp. 22, 23, 27-30; Jordan, Evermann and Clark, Rep. U. S. Comm. Fish., 1928, 2 (1930), p. 73; Norman "Discovery" Repts., 2, 1930, p. 290-291; Parr, Bull. Bingham Ocean. Inst., 2, 4, p. 11.

DESCRIPTION: Mature specimens, 25 mm. to 52 mm. standard length. Depth of body increasing with age, greatest depth immediately behind posterior margin of opercle, 5.9 (5.5-6.7) in standard length. Depth at anus 8.3 (7.7-9.1) in standard length. Least depth of caudal peduncle 2.8 (2.3-3.2) in greatest depth. Length of head 3.8 (3.3-4.2) in standard length. Horizontal diameter of orbit 0.7 (0.5-1.0) in length of snout, 3.0 (2.6-3.7) in head. Maxillary 1.4 (1.3-1.8) in head. Lower jaw extending slightly beyond upper. The entire edge of maxillary and dentary studded with subulate teeth which are compressed laterally and curved posteriorly; on the maxillary one or two short teeth, sometimes directed anteriorly, occur between regularly spaced longer ones; those on dentaries irregularly unequal in length and crowded together. Four or five teeth on palatines. One tooth on each side of vomer. Snout to origin of dorsal fin 1.7 (1.6-1.8) in standard length; fin of 14-15 rays; first ray 1.9 (1.7-2.1) in fourth, which is longest, being 2.1 (2.1-2.3) in head; succeeding rays decreasing regularly in length. Origin of anal fin vertically below eighth, ninth or tenth ray of dorsal; fin of 15 (14-16) rays; first ray 1.9 (1.8-2.0) in third or fourth, which is longest, being 2.9 (2.7-3.0) in head; remaining rays decreasing evenly in length. Pectoral base vertically below posterior edge of opercle; fin of ten rays, one specimen with nine. Pelvics located about midway between tip of snout and base of caudal; fin of seven rays, with distal third of each split; longest ray 2.4 (1.6-3.0) in head. Adipose fin located vertically above last anal ray; its length from anterior edge of base to tip 1.9 (1.6-2.0) in horizontal diameter of orbit. Caudal lunate; the fragility of the caudal rays makes comparative measurements doubtful.

The deciduous nature of the scales makes it improbable that a preserved specimen with complete squamation will be observed. On those specimens examined, however, several scattered groups of cycloid scales indicate complete covering of body in life.

All photophores are directed ventrally; the lens increasing in size with age and appearing as a silver sphere, its dorsal half surrounded by a layer of black pigment. A photophore on preorbital at lower anterior margin of orbit; one at lower posterior margin of orbit; a third immediately behind margin of preopercle, approximately on horizontal through center of orbit. Two rows of organs along each side of ventral part of body. Origin of lower row on vertical of anterior margin of orbit, extending to base of caudal. Upper row with origin at symphysis of dentary, extending to base of anal fin. The S-P, I-P, and P-V series in the individual specimens are usually constant in the number of organs on the right and left sides.

It is interesting to note that, in case the number of organs in one of the series varies from the average for the species, an equalizing variation is likely to occur in the following series. For example, if

the V-A series has nine organs (one below average), the A-C series may have fifteen organs (one above average). The result is that the variation in any one series may be greater than that for the row.

MEASUREMENTS: The following table shows ray counts and measurements in hundredths of body length, representing twenty-two specimens.

| | |
|-----------------------------------|------------|
| Length of head..... | 26 (24-30) |
| Depth of body..... | 17 (15-18) |
| Depth at anus..... | 12 (11-13) |
| Depth at caudal peduncle..... | 6 (5- 7) |
| Length of snout..... | 7 (5- 8) |
| Horizontal diameter of orbit..... | 9 (7-10) |
| Length of maxillary..... | 19 (17-20) |
| Snout to anal..... | 72 (69-74) |
| Snout to dorsal..... | 59 (54-64) |
| Snout to pelvics..... | 50 (49-51) |
| Length of pelvics..... | 12 (10-15) |
| Number of dorsal rays..... | 15 (14-15) |
| Number of anal rays..... | 15 (15-16) |
| Number of gill rakers..... | 30 (27-35) |

PHOTOPHORES: The following table shows the numbers and variations of the photophores of the same group:

| <i>Series</i> | <i>S-P</i> | <i>I-P</i> | <i>P-V</i> | <i>V-A</i> | <i>A-C</i> | <i>Totals</i> |
|---------------|------------|------------|------------|------------|------------|---------------|
| Lower... | | 10 (10-10) | 12 (11-13) | 10 (9-10) | 14 (12-16) | 46 (44-47) |
| Upper... | 11 (10-11) | | 12 (11-12) | 11 (10-11) | | 33 (33-34) |

MATERIAL: Through the courtesy of the California Academy of Sciences, I have been able to study specimens of *Vinciguerria lucetia*, collected by the Templeton Crocker Expedition of 1932 to the Galapagos Islands, from the following locations: Guadalupe Island, 10 specimens; Maria Madre Island, 8 specimens; Unknown locality, 1 specimen. Also through the Hydrobiological Survey of Hopkins Marine Station, I have had access to collections made by Mr. E. C. Scofield containing the following specimens: 32° 42' N. Lat., 122° 33' W. Long., 1 specimen; 32° 32' N. Lat., 117° 29' W. Long., 1 specimen. One specimen examined from Galapagos Islands, Natural History Museum, Stanford University, No. 8095.

JUVENILE SPECIMENS: The specific determination of juvenile specimens of this genus is extremely difficult because the proportions of the body structures change markedly as maturity is reached. As Tåning points out the only infallible character for such a determination is the number of gill rakers on the first branchial arch. A comparison of measurements of the mature and the juvenile individuals as found in the tables will show the general bodily differences. The length of the head in the young specimens is proportionally shorter

than that of the mature group. Even more distinct is the slender body of the juvenile individuals.

The photophores increase in size with age, the lens and pigment each developing proportionally. These organs also increase in number, especially in the V-A series of the upper row. This increase continues until the specimen has reached approximately 25 mm. in length. The photophores in the head are generally the smallest. This is especially true of the organ on the preopercle, which is usually the last of the cephalic organs to develop. On two small specimens, this photophore was absent on both sides of the head while on another it was present on one side and absent on the other. These specimens were typical in all other respects.

MEASUREMENTS: The following table shows ray counts and measurements in hundredths of body length, representing nine juvenile specimens:

| | |
|-----------------------------------|------------|
| Length of head..... | 24 (20-26) |
| Depth of body..... | 14 (10-15) |
| Depth at anus..... | 10 (9-10) |
| Depth at caudal peduncle..... | 5 (4- 5) |
| Length of snout..... | 5 (4- 5) |
| Horizontal diameter of orbit..... | 6 (3- 8) |
| Length of maxillary..... | 14 (10-18) |
| Snout to anal..... | 70 (68-75) |
| Snout to dorsal..... | 55 (52-69) |
| Snout to pelvics..... | 47 (45-50) |
| Length of pelvics..... | 10 (10-11) |
| Number of dorsal rays..... | 14 (14-15) |
| Number of anal rays..... | 14 (13-16) |

PHOTOPHORES: Table showing number and variation of photophores of juvenile group:

| <i>Series</i> | <i>S-P</i> | <i>I-P</i> | <i>P-V</i> | <i>V-A</i> | <i>A-C</i> | <i>Totals</i> |
|---------------|------------|------------|------------|------------|------------|---------------|
| Lower.... | | 10 (9-10) | 12 (11-13) | 10 (9-10) | 14 (12-15) | 45 (43-46) |
| Upper.... | 11 (9-12) | | 12 (11-12) | 9 (7-10) | | 32 (30-33) |

MATERIAL: The Hydrobiological Survey collection contained eight juvenile specimens from the following locations: 33° 42' N. Lat., 122° 33' W. Long., 1 specimen; 33° 42' N. Lat., 121° 24' W. Long., 1 specimen; 32° 32' N. Lat., 117° 20' W. Long., 2 specimens; 23° 45' N. Lat., 111° 10' W. Long., 2 specimens; 28° 25' N. Lat., 117° 17' W. Long., 2 specimens. One specimen, No. 20199, Albatross Hyd. Station 3798, Marquesas Islands, Natural History Museum of Stanford University.

Vinciguerria nimbaria (Jordan and Williams)

- Zalarges nimbarius* Jordan and Williams, in Jordan and Starks, Proc. Calif. Acad. Sci., (2) 5, 1896, p. 793, pl. 76; Snodgrass and Heller, Proc. Wash. Acad. Sci., 6, 1905, p. 349; Jordan and Seale, Bull. U. S. Bur. Fish. 15, 1906, p. 189.
- Vinciguerria nimbaria* Gilbert, Mem. Mus. Comp. Zool., 26, 1908, p. 237; Jordan, Evermann and Clark, Rep. U. S. Comm. Fish., 1928, 2 (1930), p. 73; Norman, "Discovery" Repts., 2, 1930, p. 292.
- Vinciguerria sanzoi* Jespersen and Tåning, Rep. Danish Ocean. Exped., 1908-10, 2A, 12, 1926, p. 22-30.

DESCRIPTION: Greatest depth of body 5.5 (5.0-6.2) in standard length. Depth at anus 7.1 (6.7-7.7) in standard length. Least depth of caudal peduncle 2.8 (2.5-3.3) in greatest depth. Length of head 3.8 (3.4-4.2) in standard length. Horizontal diameter of orbit 0.7 (0.6-0.7) in snout, 3.1 (2.1-3.3) in head. Maxillary 1.4 (1.2-1.3) in head. Lower jaw extending beyond upper. Maxillary and dentary studded with subulate teeth as in *Vinciguerria lucetia*. Snout to origin of dorsal fin 1.7 (1.6-1.8) in standard length; fin of 15 (13-15) rays. Origin of anal fin vertically below ninth or tenth ray of dorsal; fin of 15 (13-15) rays. Pectoral base vertically below posterior edge of opercle; fin of 10-11 rays. Pelvics located at a point slightly posterior of a line midway between tip of snout and base of caudal; fin of seven rays. Adipose fin located vertically above base of anal fin.

The photophores arranged on body as in *Vinciguerria lucetia*. However, the number of organs in the upper row is greater, the average being 35 instead of 33. This is largely due to the increase in number of organs in the P-V series.

MEASUREMENTS: Ray counts and measurements in hundredths of body length based on seven specimens of *Vinciguerria nimbaria*:

| | |
|-----------------------------------|------------|
| Length of head..... | 26 (24-29) |
| Depth at body..... | 18 (16-20) |
| Depth at anus..... | 14 (13-15) |
| Depth at caudal peduncle..... | 6 (6- 7) |
| Length of snout..... | 6 (6- 6) |
| Horizontal diameter of orbit..... | 9 (8- 9) |
| Length of maxillary..... | 18 (17-20) |
| Snout to anal..... | 72 (70-72) |
| Snout to dorsal..... | 58 (55-61) |
| Snout to pelvics..... | 53 (52-54) |
| Length of pelvics..... | 10 (10-12) |
| Number of dorsal rays..... | 15 (13-15) |
| Number of anal rays..... | 15 (13-15) |
| Number of gill rakers..... | 20 (18-22) |

PHOTOPHORES: Number and variations of photophores of the above group:

| Series | S-P | I-P | P-V | V-A | A-C | Totals |
|----------|------------|------------|------------|------------|------------|------------|
| Lower... | | 10 (10-10) | 13 (12-14) | 10 (9-10) | 14 (13-15) | 46 (45-47) |
| Upper... | 11 (11-11) | | 13 (12-14) | 11 (10-11) | | 35 (34-35) |

MATERIAL: Dr. A. Vedel Tåning of the Marinbiologisk Laboratorium in Copenhagen kindly sent me five representative specimens

of this species from the following localities: 28° 48' N. Lat., 20° 45' W. Long., 3 specimens; 14° 38' N. Lat., 61° 16' W. Long., 2 specimens. In the Natural History Museum of Stanford University I have examined the two syntypes from the open Pacific, No. 3125.

REMARKS: In the course of my study of *Vinciguerria lucetia* the desirability of a reexamination of the original material of *V. nimbaria* became apparent. This inquiry revealed that at least three important errors had been made in the type description of this species. Jordan and Williams record "dorsal fin of nine rays," their figure shows fifteen; however, examination of the two syntypes reveals that one has thirteen and the other fourteen rays. This error was pointed out by Gilbert (1908). While the type description states "adipose fin not evident, perhaps obliterated," a complete and evident adipose fin is present on both specimens, as was pointed out by Snodgrass and Heller (1905). Finally, two teeth are found on the vomer of each specimen, instead of "no teeth on vomer" as recorded. In view of these errors the identification of a specimen of this species was impossible without recourse to the syntypes.

As the study of specimens and of literature progressed the similarity between *Vinciguerria nimbaria* and *V. sanzoi* became very evident. After receiving specimens labeled *V. sanzoi* from Dr. Tåning, a careful comparison revealed these to be identical with *V. nimbaria*. The errors of the type description of *V. nimbaria* left Jespersen and Tåning no other course than to describe their specimens as representing a new species. It is, indeed, unfortunate that the rules of priority necessitate the substitution of the obscure name *V. nimbaria* for the much better known one of *V. sanzoi*, which has been applied to the large number of Atlantic specimens upon which the species has been so well characterized.

I am greatly indebted to Dr. Rolf L. Bolin and Dr. Tage Skogsberg of the Hopkins Marine Station for their active interest and helpful suggestions during the writing of this report.

2023

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APRIL 3, 1935

**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 20

THE TERMITES

BY
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The termites taken by the Zaca Expedition of the California Academy of Sciences, under Captain Templeton Crocker, represent 44 colonies belonging to 16 species. The most extensive collections were made in the Galapagos Islands but various islands visited and the ports of call on the western coast of Mexico and Costa Rica are represented. Lists of the species in systematic order and by localities are given below. Discussions of the species in systematic order complete the report.

Most of the collections were made by Dr. A. E. Larsen, physician of the expedition. The unusually complete records of locality and habits are due to his interest. Some collections were made by Mr. Templeton Crocker, leader and sponsor of the expedition and some by Mr. M. Willows in charge of entomological collections as noted in the specific discussions.

Types are in the Museum of the California Academy of Sciences, paratypes in the U. S. National Museum and in the author's collection.

April 3, 1935

SYSTEMATIC LIST OF SPECIES WITH LOCALITIES

1. *Zootermopsis angusticollis* (Hagen), Guadalupe Island.
2. *Kaloterme* (*Kaloterme*) *hubbardi* Banks, Socorro Island.
3. *Kaloterme* (*Kaloterme*) *immigrans* Snyder, Galapagos Islands.
4. *Kaloterme* (*Kaloterme*) *jouteli* Banks, Socorro Island.
5. *Kaloterme* (*Kaloterme*) *marginipennis* (Latreille), Socorro Island.
6. *Kaloterme* (*Kaloterme*) *minor* Hagen, Enseñada, Lower California.
7. *Kaloterme* (*Kaloterme*) *pacificus* Banks, Galapagos Islands. (= *K. tabogae* Snyder)
8. *Kaloterme* (*Neoterme*) *larseni* Light, new species, Cocos Islands.
9. *Kaloterme* (*Cryptoterme*) *darwinii* Light, new species, Galapagos Islands.
10. *Kaloterme* (*Cryptoterme*) *fatulus* Light, new name, Galapagos Islands. (New name for *Cryptoterme occidentalis* Light.)
11. *Heteroterme pallidus* Light, new species, Puentarenas, Costa Rica.
12. *Heteroterme orthognathus* Light, Puerto Vallarta and Acapulco, Mexico; Bat Island and Braxilito Bay, Costa Rica; Galapagos Islands.
13. *Nasutiterme* (*Nasutiterme*) *guatemalae* (Holmgren), Maria Madre and Puerto Vallarta, Mexico; Port Parker and Braxilito Bay, Costa Rica.
14. *Mirotorme* (*Mirotorme*) *panamaensis* Snyder, Port Parker, Costa Rica.
15. *Microceroterme struncki* (Sörensen) (?), Puentarenas, Costa Rica.
16. *Microceroterme bouweri* (Desneux) (?), Acapulco, Mexico.

LIST BY LOCALITIES

MEXICO

Enseñada, Lower California.

1. *Kaloterme minor* Hagen.

Maria Madre, Tres Marias Islands, State of Nayarit.

1. *Nasutiterme* (*Nasutiterme*) *guatemalae* (Holmgren).

Acapulco.

1. *Heteroterme orthognathus* Light.
2. *Microceroterme bouweri* (Desneux) (?).

Puerto Vallarta.

1. *Heteroterme orthognathus* Light.
2. *Nasutiterme* (*Nasutiterme*) *guatemalae* (Holmgren).

Guadalupe Island.

1. *Zootermopsis angusticollis* (Hagen).

Socorro Island.

1. *Kaloterme* (*Kaloterme*) *hubbardi* Banks.
2. *Kaloterme* (*Kaloterme*) *jouteli* Banks.
3. *Kaloterme* (*Kaloterme*) *marginipennis* (Latreille).

COSTA RICA

Bat Island.

1. *Heteroterme orthognathus* Light.

Braxilito Bay.

1. *Heteroterme orthognathus* Light.
2. *Nasutiterme* (*Nasutiterme*) *guatemalae* (Holmgren).

Puentarenas.

1. *Heteroterme pallidus* Light, new species.
2. *Microceroterme struncki* (Sörensen) (?).

Port Parker.

1. *Nasutiterme* (*Nasutiterme*) *guatemalae* (Holmgren).
2. *Mirotorme* (*Mirotorme*) *panamaensis* Snyder.

COCOS ISLAND

1. *Kalotermes (Neotermes) larseni* Light, new species.

GALAPAGOS ISLANDS

1. *Kalotermes (Kalotermes) immigrans* Snyder, Chatham, Indefatigable, James, Albemarle, Jarvis, Narborough, South Seymour and Tower Islands.
2. *Kalotermes (Kalotermes) pacificus* Banks, Albemarle and James Islands.
3. *Kalotermes (Cryptotermes) darwini* Light, new species, Albemarle, Charles and James Islands.
4. *Kalotermes (Cryptotermes) fatulus* Light, new name, Albemarle and James Islands.
5. *Heterotermes orthognathus* Light, Indefatigable Island.

Only two species of termites have been reported from the Galapagos Islands (Banks 1901), *Kalotermes pacificus* Banks and *K. galapagoensis* Banks. The descriptions of these two species are exceedingly inadequate, the illustrations of little value, if not actually misleading, and the types which were deposited in the California Academy of Sciences were destroyed in the fire of 1906. *K. galapagoensis*, based on alates only, is reported as having a length of only 9.5 millimeters with the wings, and is smaller by nearly 1.5 millimeters, therefore, than *K. perparvus* Light (1933), the smallest known species of the subgenus. Also, if Banks' drawing has any significance, it indicates a relatively long, narrow pronotum. It seems possible, indeed probable, therefore, that *K. galapagoensis* is not a species of *Kalotermes* s. str., but is based on the alate of the species described below as *K. (Cr.) darwini* n. sp. This seems more probable since the median does run to the tip of the wing in that species which is true of Banks' description and figure.

There remains the possibility that Banks may have had the alates of *K. immigrans* Snyder (see p. 236) but the smallest alates I have seen are considerably larger than Banks' measurements indicate unless this be thought to be due to the use of dried specimens. It seems probable that *K. galapagoensis* will remain a *species inquirenda*, at least until the termite fauna of the Galapagos Islands is very thoroughly known, when, by the process of elimination, it may be possible to determine what species Banks really had.

As brought out in the discussion under that name, Banks' *Kalotermes pacificus* is considered to be the same as *K. tabogae* Snyder from Panama, necessitating the reduction of that species to synonymy.

Three of the species taken in the Galapagos occur also on the American mainland, *Kalotermes pacificus* Banks (= *K. tabogae* Snyder) in Panama, *Heterotermes orthognathus* in Mexico and Central America, and *Kalotermes immigrans* in Ecuador. The other two, while new species, are related to American species. *K. immigrans* is

found also in the Marquesas, on Fanning and Jarvis islands and in the Hawaiian Islands. Its presence in the Marquesas and Hawaii may be explained on the basis of distribution by ocean currents but it seems almost certain that it must have been introduced by man on Fanning and Jarvis.

GENUS **ZOOTERMOPSIS** EMERSON 1933

Zootermopsis angusticollis (Hagen)

Termopsis angusticollis Hagen

Material.—Three soldiers from Guadalupe Island collected by Mr. Willows from a fallen dead tree at an elevation of 2,500 ft.

Discussion.—While the posterior enlargement of the head is almost lacking in these soldiers and the head is narrower than in most soldiers of the species from California the head-mandible index is 0.71 and the head index 0.85, well within the range of these values for *Z. angusticollis* (Sumner 1933). Two stout spines are present on the front of the fore tibia as in other *Z. angusticollis* soldiers examined and in contrast to the single spine present in the *Z. nevadensis* soldiers examined.

It seems probable that a reexamination of the earlier collections of the termites of this genus from Guadalupe Island (Light 1933) will show them to agree in the above characters.

GENUS **KALOTERMES** HAGEN, sensu latiore

Subgenus **Kalotermes** sensu strictiore Holmgren

Kalotermes hubbardi Banks

Three collections of this species were made on Socorro Island. Two by Mr. Crocker were from dead trees, one a mile inland and the other only about 100 yards from the shore. The third collection was made by Mr. Larsen only a quarter of a mile from the shore.

This is the first record of this species from Socorro since the original report (Light 1930a) on the basis of a collection by T. T. Craig. It is apparently abundant there as it is on the west coast of Mexico.

Kalotermes immigrans Snyder

Material.—Ten collections from the following eight islands of the Galapagos: Albemarle, Chatham, Narborough, James, Jarvis, Tower, Indefatigable and South Seymour.

K. immigrans was first known from the Hawaiian Islands (Snyder 1924) where it was believed to be an introduced species, hence the specific name. Later it was taken by Kirby on Fanning Island

(Light 1932) and a collection taken from the wood of a wrecked schooner on Jarvis Island was found to be of this species (Light 1932). Still later the Pacific Entomological Survey found it in the Marquesas (Light 1932) and the Zaca Expedition took it as noted above in the Galapagos Islands. Earlier, as material received from Dr. Alfred E. Emerson shows, it was taken by Beebe in the Galapagos. Finally it appears in collections just received from Dr. Wolfgang von Hagen taken on the coast of Ecuador together with my *Metaneotermes athertoni*, a new subgenus (1932) from the Marquesas.

The question therefore of the center of origin of *K. immigrans* and the means whereby it attained so wide a range is a tangled one. Being a wood-dwelling termite it may have been distributed in part by human agencies as seems very probable in the case on Jarvis. Ocean currents may well be invoked in the case of the Marquesas and the Hawaiian Islands but not in that of Fanning which lies in the counter equatorial current.

Kalotermes jouteli Banks

This species was reported from Socorro Island for the first time on the basis of its presence in the collection made by T. T. Craig (Light 1930a). It is represented in the Zaca collection by a single soldier present with the collection of *K. hubbardi* made by Dr. Larsen in a dead tree about a quarter of a mile from the shore of that island.

Kalotermes marginipennis (Latreille), Light 1933

Termes mexicanus Walker.

Kalotermes montanus Snyder.

Kalotermes tuberculifrons Snyder.

not *K. marginipennis* Banks and Snyder.

This species is abundant in the higher altitudes in Mexico (Light 1933) but absent near the coast. It is surprising therefore to find it in Socorro Island. The collection consists of the two queens and a king taken by Mr. Willows at an elevation of 1000 feet in the interior of the island.

Kalotermes minor Hagen

This species is represented by a single collection taken from an unused railroad tie at Enseñada, west coast of Lower California.

Kalotermes pacificus Banks

Kalotermes tabogae Snyder 1924, 1926.

Material.—Two collections both containing numerous soldiers and nymphs, one from a dead branch on a living tree 100 yards inland on James Bay, James Island, Galapagos Island, and one from a similar location at Vilaville, Albemarle Island.

Discussion.—This species has been taken previously only from Panama and was described by Snyder (1924, 1926) as *Kalotermes tabogae*. It becomes necessary to consider *K. tabogae* synonymous with Banks' very poorly described *K. pacificus* for the following reasons. *K. pacificus* is clearly a species of *Kalotermes* s. str. as brought out by Banks' descriptions of both alates and soldiers. It was fairly common as Banks had "a number of specimens from Albermarle Island" "and from Narboro Island." Now the only two species of the subgenus found by the Zaca Expedition were *K. immigrans* and the species here identified with *K. pacificus* and agreeing with *K. tabogae* Snyder. *K. pacificus* Banks must be either *K. immigrans* Snyder or *K. tabogae* Snyder. If no other evidence were available, the smaller size and greater abundance of *K. immigrans* would point to it. Fortunately a collection, supposedly from the Galapagos, and given by Banks to Silvestri, is available for study, due to the kindness of Emerson. This collection contains both an alate and a soldier which rules out *K. galapagoensis* of which only the alates were known to Banks. It is assumed, therefore, that these must be paratypes of *K. pacificus* Banks. The soldier of this collection agrees perfectly with those in the Zaca collections, which in turn agree perfectly with autotypes of *K. tabogae* Snyder from Panama. The alate in Banks' collection also agrees exactly with an autotype alate of *K. tabogae* from Snyder.

The status of the alates associated directly or indirectly with the soldiers of this species in the Zaca collection is less satisfactory. With one collection of soldiers and nymphs are two pale, incompletely pigmented alates. With the other is a dealate male and taken in the same branch were a dealate female and a physogastric, completely apterous (third form) male. Now all of these reproductives agree in size with *K. immigrans* and not with *K. tabogae* as described by Snyder and as exemplified by the Banks' collection and Snyder's autotype from Panama. Further, the color of the two dealates agrees with *K. immigrans* and not with *K. pacificus* (= *K. tabogae*) and no consistent difference has been found. We face the dilemma, therefore, of assuming either that the alates of the two species intergrade or that these reproductives do not belong with the soldiers of *K. pacificus*. These two possibilities will be considered separately.

First of course must be kept in mind the complete agreement of Banks' Galapagos specimen and that of Snyder from Panama. That the specimens are from the Galapagos, although listed with a question mark by Silvestri, seems certain since Banks knew the Panama species and Snyder, who was familiar with Banks' material, described *K. tabogae* much later (1924, 1926) and since the soldier agrees perfectly with soldiers from the Galapagos in the Zaca collection.

The next question is as to the distinguishing characters of the soldiers of the two species, if any. It must be said that the two species are very close together as to soldier characters. They agree as

to the shape of the gula, length, shape and size of mandibles, number and location of teeth, number and size of antennal segments, shape and location of eye, details of sculpture in region of the rim of the antennal foveolae and anterior margin of head capsule. A prolonged and careful comparison of all soldiers of both species from all regions represented brings out, however, the following slight but consistent differences:

1. Pigmentation of *K. tabogae* is always lighter than in *K. immigrans* and usually much lighter.
2. The eye is white in *K. tabogae* even when the head is darkly pigmented while it is typically blackish in *K. immigrans* (one small individual from Hawaii is an exception).
3. The teeth of *K. tabogae*, especially the anterior two of the left mandible, project more strongly, the first being directed more anteriorly and the second being pointed and medially directed.
4. The anterior margin of the pronotum of *K. tabogae* is only faintly biconvex and the antero-lateral corners are sharp and projecting, forming the most anterior portion of the pronotum, while in *K. immigrans* the anterior margin is strongly biconvex and the corners strongly rounded, the most anterior part being some distance mediad to them.
5. The sides of the pronotum are strongly convergent in *K. tabogae* with broadly rounded postero-lateral corners and shallowly but definitely emarginate posterior margin, while in *K. immigrans* the sides are much less strongly receding, the postero-lateral corners *squarely* rounded and the posterior margin very faintly emarginate if not straight.

For these reasons it seems impossible to consider these variants of one species. On the other hand the presence of *K. immigrans* reproductives in close association with *K. tabogae* soldiers and nymphs does not seem an unlikely situation since *K. immigrans* was very abundant and particularly since incipient colonies were abundant. For example, one vial of *K. immigrans* soldiers and nymphs contains a number of reproductives evidently representing several incipient colonies. It seems reasonable to suppose, therefore, that the collection before me contains no *K. pacificus* reproductives.

Subgenus *Neotermes* Holmgren

Kalotermes (*Neotermes*) *larseni* Light, new species

Figs. 1-4 and Plate 9, fig. 3.

Material.—A single collection including alates, soldiers and nymphs collected by Mr. Crocker on June 26 in a dead fallen tree one-half mile from the shore of Wafer Bay, Cocos Island.

DIAGNOSIS

Alate.—Generally brown, wings and ventral surface pale; eyes about 0.5 mm. in diameter, separated from ventral margin by about 0.30 mm.; ocelli large, touching the eye; Y suture fine but visible; a pale gamma-shaped spot on frons; antennae of

17/18 segments; pronotum more than twice as wide as long; radius sector with three long and four or five very short anterior branches.

Soldier.—Head relatively broad (head index 0.70) and high (ratio of height to width 0.82); antennae of 16 segments; 3rd as thick as 1st, longer than 2nd or 4th; pronotum much less than one-half as long as wide, deeply but roundly concave in front; gula twice as wide in front as behind, sides converging gradually from anterior end.

DESCRIPTIONS

Alate.—Generally brown above, head and sternites darkest, pronotum lighter; ventral sclerites, legs, antennae and costal veins of wings light brown; central areas of meso- and meta-nota whitish.

Head (fig. 2) squarish, bulging slightly behind eyes and converging in front. Y suture narrow but distinct; a faint additional Y marking on the frons.

Eyes truncated in front, longer than high, not strongly projecting, separated from lower margin of head by slightly more than half their vertical diameter and from posterior margin by one and one-half this diameter.

Ocelli large, about same size as antennal foveolae, touching eye below, oval, with long axis directed forward and upward at an angle of about 45° , slightly drawn out at point of juncture with Y suture.

Antennae of 17 or 18 segments; 3rd about as long as 2nd when 17 segments; 4th shortest, very short when 18 segments.

Pronotum (fig. 2) wider than head, broadly concave in front, roundly emarginate in the center behind; sides strongly convex, receding into biconvex posterior margin; antero-lateral corners rounded.

Head, pronotum, legs, and abdominal sclerites with prominent reddish-yellow hairs.

Wing membrane pale, transparent: median vein (fig. 1) separated from radial sector by same distance as separates radial sector from radius; transverse branches of median weak; radius joining costa near middle of wing near level of origin of first anterior branch of radius sector; radius sector with 3 or 4 long oblique anterior branches.

Measurements in millimeters of alates of *Kalotermes (Neotermes) larseni* Light, new species.

| | | |
|--------------------------------------|-------|------|
| Length with wings..... | 14. | -16. |
| Length without wings..... | 8. | |
| Length of head to tip of labrum..... | 1.92 | |
| Length of head capsule..... | 1.50- | 1.59 |
| Width of head through eyes..... | 1.70 | |
| Width of head capsule..... | 1.53 | |
| Maximum diameter of eye..... | 0.50- | 0.60 |
| Minimum diameter of eye..... | 0.48 | |
| Length of ocellus..... | 0.21 | |
| Maximum length of pronotum..... | 1.06- | 1.08 |
| Minimum length of pronotum..... | 0.93- | 0.96 |
| Width of pronotum..... | 1.95 | |
| Length of fore wing with scale..... | 13. | |
| Length of fore wing scale..... | 1.44- | 1.56 |
| Width of fore wing..... | 3.3 | |
| Pronotal index..... | 0.55 | |

Soldier.—Head shading from light yellow-brown behind through light reddish brown to dark reddish brown on front margins, pronotum pale with darker margins; body and legs pale to light yellow; antennae dark reddish brown near base, pale distally.

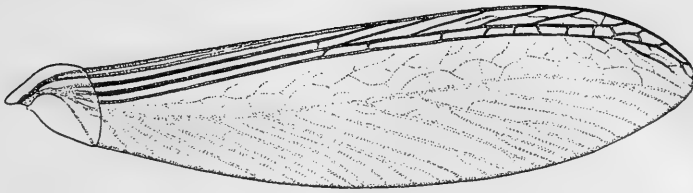


Fig. 1

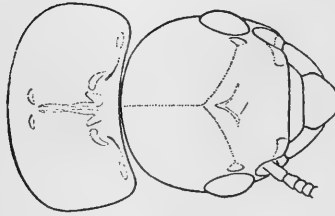


Fig. 2

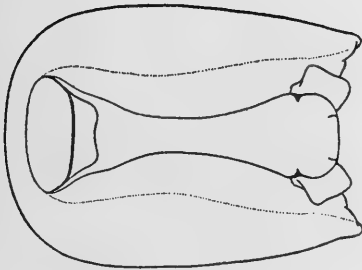


Fig. 3

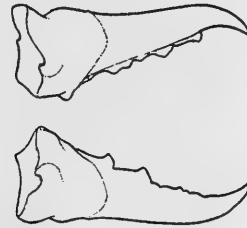


Fig. 4

Figs. 1-4. Camera lucida drawings of *Kalotermes (Neotermes) larseni* Light, new species.

1. Right fore wing. $\times 6$.
2. Head and pronotum of alate. $\times 13$. Posterior emargination not indicated.
3. Head capsule of soldier in ventral view to show gula. $\times 14$.
4. Mandibles of soldier. $\times 14$.

Head (pl. 9, fig. 3) relatively short, head index 0.70; sides of head weakly convex especially at level of ocelli, converging from ocelli forward; postero-lateral corners rounding into straight posterior margin. Head high, head height index 0.82.

Frons with declivity of about 45° ; with broad, shallow median groove narrowing posteriorly and extending back to about middle of head: Median suture of head white, conspicuous; lateral sutures visible; eyespot large, white; ocellus spot distinct (pl. 9, fig. 3).

Gulamentum (fig. 3) about twice as wide near anterior end as at narrowest point, sides converging gradually from near anterior end. Antennae of 16 segments (pl. 9, fig. 3); 3rd segment chitinized, as thick as 1st, longer than 2nd or 4th.

Mandibles as in figure 4.

Pronotum (pl. 9, fig. 3) broadly, shallowly and angularly emarginate in front, with central emargination behind; sides converging behind the middle; anterolateral corners squarely rounded.

Head, pronotum and tergites with sparse, conspicuous, stiff, reddish-brown hairs.

Measurements in millimeters of a soldier of *Kalotermes* (*Neotermes*) *larseni* Light, new species.

| | <i>mm.</i> |
|---------------------------------|------------|
| Length of head capsule..... | 3.6 |
| Width of head..... | 2.52 |
| Height of head..... | 2.07 |
| Length of left mandible..... | 1.92 |
| Maximum width of gula..... | .83 |
| Minimum width of gula..... | .36 |
| Width of pronotum..... | 2.65 |
| Maximum length of pronotum..... | 1.32 |
| Minimum length of pronotum..... | 1.08 |
| Head index..... | 0.70 |

Type.—C. A. S. Ent. No. 3912.

Systematic Affinities.—This species seems most closely related to *Neotermes castaneus* (Burmeister) as defined by Snyder (1924) but differs from it in that the head of the alate is smaller and relatively narrower and longer and the pronotum relatively shorter, while the head of the soldier is shorter and broader and the pronotum quite different in shape. This group of species is in need of careful revision.

Subgenus **Cryptotermes** Banks

Kalotermes (**Cryptotermes**) **darwini** Light, new species

Plate 9, figs. 1 and 2; figs. 7 and 8.

Material.—Seven collections of this species by the Zaca Expedition are all from the Galapagos Islands, four from Albemarle Island, two from Charles Island and one from Sullivan Island. In addition I am able to report a collection of soldiers made by Dr. Beebe on Gardner Island available through the kindness of Dr. Alfred Emerson and Dr. Harold Kirby, Jr. Several of the colonies were in standing dead trees, others in fallen branches. One colony contained alates on May 25th and dealates were taken in other collections.

DIAGNOSIS

Alate.—Generally brown with pale, faintly brown wings; a dark V-shaped band across head behind frons, head parallel-sided; antennae of 15 segments; eyes and ocelli large for genus; eyes separated from lower margin of head by slightly less than their own short diameter; ocelli about half as wide as eyes; median vein not bent up to join radius sector but sending several branches to it beyond middle of wing. Ratio length of pronotum to length of fore wing scale about 0.6.

Soldier.—Frontal rim bilobed, widely flaring; dorsal surface of head black, excavated, tuberculate and wrinkled, surrounded by a raised margin, flat above; head relatively long, low and narrow, somewhat constricted behind frontal rim.

DESCRIPTIONS

Alate.—Brown above, yellow-brown below; frons dirty yellow with a dark V-shaped band across head behind it. Head squarish, sides parallel, postero-lateral corners, broadly rounded. Antennae of 15 segments, 13th and 14th longest, each twice as long as 3rd which is about as long as 2nd and 8th and longer than 4th, 5th, 6th, or 7th. Eye large for genus, separated from lower margin by somewhat less than its own short diameter; ocellus large, about as high as half the short diameter of eye; nearly as high as long; touching eye.

Pronotum widely but very shallowly concave in front and faintly but widely emarginate behind, sides rounded, receding into biconvex posterior border.

Wing strongly narrowed at base; membrane pale, delicate, with very fine ornamentations; radius joining costal margin near origin of first branch of radius sector; radius sector with four chitinized anterior branches; median closer to cubitus than to radius sector; running to tip of wing but sending several vertical branches to the radius sector.

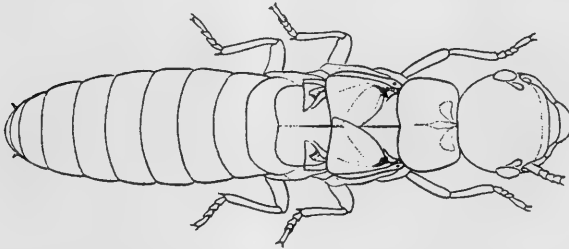


Fig. 7. Dealate of *Kaloterme* (*Cryptoterme*) *darwini* Light, new species. $\times 13$.

Soldier.—Back and lower sides of head, cervical sclerites and anterior margin of pronotum yellowish brown; frons, top and upper sides of head black; antennae white, abdomen pale brownish; in life "a bright yellow thoracic area separates the deep black head from the pale brownish abdomen" (Larsen in lit.).

Blackened areas of head (pl. 9, figs. 1 and 2) rugose, tuberculated. Head with widely flaring bilobed frontal rim, followed by an irregular lateral constriction behind which the sides swell out again, minimum width being found at about the anterior third and maximum width at about the posterior third behind which the margins round into the flatly convex posterior margin.

Dorsal concavity (pl. 9, figs. 1 and 2) roughly quadrangular, anteriorly somewhat indented by median notch in frontal rim, bounded laterally by upraised longitudinal ridges, which end anteriorly in the frontal rim, and are connected posteriorly by a somewhat convex transverse ridge. Head relatively long and narrow for the genus, greatest width about two-thirds of greatest length. Frontal rim elevated and projecting, frons making less than a right angle with the horizontal plane of head; frontal cavity deep and regular, separated by an inconspicuous median ridge running down from the notch; frontal rim thickened above the antennae (pl. 9, fig. 2) which lie in a longitudinal groove in the outer lower portion of this thickening. Antennae (pl. 9, fig. 2) of 13 or 14 segments; 3rd narrowest, clavate, somewhat chitinized, often incompletely separated from 4th.

Pronotum with broadly but very shallowly convex posterior margin; postero-lateral corners rounded; sides convex, strongly contracted anteriorly; anterior margin deeply, roundly, and broadly, concave; antero-lateral corners sharp, projecting forward over head, set off from lateral margins by a notch.

Measurements in millimeters of soldier of *Kaloterms (Cryptoterms) darwini* Light, new species.

| | |
|---|------|
| Length over all. | 5.40 |
| Length of head to center of frons. | 1.25 |
| Length of head to side of frons. | 1.44 |
| Minimum width of head. | 0.97 |
| Maximum width behind middle. | 1.14 |
| Width of head across center of frons. | 1.10 |
| Maximum height of head. | 0.86 |
| Minimum height of head. | 0.81 |
| Width of pronotum. | 1.20 |
| Maximum length of pronotum. | 0.88 |
| Minimum length of pronotum. | 0.63 |

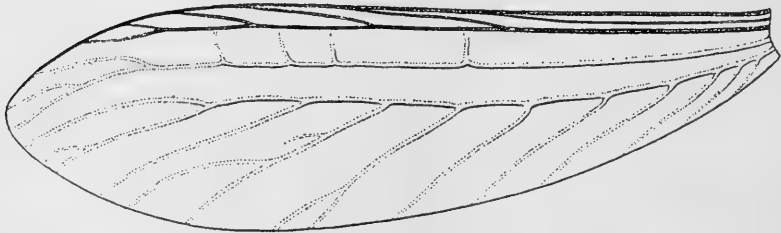


Fig. 8. Left fore wing of *Kaloterms (Cryptoterms) darwini* Light, new species. $\times 13$.

Type.—C. A. S. Ent. No. 3913.

Systematic Position.—This species is closely related to *Cryptoterms brevis* Walker and *Cr. piceatus* Snyder. The reproductives, however, are considerably smaller in every way, and differ in relative size of eyes, pronotum, etc., while the soldiers differ in that the head is decidedly lower and narrower, and is more constricted behind the frons, while the frons flares much more widely, and the dorsal surface is flattened.

Biology.—The frontal cavities of the heads of most of the soldiers in the collections were filled with a mass of granular material which also covered the mouth parts and lower side of the head in most cases. Dr. Larsen reports that when disturbed they threw out this yellowish material from the head region and would be found with the head lying in a pool of the yellowish liquid. The liquid is almost certainly regurgitated food which issuing from between the mouth parts would seem to come from the neck. It seems probable that this is a defensive mechanism against ants. It is interesting as being a new departure in termite economy.

Kaloterms (Cryptoterms) fatulus Light, new name

Plate 9, fig. 4; fig. 6.

Kaloterms (Cryptoterms) occidentalis Light 1933 [preoccupied by *K. (Rugiterms) rugosus* var. *occidentalis* Silvestri 1903].

Cryptoterms sp. ? Light (1930).

Material.—Two collections, one of king and queen and a soldier from James Island, Galapagos, and one of soldiers only, from Albe-marle Island, the first in the dead branch of a living tree, the other in a small dead bush.

DIAGNOSIS

Dealate.—Small and delicate; eye separated from lower margin by about two-thirds its short diameter; ocellus small; pronotum long, more than half as long as wide; ratio of length of pronotum to length of fore wing scale 0.87.

Soldier.—Small, head (pl. 9, fig. 4) short and broad, nearly as broad as long; low behind, high in front; frons making slightly less than a right angle with horizontal plane of head; frontal rim flaring, deeply notched; dorsal surface with a median longitudinal groove which runs back onto posterior third; head and frons with no conspicuous rugosities. Antennal scale vestigial; antennae with eleven segments; pronotum deeply and angularly concave, longer than half its breadth, antero-lateral corners only slightly acute.

DESCRIPTIONS

Dealate.—Pale brown above, yellow or yellow-brown below. Head broad, head index about 0.9; eyes large separated from lower margin by about two-thirds their short diameter; ocelli small, touching eye, obliquely elongated, directed forward and upwards; antennae (incomplete), with 3rd segment shorter than 2nd; pronotum long, index about 0.6; anterior margin of pronotum deeply, broadly, and evenly excavate; posterior margin shallowly emarginate, anterior corners squarely rounded, sides rounded, receding posteriorly into posterior margin.

Measurements in millimeters of dealates of *K. (Cryptoterms) fatulus* Light, new name, from the Galapagos Islands.

| | <i>Female</i> | <i>Male</i> |
|---|---------------|-------------|
| Length without wings | 4.41 | 4.56 |
| Length of fore wing scale | .78 | .90 |
| Length of head to tip of labrum | 1.04 | 1.07 |
| Length of head capsule | .84 | .83 |
| Width of head capsule | .78 | .76 |
| Width of head with eyes | .87 | .87 |
| Long diameter of eye | .25 | .27 |
| Short diameter of eye | .20 | .22 |
| Short diameter of ocellus | .06 | .08 |
| Long diameter of ocellus | .12 | .12 |
| Width of pronotum | .81 | .87 |
| Maximum length of pronotum | .59 | .61 |
| Minimum length of pronotum | .53 | .57 |
| Length of hind tibia | .66 | .66 |

Soldier.—Frons and anterior half of head black, posterior half mahogany to light brown; mandibles dark reddish black; anterior margin of pronotum dark brown; irregular areas just behind the anterior margin of the pronotum, the cervical

sclerites, and the tips of the maxillary palpi, brown; other parts very pale yellow to whitish.

Blackened portions of head (pl. 9, fig. 4) not rugose or wrinkled but with very fine tuberculations or very fine wrinkles. Frontal rim somewhat flaring, with conspicuous median notch, and followed somewhat posteriorly by a shallow constriction behind which the sides of the head are somewhat swollen; postero-lateral corners rounding shortly into nearly straight posterior margin.



Fig. 6. Head and pronotum of alate of *Kaloterмес (Cryptoterмес) fatulus* Light, new name. $\times 24$.

Head small, short and broad, about 1.0 mm. long and 0.96 mm. wide; head low behind and high in front due to uplifted frons; dorsal surface of head marked by broad sunken area behind the frons which is lower than frontal rim or the posterior third of head and a narrow median groove extending back onto the posterior third; anteriorly this groove begins at the posterior end of a ridge running back from the frontal rim. Frons making just about, or slightly more than, right angle with the horizontal plane of head; frontal concavity regular, relatively shallow and without any marked protuberances; antennal scale vestigial.

Mandible short, sharply incurved, antennae of 11 segments; 1st and 2nd large and chitinized, 3rd short, clavate, 3rd and 4th smallest, subequal.

Pronotum deeply and somewhat angularly concave in front; antero-lateral corners somewhat acute; sides rounded, rounding and receding into faintly emarginate posterior margin; anterior margin roughened.

Measurements of soldier of *Kaloterмес (Cryptoterмес) fatulus* Light, new name.

| | James Island | Albemarle Island |
|---|-----------------|---------------------|
| Length over all. | 4.26 | |
| Length of head to center of frons. | 0.9 | 0.93 |
| Length of head to side of frons. | 0.98 | 1.02 |
| Minimum width of head. | 0.94 | 0.96 |
| Maximum width behind middle. | 0.96 | 0.96 |
| Width of head across center of frons. | 1.00 | 1.02 |
| Maximum height of head. | 0.75 | 0.84 |
| Minimum height of head. | 0.67 | 0.75 |
| Width of pronotum. | 0.89 | 0.9 |
| Maximum length of pronotum. | 0.59 | 0.6 |
| Minimum length of pronotum. | 0.48 | 0.53 |

Systematic Position.—In 1930 I reported a single dried dealate *Cryptoterмес* collected from Socorro Island by T. T. Craig. In 1933 I gave the name *K. (Cryptoterмес) occidentalis* to a new species represented by pinned alates in the collection of the California Academy of Sciences. The collection by Larsen from James Island

contains a king and queen and a soldier which seem to represent the same species although the condition of the Socorro and Mexican material makes the comparison difficult.

Since the name *occidentalis* is preoccupied by Silvestri's *Kaloterme rugosus* var. *occidentalis* (1903) the species is given the new name *K. (Cr.) fatulus*.

The presence of soldiers has made possible the description of that hitherto unknown caste.

GENUS **HETEROTERMES** FROGGATT

(= *Leucotermes* Silvestri)

Heterotermes pallidus Light, new species.

Figure 5

Seven dealate reproductives of this species with one first instar nymph were taken from an old log lying high on the beach at Puentarenas, Costa Rica. These evidently represented incipient colonies and were located so near to soldiers and workers of *Microcerotermes struncki* (Sörenson) as to have been included with them.

It is interesting to find the incipient colonies of this species of *Heterotermes* in wood as is often the case with *Reticulitermes*. This is in contrast to observations made on *H. aureus* in the Colorado Desert which show it to start its colonies in the soil rather than in wood.

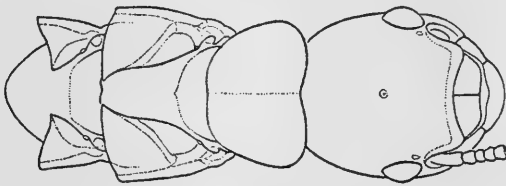


Fig. 5 Dealate of *Heterotermes pallidus* Light, new species. $\times 24$.

DIAGNOSIS

Alate.—Small, head 0.85 mm. wide through eye; generally pale in color; nota convex, mesonotum longer than wing scale and not covered by it; eye large, sharply truncate in front; ocellus vestigial, anterior wing scales short, 0.64 mm. long.

DESCRIPTION

Alate.—Generally pale brown to yellow, head especially pale with a white area just back of fontanelle (as in *H. maculatus* Light). Eye relatively large, separated from lower margin of head by a little less than its short diameter, sharply truncate in front. Ocellus very small, vestigial. Pronotum with broadly rounded corners,

posterior margin with only faint suggestion of emargination. Nota strongly convex, mesonotum extending beyond anterior wing scales.

Soldier unknown.

Measurements in millimeters of Dealate of *Heterotermes pallidus* Light, new species.

| | |
|--------------------------------------|------|
| Length of head to tip of labrum..... | 1.20 |
| Length of head capsule..... | 0.81 |
| Width of head through eyes..... | 0.85 |
| Maximum diameter of eye..... | 0.20 |
| Minimum diameter of eye..... | 0.17 |
| Maximum length of pronotum..... | 0.52 |
| Minimum length of pronotum..... | 0.49 |
| Width of pronotum..... | 0.65 |
| Length of anterior wings scale..... | 0.64 |

Type.—C. A. S. Ent. 3937.

Systematic Position.—Its very short wing scales, convex nota, small size and pale color serve to separate the species from all the other described American species of the genus. It seem probable that it is the alate of *H. orthognathus* Light but in the absence of a collection including both soldiers and alates it must be considered a separate species.

***Heterotermes orthognathus* Light**

Five collections from the following localities have been determined as belonging to this species: Acapulco, Mexico; Puerto Vallarta, Mexico; Braxilito Bay, Costa Rica; and Indefatigable Island, Galapagos. This extends materially our knowledge of its range, it having been reported only from Colima and vicinity (Light 1933).

None of the collections contained alates. The collections fall into three groups as regards size of soldier, those from Puerto Vallarta being larger in every way than those from Colima, those from Braxilito Bay, considerably smaller and those from the Galapagos of about the same size as those from Colima. All showed a remarkable agreement in proportions as brought out below.

Measurement in millimeters of soldiers of *Heterotermes orthognathus* Light.

| | <i>Galapagos</i> | <i>Puerto Vallarta</i> | <i>Braxilito Bay</i> |
|---------------------------|------------------|----------------------------|--------------------------|
| Length of head..... | 1.50 | 1.62 | 1.26 |
| Width of head..... | 0.90 | 0.92-1.02 | 0.78 |
| Length of left mandible.. | 1.05 | 1.15 | 0.99 |
| Width of pronotum..... | 0.69 | 0.78 | 0.61 |
| Head index..... | 0.60 | 0.61 | 0.64 |
| Head mandible index... . | 0.70 | 0.70 | 0.71 |
| Head pronotum index... . | 0.77 | 0.77 | 0.76 |
| Maximum width of gula.. | | 0.41-0.42 | |
| Minimum width of gula.. | | 0.18-0.20 | |
| Gular index..... | | 0.43-0.50 | |

Nasutitermes (*Nasutitermes*) *guatemalae* (Holmgren)

Material.—One colony from Maria Madre Island, Tres Marias Islands, Mexico; one from Braxilito Bay, Costa Rica; and two from Port Parker, Costa Rica.

Discussion.—The black headed nasutes of the subgenus *Nasutitermes* present a very difficult taxonomic problem which will only be settled by a careful comparative study using great numbers of extensive colony collections taken over large areas. It will be necessary to determine the nature and extent of intracolony variation, which undoubtedly is great, the intercolony variation within given localities and the geographical variation within a species. At present identifications must be considered tentative and be based when possible upon both alate and soldier characters.

The collections here considered to belong to *N. guatemalae* show considerable variation in characters of the nasutes. The alates present in the collection from Tres Marias (June 25) and those from Port Parker (July 5) agree perfectly with alates from Guerrero collected by von Hagen and identified as *N. guatemalae* by Emerson (in lit.) after comparison with type alate material.

These alates differ from *N. (N.) nigriceps* (Haldeman) (Light 1933) in the much larger eye and the close approach of the ocellus to the eye. The nasutes are characterized by darker color, generally larger heads, which are relatively broader and with shorter rostra.

Since this nasute has not been described a brief diagnosis with measurements follows.

Nasute of *Nasutitermes* (*Nasutitermes*) *guatemalae* (Holmgren)

Tergites and nota light brown, antennae somewhat darker, sternites and legs lighter, head black-brown, lightest below and just above antennae. Rostrum dense black in basal two-thirds shading into reddish apical zone.

Head very broadly ovate in dorsal view; minimum width (anterior) more than half of maximum width; contraction index 0.62. Dorsal profile of head flat in general but with a distinct median convexity set off by two narrow concavities. Rostrum short, not at all uplifted.

Measurements in millimeters of Nasute of *Nasutitermes* (*Nasutitermes*) *guatemalae*.

| | |
|---------------------------------------|------|
| Length of head with rostrum | 1.68 |
| Length of head | 1.20 |
| Length of rostrum | 0.48 |
| Head rostrum index | 0.48 |
| Width of head | 1.02 |
| Head index | 0.93 |
| Minimum width of head | 0.66 |
| Contraction index | 0.65 |

GENUS **MICROCEROTERMES** SILVESTRI

Six nearctic species of this genus have been reported: *M. exiguus* (Hagen), *M. struncki* (Sørensen), *M. bowveri* (Desneux), *M. arboreus* Emerson, *M. septentrionalis* Light and *M. gracilis* Light. The first three species are very imperfectly described, especially *M. exiguus*, which must be considered a *species inquirenda*.

Two species are represented in the material under consideration, each by a single collection and each by soldiers and workers only. These I have identified as *M. struncki* and *M. bowveri* in the absence of alates or of authentic soldier types with which to make comparisons. Such identifications are difficult and must be considered tentative. The species in question are clearly very different from *M. septentrionalis* and *M. gracilis*. From *M. arboreus* they differ in that the head is not largest just behind the antennae. *M. exiguus* cannot be definitely identified. They must therefore be considered to be either *M. struncki* and *M. bowveri* respectively or new species. The agreement is close but not entirely satisfactory in certain regard as is brought out in the discussion of the species. Diagnostic characters, measurements and illustrations are given to enable future workers to check the identifications.

Microcerotermes struncki (Sørensen) (?)

Figure 9.

A single collection from a log, lying high on the beach at Puentarenas, Costa Rica, has been identified as belonging to this species. Sørensen's (1884) description is inadequate. The agreement with Silvestri's (1903) figure is excellent, however. Holmgren's (1910) figure is evidently not this species, the head being much shorter and wider and the characteristic narrowing of the head anteriorly, as shown in Silvestri's figure and in these soldiers from Costa Rica, is lacking.

The proportion of the head (fig. 9) agrees exactly with those given by Silvestri (head index 0.62) but the mandibles are relatively longer. Otherwise the agreement is excellent.

The great distance between Costa Rica and southern Brazil where Sørensen's and Silvestri's collections were made adds to the uncertainty of this identification.

Measurements in millimeters of a soldier of *Microcerotermes struncki* (Sörensen) (?) from Puentarenas, Costa Rica.

| | |
|---------------------------------------|------|
| Length..... | 3.96 |
| Length of head without mandibles..... | 1.46 |
| Length of mandibles..... | .85 |
| Width of head..... | .89 |
| Width of head at antennae..... | .69 |
| Width of pronotum..... | .54 |
| Maximum width of gula..... | .32 |
| Minimum width of gula..... | .21 |

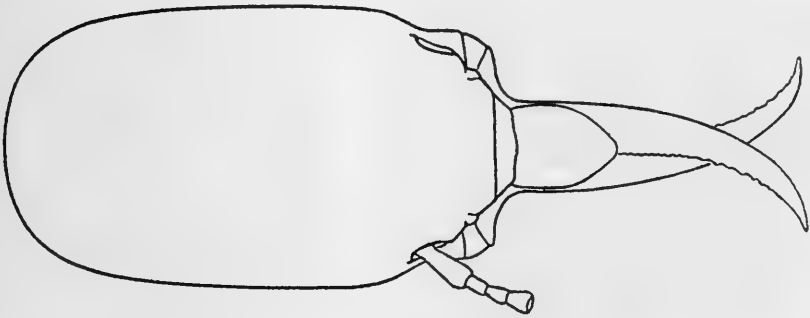


Fig. 9

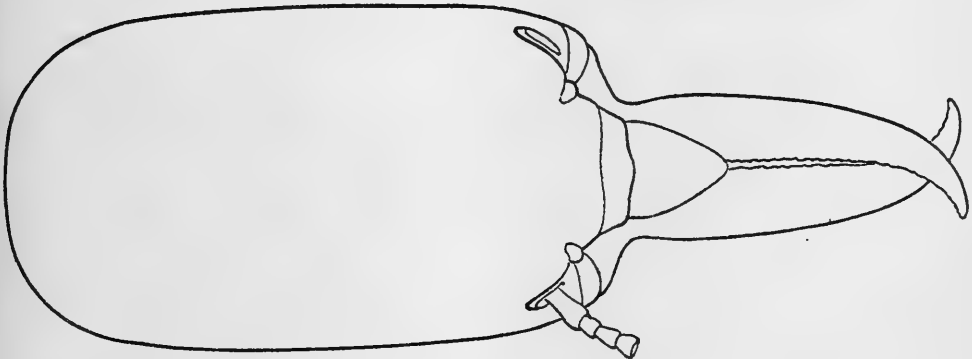


Fig. 10

Figs. 9-10. Head of soldiers of *Microcerotermes*.
 9. *Microcerotermes struncki* (Sörensen) (?). × 29.
 10. *Microcerotermes bouveri* (Desneux) (?). × 29.

Microcerotermes bouveri (Desneux) (?)

Figure 10.

A single collection from Acapulco taken from a beehive-like mound which extended a foot above the ground and a foot below it around the root of a dead shrub has been determined as belonging to this species.

Desneux's (1904) description is scanty and without illustrations but there are no outstanding differences. The 10 degrees separating the two localities, Acapulco in Mexico and Mariquita in Colombia, makes the identification questionable.

Measurements in millimeters of *Microcerotermes bouveri* (Desneux) (?) from Acapulco, Mexico:

| | |
|---------------------------------------|------|
| Length..... | 5.58 |
| Length of head without mandibles..... | 1.88 |
| Length of mandibles..... | 1.03 |
| Width of head..... | 1.14 |
| Width of head at antennae..... | .98 |
| Width of pronotum..... | .73 |
| Maximum width of gula..... | .36 |
| Minimum width of gula..... | .18 |

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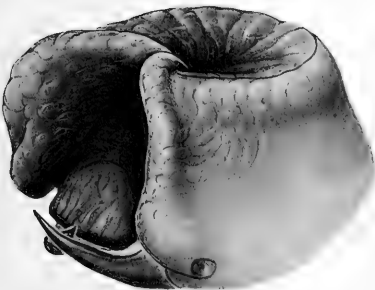
PLATE 9.

Fig. 1. Head of soldier of *Kalotermes (Cryptoterme)s darwini* Light, new species, in oblique lateral view. $\times 22$.

Fig. 2. Same in dorsal view. $\times 22$.

Fig. 3. Head and pronotum of soldier of *Kaloterme)s (Neoterme)s larseni* Light, new species, in dorsal view. $\times 9$.

Fig. 4. Head of soldier of *Kaloterme)s (Cryptoterme)s fatulus* Light, new name, in dorsal view but with head uplifted in front to show frons. $\times 22$.



1



2



3



4





PLATE 10.

Photographs of work of *Nasutitermes* (*Nasutitermes*) *guatemalae* (Holmgren) taken by Dr. A. E. Larsen at Port Parker, Costa Rica.

Fig. 1. Carton nest.

Fig. 2. Runways on tree.





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**THE TEMPLETON CROCKER EXPEDITION TO WESTERN
POLYNESIAN AND MELANESIAN ISLANDS, 1933**

No. 21

**SOME MARINE PLANTS OF SOUTHEASTERN
MELANESIA¹**

BY
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University of California

The collections of marine plants made by the "Zaca" Expedition during May, June, and July, 1933, were obtained from the Santa Cruz and Solomon islands, lying between latitudes 8° to 12° S. and longitudes 160° and 170° W. They originate, then, from southeastern Melanesia, along the western boundaries of the Pacific Ocean but in direct eastward extension of the Indo-Malayan-Papuan seas. The collection, incidental to other work, is valuable chiefly for indicating certain distributional relations existing between the tropical algae of the Indo-Malayan-Papuan archipelagoes, bordering (east-erly) the Asiatic and Australian tropics and the Samoan-Tongan-Fijian groups, with their Polynesian and Micronesian affinities. In all, 31 species have been determined, while certain epiphytic forms (chiefly *Melobesia*) remain still unnamed. Certain species of *Sargassum*, included in the collections, were of particular interest to the writer. A list of the species with critical and distributional notes seems desirable. The material was all preserved in alcohol.

¹ See *Science*, 79: 344, 345, Apr. 13, 1934.

MYXOPHYCEAE

Of the blue-green Algae, there was noticed, but not carefully determined, what seemed to be a unicellular type, probably a *Dermocarpa*, forming patches on certain of the species of *Halimeda*. No gonidangia, however, were observed.

1. *Lyngbya majuscula* (Dillw.) Harv.

Apparently abundant in floating (?) masses in Uras Cove of Tai Lagoon, on Malaita Island, on May 27 (No. 0642 B). The species is characteristic of tropical waters and of subtropical waters (in summer or in shallow situations where the temperature is raised up to 25° C. or over).

2. *Nostoc commune* Vaucher f.?

At Auki Bay, Malaita Island, on May 25, Norton Stewart collected a *Nostoc* (No. 0640 A), associated with a *Scytonema* and forming expanded thin and rather tough membranes, apparently pale yellowish-green (or pale bluish-green when living?). If marine, as seems probable, the occurrence is noteworthy. In general, the specimen seems more closely related to *Nostoc commune* than to any other, but the determination is not at all certain. Records of *Nostoc* in saline waters are almost wanting, but terrestrial species of the genus do seem, rarely, to exist just above high water mark, probably in certain contact with salt water.

3. *Scytonema polycystum* Born. et Flah., f.?

Closely associated with the preceding (No. 0640) was a loosely pannose *Scytonema*. The color is lost, the sheaths are thick, the trichomes are slender, and in general the plants seem altered from a possibly normal or juvenile state. In referring this plant to *S. polycystum*, as a doubtful form, there must be taken into account the fact that, at least, the specimens do not agree at all closely with the original description. The type locality of the species is Noumea in the New Caledonia group, consequently not far removed from Malaita Island. It has been credited also to Tahiti, in the Society Group of the eastern Pacific (see Setchell, Univ. Calif. Pub. Bot., 12:67, 1926) and to the Netherlands East Indies (see Weber-van Bosse, Siboga Exp., Mon. LIX-a, 28, 1913). Dr. Anna Weber-van Bosse (loc. cit.) has expressed the opinion that the species may possibly be only a marine form of some fresh water species such as *S. crispum* (Ag.) Born. The Malaita specimens add little to our knowledge except as to an additional occurrence of a seemingly marine *Scytonema* in close association with a seemingly marine *Nostoc*.

CHLOROPHYCEAE

The green Algae are usually represented in lagoons by members of the genera *Halimeda* (calcified) and *Caulerpa* (uncalcified). The representation of *Halimeda* is most satisfactory; that of *Caulerpa* is meager, suggesting that members of this genus were either not abundant or perhaps not conspicuously well developed in the areas chosen for collections.

4. *Dictyosphaeria cavernosa* (Forssk.) Boerg.

A fragment (No. 0631 E) of a hollow plant, presumably of this species, was collected "inside the reef" on Sikaiana Island, on May 16. This is referred here, as probably being the plant commonly known as *D. favulosa* (Mert.) Decaisne, a name recently supplanted by the one given above.

5. *Dictyosphaeria australis* Setchell

Two or three solid plants (No. 0631 F), associated with the above, seem to belong to *D. australis* Setchell, rather than to *D. Versluysii* W.-v. Bosse.

6. *Caulerpa racemosa* (Forssk.) J. Ag.

On Sikaiana Island, northeast of Malaita Island (Solomon Group) there were collected scanty specimens (No. 0631 H) belonging to var. *clavifera* f. *macrophysa* (Kuetz.) W.-v. Bosse, of this species.

7. *Caulerpa peltata* (Turn.) Lamour

A single scrap, seeming clearly of this species, was collected in Mohawk Bay of Lomlom Island of the Swallow Group in the Santa Cruz Islands on June 10.

8. *Caulerpa Fergusonii* Murray?

A single scrap (No. 0716 C), possibly of this species, was collected in Mohawk Bay, on Lomlom Island, Swallow Group, by Norton Stewart, on May 25.

9. *Caulerpa cupressoides* (Vahl.) C. Ag.

The var. *mamillosa* (Mont.) W.-v. B. (No. 0631 A) was collected inside the reef of Sikaiana Island, on May 16, and the var. *Lycopodium* (C. Ag.) f. *alternifolia* (Crouan) W.-v. B. (No. 0677) was collected on Bellona Island, south of the Solomon Islands, on June 21. The specimens are characteristic but in small quantity.

10. *Caulerpa anceps* Harv. ?

A scrap (No. 0631 J), collected "inside the reef" of Sikaiana Island, on May 16, is tentatively referred to this species.

Halimeda

The collection of species of *Halimeda*, characteristic of tropical seas of all oceans, is remarkably inclusive, considering that no extensive search was possible along this direction.

11. *Halimeda discoidea* Decaisne

A few well developed specimens (No. 0654 C) were found with other species of *Halimeda* in Kunggawa Bay on Rennell Island, southwest of the southeastern extension of the Solomon Islands, on June 8.

12. *Halimeda simulans* M. A. Howe

A number of specimens (No. 0716), of typical form, of this species were collected in Mohawk Bay on Lomlom Island in the Swallow Group of the Santa Cruz Islands on July 10. *Halimeda simulans* was described from the Caribbean region (Bahama Islands) where it is abundant. It was first credited to the Pacific Ocean from Tahiti (see Setchell, Univ. Calif. Pub. Bot., 12:81, 1926), the identification being confirmed by M. A. Howe. The present collection seems to be the second in the Pacific Ocean but extends the known distribution of the species to the extreme western limit of this ocean.

13. *Halimeda Monile* (Ell. et Sol.) Lamour

Two well developed and characteristic specimens (No. 0631 B) of this species were collected "inside the reef" on Sikaiana, on May 16. This species, apparently frequent in the Caribbean region, is only occasional in the Indo-Pacific. It occurs at Vavau in the Tonga Islands and now far to the westward on Sikaiana Island. It seems clearly distinct from *H. tridens* (Sol.) Lamour [*H. incrassata* (Ell. et Sol.) Lamour].

Halimeda tridens (Sol.) Lamour

Two varieties of this widespread and variable species occur among the collections:

14. *Halimeda tridens* var. *ovata* (J. Ag.) M. A. Howe

This variety, originally described from Noukahiva in the Marquesas Islands (J. G. Agardh, Lund, Univ. Arssks., 23:86, 1887) has also been reported from Tahiti (see Setchell, Univ. Calif. Pub. Bot., 12:81, 1926). It seems to be a very distinct form. It occurred in a number of specimens (No. 0654 B) among the collections of June 8 from Kunggawa Bay, Rennell Island, and (No. 0677 B) from Bellona Island, June 21, localities far west of any hitherto reported.

15. *Halimeda tridens* var. *tripartita* (Barton) Setchell, comb. nov.
(*Halimeda incrassata* forma *tripartita* Barton, Siboga Exp., Mon. LX:27, fig. 43, 1901).

Two specimens (No. 0654 A) were found among other *Halimeda* plants collected on June 8 at Kunggawa Bay, on Rennell Island. The variety was described from plants collected by Dr. Anna Weber-van Bosse of the Siboga Expedition (1899-1900) in the Netherlands East Indies.

16. *Halimeda Opuntia* f. *typica* Barton

Plants (No. 0631 C) of apparently the typical form were collected at Sikaiana Island, "inside the reef," on May 16.

17. *Halimeda Opuntia* f. *triloba* (Zan.) Barton

The trilobed form of *Halimeda Opuntia* occurred in two collections: No. 0631 D "inside the reef," on Sikaiana Island, May 16; and No. 0654 D, in the form of a single fragment, from Kunggawa Bay, Rennell Island, June 8.

MELANOPHYCEAE

The brown Algae represent, as is natural, the more conspicuous forms of the Dictyotaceae and the Sargassaceae. The species collected are of decided interest from a critical point of view and from that of distribution.

18. *Dictyota friabilis* Setchell

The collection (No. 0716 A) from Mohawk Bay, Lomlom Island, of the Swallow Group in the Santa Cruz Islands (July 10) consists of a somewhat extended mat of procumbent plants, thin, papery, and brittle (when fresh), which most closely approximate the Tahitian species (see Setchell, Univ. Calif. Pub. Bot., 12:91, pl. 13, figs. 4-7; pl. 20, fig. 1, 1926). The surface is not areolate, there is

little evidence of either marginal or surface proliferations, but the tetrasporangia do tend, at least here and there, to arrange themselves in horizontal lines. It may be close to *D. lata* Lamour, from the East Indies, but comparison with type is desirable before definite reference to that species can be made. It, also, has some agreement with the description of *D. nigrescens* Zan., of the Aru Islands, but again, comparison should be made with type specimens before certainty of this name may be assumed.

19. *Padina Commersonii* Bory

Two collections contain what seem to be typical, rather young plants of this species. No. 0641 B, from Auki Bay, Malaita Island, collected by Norton Stewart, on May 25, shows a few thin tetrasporic plants. The fronds are composed of 2 unequal layers of cells, are about 250μ thick, with the tetrasporangia in interrupted lines just above each successive arc of hair zone. No. 0716 B contains a few young plants, very similar to those of the preceding in general structure, but the organs in front of the hair zone arcs seem to be antheridia. The material, however, is too scanty for detailed investigation.

20. *Hormophysa triquetra* (L.) Kuetz

At Uras Cove of Tai Lagoon, on Malaita Island, on May 27, Norton Stewart collected (No. 0642 C) a single young fragment of the plant which is variously placed in *Cytoseira*, *Hormosira*, *Moniliformia*, and *Hormophysa*, and under species names of *triquetra*, *articulata*, *prolifera*, and *latifrons*. Kuetzing (Phyc. Gen., 359, 1843) created for it the generic name of *Hormophysa*, which may be retained for the present as most suitable. The species seems to be the same as that of the Red Sea and intervening areas, which Forsskål (1775) named *Fucus articulatus*. The fragment is of the "latifrons" type, but that is the usual form of the frond in young plants.

21. *Turbinaria Murrayana* Barton

Two specimens of what seems to be this plant, short, stout, simple, and with massive triangular leaves, answering well to Barton's description and figures (Trans. Linn. Soc., ser. 2, Bot., 3:218, pl. 54, f. 2, 1891) and showing close resemblances also to the more slender, branched, vesiculate *T. decurrens*. No. 0642 D is a single short plant from Uras Cove, Tai Lagoon, Malaita Island, May 27, collected by Norton Stewart, and No. 0676 A, also a single short specimen, from Bellona Island, June 20. The type collection is from Papua and the Siboga Expedition collected it at Makassar.

22. *Turbinaria turbinata* (L.) O. Ktze

Two collections of this species were made. No. 0642 E consisted of 2 plants from Uras Cove, Tai Lagoon, Malaita Island, May 27, collected by Norton Stewart; No. 0676 B included 4 fragments from Bellona Island (June 20). The species is found in all tropical oceans.

23. *Turbinaria ornata* (Turn.) J. Ag.

This common species of the Indo-Pacific region is represented by a single specimen (No. 0641 A) from Auki Bay, Malaita Island, collected by Norton Stewart, May 25.

Sargassum**24. *Sargassum echinocarpum* var. *phyllocysta* Grun.**

No. 0642 H, collected by Norton Stewart in Uras Cove, Tai Lagoon, on Malaita Island, May 27, seems to be a very distinct variety of this apparently wide-spread species of the Indo-Pacific oceans. The type of the species is from Hawaii, while that of the variety is from Tongatabu. The broadly foliaceous vesicles mark off the variety from the species, while the compact glomerules of spinose receptacles and the more obtuse, more rigid, more deeply dentate leaves with long cuneate bases distinguish it from *S. Bideri*.

25. *Sargassum Bideri* Sonder

No. 0642 F, of the same collection from Uras Cove, Tai Lagoon, Malaita Island, as the last, seems nearer to the original plant of Sonder, than the one selected by J. G. Agardh (Spec. Alg., 1:328, 1848; see also Sonder, Abh. a. d. Geb. d. Naturw. herausgegeben v. d. Naturw. Ver. in Hamburg, 5, 2:43, 1871). Sonder (loc. cit.) divides his species between var. *latifolium* and (loc. cit., p. 44) var. *angustifolium*. The former variety (from Onrust Island, near Batavia, Java) is the broader-leaved typical form, while the narrow-leaved forms have been confused, both by J. G. Agardh and others, with *S. Swartzii* (Turn.) C. Ag. and with other narrow-leaved species. J. G. Agardh also discusses this question later (see K. Sv. Vet. Akad. Handl., 23:87, 88, pl. 26, II, 1889). In the "Zaca" specimens the vesicles are ordinarily muticous but occasionally are long apiculate.

26. *Sargassum cristaefolium* C. Ag.

No. 0642 G represents still a third species in the Uras Cove mixture of *Sargassums*. The several fragments seem to be typical antheridial (male) plants, or at least those having receptacles are, of

this probably widely extended and somewhat variable Indo-Pacific species, whose variations have seemingly been described under several binomials.

27. *Sargassum polycystum* C. Ag.

Under No. 0676 C, are two small fragments from Bellona Island (June 20), which on account of their more or less strongly muricate axes and small leaves and vesicles may be associated with this species, or possibly rather with *S. myriocystum* C. Ag. The species having the characters mentioned above are usually separated into two groups, according as to whether they have the receptacles unarmed, or spinulose dentate, and further as to whether the receptacles are dioecious or androgynous. In dioecious species of this type the rule seems to be that the oogonial (female) receptacles are more or less spinulose dentate while the antheridial (male) may be devoid of lateral projections ("unarmed"). Such species are placed under the *Acanthocarpicae biserrulae parvifoliae* of J. G. Agardh (loc. cit., 1889, p. 37), while the smooth-receptacled but otherwise similar group were placed by J. G. Agardh (loc. cit., 1889, p. 39) under *Malacocarpicae racemosae glandulariae*. Grunow (Add. ad. cog. Sarg., 1915-1916) places the two groups nearer to one another, both under *Acanthocarpicae*, because the oogonial receptacles are spinulose-dentate, although the antheridial receptacles are unarmed, and makes distinctions in leaf characters, acute *versus* obtuse, percostate *versus* partially or completely ecostate. Our scanty specimens vary as to these; the larger has all the leaves ecostate, the smaller all percostate. The tips in each case are between acute and obtuse. It is therefore difficult to distinguish *S. polycystum* C. Ag. from *S. myriocystum* J. Ag. Very possibly the two species may be identical and very possibly also certain alleged closely related species may really belong to the same species-cycle.

28. *Sargassum oligocystum* Mont.

Plates 11-15, figures 1-9

Two numbers from Bellona Island of *Sargassum* with flattened primary branches suggest that possibly this species of Montagne (Pl. Cell., in Dumont D'Urville, Voy. au Pol. Sud., 1:67, 1845) from Sumatra may be the one represented, but also suggest *S. porosum* Grev., *S. Grevillei* J. Ag., and *S. oligocystoides* Grun. From the vegetative characters, the plants seem to fit descriptions of all four species, but the receptacles are described differently. *Sargassum oligocystum* was described from an oogonial (female) plant having flat or possibly triquetrous receptacles with spinulose-toothed margins. Whether the type of *S. oligocystum* may possibly be andro-

gynous is not stated, but Grunow has referred to it, as possible varieties, plants with androgynous receptacles.

Sargassum Grevillei J. Ag. and *S. porosum* Grev., proposed almost simultaneously, have somewhat elongated cylindrical, unarmed, androgynous receptacles, while *S. oligocystoides* Grun. is said to differ from *S. Grevillei* J. Ag. (and *S. porosum* Grev.) in having receptacles very similar to *S. Grevillei* but varying from unarmed, through sparingly spinulose, to dentate.

No. 0676 D, Bellona Island, June 20, and No. 0680, Bellona Island, June 21, seem to be closely of the same vegetative form as these several proposed species, but almost dimorphic as to the receptacles. In certain plants the receptacles answer to those described for *Sargassum oligocystum* Mont. They are flat, with dentate margins. Their conceptacles are largely oogonial (female) but an occasional conceptacle, among the others, is antheridial (male). The plant is, then, androgynous, although preponderantly female. Other plants, agreeing perfectly with those just mentioned in vegetative characters, have slender, cylindrical, but torulose receptacles, predominantly male, but with occasionally one, or a very few, female conceptacles. While these plants with slender, cylindrical receptacles are unarmed, there are some with a few scattered spinulose teeth. Such specimens as these seem to indicate an incomplete dimorphism of the receptacles, those predominantly male tending towards being slender, cylindrical, with only traces of spinules, while those predominantly female tend to have flat, broad, dentate, receptacles. Because of their close association in habitat and vegetative form, it seems reasonable to regard them as presumably states of the same species and refer them to *S. oligocystum* Mont., the earliest species of the series to be described (1845). It also seems reasonable to suspect that *S. Grevillei* J. Ag. (1848), *S. porosum* Grev. (1849), and *S. oligocystoides* Grunow (1916) are, likewise, simply names given to states of *S. oligocystum* Mont.

Figure 1 of Plate 11 represents two plants of No. 0680, reduced to about 0.5 diam., from Bellona Island; that below (A), the more slender of the two, showing receptacles elongated, slender, cylindrical, and slightly if at all spinulose (as seen enlarged 6 diameters in figure 2), and with their androgynous receptacles almost but not entirely antheridial. This plant falls under the description and figure of *Sargassum porosum* Grev., but which was slightly earlier described as *S. Grevillei* J. Ag. Figure 1 also shows above (B), a plant of the same collection, also reduced about 0.5 diameters, which is more robust in all its parts and, as shown in figure 3, Plate 12, enlarged 6 diameters, with broader, more congested, flattened, and dentate receptacles, which answer to those described for *S. oligocystum* Mont. The conceptacles in this specimen are almost exclusively oogonial, but an occasional associated antheridial conceptacle is found. On this basis is suggested the uniting of *S. porosum* Grev. (1849) and *S. Grevillei* J. Ag. (1848), as representing

the antheridially-(male-) dominated plants, with *S. oligocystum* Mont. (1845), the oogonially-(female-) dominated plants, as a single species under the last-mentioned name.

Figures 4 to 7, Plates 12-14, show habit and some details of receptacular variation in No. 6076 D, also collected at Bellona Island. Figure 4, Plate 12, shows plants, reduced to about 0.5 diam., whose receptacles verge towards one or another of the sexes but whose conceptacles are mixed. Figure 5, Plate 13, shows slender, undulate receptacles with antheridial dominance, figure 6, Plate 13, shows some with oogonial dominance, while figure 7, Plate 14, shows receptacles almost balanced between the two sexes, all enlarged 6 diameters. The plant of figure 6, Plate 13, comes close to *S. oligocystoides* Grun. (figure 9, Plate 15), whose primary branches are more flattened and whose receptacles (figure 8, Plate 14, enlarged 6 diameters) are mixed as to sex and, while verging towards *S. oligocystum* on the one hand and *S. Grevillei* on the other, are really intermediate. It seems reasonable, then, to add *S. oligocystoides* Grun. (as a sex state, or form?) to *S. oligocystum* Mont.

It seems, therefore, that it is reasonable to assume that here, as in the fairly closely related group of species, the *Sargassum stenophyllum* J. Ag. (1848), *S. lanceolatum* J. Ag. (1848), and *S. Skottsbergii* Sjöst. (1924), we may be dealing with a species cycle whose varying receptacular morphology is induced by the proportional representation of the one or the other sex-conceptacles, contained within it, constituting polygamous species varying from almost (possibly absolute) dioecism to an almost equitable androgyny. The strongly male plants are more slender, the strongly oogonial plants more robust, while the intersex plants are intermediate in this respect.

RHODOPHYCEAE

Only a single non-calcified member of this group occurred in the collections. Several calcified members (*Melobesieae* and *Corallineae*) were found as epiphytes on the larger green and brown algae or on the sea grasses, but no identifications are attempted at the present time.

29. *Laurencia mariannensis* Yamada

No. 0631 G, collected "inside the reef" on Sikaiana Island, seems to belong to this species, known hitherto only from the Marianne Islands. The tuft of plants has both the habit and the structural details given by Yamada for this species.

MONOCOTYLEDONAE

Two species of Sea Grasses, each with the leaves bearing *Melobesia*, were found among the "Zaca" collections.

30. *Thalassia Hemprichii* (Ehrb.) Aschers

No. 0677 A, occurred among the collections from Bellona Island (June 21). The plants are sterile but seem clearly of this species. Bellona Island is possibly as much as 200 miles eastward of its hitherto known range (see Ostenfeld, *Die Pflanzenareale* 1, 3: map 23, 1927).

31. *Cymodocea ciliata* (Forssk.) Ehrb.

No. 0642 A was collected in Uras Cove, Tai Lagoon, Malaita Island, by Norton Stewart, on May 27. These plants are also sterile but the branches are fairly long, the teeth on the flat leaves are transparent, the nerves of the leaves 21 to 23, and the peripheral vascular bundles of the stems within the inner lacunose cortex. This locality extends the eastward confines of the Australio-Papuan area of the species by at least a couple of hundred of miles (see Ostenfeld, *loc. cit.*, map 36).

PLATE 11.

Sargassum oligocystum Mont. (in sens. ampl.)

Fig. 1. (A). *S. Grevillei* J. Ag. (incl. *S. porosum* Grev.) habit (with antheridial dominance). $\times 0.5$ diam.

Fig. 1. (B). *S. oligocystum* Mont. (in sens. ang.). habit (with oogonial dominance). $\times 0.5$ diam. Both from Bellona Island. No. 0680.

Fig. 2. *S. Grevillei* J. Ag. Receptacles, leaves, and vesicles of Fig. 1, A. $\times 6$. diam.

PLATE 12.

Sargassum oligocystum Mont. (in sens. ampl.)

Fig. 3. *S. oligocystum* Mont. (in sens. ang.). Receptacles, leaves, and vesicles of Fig. 1, B. $\times 6$. diam.

Fig. 4. *S. oligocystum* Mont. (in sens. ampl.), habits of several plants of varying sexual dominance. Bellona Island, No. 0676 D. $\times 0.5$ diam.

PLATE 13.

Sargassum oligocystum Mont. (in sens. ampl.)

Fig. 5. *S. Grevillei* J. Ag. (incl. *S. porosum* Grev.) Receptacles, leaves, and vesicles of a plant shown in Fig. 4 (with antheridial dominance). $\times 6$. diam.

Fig. 6. *S. oligocystum* Mont. (in sens. ang.) Receptacles, leaves, and vesicles of a plant shown in Fig. 4, (with oogonial dominance). $\times 6$. diam.

PLATE 14.

Sargassum oligocystum Mont. (in sens. ampl.)

Fig. 7. *S. oligocystoides* Grun. Receptacles and leaves of a plant shown in Fig. 4 (with nearly balanced dominance). $\times 6$. diam.

Fig. 8. *S. oligocystoides* Grun. Receptacles, leaves, and vesicles from syntype shown in Fig. 9 (with slight oogonial dominance). $\times 6$. diam.

PLATE 15.

Sargassum oligocystum Mont. (in sens. ampl.)

Fig. 9. *S. oligocystoides* Grun. Habit of a syntype from the E. coast of the Malacca Peninsula. $\times 0.5$ diam.

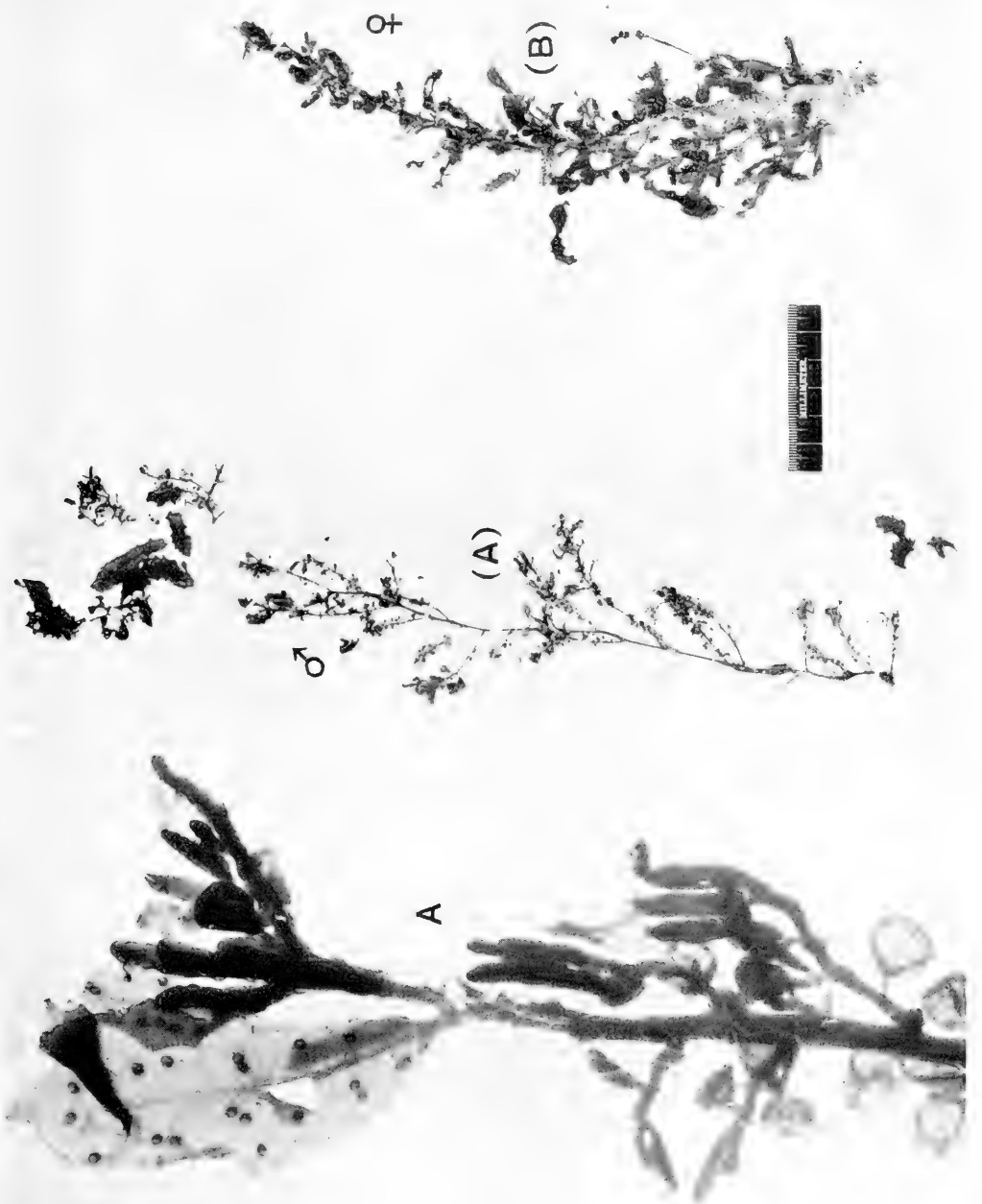


FIG. 1

FIG. 2



FIG. 4



FIG. 3



FIG. 5

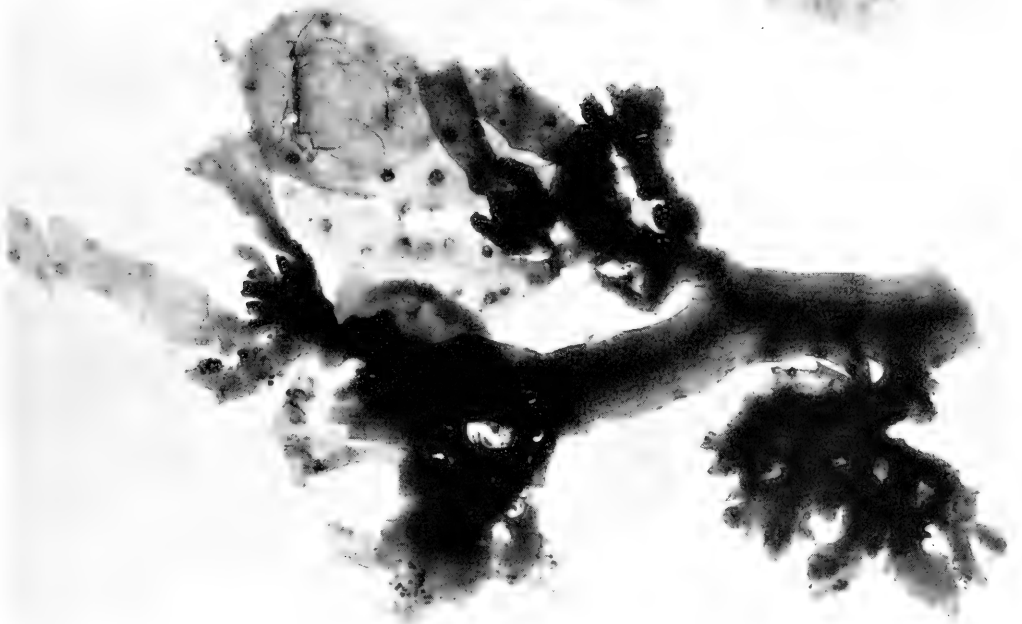


FIG. 6

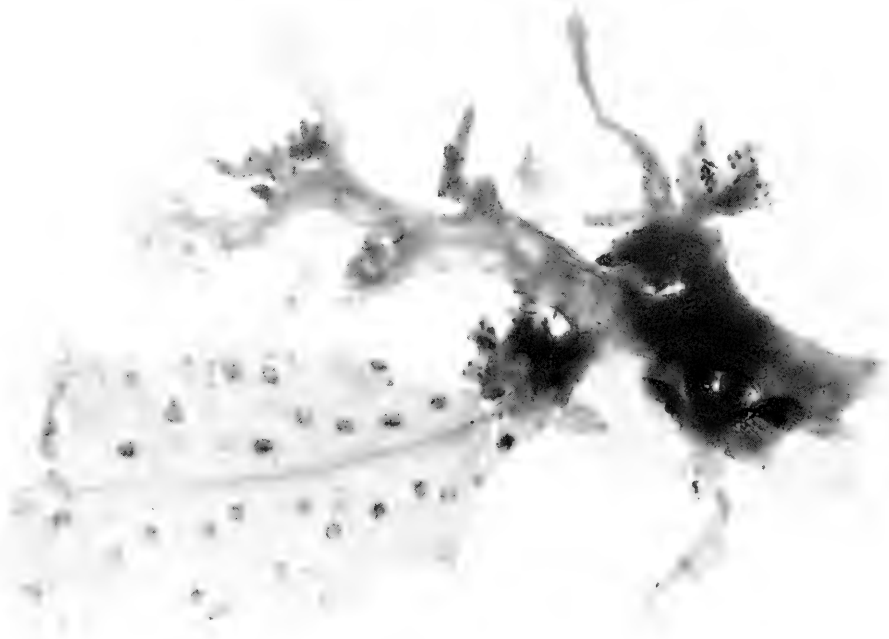


FIG. 7



FIG. 8



FIG. 9

25

E

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**THE TEMPLETON CROCKER EXPEDITION OF THE
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No. 22

**THE VASCULAR PLANTS FROM SAN NICOLAS ISLAND,
CALIFORNIA**

BY

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INTRODUCTION

So that the special botanical problems of each region can be properly emphasized and treated, it has appeared best to present the formal report on the vascular plants of the Templeton Crocker Expedition of the California Academy of Sciences, 1932, in several papers, each dealing with the collections from a relatively limited, definite geographic area. The first of these deals with the small collection from San Nicolas Island, California, both the first and last place visited for scientific studies by the Templeton Crocker Expedition.

San Nicolas Island lies nearly 70 miles west-southwest of San Pedro on the mainland of California, and is in the southern group of the Santa Barbara Islands. It is adjacent to the islet of Santa Barbara and to the larger islands of Santa Catalina and San Clemente. San Nicolas Island is a small island, about 10 miles long, a third as wide, and from 500 to 800 feet high along the mesa-like top. Although it lacks the interesting and varied vegetation of its larger neighbors, it is, nevertheless, the classic locality for a number of insular species, some of which are known in no other place. Most of these were described by Alice Eastwood in the only account of the flora of the island that has been published (*Proc. Calif. Acad. Sci.*,

September 26, 1935

ser. 3, Botany, 1: 89-120, 1898). Miss Eastwood's report was based on the collection of 1897 of Mrs. Blanche Trask, intrepid and ingenious explorer of the southern members of the Santa Barbara Islands, where several rare endemic plants are named in her honor.

The following account, taken from the botanical notebooks of the expedition, briefly describes the features and floral aspect of San Nicolas Island:

March 12, 1932. "We arrived off San Nicolas Island about 3 P. M. The north end presented an uninviting expanse of barren sand-dunes. Midway down the island, patches of green could be seen on steep slopes between the beach and the summit of the island. The slopes were scoured and cut by gullies and arroyos. From the east, the island appeared like a mesa, its top being uniform and nearly flat. About 4 P. M., I landed at the south end where I collected on the lower slopes of the island. *Lycium* was the characteristic shrubby plant, and, although it was not uncommon, at no place did it form a thicket extensive enough to impede one's progress. Two species of *Opuntia* were also present but were not abundant. A shrubby *Artemisia* and *Coreopsis gigantea* were rare in the arroyos. Between these shrubby plants on flats and gentle slopes was herbaceous vegetation, many of the species being introduced weeds."

March 13, 1932. "Shortly after day-break, I landed and climbed to the top of the island which was buried in a heavy fog. The top of the island is an undulating plain, the edges of which are being dissected by raw-walled gullies. Only low herbaceous vegetation was seen on the plain, and grazing on it were numerous sheep. On the south wall of a canyon, I found three hepatics: *Asterella*, *Targionia*, and *Sphaerocarpus*. I looked for *Riccia* but found none. Below the top of the mesa, the gullies and ravines give rise to bad lands. Here there is little or no vegetation to cover the eroding slopes. Still lower down is a terrace, probably an elevated beach, on which I collected last evening. The vegetation there was the most luxuriant seen on the island and there were the thickets of *Lycium* and cacti. . . . This afternoon we sailed between Santa Catalina and San Clemente islands; and just before sunset, we could see Santiago Peak in the Santa Ana Range on the mainland, the characteristic saddle-back summit marking it."

On the homeward journey, the expedition again visited San Nicolas Island for two and a half days, August 26 to 28. The time was spent dredging, and, because of the heavy surf, no party was landed.

The present collection of vascular plants from San Nicolas Island consists of 34 numbers representing 32 species and varieties, 7 of which were not reported in Miss Eastwood's list. In that account, 82 species and varieties were listed, so that the present list brings the number of plants known from San Nicolas Island to 89.

LIST OF SPECIES

1. **Bromus carinatus** H. & A., Bot. Beechy Voy. 403 (1841)

The determinations of this and the two other grasses found on San Nicolas Island have been checked at the Grass Herbarium of the United States Department of Agriculture through the kindness of Dr. A. S. Hitchcock. The present number is probably *B. Hookerianus* or *B. virens* of Miss Eastwood's list. No. 8226.

2. **Festuca octoflora** subsp. **hirtella** Piper, Contrib. U. S. Nat. Herb. 10: 12 (1906)

This plant, not included in Miss Eastwood's list, may be a more recent introduction from the mainland where it is widespread and rather common. No. 8222.

3. **Hordeum murinum** L., Sp. Pl. 85 (1753)

Although this weedy foxtail was noted as "not common," two collections of it were made. No. 8211, 8218.

4. **Brodiaea capitata** Benth., Pl. Hartw. 339 (1857)

This grew among protecting thickets of *Opuntia* and *Lycium*. The flowers were pale lavender-rose. No. 8225.

5. **Parietaria floridana** Nutt., Gen. Am. 2: 208 (1818)

From a thicket of *Lycium*. No. 8228.

6. **Atriplex californica** Moq. in DC., Prodr. 13, pt. 2: 98 (1849)

Clay slopes and flats. No. 8209.

7. **Abronia maritima** Nutt. in Wats., Bot. Calif. 2: 4 (1880)

Sand-dunes just back of the beach. No. 8230. The rarer *A. alba* Eastw., with type locality San Nicolas Island, was not found.

8. **Lepidium nitidum** Nutt. in T. & G., Fl. 1: 116 (1838)

No. 8208A.

9. **Lepidium Robinsonii** Thell., Gatt. *Lepidium* 255 (1906)

This species, reported by Miss Eastwood as *L. bipinnatifidum* Desv., was common in open level places on the lower part of the island. No. 8208.

10. **Tillaea erecta** H. & A., Bot. Beechy Voy. 24 (1841)

This low herb, which was not reported in Miss Eastwood's list, was common on clay flats at the south end of the island. No. 8214.

11. **Jepsonia** sp.

Specimens belonging to a species of this interesting genus were found on northern clay slopes near the south end of the island. The plants were in leaf and no flowers or fruits could be found. The leaves are orbicular and about 2 cm. in diameter. Thus it appears that the plants are nearer to *J. Parryi* (Torr.) Small (Bull. Torr. Club 23: 18, —1896) than to *J. malvaefolia* (Greene) Small (*loc. cit.*, 19), a closely related species which is found on Santa Cruz and Santa Rosa islands to the northward. In the latter species, the leaves are described as being longer than wide and ovate-orbicular. *Jepsonia* has not been reported heretofore from San Nicolas Island. No. 8210.

12. **Medicago hispida** Gaertn., Fruct. 2: 349 (1791)

A common weed on clay flats. No. 8215.

13. **Trifolium stenophyllum** Nutt., Journ. Phil. Acad.,
n. ser., 1: 151 (1848)

The plant on San Nicolas Island is referable to *T. depauperatum* Desv. var. *stenophyllum* (Nutt.) McDerm. f. *franciscanum* (Greene) McDerm. according to Miss McDermott's North American Trifoliums (p. 140). It would seem better to treat this variable group as Jepson has and consider the island plant a broad-leaved form of *T. amplectens* T. & G. var. *stenophyllum* (Nutt.) Jepson (Man. Fl. Pl. Calif. 537). The plant was common on the mesa. No. 8212.

14. **Erodium cicutarium** L'Her. in Ait., Hort. Kew.,
ed. 1, 2: 414 (1789)

In Miss Eastwood's list, this weedy species was reported as uncommon. It is now abundant in areas visited near the south end of the island. No. 8217.

15. **Erodium moschatum** L'Her. in Ait., Hort. Kew., ed. 1,
2: 414 (1789)

This plant, although not uncommon, was less abundant than the preceding. It was not listed by Miss Eastwood. No. 8216.

16. **Opuntia occidentalis** Engelm. & Bigel., Pacif. R. R. Rep.
4: 38 (1856); Proc. Amer. Acad. 3: 29 (1856)

Forming low thickets about a meter tall on the lower slopes of the island. Two collections were prepared to show variation, No. 8204A and 8205A. In the first, the joints are elongate-obovate and yellow-green, the areoles bear 4 or more spines, and the fruits are sterile. In the second, the joints are rather broadly obovate and glaucous-green or bluish-green, the areoles bear 1-3 or occasionally 4 spines, and the fruits are fertile. This sort of variation is characteristic of the species as it occurs on the coast of Southern California. The plant was reported as "probably *O. Engelmanni* Salm. var. *littoralis* Engelm." by Miss Eastwood who had only a single flower without an ovary for study. According to Britton and Rose in *The Cactaceae*, the dull brownish spines of the present collections mark them as nearer to *O. occidentalis* than to *O. littoralis* (Engelm.) Cockerell.

17. **Opuntia prolifera** Engelm., Amer. Journ. Sci., ser. 2,
14: 338 (1852)

This *Opuntia* was not as common as *O. occidentalis*. It was about a meter tall. No. 8206.

18. **Apiastrum angustifolium** Nutt. in T. & G., Fl. 1: 644 (1840)
No. 8227.

19. **Lomatium insulare** (Eastw.) Munz, Man. S. Calif.
Bot. 358 (1935)

Euryptera insularis (Eastw.) C. & R., Contrib. U. S. Nat. Herb. 7:
243 (1900).

Peucedanum insulare Eastw., Proc. Calif. Acad. Sci., ser. 3,
Botany, 1: 106 (1898). This endemic species was rather common on the steep clay sides of arroyos just back of the beach. The leaves are somewhat glaucous and are variously cleft, the final segments sometimes being coarse and broad, sometimes finely divided and narrow. The flowers are bright yellow. No. 8207.

20. ***Sanicula arguta*** Greene in C. & R., Contrib. U. S. Nat. Herb. 7: 36 (1900)

This is *S. Menziesii* of Miss Eastwood's list. The plant was common around thickets of *Opuntia* and *Lycium* and on moist slopes in partially shaded places. No. 8201A.

21. ***Nemophila insularis*** Eastwood, spec. nov.

Nana, prostrata, basi divaricati ramosa, ramis gracilibus, subglabris; foliis 2-3 cm. longis, 5-7 pinnatifidis, segmentis rotundis, plerumque oppositis, 3-4 mm. diametro, laeviter hirsutis et minute pustulatis, petiolis aequilongis laminis, divaricati-hirsutis; pedunculis subaequalibus petiolis, gracilibus, appresse hispidis; calycis segmentis subovatis, hispidis, auriculis minoribus; corolla caerulea, campanulata, circa 4 mm. longa, segmentis obtusis, ciliatis, inter staminibus prope basi minute atro-maculata et duobus, parallelis, hirsutis lineis; staminibus corolla brevioribus; capsula orbiculata, 3 mm. diametro, hispida, stylo bilobato, persistenti

Type: Herb. Calif. Acad. Sci. No. 206984, collected on March 13, 1932, on moist northern slopes of SAN NICOLAS ISLAND, California, by John Thomas Howell, No. 8213.

This belongs to the group of small-flowered species of *Nemophila* described and figured by the author in Bull. Torr. Bot. Club 28: 137-160. The base of the corolla with the two rows of parallel hairs resembles Fig. 1a in Pl. 15, and the corolla is similar in shape to Fig. 6a on the same plate. The little black dots between the filaments above the base are unusual in these small-flowered species.

Nemophila insularis is a low annual reclining on the ground with spreading stems and begins to flower and fruit soon after springing from the ground, often while the round cotyledons are still present. The leaves have from 5 to 7 round divisions, generally opposite and decurrent along the rhachis, and each is tipped with a weak mucro. The petiole, which is about as long as the blade, is pubescent with spreading hairs and the lobes are clothed with appressed hairs minutely pustulate at base. The slender peduncles are generally as long as the adjacent petioles, spreading and recurving in fruit. The little flowers are pale blue, with calyx about 1.5 mm. long, corolla bell-shaped, 4 mm. long, somewhat hairy externally, and ciliate on the margins of the rounded lobes. Within the corolla above the base and between each pair of filaments are two parallel lines of hairs and a small black dot. The seed-pod is orbicular and generally contains 4 orbicular, minutely papillose seeds, each with a stout calyptra resembling a little handle.

22. ***Cryptantha Traskae*** Johnston, Contrib. Gray Herb., n. ser., 74: 77 (1925)

At the south end of San Nicolas Island, this local endemic was not common. It was reported by Miss Eastwood as *C. Torreyana*. No. 8223.

23. **Lycium californicum** Nutt. in Gray, Bot. Calif. 1: 542 (1876)

This was the commonest woody species at the southern end of San Nicolas Island and formed broad low thickets 6 dm. tall and 5 m. or less across. The leaves were fleshy but distinctly flattened; the corollas were sordid-white with dashes of brownish-purple in the throat below the lobes. No. 8203A.

24. **Galium Aparine** L., Sp. Pl. 108 (1753)

A widespread weedy species not reported heretofore from San Nicolas Island. No. 8224.

25. **Marah major** Dunn, Kew Bull. 151 (1913)

This plant is not listed by Miss Eastwood but Dunn (*loc. cit.*, 152) cites specimens of it from San Nicolas, Santa Catalina, and San Clemente islands. No. 8231.

26. **Achillea Millefolium** var. **lanulosa** (Nutt.) Piper, Fl. Palouse Reg. 196 (1901)

No. 8231A.

27. **Artemisia californica** Less. var. **insularis** (Rydb.) Munz, Man. S. Calif. Bot. 575 (1935)

Crossostephium insulare Rydb., N. A. Fl. 34: 244 (1916).

A rare shrub in the arroyos, worthy of varietal recognition because of the leaves which are so different from those of typical *A. californica*. Miss Eastwood had only sterile shoots and wrote: "if an *Artemisia*, it is probably undescribed." Hall and Clements in their monograph of the North American species of *Artemisia* discuss this interesting insular plant as minor variation number 7 under *A. californica* (Carn. Inst. Wash. Publ. No. 326: 54, —1923). Besides San Nicolas Island, it is known only from San Clemente Island, the type locality. No. 8219.

28. **Baeria Palmeri** var. **clementina** Gray, Syn. Fl. 1, pt. 2, ed. 2: 452 (1886)

Found in open grassy places and about protecting shrubs. By Hall, it is called *B. chrysostoma* var. *gracilis* f. *clementina* in Univ. Calif. Publ. Bot. 3: 171 (1907) and simply *B. chrysostoma* F. & M. in N. A. Fl. 34: 77 (1914).

29. **Coreopsis gigantea** (Kell.) Hall, Univ. Calif. Publ. Bot. 3: 142 (1907)

Leptosyne gigantea Kell., Proc. Calif. Acad. Sci. 4: 198 (1873).

A single robust specimen of this was seen in an arroyo back from the beach. It was nearly 2 m. tall with a crown about as broad which carried hundreds of yellow heads. No. 8220.

30. **Malacothrix implicata** Eastw., Proc. Calif. Acad. Sci., ser. 3, Botany, 1: 113 (1898)

M. saxatilis (Nutt.) T. & G. var. *implicata* (Eastw.) Hall, Univ. Calif. Publ. Bot. 3: 269 (1907).

Sterile specimens of this plant, first described from San Nicolas Island, were obtained from clay bluffs of an arroyo. No. 8228A.

31. **Sonchus asper** (L.) Hill, Herb. Brit. 1: 47 (1769)

Only a single plant of this weed was found. No. 8221.

32. **Sonchus oleraceus** L., Sp. Pl. 794 (1753)

No. 8229.

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**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 23

THE ROCCELLACEAE

**With Notes on Specimens Collected During the Expedition
of 1905-06 to the Galapagos Islands**

BY

OTTO VERNON DARBISHIRE

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PART I

This portion of the paper deals with specimens collected by Alban Stewart during the 1905-1906 expedition of the California Academy of Sciences to the Galapagos Islands, and is based on material in the Farlow Herbarium of Harvard University and the Herbarium of the California Academy of Sciences. The numbers cited below are those of the Stewart collection.

***Rocella portentosa* Mtg.**

Darbishire, O. V., *Monographia Rocelleorum, Bibliotheca Botanica*, p. 29, pl. 7-11, figs. 27-41, 1898; idem, *Pflanzenareale 2 (part 1)*: p. 4, 1928; Farlow, W. G., *Thallophytes and Musci of the Galapagos Islands, Proc. Am. Acad. Arts Sci.* 38: 83, 1902; Zahlbruckner, A., *Cat. Lich. Univ.* 2: no. 4187, 1924.

The specimens were on the whole apparently very weather beaten and old, but in their general habit quite typical of the species.

No. 393. Common on rocks, Barrington Island, October 20, 1905.

No. 394. Common on the sides of cliffs, Hood Island, September 26, 1905.

September 26, 1935

Rocella Babingtonii Mtg.

Darbishire, O. V., *Monographia Rocelleorum*, Bibliotheca Botanica, p. 47, pl. 18-19, figs. 83-85 and 87 and 88, 1898 (as *R. peruensis* Krphbr.); idem, *Pflanzenareale* 2:4, 1928 (as *R. peruensis* Krphbr.); Farlow, W. G., *Thallophytes and Musci of the Galapagos Islands*, Proc. Am. Acad. Arts Sci. 38: 87, 1902; Wainio, E. A., *Lichens. Catalogue of "Welwitsch's African Plants,"* part II, p. 434, 1901;¹ Zahlbruckner, A., *Cat. Lich. Univ.* 2: no. 4168, 1924.

The specimens were all typical, exhibiting the characteristic yellow coloring of the medullary hyphae inside the attachment organ.

- No. 382. Abundant on trees and bushes on the lower and dryer parts of the island, Villamil, Albermarle Island, March 7, 1906.
- No. 386. Common on the branches of trees on the lower parts of Charles Island, October 4, 1905.
- No. 387. Common on dead bushes, Hood Island, September 26, 1905.
- No. 388. The same, collected September 25, 1905.
- No. 390. On dead bushes, Indefatigable Island, southeast side, October 27, 1905.
- No. 391. Common on trees of *Bursera graveolens*, Jarvis Island, December 20, 1905.
- No. 392. The same, Barrington Island, October 26, 1905.

Rocellodea nigerrima Darbishire

Darbishire, O. V., A new genus of Rocellaceae. *Ann. Cryptog. Exot.* 5: 153, pl. 3, 1932.

The specimens in question were rather broken up. This is typical of the species. In form and anatomy too, the specimens correspond to the type. The apothecia however were old and blackened. The soralia were those typical of the species. The specimens were labelled *Rocella portentosa* Mtg. but certainly do not belong to that species. I do not really doubt that they belong to *Rocellodea nigerrima*.

- No. 395. Common on the sides of cliffs, Hood Island, September 26, 1905.
- No. 396. Covering the lower sides of projecting masses of lava, Charles Island, October 5, 1905.

¹ Wainio looks upon *R. peruensis* Krphbr. as always soraliferous and *R. Babingtonii* Mtg. as not bearing soralia.

PART II

The specimens mentioned in the second part of this paper were collected, for the most part, during the Templeton Crocker Expedition of the California Academy of Sciences in 1932. The specimens are deposited in the Herbarium of the California Academy of Sciences and in the Farlow Herbarium of Harvard University.

***Dendrographa leucophaea* (Tuck.) Darbishire**

Darbishire, O. V., *Monographia Rocelleorum*. *Bibl. Bot.*, p. 65, pl. 27, fig. 121, 1898; Zahlbruckner, A., *Cat. Lich. Univ.* 2: no. 4159, 1924.

(a) Collected on San Nicolas Island, California, *J. T. Howell*, March 13, 1932.

These specimens were fully grown, exhibiting externally the characteristic smooth, though stringy appearance of the cortex. Anastomoses between branches were not infrequent. Apothecia were plentiful and on the younger branches spermogonia also occurred.

(b) Collected at the south end of Guadalupe Island, Lower California, *H. L. Mason*, April, 1925.

These specimens were small and evidently represented young plants. The surface was smooth but in section showed the structure associated with *Dendrographa leucophaea*. Anastomoses were common, but apothecia and spermogonia completely absent.

***Rocella fimbriata* Darbishire, spec. nov.**

Plate 16, figures 1, 2; plate 17, figures 3, 4.

Thallus fruticulosus, basi placenta substrato affixus. Placenta² bene evoluta, crassa margine crescens, strato corticali instructa ex hyphis formato rectis, strato gonidiali instructa et strato medullari, cuius hyphae internae intense luteae sunt sed externae et substrati propincae nigrescentes. Podetia recta, basin versus constricta sed mox amplificata, complanata, ramosa, fimbriata, usque ad 6 et 10 mm. lata, et rarissime 15 mm., ad 10 cm. alta, apicibus angustioribus et paulo teretibus; stratum corticale ex hyphis formatum transversalibus, rectis; stratum gonidiale distinctum; gonidia *Trentepohliae* species; stratum medullare ex hyphis formatum longitudinalibus, conglutinatis, chondroideis. Apothecia lateralia, aut superficialia, basi paulo constricta et breviter stipitata, rotundata, 1 mm. lata, disco nigro instructa pruinoso, margine pallido, paulo elevato, laevi, deinde crenato, hypothecium nigrum, sub media parte ad 200 μ crassum, parathecium versus 30 μ crassum, gradatim in parathecium transiens, tenue; amphithecium evolutum, marginem efficiens, gonidiis instructum; paraphyses ramosae, apicibus fusciscentes (epithecium) et foris pruina albidam efficientes; thecium 60 μ altum; asci 10 μ crassi; sporae octonae, decolores, 28-32 x 5-8 μ , quadriloculares, paulo arcuatae, fusiformes. Spermogonia (apotheciis propinqua) simplicia, immersa, sed ostiolo paulo elevato, perithecio instructa decolori; ostiolum decolor; spermata bacillariformia, curvatula, 12-14 x 0.5 μ . Soralia non visa.

² The term "placenta" is due to Wainio (*Lich. Welw.* 1901, p. 443). It stands for "attachment organ" and it is to take the place of the "thallus" and "protothallus" of various authors, at any rate in the case of *Rocella*. It corresponds to the German term "Haftscheibe" (*Lindau, Lich. Beitr.* p. 59, 1895).

Habitat ad saxa maritima, California Inferior, Americae borealis.

Rocella fimbriata a *R. fuciformis* differt reactione chemica et morphologica et placentae medulla interna lutea; a *R. Babingtonii* differt hyphis placentae externis nigrescentibus; a *R. Montagnei* differt medulla placentae lutea; et a *R. decipienti* hyphis luteis placentae et thallo latiore.

Type: Herb. Calif. Acad. Sci. No. 221700, collected at South Bay, CEDROS ISLAND, Lower California, *Templeton Crocker*, August 17, 1932. Also collected at south end of GUADALUPE ISLAND, Lower California, *H. L. Mason*, April, 1925.

The material from both these localities was plentiful and thus it was easy to establish a new species. There is no doubt in my mind that the specimen identified as *Rocella peruensis* Krphbr. and figured in my Monograph on plate 19, fig. 86, is not an exceptionally broad specimen of *R. peruensis* (= *R. Babingtonii* Mtg.) but that it belongs to the new species. It was collected by Dr. Eckfeldt in Lower California and sent to me in 1897 and it is now in my own herbarium. In the Farlow Herbarium there are also specimens belonging to *Rocella fimbriata* collected on Guadalupe Island by Dr. Edward Palmer in 1889 (Flora California, Guadalupe Island, No. 905c) and labelled *Rocella leucophaea* Tuck. and relabelled *R. portentosa* Mtg. Some specimens in the Herbarium of the University of Michigan from the same source (Flora of Southern California, Coronados Island, No. 260c) collected by Dr. Palmer in 1888, labelled *Rocella leucophaea* Tuck. are also *Rocella fimbriata*. These particular specimens showed a very large number of apothecia borne on the flat portion of the upright podetia.

Rocella fimbriata follows in the general differentiation of its thallus the usual type of the members of its genus such as *Rocella fuciformis* (L) DC., *R. Montagnei* Bel., and *R. Babingtonii* Mtg. in having a well developed attachment organ from which arise upright flat podetia.

The attachment organ is firmly fixed to a rocky substratum. The outer tissues in immediate touch with the substratum consist of blackish hyphae, whereas the inner medullary hyphae are intensely yellow in color. In addition, cortex and gonidial layers are seen. The whole attachment organ exhibits marginal growth and it is from the mature metathallus of the attachment organ that the upright podetia arise and in the end these stand so close together that little can be seen of the actual attachment organ. The cortex and gonidia together form a tissue about 120-140 μ in depth. The gonidia do not form a very dense layer but their *Trentepohlia*-branching is very clearly seen. The want of light at this point may affect the healthy development of the gonidia. The yellow hyphae of the medulla measure 2-3 μ in thickness and they possess a thin but hard

wall. The black hyphae are slightly thinner and also show a firm wall.

The upright flat podetia vary in breadth from 3-6 mm., with a height of about 10 cm. Occasionally the breadth may exceed 15 mm. The podetia are narrow just above the point where they are attached to the attachment organ. They then broaden out gradually. The branching seems to take the form of a splitting or lobing of the flat frond. Frequently numerous narrower portions arise on one or both sides of a flat podetium, thus producing a fimbriate appearance. The broadest portion is generally about 4-5 cm. above the attachment disk. In most of the specimens the branches seemed to bend over to one side but this may not be the case under natural conditions. In any case, branching seems to take place more or less in one plane. The side branches are always much narrower than the main stems. The color of the podetium is a faint yellowish or greenish-gray, merging sometimes into a deeper but faint reddish-brown. The color on one side is often darker than on the other. When the thallus is moistened, the color generally tends to become faintly greenish throughout. The upright thallus of this species is tough and hard and not easily bent. It is slightly brittle.

In the metathallus of the podetium, the cortex in its structure to a certain extent resembles that of *R. fuciformis*, fasciated bundles of hyphae passing out into the cortex and then spreading out to make the cortical hyphae stand out at right angles to the outer surface. The separate hyphae are not, however, so closely cemented together as they are in *R. fuciformis* and they form a smooth outer surface. In the median portion of a flattened podetium the cortex is 40-50 μ deep but groups of gonidia may push their way in between the hyphae bundles, often getting as near as 20 μ to the outside of the cortex. The cortical hyphae are 2-4 μ in diameter with a lumen of about 1.5 μ . Further inside, the hyphae have a smaller lumen. Between the gonidia, hyphae not passing out into the cortex are barely 2 μ in diameter. They are in touch with the gonidia by means of haustoria. The gonidia measure about 4 x 10 μ and are oval in shape and belong to the algal genus *Trentepohlia*. The whole gonidial layer may be 40-50 μ deep. The combined cortical and gonidial layers are deeper in the middle line of the flat podetium and much shallower at the edges. This is the case, too, with *R. fuciformis*. It is at this edge that the lateral expansion of the podetium mainly takes place and it is where the new hyphae are actively pushing their way into the cortex. Also, it is at this point that apothecia generally arise, and in *R. fuciformis*, also the soralia. In a younger portion of the podetium, the fasciated hyphae giving rise to the cortex are well seen.

The medulla of the mature podetium is of the usual *Roccella* type. The hyphae run longitudinally in the main, and they are firmly cemented to form strands. These strands anastomose in the way characteristic of *Roccella*. The separate hyphae are about 6-7 μ in diameter with a lumen barely 1 μ across. There are thinner hyphae between the bigger ones. Towards the attachment organ, the medullary hyphae become more closely cemented together.

Apothecia and spermogonia are found on the same podetia, often very close together, but in that case the latter are generally no longer active. Young spermogonia still containing spermatia are to be observed nearer the tips of the branches, where mature apothecia do not yet occur. The apothecia seem to arise mainly at the edges of the flat podetia. Many, however, are later formed on the flat surface, especially in the broadest specimens. This may in part be due to the apothecia gradually moving away from the edges as the fronds expand by active marginal growth. But that is not always so, and many apothecia certainly arise actually away from the edges. Apothecia appear to be mature when they are about 1 mm. in diameter, when they are circular in outline and have a black disc which is whitely pruinose. As the apothecia become older, their smooth and entire margin becomes crenate. These apothecia do not generally contain spores. As is the case in many species of *Roccella*, they just grow vegetatively and no longer function as apothecia.

The epithecium consists of dark brown hyphae about 1-2 μ thick which end in the colorless tips forming the pruina. The whole epithecium is about 40 μ deep. The thecium is 60 μ deep and the narrow asci are 10 μ across, the spores measuring 28-32 x 5-8 μ . They are in shape quadrilocular, cylindrical, slightly arcuate and colorless. The hypothecium is black and 200 μ deep under the center of the apothecium, tapering to 30 μ at the margin where it passes into the parathecium, which is thin and slightly brown. The hyphae of the hypothecium and parathecium are firmly united and thus form the usual air-tight cup in which the thecium rests. The amphithecium is well developed and contains gonidia. The whole apothecium is slightly raised above the level of the podetium and shows a constriction at that point. It therefore appears to be shortly stalked.

The spermogonia are of the usual flask-shaped form, the narrow ostiole being slightly elevated. The whole spermogonium is 170-200 μ high and 100-120 μ broad. The actual air-tight wall is colorless and about 25 μ thick. The spermatia are 12-14 μ long and about 0.5 μ thick. They are colorless and slightly curved.

Soralia have not been observed.

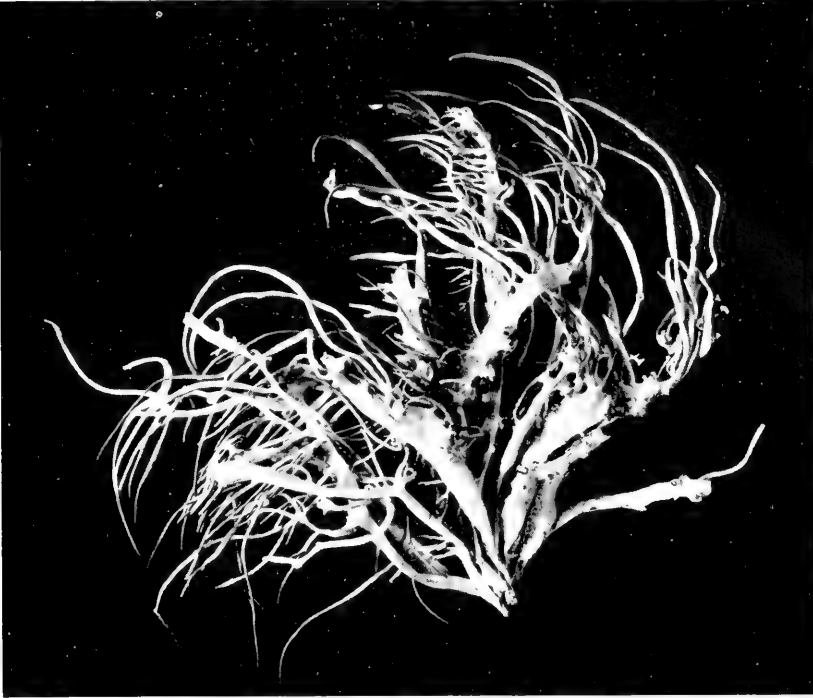


Fig. 1. *Roccella fimbriata* Darbshire, sp. nov. $\times 11/12$.

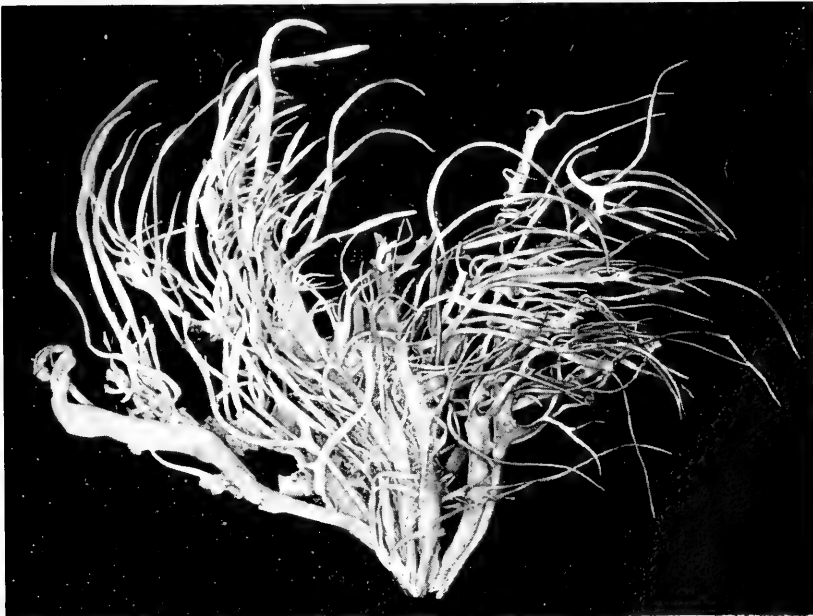


Fig. 2. *Roccella fimbriata* Darbshire, sp. nov. $\times 1/1$.



Fig. 3. *Rocella fimbriata* Darbshire, sp. nov. $\times 7/8$.



Fig. 4. *Rocella fimbriata* Darbshire, sp. nov. $\times 5/8$.

There is a certain resemblance between *R. fimbriata* and *R. Montagnei* Bel., *R. fuciformis* (L.) DC., and *R. Babingtonii* Mtg. The more or less uniformly broad and thick frond of the podetium of *R. fuciformis* separates this species from the new one. The gradual narrowing down from almost the base of the podetium of *R. Montagnei* and *R. Babingtonii* separates these two species. Of the four species, *R. fimbriata* and *R. fuciformis* are the hardest and toughest, though *R. fuciformis* is perhaps the more fragile. The medulla in the attachment organ of *R. Montagnei* and *R. fuciformis* is colorless, while yellow in the other two species. In addition, in *R. fimbriata*, the outer tissues of the attachment organ are black; the cortex of the podetium turns red with Ca ClO_2 in all cases except *R. fuciformis*. The podetia of *R. decipiens* Darbishire are narrower than those of *R. fimbriata* and the inner medullary hyphae of the attachment organ are white in color, but those in touch with the substratum are black.

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**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 24

**NEW SPECIES OF GRASSES FROM THE GALAPAGOS
AND THE REVILLAGIGEDO ISLANDS**

BY

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(With an introductory paragraph by John Thomas Howell)

During the course of the Templeton Crocker Expedition of the California Academy of Sciences in 1932, more than 250 specimens of grasses were collected in Mexico, Central America, and the Galapagos Islands by Mr. John Thomas Howell, botanist of the expedition. The entire collection was referred to Dr. A. S. Hitchcock, United States Department of Agriculture, who, with Mrs. Agnes Chase, kindly named the species. A full report on the grasses will accompany the account of the vascular plants of the expedition which is now being prepared. But, since several years will probably elapse before it is completed, descriptions of the new grasses found in the collection have been prepared for publication. The new species of *Trisetum* from the Galapagos Islands and the two new species of *Aristida* from the Revillagigedo Islands, Mexico, have been described by Dr. Hitchcock, while the new Galapagian species and variety of *Paspalum* have been named by Mrs. Chase.

J. T. H.

September 26, 1935

30 1935

Trisetum Howellii Hitchcock, spec. nov.

Perenne; culmi laxe caespitosi, erecti, tenues, glabri, 70 cm. alti, nodis multis; vaginae glabrae vel paullum pilosae; ligula 1-2 mm. longa; laminae planae, laxae, glabrae, 10-15 cm. longae, 1-3 mm. latae; panicula angusta, laxiuscula, 10-15 cm. longa, ramis tenuibus, laxe appressis, paucifloris, 1-3 cm. longis; spiculae 2-florae; rachilla pilosa; glumae aequales, angustae, acuminatae, 4 mm. longae, prima 1-nervia glabra, secunda 3-nervia quam prima latior, carina scabra; lemmata glabra tenuiter 5-nervia, callo breviter piloso, apice acuta, primum 3-3.5 mm. longum, secundum quam primum paulo minus, 1 mm. infra apicem aristam geniculatam circa 5 mm. longam exserentia.

Perennial; culms rather loosely caespitose, erect, slender, glabrous, several-noded, about 70 cm. tall; sheaths striate, glabrous or the lower sparingly short-pilose; ligule 1-2 mm. long; blades flat, lax, glabrous, or somewhat scaberulous on the upper surface, often somewhat bulged out on the margins at base, 10-15 cm. long, 1-3 mm. wide; panicle erect, narrow, rather lax, brownish or greenish, 10-15 cm. long, the axis slender, scaberulous or nearly glabrous, the slender branches loosely appressed, 1-3 cm. long, loosely flowered; glumes equal in length, narrow, acuminate, about 4 mm. long, the first 1-nerved, glabrous or slightly scabrous on the keel near the slightly awn-pointed tip, the second a little broader than the first, strongly 3-nerved, scabrous on the keel; florets 2, the slender rachilla joint pilose, 1 mm. long; first lemma 3-3.5 mm. long, faintly 5-nerved, glabrous, short-pilose on the callus, the hairs less than 0.5 mm. long, the apex rather firm, acute, the awn from about 1 mm. below the tip, geniculate, about 5 mm. long; second lemma similar to the first, smaller, the hairs at the summit of the rachilla joint below about 1 mm. long, the rachilla extending above about 1 mm., pilose, the hairs at summit about 1 mm. long.

Type: Herb. Calif. Acad. Sci. No. 211262, co-type in the U. S. National Herbarium, collected on Mt. Crocker, INDEFATIGABLE ISLAND, Galapagos Islands, March 9, 1932, *J. T. Howell No. 9208.*

Aristida tenuifolia Hitchcock, spec. nov.

Culmi dense caespitosi, tenues, 1 m. alti, nodis multis; ligula brevissima; laminae plerumque involutae, tenues, interdum basi planae (1-1.5 mm. latae), glabrae; panicula angusta, patula, 15-20 cm. longa, ramis ascendentibus, laxe paucifloris, inferioribus 5 cm. longis; glumae aequales, attenuatae, 10-12 mm. longae; lemma 1 cm. longum, apice minute scaberulo vix torto, callo 0.5 mm. longo dense et breviter piloso; aristae denique horizontaliter patulae, basi paulo tortae, laterales 1-1.5 cm. longae, media paulo longior.

Culms densely caespitose, with numerous innovations, slender, many-noded, about 1 mm. thick, about 60 cm. tall; sheaths glabrous, not keeled, bearing a few long hairs at the summit on each side of the blade; ligule very short, scarcely measurable; blades at first flat below and involute above, as much as 20 cm. long, those of the innovations closely involute, the flat base as much as 1.5 mm. wide, firm, bearing a few scattering long hairs, otherwise glabrous on both surfaces and margin, the margins and center thickened; panicles narrow, somewhat condensed, 15-20 cm. long, the axis slightly scabrous, the branches ascending, rather loosely few-flowered, the lower about 5 cm. long; glumes equal, attenuate to an awn-point, 10-12 mm. long, the first 3-nerved, scabrous on the nerves, the second weakly 3-nerved, glabrous; lemma about 1 cm. long, glabrous, minutely scabrous near the scarcely twisted summit, the callus slender, 0.5 mm. long, densely short-pilose; awns finally strongly or horizontally divergent, somewhat contorted at base, the lateral 1-1.5 cm. long, the central a little longer.

Type: Herb. Calif. Acad. Sci. No. 211473, co-type in U. S. National Herbarium, collected among rocks on ridge above Sulphur Bay, CLARION ISLAND, Revillagigedo Islands, March 23, 1932, J. T. Howell, No. 8361.

This species differs from *A. vaginata*, in its more slender culms about 60 cm. tall, its narrower mostly involute blades, with scattering long hairs on the upper surface near the base, and looser, shorter panicles. The spikelets are similar, though the awns are somewhat shorter and are finally widely spreading.

***Aristida vaginata* Hitchcock, spec. nov.**

Perennis; culmi caespitiosi, erecti, robusti, 1 m. alti, nodis multis; vaginae numerosae, imbricatae; laminae durae, planae, elongatae, supra scabrae, subtus glabrae, 1-4 mm. latae, longe attenuatae; panicula angusta, condensata, 20-30 cm. longa, ramis appressis; glumae paulo inaequales, longe attenuatae, circa 1 cm. longae, prima scabra, secunda glabra; lemma glabrum, 10-15 cm. longum, apice (2-3 mm.) leviter torto et scabro, callo dense et breviter piloso; aristae aequales, aequaliter patulae, 2-3.5 cm. longae, basi paulo contortae.

Culms caespitose, erect, many-noded, stout, about 2.4 mm. thick on the lower part, about 1 m. tall; sheaths overlapping, glabrous, tight, not at all keeled, broader than the base of the blade, the shoulder on each side obscurely pubescent and also villous with a few long hairs; ligule a firm short ciliolate membrane, less than 0.5 mm. long; blades of the culm firm, flat, glabrous beneath or obscurely pubescent near the base, strongly sulcate-striate and scabrous on the upper surface, elongate, as much as 4 mm. wide, long-attenuate and involute at tip; panicles narrow, condensed, about 30 cm. long, the axis scabrous, the branches, branchlets, and spikelets all appressed, the branches 5-8 cm. long, overlapping; glumes narrow, somewhat unequal, gradually narrowed into an awn-tip, the first about 1 cm. long, 3-nerved, more or less scabrous on the nerves, the second a little longer, weakly nerved, less scabrous; lemma slender, 10-15 mm. long, glabrous on the lower half, scaberulous above, the upper 2 to 3 mm. long, rather weakly twisted and lighter in color, the callus rather blunt, about 0.5 mm. long, densely short-pilose; awns about equally divergent, ascending, about equal in length, 2-3.5 cm. long, more or less contorted at base.

Type: Herb. Calif. Acad. Sci. No. 211474, co-type in U. S. National Herbarium, collected on dry slopes, north anchorage, SOCORRO ISLAND, Revillagigedo Islands, March 29, 1932, J. T. Howell No. 8448.

No. 8386 collected on the same island at Benner's Cove is somewhat less robust.

***Paspalum galapageium* Chase, spec. nov.**

Perenne, dense caespitosum; culmi 45-80 cm. alti, interdum basi racemos brevissimos sessiles ferentes; laminae planae, 15-25 cm. longae, 3-8 mm. latae, utrinque dense canescentes; racemi 2-8, ascendentes vel patentes, 3-6.5 cm. longi; rachis 0.6-0.8 mm. lata, scabra; spiculae binatae, 2-2.8 mm. longae, 1.5-1.8 mm. latae, ellipticae, subacutae; gluma prima interdum extans; gluma secunda et lemma sterile subaequalia vel gluma quam lemma brevior, 3-nervia, glabra; fructus 2-2.3 mm. longus, 1.5 mm. latus, laevis, nitens.

Perennial, grayish-olivaceous; culms 45 to 80 cm. tall, simple, leafy to the summit or nearly so, sometimes with a few to several few-flowered racemes of cleistogamous spikelets in the basal sheaths; sheaths mostly overlapping, from glabrous to finely canescent toward the summit, the margin sometimes ciliate; ligule fragile, 2 to 4 mm. long; blades flat, mostly 15 to 25 cm. long, 3 to 8 mm. wide, densely canescent on both surfaces, the pale midnerve prominent beneath; racemes 2 to 8, mostly 4 to 6, ascending to spreading, 3 to 6.5 cm. long, rather distant on a slender axis; rachis flexuous, 0.6 to 0.8 mm. wide, scabrous and with a tuft of long hairs at base; spikelets in pairs or the lower of the pair often undeveloped on flat scabrous pedicels, mostly not crowded, 2 to 2.8 mm. long (typically 2.3 to 2.8 mm.), 1.5 to 1.8 mm. wide, elliptic, subacute (the cleistogamous basal ones slightly larger, more turgid); first glume occasionally developed; second glume and sterile lemma subequal, or the glume somewhat shorter, 3-nerved, glabrous, mostly pale, sometimes obscurely speckled with pale brown; fruit 2 to 2.3 mm. long, about 1.5 mm. wide, pale, smooth and shining.

Type: Herb. Calif. Acad. Sci. No. 211105, co-type in U. S. National Herbarium, collected 3 miles south of the Equator, east side of ALBEMARLE ISLAND, Galapagos Islands, May 30, 1932, *J. T. Howell No. 9612.*

In the type specimen the visible basal cleistogenes are only 3, and are 3 mm. long, the other spikelets are 2.5 to 2.8 mm. long and the first glume is developed in occasional spikelets.

This species was described by Andersson as *Paspalum canescens* but since that name is preoccupied, Andersson's specimen incomplete, and his description inadequate, *Paspalum galapageium* is based on a new type instead of on *P. canescens* Anderss.

Paspalum canescens Anderss., Vet. Akad. Handl. Stockh. 1853: 132. 1855. Not *P. canescens* Nees, 1826. "Hab. in insula Abemarle [Albemarle] locis siccissimis elevatis." The type, collected by Andersson, was examined by A. S. Hitchcock in the Riksmuseets, Stockholm.

Of the ten collections referred to this species only three, the type and *Howell No. 8905* and *No. 9375A*, show the basal cleistogenes, but the Snodgrass & Heller and most of the Stewart collections show little or nothing of the base. The spikelets vary in size, even in individual plants, more than usual in *Paspalum*. In Andersson's type and in the three Howell collections mentioned above the spikelets range from 2.3 to 2.8 mm. long; in *Howell No. 9531*, and *Stewart No. 1310* they range from 2 to 2.5 mm., and in *Howell No. 9424* and *No. 9508*, and *Stewart No. 1309* and *No. 1319* from 2 to 2.3 mm. In all the blades are velvety-canescant.

Known only from the Galapagos Islands.

Albemarle Island: Tagus Cove, *Howell No. 9508*; *Snodgrass & Heller No. 198*. Tagus Cove Mountain, *Howell No. 9531*, *Stewart No. 1309* and *1319*. Iguana Cove, *Howell No. 9424*. East side, 3 miles south of the Equator, *Howell No. 9612*.

Charles Island: Black Beach, *Howell No. 8905*. Post Office Bay, *Howell No. 9375A*.

James Island: Sullivan Bay, *Howell No. 10019*.

Narborough Island: north side, *Stewart No. 1310*. South side, *Snodgrass & Heller No. 312*.

***Paspalum galapageium* var. *minoratum* Chase, var. nov.**

Laminae minores canescentes vel glabrescentes; racemi 2-6; rachis 0.5 mm. lata; spiculæ 1.5-1.8 mm. longae, 1.3-1.4 mm. latae, obovatae.

Culms ascending to spreading, 30 to 70 cm. tall; foliage mostly darker olivaceous, the blades less densely canescent to glabrescent; racemes 2 to 6, mostly arcuate-spreading, the rachis 0.5 mm. wide; spikelets 1.5 to 1.8 mm. long, 1.3 to 1.4 mm. wide, broadly obovate; glume and sterile lemma subequal, mostly more thickly spotted with pale brown.

Type: Herb. Calif. Acad. Sci. No. 211101, co-type in U. S. National Herbarium, collected at Academy Bay, INDEFATIGABLE ISLAND, Galapagos Islands, May 2, 1932, *J. T. Howell No. 9042*.

The type and most of the specimens assigned here might be considered specifically distinct, but the differences are in degree. Since the spikelets of the species vary so greatly it seems more reasonable to regard these smaller plants with smaller spikelets as a variety.

This form appears to be what Andersson (Vet. Akad. Handl. Stockh. 1853: 132. 1855) referred to *Paspalum longepedunculatum* LeConte, a very different species, known only from the United States. The Darwin and Macrae collections referred to *P. longepedunculatum* by Hooker (Linn. Soc. Trans. 20: 171. 1847) may, judging from his discussion, have included *P. galapageium*. No basal cleistogenes are found in any of the specimens referred to the variety, and in only a few spikelets of *Stewart's No. 1317* is a first glume developed.

Stewart's No. 1322, with spikelets 2 mm. long and glabrescent blades is intermediate.

Known only from the Galapagos Islands.

Albemarle Island: Iguana Cove, in bunches on sides of cliffs above the Cove, *Stewart No. 1317* and *1318*. Villamil, common at 3150 feet, *Stewart No. 1311*.

Charles Island: north side of Floreana Peak, *Howell No. 9321*.

Chatham Island: Wreck Bay, *Stewart No. 1321* and *1322*.

Indefatigable Island: Academy Bay, *Howell No. 9042*; "50 to 75 feet, only 4 or 5 clumps," *Svenson No. 59*; Mt. Crocker, *Howell No. 9226*.

***Paspalum redundans* Chase, spec. nov.**

Perenne, dense caespitosum; culmi erecti vel ascendentes, 70-90 cm. alti, basi racemos brevissimos numerosos breviter pedunculatos spicularum cleistogamarum ferentes; laminae planae, 5-20 cm. longae, 3-7 mm. latae, utrinque pilosae; racemi paniculae terminales 2-4, erecti vel ascendentes, 2.5-6 cm. longi; rachis 1.1-3 mm. lata, scabra; spiculae binatae subcrebrae, 4-5 mm. longae, 2.5-2.8 mm. latae, obovatae; gluma et lemma sterile subequalia, 5-nervia, glabra; fructus 4 mm. longus, 2.3-2.5 mm. latus, laevis, nitens.

Perennial; culms compressed, in dense tufts, erect or ascending, 70 to 90 cm. tall, simple, leafy nearly to the summit, with numerous short racemes of cleistogamous spikelets at base, some partly hidden in the basal bladeless sheaths, some on peduncles 1 to 7 cm. long; foliage olivaceous, somewhat purplish at base, the sheaths mostly overlapping, pilose toward the summit to nearly glabrous, the lower short, loose, bladeless; ligule fragile, about 2 mm. long; blades flat, 5 to 20 cm. long, 3 to 7 mm. wide (the uppermost much-reduced), finely papillose-pilose on both surfaces, the pale midnerve rather prominent beneath; racemes of the terminal panicles 2 to 4 (mostly 3), erect to ascending, 2.5 to 6 cm. long, on a slender but stiff channeled axis; rachis flexuous, 1 to 1.3 mm. wide, scabrous and usually with a few long hairs at base; spikelets in pairs on short flat scabrous pedicels, somewhat crowded, 4 to 5 mm. long, 2.5 to 2.8 mm. wide, obovate, turgid; glume and sterile lemma rather firm, subequal, 5-nerved (the marginal nerves sometimes obscure), glabrous, tinged with purplish brown; fruit about 4 mm. long, 2.3 to 2.5 mm. wide, grayish-tawny, smooth and shining; basal racemes 1 or 2 on short peduncles, of 2 to 6 spikelets.

Type: Herb. Calif. Acad. Sci. No. 211116, co-type in U. S. National Herbarium, collected on the north side of INDEFATIGABLE ISLAND, Galapagos Islands, June 9, 1932, *J. T. Howell* No. 9902.

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**THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932**

No. 25

THE RECENT PECTINIDAE

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Eleven species of pectens are present in the collection made by the Templeton Crocker Expedition to the Galapagos Islands in 1932.

The writer wishes to express his appreciation to Mr. Templeton Crocker whose interest and generosity provided the collection. Acknowledgment is also due Dr. G. Dallas Hanna for photography of the specimens illustrated in this paper. Mr. W. M. Grant also assisted with the preparation of certain of the photographs. The author also acknowledges the kindness of Dr. Alexander Wetmore, Assistant Secretary, Smithsonian Institution, who furnished photographs of certain specimens in the U. S. National Museum.

The genus *Pecten* is attributed to Müller whose valid usage of the name is rather generally accepted. The type species is *Ostrea maxima* Linnaeus. A few authors have accepted Osbeck's¹ usage as valid, but that author's use of the name has been discussed by Dall², Iredale³, and by Winckworth⁴, all of whom rejected it.

It is not definitely known what species was represented by Osbeck's reference to "*Pecten adscensionensis*." Iredale suggested it might even be a *Spondylus*, and Winckworth suggested it might be *Spondylus powelli* Smith. Under the circumstances it seems far better to accept Müller as the author of the genus *Pecten*.

¹ See Grant IV, U. S., and H. R. Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, pp. 157, 158.

² Dall, W. H., Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 400.

³ Iredale, T., Trans. New Zealand Inst., vol. 49, pt. 3, 1915, p. 194.

⁴ Winckworth, R., Jour. Conch., vol. 20, no. 2, 1934, p. 51.

Pecten (Pecten) diegensis Dall

Plate 19, figures 5, 6

Pecten floridus Hinds, Zool. Voy. *Sulphur*, Moll., pt. 3, 1844 [dated January, 1845 on cover of pt. 3], p. 60, pl. 17, figs. 6, 6a. "Inhab. San Diego, California. In five fathoms among mud."

Not *Ostrea* [= *Pecten*] *florida* Gmelin, Linn. Syst. Nat., Ed. 13, vol. 1, pt. 6, 1790, p. 3330. "Habitat . . .". (Reference given to Gaultieri, Test., T. 74, f. Q.).—Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1887, p. 212, Taf. 57, fig. 2. Earlier record cited.

Pecten (Pecten) diegensis Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898, p. 710. New name for *P. floridus* Hinds, not *Ostrea* [= *Pecten*] *florida* Gmelin.—Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 127, pl. 51, figs. 1, 1a, 1b. Pleistocene at San Diego, California. Recent from Monterey to San Diego, California.—I. S. Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, 1924, p. 51, pl. 29, fig. 5; pl. 41, fig. 3.

Range: Monterey Bay, California to the San Benito Islands, Lower California. Fossil in the Pleistocene.

A fragment of the right valve of *Pecten diegensis* was dredged by the Templeton Crocker Expedition at Loc. 27603 (C. A. S.) in 30 to 50 fathoms off San Nicolas Island, California. Mr. H. N. Lowe has collected the species at San Benito Islands, Lower California, at a depth of 10 fathoms.

The stronger, squarer and slightly narrower ribs and the slightly narrower interspaces on the right valve, and the strongly rounded, and more closely spaced ribs in the adult stage of the left valve, separate this species from the more southern *P. sericeus* Hinds. The ribs and interspaces of *P. diegensis* are crossed by imbricating lamellae.

The smaller number and greater height of the ribs and the relatively longer hinge line separate *P. diegensis* from *P. stearnsii* Dall which occurs in the Pliocene. Related forms which occur as fossils, include *P. beali* Hertlein, *P. bösei* Hanna & Hertlein, and *P. bakeri* Hanna & Hertlein. The last two forms are quite distinct and not synonymous as indicated by Grant and Gale. Bavay⁵ has mentioned a similarity between *P. diegensis* and a fossil form found in Patagonia.

Pecten soror codercola Harris⁶ from the later Tertiary of Venezuela, belongs to the present group. *P. soror* Gabb⁷ from the medial Tertiary of Santo Domingo, and *P. hemicyclus* Ravenel⁸ from the

⁵ Journ. de Conchyl., vol. 54, no. 1, 1906, p. 10.

⁶*Pecten soror codercola* Harris, Bull. Amer. Paleo., vol. 13, Bull. 49, 1927, p. 23, pl. 13, fig. 3; pl. 14, figs. 1, 5; pl. 15, fig. 7. "Districts of Democracia and Colina, State of Falcón, locality numbers 69,123." Venezuela. "Miocene and Pliocene."

⁷*Janira soror* Gabb, Trans. Amer. Phil. Soc., vol. 15, 1873, p. 257. Santo Domingo.

Pecten soror Gabb, Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pt. 2, 1922, p. 410, pl. 44 figs. 1, 2.

⁸*Janira hemicycla* Ravenel, in Tuomey & Holmes, Pleiocene Fossils of South-Carolina, 1857, p. 25, pl. 8, figs. 1, 2, 3, 4. "Grove, Cooper River."

Pecten (Chlamys) kathrinepatmerae Tucker, (Proc. Indiana Acad. Sci., vol. 40, 1931, p. 244, pl. 1, figs. 2, 5. "Near Baileys Ferry, Fla." "Chipola Miocene.") has been compared to *P. hemicyclus*, by Tucker.

later Tertiary of South Carolina, also bear some resemblance to the present group.

P. diegensis shows some resemblance to *P. fraterculus* Sowerby of the *P. besseri* group, which occurs in the later Tertiary of the Mediterranean region.

Pecten (Pecten) sericeus Hinds

Plate 18, figures 14, 15; plate 19, figures 3, 4

Pecten sericeus Hinds, Zool. Voy. *Sulphur*, Moll., pt. 3, 1844 [dated January, 1845 on cover of pt. 3], p. 60, pl. 17, figs. 1, 1a. "Inhab. Bay of Panama. In fifty fathoms, on a muddy floor."—Reeve, Conch. Icon., vol. 8, *Pecten*, 1852, sp. 23, pl. 5, fig. 23. "Bay of Panama (on a muddy floor at the depth of fifty-three fathoms); Belcher."—Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1887, p. 211, Taf. 57, fig. 1. Original record cited.—Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 400. "Panama Bay, 53 fathoms, Hinds." Also "near Cocos Island, Gulf of Panama, in 66 fathoms, rocky bottom, temperature 58°.4F."

Not *Pecten sericeus* Verneuil, Keyserling, Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-Land, im Jahre 1843, (St. Petersburg), 1846, p. 246, Tab. 10, fig. 12. "Aus den Permischen Schichten im grauen Mergelkalke an der Uchta des Wymm, und im Kalksteine am Wel bei dem Dorfe Kischerma." (= *Avicula sericea* Verneuil, in Murchison, Verneuil & Keyserling, Geol. Russia, vol. 2, Aug. 1845, p. 321, Tab. 20, fig. 5.)

Not *Pecten sericeus* Grönwall & Harder, Danmarks Geol. Undersog., ser. 2, vol. 18, 1907, p. 28.—Ravn, Mem. l'Acad. Roy. Sci. et Lett. Danemark, Copenhague, Sect. Sci., ser. 9, vol. 5, no. 2 (D. Kgl. Danske Vidensk. Selsk. Skrifter, Naturv. og Math., Afd. 9, Række 5, No. 2), 1933, p. 20. Denmark. Danian, upper Cretaceous.

Range: Panama to Acapulco and Mazatlan, Mexico. Cocos Island; Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W.; and Maria Madre Island, Tres Marias Group, Mexico.

Templeton Crocker Expedition:

Loc. 27527 (C. A. S.), dredged in Acapulco Bay, Mexico.

Loc. 27584 (C. A. S.), dredgings about 10 miles due east of San Jose del Cabo, Lower California, Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W. 20-220 fathoms.

Also in the collections of the California Academy of Sciences:

Loc. 23779 (C. A. S.), off Maria Madre Island, Tres Marias Group, Mexico, in five to ten fathoms. G. D. Hanna & E. K. Jordan, colls.

Loc. 27202 (C. A. S.), dredged in Acapulco Bay, Mexico. L. G. Hertlein, coll.

Loc. 27223 (C. A. S.), Mazatlan, Sinaloa, Mexico. L. G. Hertlein, coll.

The shell of *P. sericeus* resembles that of *P. diegensis* Dall. The right valve is usually somewhat less brightly colored than the left. The ribs on the right valve are somewhat lower and broader and separated by slightly wider interspaces than those of *P. diegensis* Dall. Young specimens of the two species are very similar. The development of stronger, narrower and more squarish ribs, crossed by sharp, concentric, raised lines, appears to take place earlier on the right valve of *P. diegensis* than on *P. sericeus*. According to Reeve, the ribs on the large left valve of the type specimen of *P. sericeus* are sharply triangular. The specimens of *P. sericeus*, at hand, are small forms, and the ribs on the left valves are not especially triangular, but they are less prominent and wider spaced than those on *P. diegensis*. In very large specimens of *P. diegensis*, the ribs on the left valve show a slight tendency toward a triangular shape in the later stages of growth.

It seems probable that *P. sericeus*, a southern species, intergrades with the northern *P. diegensis*.

The single, small valves found at Locs. 23779 (C. A. S.), from Maria Madre Island, Mexico, and 27223 (C. A. S.), Mazatlan, Mexico, seem referable to *P. sericeus* rather than to *P. diegensis*.

Pecten (Pecten) vogdesi Arnold

Plate 19, figures 16, 17

Pecten dentatus G. B. Sowerby, Proc. Zool. Soc. London, 1835, p. 109. "Hab. ad Sanctam Elenam." "Among sand and stones in twelve fathoms."—Kobelt, Syst. Conchyl.-Cab. Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1887, p. 155, Taf. 44, figs. 1, 2. Original record cited.—Olsson, Nautilus, vol. 37, no. 4, 1924, p. 127. "Lobitos," Peru. "Salinas," Ecuador.

Not *Pecten dentatus* J. Sowerby, Miner. Conch. Great Britain, vol. 6, 1829, p. 143, Tab. 574, fig. 1. Fossil at "Bugbrook and Staverton, in Northamptonshire."

Pecten (Pecten) excavatus Anton, Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 134, pl. 46, figs. 1, 1a, 1b. Gulf of California. Recent.

Not *Pecten excavatus* Anton, Verzeich. der Conchyl., 1839, p. 19, no. 710. China.

Pecten (Pecten) vogdesi Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 100, pl. 33, figs. 1, 1a; pl. 34, fig. 1, "San Pedro formation (Pleistocene), San Pedro, Los Angeles County Calif." Also other localities.

Pecten (Euvola) cataractes Dall, Nautilus, vol. 27, no. 11, p. 121, 1914. New name for *P. dentatus* G. B. Sowerby, not *P. dentatus* J. Sowerby.

Pecten (Janira) vogdesi Arnold, Grant & Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 228, pl. 3, figs. 3a, 3b.

Range: Magdalena Bay, Lower California; Gulf of California and south to Paita, Peru. Pliocene and Pleistocene of California and Lower California.

Templeton Crocker Expedition:

Loc. 27581 (C. A. S.), between Isabel Island and Mazatlan, Mexico.

Loc. 27584 (C. A. S.), dredged about 10 miles due east of San Jose del Cabo, Lower California, Lat. $23^{\circ} 03'$ to $23^{\circ} 06'$ N., Long. $109^{\circ} 31'$ to $109^{\circ} 36'$ W.

Also in the collections of the California Academy of Sciences from:

Loc. 23802 (C. A. S.), San Luis Gonzaga Bay, Gulf of California.

Loc. 27229 (C. A. S.), Bahia Honda, Veragua, Panama, in three to nine fathoms. L. G. Hertlein coll.

Loc. 27827 (C. A. S.), Puerto Bellandra, Carmen Island, Gulf of California.

Loc. 23779 (C. A. S.), Maria Madre Island, Tres Marias Group, Mexico.

Pecten vogdesi is well known in the Recent fauna from Magdalena Bay, Lower California, and the Gulf of California, south to Peru.

The highly arched right valve, which is ornamented by low rounded ribs, and the flat or concave lower valve easily distinguish this species from others in the Recent fauna of tropical North America. Exteriorly the shell is usually colored light brown or reddish brown.

The fewer ribs, and greater convexity of the right valve of *P. hartmanni* Hertlein from the Pliocene of Lower California, easily separate it from *P. vogdesi*.

P. vogdesi and *P. hartmanni* appear to belong to the *P. benedictus* group which occurs in the Miocene and Pliocene of the Mediterranean region.

***Pecten (Chlamys) amandi* Hertlein, new name**

Pecten australis Philippi, Archiv f. Naturgesch., Jahrg. 11, Bd. 1, 1845, p. 56.

"Patria: Insulae Chonos."

Not *Pecten australis* Sowerby, Thes. Conch., vol. 1, 1842, p. 76, pl. 19, figs. 210, 220.

"Swan River," Australia.

Pecten rosaceus Stempel, Zool. Jahrb., Suppl.-Bd. 6, 1902 (Fauna Chilensis), p. 228. "Fundort: Calbuco," Chile, Recent. New name for *P. australis*

Philippi, not *P. australis* Sowerby.—Dall. Proc. U. S. Nat. Mus., vol. 37, 1909, p. 256. "Calbuco, Chiloë, and the Chonos Islands."

Not *Pecten rosaceus* Deshayes, Conchyl. d. l'Île d. Réunion, 1863, p. E-31. [No description.]

Not *Pecten distortus* Da Costa var. *rosacea* Locard, Contrib. a. 1. Faune Malacol. Franc., 11, Prod. Genr. Pecten, 1888, p. 46; not *P. tigrinus* var. *rosacea* Locard, p. 117; not *P. laevis* Pennant var. *rosacea* Locard, p. 120; not *P. varius* var. *rosacea* Locard, p. 34.

Range: Calbuco; Chiloë; and the Chonos Islands (Dall).

This species is not present in the collection of the Templeton Crocker Expedition, but it is listed here because it is known farther south in the fauna of Chile and Peru. It was originally named *Pecten australis* by Philippi, but due to an earlier usage of that name by Sowerby, Stempell proposed *P. rosaceus* for Philippi's species. Stempell's name *P. rosaceus* is also preoccupied in the genus *Pecten*; therefore the name *Pecten amandi* is here proposed in honor of Dr. Rudolph Amandus Philippi⁹, in recognition of his work on the natural history of Chile.

According to Philippi, the species bears some resemblance to the Caribbean *P. ornatus* Lamarck.¹⁰

***Pecten (Chlamys) zeteki* Hertlein, new name**

Plate 19, figure 9

Pecten digitatus Hinds, Zool. Voy. *Sulphur*, Moll., pt. 3, 1844, [date on cover given as January, 1845], p. 61, pl. 17, fig. 2. "Bay of Guayaquil. In twenty-three fathoms."—Reeve, *Conch. Icon.*, vol. 8, 1853, *Pecten*, sp. 172, pl. 35, fig. 172. Hinds' record cited.—Kobelt, *Syst. Conchyl.-Cab.*, Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1888, p. 227, Taf. 60, fig. 8. Earlier record cited.—Paetel, *Cat. Conch.-Samml.*, Ed. 4. Abt. 3, 1890, p. 229 "Guayaq."—Dall, *Proc. U. S. Nat. Mus.*, vol. 37, 1909, p. 256. "Bay of Guayaquil."—Zetek, *Los Mol. Republ. Panama. Revista Nueva*, nos. 1 & 2, 1918, p. 52. Probably Panama.

Not *Pecten digitatum* Perry, *Conch.*, April, 1811, no. 2 on Expl. to pl. 55, pl. 55, fig. 2. "A native of Amboyna and the Eastern Seas."

Range: Guayaquil, Ecuador (Hinds; Reeve); probably Panama (Zetek).

This species is not present in the collection made by the Templeton Crocker Expedition. The valves of the species are said to be very similar and are ornamented by nine rounded, grooved ribs. Dall¹¹ has mentioned that probably the species is only a young specimen of *P. subnodosus* Sowerby. A comparison of young specimens of *P. subnodosus* Sowerby with Hinds' figure of *P. "digitatus"*, however, indicates that Sowerby's species has a very much larger anterior ear on the right valve and the shell is rounder in outline.

Zetek in 1918 cited the species as one which probably occurs at Panama.

⁹ See Fürstenberg, P., *Verhandl. d. Deutschen Wiss. Ver. zu Santiago de Chile*, Bd. 5, Heft 2, 1906, pp. 233-271.—Also, M. E. McLellan, *Auk*, vol. 44, 1927, pp. 158-159.

¹⁰ *Pecten ornatus* Lamarck, *Hist. Nat. Anim. s. Vert.*, vol. 6, 1819, p. 176. "Habite l'Océan Atlantique austral."—Sowerby, *Thes. Conch.*, vol. 1, *Pecten*, 1842, [the date on the title page is 1847, but according to Sherborn this part was issued prior to November, 1842.] p. 72. pl. 14, figs. 77, 78, 79. "Atlantic Ocean."—Reeve, *Conch. Icon.*, vol. 8, *Pecten*, 1873, sp. 68, pl. 19, fig. 68. "Hab. Barbados."—Maury, *Bull. Amer. Paleol.*, vol. 8, *Bull.* 34, 1920, p. 59 (27). North Carolina to Brazil.

Pecten (Chlamys) ornatus Lamarck, Dall, *Nautilus*, vol. 38, no. 4, 1925, p. 118 [but probably not all of his synonymy].

¹¹ Dall, W. H., *Nautilus*, vol. 27, no. 11, March, 1914, p. 122.

Dautzenberg and Bavay¹² have pointed out the great resemblance between *P. digitatus* Hinds and *P. vexillus* Reeve.¹³ The only differences noticed by them, in the two species, were the slightly less height of the shell, and the presence of nine ribs in Hinds' species rather than ten in *P. vexillus*.

Possibly the locality "Bay of Guayaquil," given by Hinds for *P. digitatus*, is incorrect, although that is not definitely known. *P. vexillus* Reeve is known from New Caledonia, Nouméa, Island of Nou, Lifou, Madagascar, and the Philippine Islands.

Dautzenberg and Bavay pointed out that *P. distans* Reeve (not Lamarck), which was renamed *P. janus* Montrouzier¹⁴ (not Münster), can be considered to be a synonym of *P. vexillus* Reeve. The true *P. distans* of Lamarck¹⁵ is considered to be a variety of *P. glaber* Linnaeus, a Mediterranean species.

The name *Pecten digitatus* Hinds, is preoccupied by the earlier usage by Perry. In view of the conflicting evidence regarding this form, the name *zeteki* is substituted for the species described by Hinds.

Possibly this species could be included in the subgenus *Decadopen* Rüppell in Sowerby.

Pecten (*Chlamys*) *hastatus* Sowerby

Pecten hastatus Sowerby, Thes. Conch., vol. 1, 1842, [the date on the title page is 1847, but according to Sherborn this part was issued prior to November, 1842.], p. 72, pl. 20, fig. 236. [No locality given.]—Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten* 1888, p. 233, Taf. 62, figs. 1, 2. Northwest coast of North America.

Pecten (*Chlamys*) *hastatus* Sowerby, Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 108, pl. 41, fig. 4; pl. 42, figs. 1, 1a, 2, 2a. Pliocene and Pleistocene. Recent, from Quatsino Sound, British Columbia to San Diego, California.—I. S. Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, 1924, p. 53, pl. 29, figs. 1, 3. Monterey Bay to San Pedro, California.

¹² Dautzenberg, P., & A. Bavay, *Siboga-Expedition*, Mon. 53b, Les Lamellibranches de L'Expédition du *Siboga*, Partie Syst. 1, Pectinidés, 1912, p. 26.

¹³ *Pecten vexillum* Reeve, Conch. Icon., vol. 8, *Pecten*, May, 1853, sp. 114, pl. 27, figs. 114a, 114b. "Hab. —?"

Pecten (*Pallium*) *vexillum* Reeve, Dautzenberg & Bavay, *Siboga-Exped.*, Mon. 53b, 1912, p. 26. "Nouvelle Calédonie (Marie, Rossiter), Nouméa (Bougier, Culliéret, Rossiter), Ile Nou (Bougier), Lifou (Musée de Boulogne), Philippines (collect. Bavay)."

Chlamys vexillum Reeve, Dautzenberg, Journ. de Conchyl., vol. 76, no. 1, 1932, p. 91. "Diego-Suarez," Madagascar. Recent.

¹⁴ *Pecten distans* Lamarck, Reeve, Conch. Icon., vol. 8, *Pecten*, February, 1853, sp. 49, pl. 13, fig. 49. "Hab. Philippine Islands; Cuming."

Pecten janus Montrouzier in Fischer, Journ. de Conchyl., vol. 7, (ser. 2, vol. 3), 1858, p. 340. "Hab. Ile Art. C. C." Caledonian Archipelago.—Lischke (Jap. Meeres-Conchyl., Bd. 2, 1871, p. 159) pointed out that *P. janus* Montrouzier = *P. distans* cited by Reeve, not *P. distans* Lamarck.

Not *P. janus* Münster in G. A. Goldfuss, Petref. Germaniae, Bd. 2 (pt. 4), 1833, p. 62. "Findet sich im tertiären Sande zu Baden bei Wien."

¹⁵ *Pecten distans* Lamarck, Hist. Nat. Anim. s. Vert., vol. 6, 1819, p. 169. "Habite l'Océan atlantique."—See also Bucquoy, Dautzenberg & Dollfus, Moll. Marins du Roussillon, vol. 2, fasc. 3, 1889, p. 88.

Range: Monterey to San Pedro, California. Also fossil in the Pliocene and Pleistocene.

A single left valve of *Pecten hastatus* was dredged by the Templeton Crocker Expedition at Loc. 27603 (C. A. S.), at the west end of San Nicolas Island, California, in 30 to 50 fathoms. *P. hastatus* is known from Pliocene to Recent.

The right valve is characterized by about nine pairs of strongly individualized ribs which are ornamented by prominent spines. There are nine narrow, prominent spiny ribs on the left valve. The right valve of the northern species, *hericius*, is ornamented by fascicules of three spiny riblets which are nearly equal, although the central riblet is slightly more prominent and spiny; while in *P. hastatus* there is a central spiny rib, with from two to four small scaly riblets between the major rib and the central riblet of the interspace.

P. hericius pugetensis I. S. Oldroyd,¹⁶ is close to *P. hericius* but it is a smaller form; it has fewer ribs, a broader, anterior ear on the right valve, and the notch on the anterior ear of the left valve is less developed. It has been recorded from Puget Sound, and it has been collected at Craig, and at Ketchikan, in southeastern Alaska by Mr. George Willett of Los Angeles, California.

A subspecies, *P. hastatus* var. *ingeniosa* Yokoyama,¹⁷ has been described from the Pliocene of Japan. *P. hindsii* Carpenter is also related to *P. hastatus* but is easily distinguished by the character of the ribbing.

Vaillant's record of Recent *P. hastatus* from Suez, which was referred to *P. laetus* by Fischer, has been referred by Lamy,¹⁸ who studied the original specimens, to *P. squamosa* var. *decoriata* Jousseume.

***Pecten (Chlamys) lowei* Hertlein, new species**

Plate 19, figures 1, 2, 7, 8

Shell moderately small, nearly equivalve, higher than long. Right valve with the exterior surface ornamented with 20 to 22 roundly triangular ribs; the ribs are crossed by strong imbricating lamellae which are fused to form a row of spinose nodes on the top of each rib; toward the ventral margin traces of small riblets appear on each side of the major ribs about halfway between the tops of the ribs and the bottoms of the interspaces; interspaces narrower than the ribs and in each, a

¹⁶ *Pecten islandicus pugetensis* I. S. Oldroyd, *Nautilus*, vol. 33, no. 4, April, 1920, p. 136, pl. 4, figs. 5, 6.—I. S. Oldroyd, *Stanford Univ. Publ., Univ. Ser. Geol. Sci.*, vol. 1, no. 1, 1924, p. 55, pl. 12, figs. 4, 5. "Type locality, off San Juan Island, Washington." Puget Sound.

Pecten (Pecten) hastatus Sowerby var. *pugetensis* I. S. Oldroyd, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, vol. 1, 1931, p. 168. Type locality cited. Also ? middle Pliocene, southeast of Pico Canyon, Los Angeles County, California.

¹⁷ *Imper. Geol. Survey of Japan, Rept.* 104, 1929, p. 5, pl. 6, fig. 2. "near Nanao." Pliocene.

¹⁸ Lamy, E., *Bull. Mus. d'Hist. Nat.*, vol. 34, 1928, no. 2, p. 170.—See also Cox, *Proc. Malacol. Soc. London*, vol. 18, pt. 5, 1929, p. 204.

Lischke (*Jap. Meer. Conch.*, Th. 2, 1871, pp. 157-158) also pointed out that the Red Sea species could not be *P. laetus* Gould.

spinose riblet is present. Ears unequal, the anterior ear large, ornamented by about four to five riblets which are crossed by imbricating spines; a distinct byssal notch is present and a ctenolium consisting usually of four to five spines; posterior ear very small and ornamented by four to six spinose riblets. Left valve ornamented similarly to right; anterior ear with eight to ten spinose riblets, while on the posterior ear there are four to six riblets. The color in the living shells is generally gray toward the umbos flecked with brown spots, but grading to brown toward the ventral margin. Some specimens are reddish or orange brown. Type specimen, altitude 13.8 mm.; longitude 11.5 mm.; diameter of both valves 4.5 mm.

Range: Gulf of California; Galapagos Islands. ?Catalina Island, California.

Holotype: No. 6878 (Mus. Calif. Acad. Sci. Paleo.); paratype, No. 6879 (Mus. Calif. Acad. Sci. Paleo.), and paratypes in H. N. Lowe collection, from **Carmen Island, Gulf of California**, from a depth of 20 fathoms; H. N. Lowe collector.

In the Lowe collection there were eight paired valves from Carmen Island and 16 unpaired valves of *P. lowei* from Angel de la Guardia Island in the Gulf of California; there are three specimens with paired valves from Loc. 27587 (C. A. S.) in the collection made by the Templeton Crocker Expedition, off Cape San Lucas, Lower California, in 20 to 25 fathoms; one left valve from Loc. 27232 (C. A. S.) was collected on the Hancock Expedition by L. G. Hertlein at Conway Bay, Indefatigable Island, Galapagos Group. A single worn valve of this species in the collection at Stanford University came from Tagus Cove, Albemarle Island, Galapagos Group. One left valve is present from Loc. 25610 (C. A. S.), said to have been dredged on the north side of Catalina Island, California, in 30 to 80 fathoms. There seems no reason to doubt this locality, although the range is longer than that of most west American pectens. The characters of the new species are rather constant in all the specimens, the largest of which attains an altitude of 14.5 mm.

Pecten lowei is very close to *Pecten sancti-ludovici* Anderson & Martin¹⁹ from the upper Miocene Santa Margarita formation of San Luis Obispo County California, and from the Pliocene of Alverson Cañon, Imperial County, California. Possibly the species here described as new, may be a living *P. sancti-ludovici* but on the adult fossil form there are three beaded riblets ornamenting the ribs and three in the interspaces. From the specimens of *P. sancti-ludovici* at hand, it appears that the development of the beaded riblets takes place earlier than on the corresponding forms of equal size in *P. lowei*. Furthermore *P. lowei* has much smaller posterior ears.

P. collazoensis Hubbard²⁰ from the Miocene of Porto Rico,

¹⁹ *Pecten sancti-ludovici* Anderson & Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, December 30, 1914, p. 55, pl. 3, figs. 10a, 10b. . . . "from the Santa Margarita formation along the west side of the San Juan River about one half mile above the mouth of Navajoa Creek, northeastern San Luis Obispo County, California."—G. D. Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 14, no. 18, 1926, p. 473, pl. 22, figs. 1, 2, 3, Coral reef of Alverson Cañon, Imperial County, California. Pliocene.

²⁰ *Pecten (Chlamys) collazoensis* Hubbard, New York Acad. Sci., Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 2, 1920, p. 87, pl. 11, fig. 1, "Collazo Falls", "Lower? San Sebastian shale," Porto Rico. Referred to lower Oligocene.

appears to have somewhat similar sculpture, but the scales on the ribs are apparently not fused into small spinose nodes as in *P. lowei*, and the form from Porto Rico has much larger posterior ears. Several species in the Miocene of the Caribbean region have ornamentation similar to *P. sancti-ludovici*.

P. sancti-ludovici resembles closely *P. plurinominis* Pilsbry & Johnson,²¹ from the Miocene of Santo Domingo. The subspecies *Pecten plurinominis morantensis* Woodring²² from the Bowden Miocene, has also been questionably recorded by Trechtmann²³ from beds referred to the Pliocene, on St. Kitts Island in the West Indies.

Pecten oxygonus optimus Brown & Pilsbry²⁴ from the Miocene of Costa Rica and Panama and *P. oxygonus canalis* Brown & Pilsbry²⁵ from the Miocene of Panama, possess shells in which the ribs and interspaces are ornamented by spinose beaded riblets. In the Miocene of Venezuela, *P. buchivacoanus* F. & H. Hodson,²⁶ *P. buchivacoanus maracaibensis* F. & H. Hodson,²⁷ and *P. buchivacoanus falconensis* F. & H. Hodson,²⁸ likewise possess spiny beaded riblets. *P. hodgii* Hubbard,²⁹ from the Miocene of Porto Rico, has squarer ribs than *P. sancti-ludovici*.

Pecten exasperatus Sowerby,³⁰ now living in the Caribbean region has ornamentation similar to *P. sancti-ludovici* and others of that group.

²¹ *Pecten plurinominis* Pilsbry & Johnson, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, September, 1917, p. 193. New name for *P. oxygonum* Sowerby, Gabb, Trans. Amer. Phil. Soc., vol. 15, 1873, p. 256. Not *P. oxygonum* Sowerby, Quart. Jour. Geol. Soc., vol. 6, 1850, p. 52. San Domingo. Tertiary.—Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pt. 2, 1922, p. 411, pl. 45, figs. 1, 2. Gabb's collection from Santo Domingo. [According to Gardner (U. S. Geol. Survey, Prof. Paper 142-A, 1926, p. 46) "*Pecten pleurinominis* Woodring = *P. thelidus* Dall."]

²² *Chlamys (Aequipecten) plurinominis morantensis* Woodring, Carnegie Inst. Washington, Publ. 366, May, 1925, p. 67, pl. 8, figs. 4, 5. Bowden, Jamaica. Miocene.

²³ *Chlamys (Aequipecten)* cf. *plurinominis* Woodring, Trechtmann, Geol. Mag., vol. 69, no. 816, 1932, pp. 249, 253, pl. 15, fig. 3. Brimstone Hill, St. Kitts Island. Pliocene.

²⁴ *Pecten oxygonum optimum* Brown & Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, January 30 1913, p. 511, pl. 24 [cited in text as pl. 23], fig. 2. "Reventazon River, Costa Rica." [Miocene]. (= *P. paranensis* d'Orbigny, Gabb. Not *P. Paranensis* d'Orbigny). This species has been recorded from the Miocene of Lower California by Dickerson (Proc. Calif. Acad. Sci., ser. 4, vol. 7, no. 8, 1917, p. 202.—Bull. Geol. Soc. Amer., vol. 28, 1917, p. 231) and by Clark & Arnold (Bull. Geol. Soc. Amer., vol. 28, 1917, p. 224). According to Woodring (Carnegie Inst. Washington, Publ. 385, 1928, p. 95) Dickerson's record probably refers to *P. canalis* Brown & Pilsbry.

²⁵ *Pecten oxygonum canalis* Brown & Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, January 30, 1913, p. 511, pl. 24 [cited in text as pl. 23], fig. 3. "Tower N, Culebra Cut, Canal Zone."

²⁶ *Pecten (Chlamys) buchivacoanus* F. & H. Hodson, Bull. Amer. Paleo., vol. 13, Bull. 49, October 1927, p. 29, pl. 16, figs. 6, 8, 10, 11. "Districts of Buchivacoa, Miranda and Petit, State of Falcón", Venezuela. "Oligocene." [Probably Miocene].

²⁷ *Pecten buchivacoanus maracaibensis* F. & H. Hodson, Bull. Amer. Paleo., vol. 13, Bull. 49, October, 1927, p. 30, pl. 17, fig. 6. "Districts of Democracia, Miranda, Colina and Acosta, State of Falcón", Venezuela. "Miocene."

²⁸ *Pecten buchivacoanus falconensis* F. & H. Hodson, Bull. Amer. Paleo., vol. 13, Bull. 49, October, 1927, p. 31, pl. 17, figs. 2, 3, 4, 5, 7. "Common in the state of Falcón", Venezuela. "Miocene."

²⁹ *Pecten (Chlamys) hodgii* Hubbard, New York Acad. Sci., Sci. Surv. Porto Rico and the Virgin Islands, vol. 3, pt. 2, 1920, p. 93, pl. 12, fig. 5. "Quebradillas limestone (rare)", Porto Rico. Referred to upper Oligocene. [Probably Miocene].

³⁰ *Pecten exasperatus* Sowerby, Thes. Conch., vol. 1, *Pecten*, 1842 [on title page date given as 1847, but according to Sherborn, this part was issued prior to November, 1842], p. 54, pl. 18, figs. 183 to 186. "Medi-

Pecten coccymelus Dall³¹ bears only a general resemblance to *P. lowei*, and has much narrower ribs, wider interspaces and a larger posterior ear, as well as differing in details of ornamentation.

Pecten varius Linnaeus,³² common in northern Europe and in the Mediterranean region, possesses more ribs and lacks the interribs which are present in *P. lowei*.

This new species is named for Mr. Herbert N. Lowe, of Long Beach, California, in recognition of his work on west American mollusks.

Pecten (Plagioctenium) circularis Sowerby

Pecten tumidus Sowerby, Proc. Zool. Soc. London, 1835, p. 109. "*Hab.* ad Sanctam Elenam et ad Salango, Columbiae Occidentalis." "Found in sandy mud at from six to ten fathoms.—G. B. S."

Not *Pecten tumidus* Turton, Conch. Insul. Brit., 1822, p. 212 "Taken from the *Serpula tubularia*, in Torbay." (= *Ostrea tumida* Turton, Conch. Dict., 1819, p. 132).

Not *Pecten tumidus* Hartmann in C. H. v. Zieten, Petrif. Wurt., (9), 1833, p. 68.

Not *Pecten tumidus* Dujardin, Mem. Soc. Geol. France, II (2), 1832, p. 214 [according to Sherborn].

Pecten circularis Sowerby, Proc. Zool. Soc. London, 1835, p. 110. "*Hab.* ad Sinum Californiae (Guaymas)." "Found in sandy mud at a depth of seven fathoms.—G. B. S."—Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 254, pl. 2, figs. 9, 9a. Bay of Panama, Recent.

Not *Pecten circularis* Goldfuss, Petref. Germaniae, Bd. 2 (pt. 5), 1836, p. 76, pl. 99, figs. 10a, 10b. "Ex arena viridi Westphaliae." Cretaceous.

Pecten ventricosus Sowerby, Thes. Conch., vol. 1, 1842 [the date on the title page is 1847, but according to Sherborn this part was issued prior to November, 1842], *Pecten*, p. 51, pl. 12, figs. 18, 19, 26. "St. Elena" [The record from the Philippines is erroneous]. New name for *P. tumidus* Sowerby, not *P. tumidus* Turton, nor *P. tumidus* Zieten, 1830.—Reeve, Conch. Icon., vol. 8, *Pecten*, 1852, sp. 31, pl. 7, figs. 31a, 31b. Earlier records cited.—Küster, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1859, p. 100, Taf. 28 [plate 28 issued 1858], figs. 1, 2. "West-Columbia." [Fig. 3 is referred to *P. ventricosus* in the text, but in the explanation to the plate it is referred to *P. gibbus*, which it apparently represents].—Olsson, Nautilus, vol. 37, no. 4, 1924, p. 128. "Negritos, Lobitos, Mancora, Zorritos," Peru. "Salinas," Ecuador.

Pecten (Dentipecten) circularis Sowerby, Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1887, p. 188, Taf. 51, figs. 5, 6, 7, 8. California to Mazatlan, Mexico.

terranean." [Locality erroneous].—Reeve, Conch. Icon., vol. 8, *Pecten*, 1852, sp. 7, pl. 2, figs. 7, 8a, 8b; pl. 26, fig. 108; pl. 29, fig. 127. [pls. 26 and 29 issued in 1853]. "*Hab.* Island of St. John, West Indies."—Brown & Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 65, 1913, p. 496. "Oyster-shell Layers from the Black swamp near Mount Hope", Isthmus of Panama. Pleistocene.—Maury, Bull. Amer. Paleo., vol. 8, Bull. 34, 1920, p. 59 (27) Cape Hatteras to Guadeloupe Island; also Yucatan Strait. Pliocene to Recent. It has also been reported from the Bermuda Islands and Porto Rico. Also fossil at Barbados Island.

³¹ *Pecten (Chlamys) coccymelus* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898, p. 741, pl. 34, fig. 1. "Miocene of Plum Point, Maryland; Clark."—Glenn, Maryland Geol. Survey, Miocene, 1904, p. 374, pl. 99, fig. 3. Several localities in the Calvert formation, Maryland. Miocene.

³² It is interesting to note that Dautzenberg has recorded this species from the coast of Venezuela. (Mem. Zool. Soc. France, vol. 13, 1900, p. 224). "Golfe de Maracaibo, Stn. 39; ile Tortuga, Stn. 36."

Pecten (*Plagiectenium*) *circularis* Sowerby, Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 125, pl. 42, figs. 3, 4, 5, 6; pl. 44, figs. 6, 6a, 6b, 7. Pliocene and Pleistocene. Recent from the Gulf of California to Santa Elena, Ecuador.

Pecten cf. *circularis* Sowerby, Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 255, pl. 1, fig. 8. Bay of Panama. "Probably Gatun formation." [According to Pilsbry, (Proc. Acad. Nat. Sci. Philadelphia, vol. 83, 1931, p. 429) "Two right valves of *P. ventricosus* Sowb."]

Pecten filitextus Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 255, pl. 2, fig. 10. Panama Bay. "Probably Gatun formation." [According to Pilsbry (Proc. Acad. Nat. Sci. Philadelphia, vol. 83, 1931, p. 429) "a left valve of *Pecten ventricosus* Sowb., in which the fine sculpture is well preserved."]

Pecten purpuratus Lamarck, Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, vol. 84, 1932, p. 139. "San Juan del Sur and Montijo Bay." "Taboga Island." "Corinto." [Not *P. purpuratus* Lamarck.]

For further synonymy of *P. circularis*, see Arnold, 1906, and E. K. Jordan & Hertlein, (Proc. Calif. Acad. Sci., ser. 4, vol. 15, no. 14, 1926, p. 439). See also remarks by Grant & Gale (Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 218).

Range: Monterey, California to Paita, Peru (Dall). Fossil in Pliocene and Pleistocene.

This well known species was collected at a number of localities by the Templeton Crocker Expedition.

Loc. 27527 (C. A. S.), dredged in Acapulco Bay, Mexico.

Loc. 27557 (C. A. S.), dredged between Punta Arenas and Bat Island, just off Punta Arenas, Costa Rica.

Loc. 27566 (C. A. S.), dredged in 35 fathoms in Lat. 14° 15' N., Long. 92° 28' W.

Loc. 27568 (C. A. S.), dredged in 35 fathoms in Lat. 14° 52' N., Long. 93° 04' W.

Loc. 27569 (C. A. S.), dredged in 28 fathoms in Lat. 15° 40' N., Long. 93° 49' W.

Loc. 27571 (C. A. S.), dredged in Lat. 16° 38' N. to 16° 39' N., Long. 99° 24' 30" to 99° 27' 30" W.

Loc. 27580 (C. A. S.), dredged one-half mile east of Isabel Island, between Isabel Island and Mazatlan, Mexico.

Loc. 27581 (C. A. S.), dredged between Isabel Island and Mazatlan, Mexico.

Loc. 27583 (C. A. S.), dredged in 10-17 fathoms, Lat. 22° 44' N., Long. 105° 59' W.

Loc. 27584 (C. A. S.), dredged about 10 miles due east of San Jose del Cabo, Lower California, Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W.

The species was also collected in Braxilito Bay, Costa Rica, and as a fossil in the Pleistocene beds on Maria Madre Island, Mexico. In

the collections of the California Academy of Sciences, the species is present from many other localities.

There appears to be all gradations between typical *circularis* and the form *ventricosus* Sowerby from western Colombia and Ecuador, with no practical method of separating the two forms, and Arnold, who studied a large series of the species in the U. S. National Museum, came to the same conclusion. Mörch³³ described a scarlet colored variety from Costa Rica, which can apparently be considered to be one of the variations of *P. circularis*. Records of *P. circularis* from the Asiatic region³⁴ can evidently be referred to some other species. The species described by Li from Panama Bay as *P. filitextus*, can apparently be referred to *P. circularis*.

The subspecies *P. circularis aequisulcatus* Carpenter from southern California, and western Lower California, attains a larger size when adult, the shell is thinner and flatter, the ribs narrower, and the coloration is more subdued.

P. abietis E. K. Jordan & Hertlein, in the Pliocene of Maria Madre Island, and Lower California, is closely related to *P. circularis*, but can be distinguished by the triangular shaped ribs.

P. gibbus Linnaeus, found living along the Atlantic Coast of North America is also closely related to *P. circularis*. Members of the *circularis* group, also occur in beds referred to the Miocene and Pliocene in Venezuela. (See Bull. Amer. Paleo. vol. 13, Bull. 49, 1927. *P. circularis venezuelanus* F. & H. Hodson, p. 25, pl. 14, fig. 6; pl. 15, figs. 2, 4, 5; pl. 17, fig. 1; *P. circularis cornellanus* F. & H. Hodson, p. 26, pl. 14, fig. 2; pl. 15, figs. 3, 10; pl. 16, fig. 3; *P. circularis caucanus* F. & H. Hodson, p. 27, pl. 15 figs. 1, 8).

P. demiurgus Dall³⁵ from the upper Miocene of Trinidad is close to *P. circularis*.

Zetek³⁶ has indicated that the east American *P. gibbus ampliacostatus* Dall, might occur in the fauna of western Panama, but it seems likely that this record can be referred to some of the numerous variants of *P. circularis*.

³³ *Pecten (Argus) ventricosus* Sow. var. *coccinea* Mörch, Malakzool. Blätter, Bd. 7, 1861, p. 210.

"Var. *coccinea*; valva dextra lituris atris, intus alba. Sow. thes. f. 26.—Puntarenas ad prof. 14 org. Long. 16, alt. 17 mill."

³⁴ Campbell, A. S., [Identification attributed to H. A. Pilsbry], Jour. Entomol. and Zool., vol. 15, no. 3, 1923, p. 40. Near Canton, and at Chung Chow, Hong Kong territory, China. Recent.

³⁵ *Pecten (Plagiodenium) demiurgus* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898, p. 718, pl. 26, fig. 3. "From the Caroni Series of Trinidad at Savanetta; Guppy." Miocene.

³⁶ Zetek, J., Los Mol. Republ. Panama. Revista Nueva, nos. 1 & 2, 1918, p. 52.

Pecten (Leptopecten) latiauratus Conrad

Pecten latiauratus Conrad, Jour. Acad. Nat. Sci. Philadelphia, vol. 7, 1837, p. 238, pl. 18, fig. 9. "Inhabits below the efflux of the tide near Sta. Diego and Sta. Barbara."—Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1887, p. 203, Taf. 54, figs. 7, 8. West Coast of North America, especially California.

Pecten (Chlamys) latiauritus Conrad, Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 115, pl. 46, figs. 2, 2a, 3, 3a. Monterey to San Diego, California. Also Pliocene and Pleistocene.—I. S. Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, 1924, p. 57, pl. 22, fig. 2 (under subgenus *Chlamys*, section *Leptopecten*). (Reproduction of Conrad's type figure). Monterey, California, to the Gulf of California. See also remarks by Grant & Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, pp. 203-204.

Range: Monterey, California to Gulf of California (I. S. Oldroyd); ?San Francisco Bay, California (Packard). Pliocene to Recent.

One specimen of this species with both valves was dredged by the Templeton Crocker Expedition at Loc. 27600 (C. A. S.), in 25 fathoms off San Martin Island, Lower California. The exact locality is given as "above long spit."

An inspection of Conrad's original figures of *latiauratus* and *monotimeris*, indicates that *latiauratus* has more squarely shaped ribs, a longer hinge line, and acutely pointed ears. The longer hinge line and prominently lamellated interspaces distinguish the subspecies *latiauratus delosi* (Plate 19, figure 10) from Conrad's species. *P. latiauratus cerritensis* Arnold in the Pleistocene has fewer ribs. *P. andersoni* Arnold in the Miocene of western North America is a related species.

Pecten (Leptopecten) tumbezensis d'Orbigny

Plate 19, figures 11, 12

Pecten aspersus Sowerby, Proc. Zool. Soc. London, 1835, p. 110. "Hab. ad Tumbez, Peruviae."

Not *Pecten aspersus* Lamarck, Anim. s. Vert., vol. 6, 1819, p. 167. "Habite . . . Mon cabinet."

Pecten tumbezensis d'Orbigny, Voy. Amér. Mérid.,⁸⁷ vol. 5, 1846, p. 663. Tumbez, Peru (Cuming). New name for *P. aspersus* Sowerby, not *P. aspersus* Lamarck.—Peile in Bosworth, Geol. N. W. Peru, 1922, p. 178, pl. 25, fig. 8. "Talara Tablazo" and "Lobitos Tablazo." Quaternary, Peru.—Olsson, Nautilus, vol. 37, no. 4, 1924, p. 127. "Paita, Negritos, Lobitos, Jorritos," Peru. "Salinas," Ecuador.

Pecten sowerbyi Reeve, Conch. Icon., vol. 8, 1852, *Pecten*, sp. 4, pl. 1, fig. 4. "Tumbez, Peru." New name for *P. aspersus* Sowerby, not *P. aspersus* Lamarck.—Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1888, p. 229, Taf. 61, fig. 3. Peru.

⁸⁷ For a collation of this work see Sherborn, C. D., and F. J. Griffin, Ann. & Mag. Nat. Hist., ser. 10, vol. 13, no. 73, 1934, pp. 130-134.

- Pecten paucicostatus* Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 [issued 1864.], p. 645. Neighborhood of Santa Barbara (Jewett).—Kobelt, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1888, p. 281. Original record cited.
- Pecten* (*Plagioctenium*) *paucicostatus* Carpenter, Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 137, pl. 39, figs. 3, 3a, 4. Gulf of California.—I. S. Oldroyd, Stanford Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, 1924, p. 56, pl. 41, figs. 4, 5. "Santa Barbara, California, to the Gulf of California."
- Pecten* cf. *latiauritus fucicolus* Dall, Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 255, pl. 2, fig. 11. Mouth of the Rio Grande near La Boca about one mile from the mainland in Panama Bay. Recent. [Not *P. latiauritus fucicolus* Dall. See Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 83, 1931, p. 429.]
- Pecten latiauritus* Conrad *indentus* Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 256, pl. 2, fig. 13. Mouth of Rio Grande near La Boca about one mile from mainland in Panama Bay. [= *P. tumbezensis* d'Orbigny, according to Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 83, 1931, p. 429].
- Pecten latiauritus* Conrad *splendens* Li, Bull. Geol. Soc. China, vol. 9, no. 3, 1930, p. 256, pl. 2, fig. 12. Mouth of Rio Grande near La Boca, about one mile from the mainland in Panama Bay. Recent. [= *P. tumbezensis* d'Orbigny, according to Pilsbry, Proc. Acad. Nat. Soc. Philadelphia, vol. 83, 1931, p. 429].
- Pecten* (*Aequipecten*) *tumbezensis* d'Orbigny, Grant & Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 206. Earlier records cited. [Not *P. palmeri* Dall in the synonymy.]

Range: Gulf of California to Tumbez and Paita, Peru. Also Quaternary of Peru.

This interesting species was secured at a number of localities by the Templeton Crocker Expedition.

Loc. 27527 (C. A. S.), dredged in Acapulco Bay, Mexico.

Loc. 27558 (C. A. S.), dredged in 50 fathoms between Punta Arenas and Bat Island, about five to six miles off Delas, Costa Rica.

Loc. 27569 (C. A. S.), dredged in 28 fathoms, Lat. 15° 40' N., Long. 93° 49' W.

Loc. 27571 (C. A. S.), dredged off Mexico in 20-45 fathoms, Lat. 16° 38' to 16° 39' N., Long. 99° 24' 30" to 99° 27' 30" W.

Loc. 27580 (C. A. S.), dredged one-half mile east of Isabel Island, between Isabel Island and Mazatlan, Mexico.

Loc. 27583 (C. A. S.), dredged in 10-17 fathoms. Lat. 22° 44' N., Long. 105° 59' W.

Loc. 27584 (C. A. S.), dredged in 20-220 fathoms off Mexico, Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W.

Loc. 27584A (C. A. S.), dredged about five miles west of Mazatlan, Sinaloa, Mexico, Lat. 23° 12' N., Long. 106° 29' W.

Pecten tumbezensis d'Orbigny is known to range from the Gulf of California to Peru. It has been recorded from Santa Barbara,

California, but this is a very doubtful record. Arnold in referring to *P. paucicostatus* Carpenter, which can be regarded as a synonym of *tumbezensis*, stated that it undoubtedly came from the Gulf of California, and that no species with its characteristics is known outside the tropics.

P. tumbezensis possesses a rather small but fairly heavy shell. The largest specimen in the collection has an altitude of 30.4 mm. The shell is usually ornamented by about 14 ribs. The left valve usually shows a sprinkling of light bluish dots on a slate-colored or brownish background.

Olsson has mentioned a similarity between *P. tumbezensis* and *P. woodringi* Spieker,³⁸ from the Miocene of Peru.

Rutten's record (Leid. Geol. Mededeel., Deel 5, 1931, p. 661) of "*Pecten sowerbyi* Reeve" in the Quaternary of Surinam, South America, can apparently be referred to some other species.

***Pecten (Leptopecten) velero* Hertlein, new species**

Plate 19, figures 13, 14

The type is a left valve with 16 strong ribs, of which every third rib is higher than the intervening ones; the two ribs on the margins are a little stronger than those on the middle; strong imbricating lamellae cross the ribs and interspaces and are especially prominent on the stronger ribs. The anterior ear is ornamented by about six to seven imbricated riblets and the posterior ear shows about five such riblets. The exterior of the shell is colored pink with whitish and brownish spots. The hinge line has transverse striations; and the ribs are shown on the interior of the shell by strong ridges and hollows. Other specimens sometimes have pairs of raised ribs instead of only one. Type, altitude approximately 6.4 mm.; length of hinge line approximately 6.2 mm.

Range: Bahia Honda, Veragua, Panama; Mazatlan, Mexico; and Maria Madre Island, Tres Marias Group, Mexico.

Holotype: Left valve No. 6857 (Mus. Calif. Acad. Sci. Paleo.); paratype, left valve No. 6886, and plesiotype, right valve No. 6887 (Mus. Calif. Acad. Sci. Paleo. type coll.), **Bahia Honda, Veragua, Panama**, in three to nine fathoms, G. Allan Hancock Expedition; L. G. Hertlein, collector.

P. velero is not present in the collection made by the Templeton Crocker Expedition, but is recorded here as a new species.

The new species differs from *P. latiauratus delosi* Arnold, in the character of the ribs, of which every third one is raised and occasionally a pair is raised. Another left valve and a right valve, slightly worn, occurred with the type at Bahia Honda, Panama. The right valve has about 16 ribs, every third one is slightly raised, and

³⁸ *Pecten woodringi* Spieker, Johns Hopkins Univ. Studies in Geol., no. 3, 1922, p. 125, pl. 7, figs. 4, 5. "Upper Zorritos. Quebradas Pantheon, del Toro, de las Alturas and del Grillo."—Olsson, Bull. Amer. Paleol., vol. 19, Bull. no. 68, 1932, p. 81, pl. 5, figs. 2, 5 (as *Pecten (Plagiocentrum) woodringi*). "Tumbez formation, probably Que. Tucillal, Zorritos (Nelson)."

it is presumably the right valve of the new species. Its general appearance is considerably like *P. latiauratus* Conrad, Recent west American species, and *P. ischnon* Pilsbry & Johnson³⁹ from the Miocene of Santo Domingo.

Several specimens of *P. velero* were collected by the author at Loc. 27,223 (C. A. S.), Mazatlan, Mexico. One left valve was collected by G. D. Hanna & E. K. Jordan at Loc. 23,779 (C. A. S.), Maria Madre Island, Tres Marias Group, Mexico, in ten fathoms.

This new species is named for Captain G. Allan Hancock's yacht, *Velero III*.

Pecten (Lyropecten) subnodosus Sowerby

Plate 19, figure 15

Pecten subnodosus Sowerby, Proc. Zool. Soc. London, 1835, p. 109. Var. brownish red with white striae, "ad Sinum Californiae." Var. variegated with brown and white patches, "ad Insulam Platae Columbiae Occidentalis." Var. A more depressed shell of a bright orange color, "ad Sinum Tehuantepec, Mexicanorum." "in sandy mud and coral sand in from ten to seventeen fathoms."—Sowerby, Thes. Conch., vol. 1, 1842, p. 65, pl. 15, figs. 97 and 112. Earlier records cited.—Küster, Syst. Conchyl.-Cab., Bd. 7, Abt. 2, *Spondylus* und *Pecten*, 1859, p. 112, Taf. 32, fig. 3. "Mexico und Westcolumbien."—Dall, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 256. "Gulf of California to Guayaquil and the Galapagos Islands. —Olsson, Nautilus, vol. 37, no. 4, 1924, p. 127. "Negritos, Mancora," Peru. "Salinas," Ecuador.

Lyropecten intermedius Conrad, Amer. Jour. Conch., vol. 3, 1867, p. 7. "Cape St. Lucas, California."

Pecten (Nodipecten) subnodosus Sowerby, Arnold, U. S. Geol. Survey, Prof. Paper 47, 1906, p. 128, pl. 52, fig. 1; pl. 53, figs. 1, 1a. Recent from Coast of Lower California to Ecuador. Also Pliocene and Pleistocene.

Pecten (Lyropecten) nodosus (Linnaeus) variety *subnodosus* Sowerby, Grant & Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 180. "Panama and West Columbia."

Pecten (Lyropecten) nodosus (Linnaeus) variety *intermedius* (Conrad), Grant & Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 181. Earlier records cited from Pliocene to Recent.

Range: Scammon Lagoon, Lower California, and the Gulf of California, to Guayaquil, Ecuador (Dall and others). Also Pliocene and Pleistocene of Lower California and Pliocene of Imperial County, California.

This well known species was collected at four localities by the Templeton Crocker Expedition.

Loc. 27559 (C. A. S.), Braxilito Bay, Costa Rica.

³⁹ *Pecten ischnon* Pilsbry & Johnson, Proc. Acad. Nat. Sci. Philadelphia, vol. 69, 1917, p. 194. Santo Domingo. Miocene.—Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 73, pt. 2, January 18, 1922, p. 413, pl. 44, figs. 7, 8, (type) 9. Santo Domingo. Miocene.

Loc. 27562 (C. A. S.), Port Parker, Costa Rica.

Loc. 27577 (C. A. S.), on south shore of Maria Madre Island, Mexico.

Loc. 27578 (C. A. S.), San Juanito Island, Tres Marias Group, Mexico.

Pecten subnodosus is quite variable in color. It may be red, variegated with red and brown or white, or orange in color. An excellent specimen from San Juanito Island has eleven ribs on the right valve and ten on the left. This, as well as specimens from the Gulf of California, does not substantiate Grant & Gale's⁴⁰ conclusion that the more northern forms described as *intermedius* by Conrad, can be recognized as a separate subspecies possessing one less rib than the Panama shells.

P. nodosus Linnaeus,⁴¹ from the Caribbean region is a closely related species as is *P. veatchii* Gabb from the Pliocene of Cedros Island, Lower California. Related species such as *P. peedeensis* Tuomey & Holmes,⁴² *P. pernodosus* Heilprin,⁴³ *P. pittieri* Dall,⁴⁴ *P. pittieri collierensis* Mansfield⁴⁵ and *P. colinensis* F. & H. Hodson,⁴⁶ occur in the Miocene and Pliocene of the Caribbean region.

Pecten (Decadopecten) fasciculatus Hinds

Plate 18, figures 1, 2

Pecten fasciculatus Hinds, Zool. Voy. *Sulphur*, Moll., pt. 3, 1844 [date on cover January, 1845], p. 61, pl. 17, fig. 4 "West coast of Veragua. In seventeen fathoms, among sandy mud."—Reeve, *Conch. Icon.*, vol. 8, 1853, *Pecten*, sp. 171, pl. 35, fig. 171. Hinds' record cited.

Pecten (Pallium) miser Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 401, pl. 8, fig. 6. Gulf of Panama, in 182 fathoms, mud, bottom temperature 54.1° F.

?*Pecten panamensis* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898, p. 696.

⁴⁰ Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 181.

⁴¹ *Ostrea nodosa* Linnaeus, Syst. Nat., Ed. 10, 1758, p. 697. "Habitat in O. Africano E Indico."
Pecten corallinus Chemnitz, Neues Syst. Conch.-Cab., Bd. 7, 1784, p. 306, pl. 64, figs. 609, 610, 611. St. Croix, St. Thomas and St. Jean, Danish West Indies.

⁴² *Pecten nodosus* Linnaeus, Reeve, *Conch. Icon.*, vol. 8, *Pecten*, 1852, sp. 15, pl. 3, fig. 15. "Hab. Gulf of Mexico."

⁴³ *Pecten peedeensis* Tuomey & Holmes, Pleiocene Fossils of South Carolina, 1857, p. 30, pl. 12, figs. 1, 2, 3, 4, 5. "Darlington District."

⁴⁴ *Pecten pernodosus* Heilprin, Trans. Wagner Free Inst. Sci., vol. 1, 1887, p. 131, pl. 16b, figs. 69, 69a. Caloosahatchie, Florida. Pliocene.

⁴⁵ *Pecten (Lyropecten) pittieri* Dall, Smithsonian, Misc. Coll., vol. 59, no. 2, March 2, 1912, p. 10. "Moin Hill, near Port Limon, Costa Rica, niveau a. H. Pittier. 1899."—Dall, Proc. U. S. Nat. Mus., vol. 66, 1925, p. 23, pl. 17, fig. 6.

⁴⁶ *Pecten (Nodipecten) pittieri collierensis* Mansfield, U. S. Geol. Surv., Prof. Paper 170-D, 1932, p. 47, pl. 16, figs. 3, 5. "Tamiami trail, about 11 miles east by north of Marco, Collier County, Fla." Pliocene.

⁴⁷ *Pecten (aff. Nodipecten) colinensis* F. & H. Hodson, Bull. Amer. Paleol., vol. 13, Bull. 49, October 7, 1927, p. 33, pl. 18, figs. 3, 6; pl. 19, fig. 4. "District of Colina, State of Falcón," Venezuela. "Miocene-Pliocene."

Range: Panama.

This species is not present in the Templeton Crocker Collection. Hinds illustrated only a left valve, and Dall a right valve, of species occurring off Panama. The number of ribs in each, is about the same, and the descriptions seem to indicate that Dall's species will need to be placed in the synonymy of *P. fasciculatus* Hinds. This species appears to be the only representative of the subgenus *Decadopecten*, to be reported Recent or fossil from western North America. Recent and fossil forms of *Decadopecten* are represented in the Asiatic and Mediterranean regions.

Dall in 1898 gave a brief description of a species cited as *Pecten panamensis* Dall. According to the description the species differs from *P. plica* Linnaeus, "by having the cardinal laminae obsolete and in the presence of a byssal sinus and ctenolium." No locality is given for the species but the name suggests that it came from or occurs near Panama. Possibly this is the species later described by Dall as *P. miser* which in the present paper is referred to *P. fasciculatus* Hinds.

P. parmeleei Dall and related forms in the Pliocene belongs to the subgenus *Swiftiopecten* Hertlein, the type of which is *P. swiftii* Bernardi.

***Pecten (Cyclopecten) cocosensis* Dall**

Plate 18, figures 7, 8

Pecten (Cyclopecten) cocosensis Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 405, pl. 6, figs. 1, 3. "near Cocos Island Gulf of Panama, in 52 fathoms, rocky bottom, temperature 62°.2 F."—Zetek, Los Mol. Republ. Panamá. Revista Nueva, nos. 1 & 2, 1918, p. 39.

Range: San José Island, Gulf of California to Acapulco Bay, Mexico, and near Cocos Island, Costa Rica.

This species was dredged at several localities by the Templeton Crocker Expedition. At some localities the species was represented only by small juvenile specimens.

Loc. 27527 (C. A. S.), in Acapulco Bay, Mexico.

Loc. 27581 (C. A. S.), between Isabel Island and Mazatlan, Mexico.

Loc. 27584 (C. A. S.), dredged about 10 miles due east of San Jose del Cabo, Lower California, in Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W., in 20 to 220 fathoms.

Loc. 27587 (C. A. S.), off Cape San Lucas, Lower California, in 20 to 25 fathoms.

It is also present in the collections of the California Academy of Sciences from the following localities:

Loc. 23779 (C. A. S.), in five to ten fathoms off Maria Madre Island, Tres Marias group, Mexico; G. D. Hanna & E. K. Jordan, colls.

Loc. 23804 (C. A. S.), Amortajada Bay, San José Island, Gulf of California. F. Baker coll.

The shell of this species has a subangular posterior margin, and a broad shallow sulcus occurs on the posterior fourth of the shell. The color of the exterior of the shell consists of white, red, and brown, occurring in lines, zigzags, or in clouded patches.

P. catalinensis Willett,⁴⁷ has more nearly equal ears and a different color pattern and lacks the sulcus on the posterior portion of the valves.

Dall's figures of *P. guppyi* Dall,⁴⁸ from the late Tertiary of the Caribbean region, show a resemblance to *P. cocosensis*. The Caribbean shell apparently has a broad shallow sulcus on the posterior portion of the shell, and traces of coloration in blotches, is said to be present. *P. subminutus* Aldrich,⁴⁹ from the Tertiary of Mississippi is said to resemble *P. guppyi* but is smaller.

Pecten aotus Olsson⁵⁰ from the Miocene of Costa Rica, has, on the left valve, fine radial lines, which according to the description, occur in irregular streaks or blotches.

Pecten (Cyclopecten) oligolepis Brown & Pilsbry⁵¹ bears some resemblance to *P. cocosensis*.

***Pecten (Cyclopecten) pernomus* Hertlein, new name**

Plate 18, figures 11, 12, 13

Pecten (Cyclopecten) rotundus Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 404. "Panama Bay, in 29½ fathoms; also at station 2784, in 194 fathoms, mud bottom temperature 51° 9 F." "A single valve from near the Straits of Magellan, apparently the same species."—Zetek, Los Mol. Republ. Panama. Revista Nueva, nos. 1 and 2, 1918, p. 39. Panama.

⁴⁷ *Pecten (Cyclopecten) catalinensis* Willett, Nautilus, vol. 45, no. 2, 1931, p. 65, pl. 4, figs. 1, 2. . . . "in 100 fathoms off White's Landing, north side of Catalina Island, California."

⁴⁸ *Pecten (Pseudamysium) guppyi* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898, p. 718, pl. 34, figs. 12, 13. "Oligocene of the Bowden marl, Jamaica, and of the Alum Bluff sand at Oak Grove, Santa Rosa County, Florida, Burns; and in the Pliocene Marl of Port Limon, Costa Rica, Hill."

Chlamys (Palliolum?) guppyi (Dall), Woodring, Carnegie Inst. Washington, Publ. 366, 1925, p. 72, pl. 8, figs. 13, 14, 15, 16. "Bowden, Jamaica."

⁴⁹ *Pecten (Pseudamysium) subminutus* Aldrich, Nautilus, vol. 16, no. 9, January, 1903, p. 100, pl. 4, figs. 16, 17. "Red Bluff, Miss., Jackson, Miss."

⁵⁰ *Pecten aotus* Olsson, Bull. Amer. Paleol., vol. 9, Bull. 39, 1922, p. 376 (204), pl. 21 (18), figs. 17, 18. "Gatun Stage: Port Limon." "Coll. 5, Red Cliff Creek," Costa Rica. Miocene.

⁵¹ *Pecten (Cyclopecten) oligolepis* Brown & Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, vol. 64, 1912, p. 512, text fig. 5. "From the excavation of the lower locks at Gatun." Miocene.

Not *Pecten rotundus* v. Hagenow, Neues Jahrb. f. Min., 1842, p. 554. "Rügen, schen Kreide."

Range: Panama Bay (Dall). (?) Straits of Magellan (Dall).

This species is not present in the Templeton Crocker Expedition collection. The name *Pecten rotundus* was used by von Hagenow much earlier than by Dall, and the name *pernomus* is here proposed for the West American species.

According to Townsend,⁵² No. 2799 U. S. B. F. Sta., is given as Lat. 8° 44' 00" N., Long. 79° 09' 00" W., at a depth of 29.5 fathoms, green mud, surface temperatures 75° F., March 6, 1888, and Dall in his original record of *P. rotundus* gave the locality as . . . "in Panama Bay, in 29½ fathoms."

The specimens illustrated on plate 18, figures 11, 12, 13, are considered in the present paper to be syntypes of *Pecten rotundus* Dall, due to the fact that the altitude given in the original description is 3 mm., and the altitude of the specimens illustrated in figures 11 and 13 are both 3 mm. From the present information it is not clear which specimen, if any, was selected as holotype by Dall. The photographs of the "types" of *P. rotundus*, were received from the U. S. National Museum, through the kindness of Dr. A. Wetmore.

Additional collections may show that this is the young of *P. cocosensis* Dall, but for the present it is regarded as a separate species.

***Pecten (Delectopecten) zacaë* Hertlein, new name**

Plate 18, figures 3, 4, 5, 6, 9, 10

Pecten (Pseudamusium) panamensis Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 404, pl. 6, figs. 8 and 10. "Gulf of Panama, in 322 fathoms, mud, bottom temperature 56°F."

Not *Pecten panamensis* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898, p. 696. No locality cited [? = *P. fasciculatus* Hinds].

Range: Cape San Lucas, Lower California to Panama.

Holotype: No. 6880 (C. A. S. Paleo. type collection), from Loc. 27587 (C. A. S.), off Cape San Lucas, Lower California; paratypes: Nos. 6881, 6882 (C. A. S. Paleo. type collection), from Loc. 27584 (C. A. S.), dredged in 20 to 220 fathoms from Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W.; Templeton Crocker collector.

This species was dredged by the Templeton Crocker Expedition at two localities. Loc. 27584 (C. A. S.), about 10 miles due east of San Jose del Cabo, Lower California, in 20 to 220 fathoms, Lat.

⁵² Townsend, C. H., Dredging and other records of the United States Fish Commission Steamer *Albatross* with bibliography relative to the work of the vessel, in Rept. U. S. Commission of Fish and Fisheries, pt. 26. 1900 [issued 1901], p. 404.

23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W.; and Loc. 27587 (C. A. S.), off Cape San Lucas, Lower California, in 20 to 25 fathoms.

The thin, delicate forms of this species, collected by the Templeton Crocker Expedition, possess the shell characters of the species described by Dall as *P. panamensis* in 1908 (not *P. panamensis* Dall, 1898). Due to the fact that Dall has used the name *panamensis* for a species in 1898, the name *zaca* is here proposed for the present species. It is named for Mr. Templeton Crocker's yacht, *Zaca*.

Some specimens are nearly smooth, while others have 40 to 65 fine radial, minutely scaly threads. The whole surface externally, is covered by fine camptonectes striations.

The more elongate form, fewer and more widely spaced ribs, the broader anterior ear of the right valve, and the squarer posterior margin of the posterior ears of both valves, separate the species from *P. randolphi* Dall and *P. randolphi tillamookensis* Arnold.

Pecten lillisi Hertlein⁵³ from the Kreyenhagen Shale (upper Eocene or lower Oligocene), appears to be a related species.

⁵³ *Pecten (Pseudamusium) lillisi* Hertlein, Bull. South Calif. Acad. Sci., vol. 33, pt. 1, January-April (issued February 28), 1934, p. 5, pl. 1, fig. 1, pl. 2, figs. 2, 3. "diatomite, Kreyenhagen shale, from S. E. corner of Sec. 35, T. 6 S., R. 7 E., M. D. M., Stanislaus County, California; on the north side of Crow Creek road."

PLATE 18

Fig. 1. *Pecten (Decadopecten) fasciculatus* Hinds. A reproduction of the original figure of *Pecten (Pallium) miser* Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, pl. 8, fig. 6 "Gulf of Panama, in 182 fathoms." P. 318.

Fig. 2. *Pecten (Decadopecten) fasciculatus* Hinds. A reproduction of the original figure of *Pecten fasciculatus* Hinds, Zool. Voy. Sulphur, Moll., pt. 3, 1844 [date on cover given as January, 1845], pl. 17, fig. 4. "West coast of Veragua." P. 318.

Fig. 3. *Pecten (Delectopecten) zacaе* Hertlein, new species. Altitude 12 mm.; longitude approximately 10 mm. Paratype, right valve, No. 6881 (C. A. S. Paleo. type coll.) from Loc. 27584 (C. A. S.), Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W., in 20 to 220 fathoms. P. 321.

Fig. 4. *Pecten (Delectopecten) zacaе* Hertlein, new species. Altitude 11 mm.; longitude 10.8 mm. Holotype, right valve, No. 6880 (C. A. S. Paleo. type coll.), from Loc. 27587 (C. A. S.), off Cape San Lucas, Lower California, in 20 to 220 fathoms. P. 321.

Fig. 5. *Pecten (Delectopecten) zacaе* Hertlein, new species. Altitude approximately 13.8 mm.; longitude approximately 13.8 mm. Paratype, left valve, No. 6882 (C. A. S. Paleo. type coll.), from same locality as specimen shown in figure 3. This valve shows stronger ribbing than that on the left valve of the holotype. P. 321.

Fig. 6. *Pecten (Delectopecten) zacaе* Hertlein, new species. Holotype, left valve of specimen shown in figure 4. P. 321.

Fig. 7. *Pecten (Cyclopecten) cocosensis* Dall. A reproduction of the original figure of the right valve given by Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, pl. 6, fig. 3. . . . "near Cocos Island, Gulf of Panama, in 52 fathoms." P. 319.

Fig. 8. *Pecten (Cyclopecten) cocosensis* Dall. A reproduction of the original figure of the left valve given by Dall, 1908, pl. 6, fig. 1. From same locality as specimen shown in figure 7. P. 319.

Fig. 9. *Pecten (Delectopecten) zacaе* Hertlein, new species. A reproduction of the original figure of the right valve of *Pecten (Pseudamusium) panamensis* Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, pl. 6, fig. 10. "Gulf of Panama, in 322 fathoms." P. 321.

Fig. 10. *Pecten (Delectopecten) zacaе* Hertlein, new species. A reproduction of the original figure of the left valve of *Pecten (Pseudamusium) panamensis* Dall, 1908, pl. 6, fig. 8. Same locality as specimen shown in figure 9. P. 321.

Fig. 11. *Pecten (Cyclopecten) pernomus* Hertlein, new name. Altitude 3 mm. Paratype, left valve Cat. No. 110708 (U. S. Nat. Mus.), from U. S. B. F. Sta. 2799, Lat. 8° 44' 00" N., Long. 79° 09' 00" W., at a depth of 29.5 fathoms. Figures 11, 12, 13 are photographs of *Pecten (Cyclopecten) rotundus* Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 404. [Not *Pecten rotundus* von Hagenow.] P. 320.

Fig. 12. *Pecten (Cyclopecten) pernomus* Hertlein, new name. Altitude 3.5 mm. Holotype, right valve, Cat. No. 110708 (U. S. N. M.), from same locality as specimen shown in figure 11. P. 320.

Fig. 13. *Pecten (Cyclopecten) pernomus* Hertlein, new name. Altitude 3 mm. Paratype, left valve (Cat. No. 110708 U. S. N. M.), from same locality as specimen shown in figure 11. P. 320.

(Plate 18 continued on next page)

PLATE 18—Continued

Fig. 14. *Pecten (Pecten) sericeus* Hinds. A reproduction of one of the original figures of *Pecten sericeus* Hinds, Zool. Voy. *Sulphur*, Moll., pt. 3, 1844, pl. 17, fig. 1a. "Bay of Panama. In fifty fathoms." P. 303.

Fig. 15. *Pecten (Pecten) sericeus* Dall. A reproduction of the original figure of the left valve given by Hinds, 1844, pl. 17, fig. 1. Same locality as specimen shown in figure 14. P. 303.

Fig. 16. *Pecten (Delectopecten) liriopæ* Dall. Altitude 7.5 mm.; longitude 8 mm.; length of hinge line 4.5 mm. Holotype, right valve of *Pecten (Pseudamusium) liriopæ* Dall, Bull. Mus. Comp. Zool., vol. 43, no. 6, 1908, p. 402. Cat. no. 122,869 (U. S. Nat. Mus.), from "U. S. S. 'Albatross', station 3392, Gulf of Panama, in 1270 fathoms, hard bottom, temperature, 36°.4 F., U. S. N. Mus. 122,869." This photograph was furnished through the kindness of Dr. A. Wetmore, Assistant Secretary Smithsonian Institution.

PLATE 19

Fig. 1. *Pecten (Chlamys) lowei* Hertlein, new species. Altitude 13.8 mm.; longitude 11.5 mm. Holotype, right valve, No. 6878 (C. A. S. Paleo. type coll.), from Carmen Island, Gulf of California, from a depth of 20 fathoms; H. N. Lowe, collector. P. 308.

Fig. 2. *Pecten (Chlamys) lowei* Hertlein, new species. Holotype, left valve. P. 308.

Fig. 3. *Pecten (Pecten) sericeus* Hinds. Altitude approximately 17 mm.; longitude approximately 17.5 mm. Plesiotype, right valve of a juvenile specimen, No. 6876 (C. A. S. Paleo. type coll.), from Loc. 27584 (C. A. S.), dredged in 20 to 220 fathoms, Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W. P. 303.

Fig. 4. *Pecten (Pecten) sericeus* Hinds. Left valve of specimen shown in figure 3. P. 303.

Fig. 5. *Pecten (Pecten) diegensis* Dall. Altitude approximately 25 mm.; longitude approximately 26 mm. Plesiotype, right valve of a juvenile specimen, No. 6875 (C. A. S. Paleo. type coll.), from Loc. 27824 (C. A. S.), Isthmus Cove, Santa Catalina Island, California, in 30-50 fathoms. P. 302.

Fig. 6. *Pecten (Pecten) diegensis* Dall. Left valve of specimen shown in figure 5. P. 302.

Fig. 7. *Pecten (Chlamys) lowei* Hertlein, new species. A much less enlarged view of specimen shown in figure 1. P. 308.

Fig. 8. *Pecten (Chlamys) lowei* Hertlein, new species. A much less enlarged view of specimen shown in figure 2. P. 308.

Fig. 9. *Pecten (Chlamys) zeteki* Hertlein, new name. A reproduction of the original figure of *Pecten digitatus* Hinds (not *P. digitatus* Perry), Zool. Voy. *Sulphur*, Moll., pt. 3, 1844, pl. 17, fig. 2. "Bay of Guayaquil." P. 306.

Fig. 10. *Pecten (Leptopecten) latiauratus delosi* Arnold. Altitude approximately 7.5 mm.; longitude approximately 7.8 mm. Plesiotype, left valve No. 6885 (C. A. S. Paleo. type coll.), from San Benito Island, Lower California, in ten fathoms; H. N. Lowe, collector. P. 314.

Fig. 11. *Pecten (Leptopecten) tumbezensis* d'Orbigny. Altitude approximately 18.4 mm.; longitude approximately 20 mm.; diameter (both valves) approximately 8.2 mm. Plesiotype, right valve No. 6883 (C. A. S. Paleo. type coll.) from Loc. 27584 (C. A. S.), Lat. 23° 03' to 23° 06' N., Long. 109° 31' to 109° 36' W., in 20 to 220 fathoms. P. 314.

Fig. 12. *Pecten (Leptopecten) tumbezensis* d'Orbigny. Left valve of specimen shown in figure 11. The left valve shown in this figure has more white marking than the other specimens in the collection. Usually they are ornamented by smaller white patches, or in some specimens only by light bluish dots on a brownish or slate colored background. P. 314.

Fig. 13. *Pecten (Leptopecten) velero* Hertlein, new species. Altitude approximately 6.1 mm.; length of hinge line approximately 5.9 mm. Plesiotype, right valve, No. 6887 (C. A. S. Paleo. type coll.), from Loc. 27229 (C. A. S.), Bahia Honda, Veragua, Panama, in three to nine fathoms. P. 316.

(Plate 19 continued on next page)

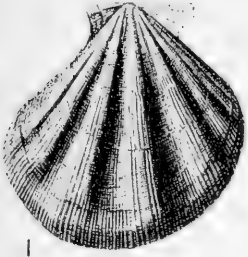
PLATE 19—Continued

Fig. 14. *Pecten (Leptopecten) velero* Hertlein, new species. Altitude approximately 6.4 mm.; length of hinge line approximately 6.2 mm. Holotype, left valve, No. 6857 (C. A. S. Paleo. type coll.), from Loc. 27229 (C. A. S.), Bahia Honda, Veragua, Panama, in three to nine fathoms. P. 316.

Fig. 15. *Pecten (Lyropecten) subnodosus* Sowerby. Altitude 37.2 mm.; longitude 36.5 mm. Plesiotype, right valve (left ear imperfect), No. 6884 (C. A. S. Paleo. type coll.), from Loc. 27577 (C. A. S.), Maria Madre Island, Tres Marias Islands, Mexico. P. 317.

Fig. 16. *Pecten (Pecten) vogdesi* Arnold. Altitude approximately 37.4 mm.; longitude approximately 41 mm. Plesiotype, left valve No. 6877 (C. A. S. Paleo. type coll.), from Loc. 27584 (C. A. S.). Lat. $23^{\circ} 03'$ to $23^{\circ} 06'$ N., Long. $109^{\circ} 31'$ to $109^{\circ} 36'$ W., in 20 to 220 fathoms. P. 304.

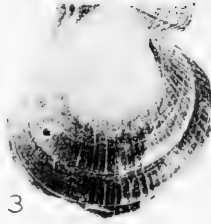
Fig. 17. *Pecten (Pecten) vogdesi* Arnold. Right valve of specimen shown in figure 16. Convexity of valve approximately 13.1 mm. P. 304.



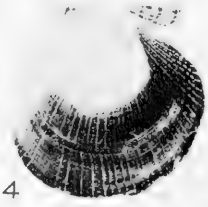
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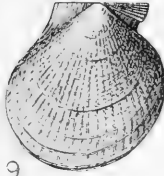
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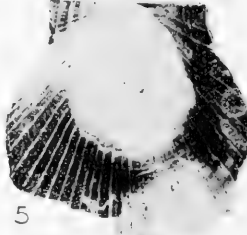
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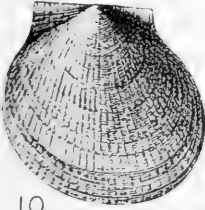
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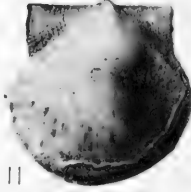
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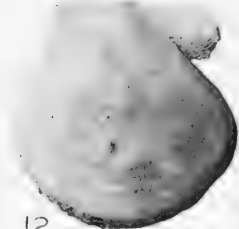
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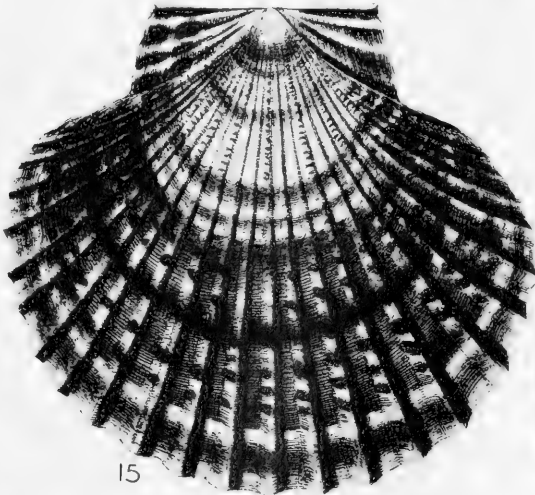
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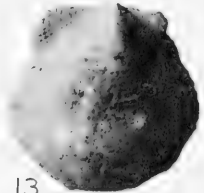
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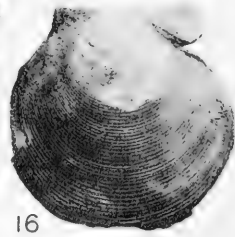
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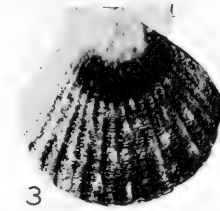
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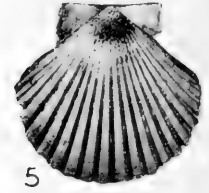
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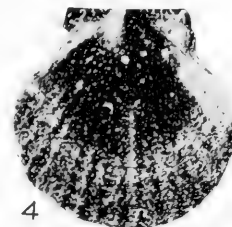
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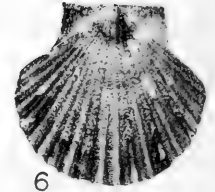
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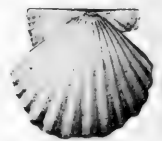
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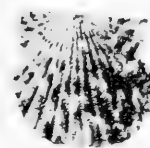
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PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES
FOURTH SERIES

VOL. XXI, No. 26, pp. 329-336.

SEPTEMBER 26, 1935

THE TEMPLETON CROCKER EXPEDITION OF THE
CALIFORNIA ACADEMY OF SCIENCES, 1932

No. 26

NEW FLOWERING PLANTS FROM THE
GALAPAGOS ISLANDS

BY

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In the course of my studies on the rich collections of flowering plants of the Templeton Crocker Expedition of the California Academy of Sciences, 1932, from the Galapagos Islands, a number of plants have appeared to be new and undescribed. Although some of these must await further study or comparison with critical historical specimens and types, a few have seemed undoubtedly new and worthy of taxonomic recognition. Descriptions of these new plants from the Galapagos Islands are given herewith.

***Drymaria monticola* Howell, spec. nov.**

Herba glabra; caulibus decumbentibus, radicanibus, lignescentibus in senectute; foliis 1-2.5 cm. longis, late ovatis, suborbicularibus, subsessilibus, basi rotundis vel subcordatis, ex basi 3 nervis prominentibus et nonnullis minoribus, abrupte acutis et cuspidatis, integris, stipulis numerosis, filiformibus, subcaducis; inflorescentia pauciflora, pedicellis 2-5 mm. longis, glabris; sepalis 4, 6 mm. longis, elliptico-lanceolatis, 3-nervatis, subcarinatis, acutis; petalis 4 vel 5, 4-5 mm. longis, fissis 3-3.5 mm., lobis circa 1 mm. latis, obtusis, ungui angustissimo; staminibus 5, ovarium subaequantibus, filamentis glabris, antheris oblongis; stylo 1 mm. longo, trifido, capsula vix angulata supra, dura et nitenti, glabra; seminibus 16, muriculato-tuberculatis.

September 26, 1935

Creeping, glabrous plant, the old stems becoming woody, rooting; leaves broadly ovate, nearly round, subsessile, subcordate or rounded at base, with 3 prominent and several less prominent nerves, 1-2.5 cm. long, shortly acute and cuspidate, entire; stipules numerous, filiform, more or less cauducous; inflorescence few-flowered, pedicels 2-5 mm. long, glabrous; sepals 4, 6 mm. long, elliptic-lanceolate, 3-nerved, somewhat carinate along midrib, acute; petals 4 or 5, 4-5 mm. long, cleft 3-3.5 mm., the lobes about 1 mm. wide, obtuse, the claw very narrow; stamens 5, about equalling the ovary, filaments glabrous, anthers oblong; style 1 mm. long, 3-parted $\frac{1}{4}$ - $\frac{1}{3}$ length, capsule scarcely angled above, hard and shining, glabrous, 16-seeded; seeds muriculate-tuberculate.

Type: Herb. Calif. Acad. Sci. No. 213492, collected on the summit of Mt. Crocker, INDEFATIGABLE ISLAND, *Howell No. 9243*.

This *Drymaria* is related to *D. macrantha* Gray but the entire plant is glabrous and the flowers are only $\frac{1}{2}$ to $\frac{2}{3}$ as large. The collection of *Drymaria* made by Miss Rorud on Indefatigable Island at Hacienda Fortuna and doubtfully referred by Christophersen to *D. cordata* (Nyt. Mag. Naturvid. 70:75) may be *D. monticola*. The two species can be readily separated by the pedicels which in *D. cordata* are closely glandular-papillose.

***Euphorbia bisulcata* Howell, spec. nov.**

Herba annua glabra; caulibus 6-8 dm. altis, erectis, ramulis numerosis, subdivaricatis; foliis oppositis, oblongo- vel lineari-lanceolatis, 0.2-1.5 cm. longis, 0.5-2 mm. latis, integris, subacutis, basi obliquis et auriculatis, cinereo- viridibus vel rufescentibus, utrinque subsimilibus, petiolis brevissimis, stipulis parvis, circa 0.5 mm. longis, filiformibus, basi plus minusve coalescentibus; involucris axillaribus, brevissimi pedicellatis, campanulatis, 0.5-0.75 mm. longis, lobis involucribus triangulari-subulatis, sparse ciliatis, glandulis transverse oblongis, atropurpureis, appendicibus non evidentibus vel angustissimis; ovario glabro; stylis brevibus, bifissis ad medium; capsula depresso-globosa, circa 1.5 mm. longa et 2 mm. lata, basi rotundata, apice trilobata, dorso carpelli late bisulcato, sulcis carina abrupta acuta separatis, sulcis carpellorum contiguorum carina lata, plana, septali separatis; seminibus quadrangularibus, suboblongis, 1 mm. longis, cinereis, profunde propinque et transverse rugosis, rugis plus minusve fractis et muriculatis.

Annual, glabrous, herb; stems 6-8 dm. tall, erect, branchlets numerous, somewhat divaricate; leaves opposite, oblong- or linear-lanceolate, 0.2-1.5 cm. long, 0.5-2 mm. broad, entire, subacute, oblique and auriculate at base, gray-green or reddish-brown, the upper and lower surfaces nearly the same, petioles very short, stipules small, circa 0.5 mm. long, filiform, more or less coalescent below; involucre axillary, very shortly pedicellate, campanulate, 0.5-0.75 mm. long, involucre lobes triangular-subulate, sparsely ciliate, gland transversely oblong, purplish-black, appendage not evident or very narrow; ovary glabrous; style short, cleft to the middle into 2 broad branches; capsule depressed-globose, about 1.5 mm. long and 2 mm. wide, rounded at base, 3-lobed at summit, back of each carpel broadly bisulcate, the grooves on the carpels separated by an abrupt sharp ridge, the grooves of adjacent carpels separated by a broad, flattened, septal ridge; seeds quadrangular, oblongish, 1 mm. long, ashy, deeply and closely transversely wrinkled, the wrinkles more or less broken and muriculate.

Type: Herb. Calif. Acad. Sci. No. 220745, north side, INDEFATIGABLE ISLAND, *Howell No. 9880*, June 9, 1932.

This *Euphorbia* is most closely related to *E. diffusa* Hook. f. but it differs from this and all the other Galapagian species of *Euphorbia* in the bisulcate backs of the carpels which together form the peculiar 6-ridged fruit.

Malvastrum dimorphum Howell, spec. nov.

Planta herbacea, perennis (?); caulibus erectis, 2 m. altis; foliis ovatis, dentatis vel crenato-dentatis, acutis, latissime cuneatis vel subcordatis basi, cinereo-viridibus supra, pallidioribus incanisque subter, foliis primariis magnis, 4-7 cm. longis, 3-5.5 cm. latis, petiolis 3-5 cm. longis, foliis superioribus et secundis parvis, 1.5 cm. longis, 1 cm. latis, petiolis 2-4 mm. longis; floribus primo solitariis in pedicellis longis ex axillis foliorum magnorum primariorum, pedicellis 1-2 cm. longis, vel tardius subsessilibus congestis solitariisve in ultimis caulibus vel in ultimis ramulis contractis axillaribus peduncularibus; bracteolis 3, filiformibus, 0.5 cm. longis; calyce 1.5-2 cm. lato, in fructu stellato-rotato, fisso infra medium, lobis ovato-lanceolatis, subacuminatis, utrinque pubescentibus; corolla lutea, 1-5 cm. diametro, petalis subintegris, late obovatis basi barbatis; tuba staminali stellato-pubescenti; stylis staminibus aequilongis; carpellis circa 12, stellato-depressis, 4 mm. longis, in exteriori angulo cornibus 2, gracilibus, prominentibus, horizontalibus, radialiter extendentibus et in interiore angulo puncta brevissima erecta, pubescentibus circum undique, dense supra; seminibus oblique reniformibus, subopacis, laevibus.

Plant herbaceous, probably from a perennial base, clothed with dense, close stellate pubescence; stems erect, 2 m. tall; leaves ovate, dentate or crenate dentate, acute, very broadly cuneate to subcordate at base, gray-green above, paler and incanous below, primary leaves large, 4-7 cm. long, 3-5.5 cm. wide, petioles 3-5 cm. long, the upper leaves and secondary leaves small, 1.5 cm. long, 1 cm. wide, petioles 2-4 mm. long; flowers at first solitary on long pedicels from the axils of the large primary leaves, pedicels 1-2 cm. long, or later subsessile congested or solitary near the ends of stems or at the ends of abbreviated peduncle-like axillary branchlets; bractlets 3, filiform, 0.5 cm. long; calyx 1.5-2 cm. broad, subrotate in fruit, cleft to below the middle, lobes ovate-lanceolate, subacuminate, pubescent above and below; corolla yellow, 1.5 cm. in diameter, petals subentire, obovate, bearded at base; stamen-tube stellate-hairy; styles equalling stamens; carpels 4 mm. long with 2 prominent horizontal, outwardly pointing horns at outer angle and a very short, inconspicuous, erect point at the inner angle; pubescent on all sides, densely so above; seed obliquely reniform, somewhat dull, smooth.

Type: Herb. Calif. Acad. Sci. No. 220768, Academy Bay, INDEFATIGABLE ISLAND, *Howell No. 9294*, May 13, 1932. Other collections, all from Indefatigable Island: southeast side at 600 ft., *Stewart No. 2014* and *No. 2015* (reported as *M. spicatum*); Academy Bay, *Schimpff No. 35* (determined as *M. scoparioides*). Almost without doubt, the flowering collection reported by Dr. H. K. Svenson as ?*Sida* sp. (*Amer. Journ. Bot.* 22: 244, —1935) is to be referred here.

This *Malvastrum*, whose name connotes the diverse aspect of habit, leaves, and inflorescence in youth and age, is related to *M. scoparium* (L'Her.) Gray and to *M. scoparioides* Ulbr. (*Notizbl. Bot. Gart. Berlin*, 11: 525, —1932). Like the latter, *M. dimorphum*

differs from *M. scorparium* in the much larger flowers and fruit, but *M. dimorphum* appears very distinct from *M. scoparioides* in the dimorphic characters of leaves and inflorescence and in the very different carpellary horns. A specimen of *M. scorparium* (Chosica, Peru, *Macbride & Featherstone No. 531*) and a photograph of the type of *M. scoparioides* (Peru, *Weberbauer No. 3196*, ex Mus. Bot. Berol.) were kindly loaned for study by the Field Museum of Natural History.

Salvia floriana Howell, spec. nov.

Perennis, suffrutescens, humilis; caulibus 1.5-9 dm. altis, puberulis, erectis; foliis deltoideo-ovatis, 1-2.5 cm. longis, 0.5-2 cm. latis, obtusis subacutisve, truncatis vel late rhomboideis basi, prominenter crenato-serratis, petiolis 0.5-1.5 cm. longis; verticillastris 7-20-floris, racemosis, distantibus subter, contiguus supra, bracteis deciduis, oblongo-linearibus, pubescentibus, 1.5 mm. longis, pedicellis canescentibus, circa 2 mm. longis; calyce tubulato-campanulato, subturbinato, subtruncato supra, 3 mm. longo in flore, 4-5 mm. longo in fructu, striate 13-nervato, pubescenti, glanduloso, ciliato, bilabiato, labio superiore late subquadrilaterali et vix apiculato, inferiore bilobato, lobis asymmetricis late ovato-triangularibus, breviter acutis; corolla alba, conspicue exserta, labio inferiore 4 mm. longo, trilobato, lobis lateralibus 2, parvis, medio magno, subquadrangulato, labio superiore obcordato, 1.5 mm. longo; filamentis subglabris, connectivo longe producto, filamento longiore, rudimentis staminum superiorum parvis; stylo clavellato, lobo inferiore obsoleto; nuculis subobovatis, opacis, brunneis, trigonis, dorso plano-convexo, faciebus ventralibus planis.

Low suffrutescent perennial; stems 1.5-9 dm. tall, puberulent, erect; leaves deltoid-ovate, 1-2.5 cm. long, 0.5-2 cm. wide, brownish-green and minutely pubescent above, incanous and subtomentose below, finely but definitely rugulose, obtuse or subacute, truncate or broadly rhomboidal at base, prominently crenate-serrate; petioles 0.5-1.5 cm. long; flowers verticillate, the verticils 7-20-flowered, racemose, distant below, forming a continuous inflorescence above, subtended by early deciduous, oblong-linear, pubescent bracts 1.5 mm. long, pedicels canescent and about 2 mm. long; calyx tubular-campanulate, subturbinate, subtruncate above, 3 mm. long in anthesis, 4-5 mm. long in fruit, striately 13-nerved, pubescent, glandular, ciliate, 2-lipped, the upper lip broadly subquadrilateral and scarcely pointed, the lower lip 2-lobed, the lobes asymmetrical, broadly ovate-triangular, shortly acute; corolla white, conspicuously exserted, the lower lip 4 mm. long, with 2 small lateral lobes and large expanded subquadrangular middle lobe, the upper lip obcordate, 1.5 mm. long; filaments subglabrous, connective long-produced, longer than the free part of the filament, rudiments of upper stamens present; style clavellate, the lower lobe obsolete; nutlets subobovate, dull, brown, trigonous, plano-convex dorsally, the inner faces plane.

Type: Herb. Calif. Acad. Sci. No. 220744, from the summit of Floreana Peak, CHARLES ISLAND, *Howell No. 9336*, May 15, 1932.

This is the plant collected by Stewart (*No. 3339* and *3340*) and reported by him as *S. prostrata* (Proc. Calif. Acad. Sci., ser. 4, 1: 135); and it is probably the plant collected by Darwin and reported by Hooker f. as *S. tiliaefolia* (Trans. Linn. Soc. 20: 200). In habit

and foliage, *S. floriana* looks like a xerophytic form of *S. tiliaefolia* but in the characters of the flower it is very different. The style appears especially remarkable.

***Elvira atripliciformis* Howell, spec. nov.**

Herba annua, caulibus strigosis, decumbentibus, 2-5 dm. longis, raro radican-
tibus; foliis ovatis, 1-5 cm. longis, 0.5-2.5 cm. latis, acutis, serratis, subflaccidis,
sparse pubescentibus et minute scabridulis, petiolis brevibus, 2-5 mm. longis,
subcuneate marginatis subter basi rotunda folii; capitulis 1 vel 2 in axillis foliorum,
compressis vel saepe tripteris, brevissime pedunculatis, floribus 2 vel 3; bracteis
involucralibus 3, bractea exteriori maxima, foliacea, sparse pubescenti, 5-9 mm.
lata, 3-5 mm. longa, truncata vel obcordata, breviter et abrupte acuminata, basi
truncata vel tenuiter et late cordata, basi conjuncta cum bracteis minoribus, margini-
bus bractearum volutis et basi involucri induratis in senectute; flore pistillato 1,
corolla ligulata, albida, parva, 1.5 mm. longa, bidentata; floribus staminalibus 1 vel
2, tubulatis, 4-dentatis, 1.5 mm. longis; acheniis nigrescentibus, 2 mm. longis,
obovato-cuneatis, superne puberulis, valde compressis, latere exteriori plano-
convexo, interiori costato vel carinato, cum involucrio purpurascenti deciduis.

Annual herb with spreading stems 2-5 dm. long, sparsely rooting, strigose; leaves
ovate, 1-5 cm. long, 0.5-2.5 cm. wide, acute, serrate, subflaccid, sparsely pubescent
and minutely scabridulous, shortly petiolate, petiole 2-5 mm. long, subcuneately
winged below the rounded base of the blade; heads 1 to several in the axils of the
leaves, compressed or commonly tripterous, very shortly pedunculate, 2- or 3-
flowered, involucre bracts 3, more or less united at base, the exterior one largest,
foliaceous, 5-9 mm. broad, 3-5 mm. long, truncate or obcordate and shortly and
abruptly acuminate, the base truncate or shallowly and broadly cordate, thinly
pubescent, more or less united at the base with the smaller bracts, the edges of the
bracts becoming folded and the base of the involucre becoming indurated in age;
pistillate flower 1, corolla whitish, minute, 1.5 mm. long, bidentate; staminate
flowers 1 or 2, tubular, 4-toothed, 1.5 mm. long; achene slaty-black, 2 mm. long,
obovate-cuneate, puberulent above, strongly flattened, exterior face plano-convex,
interior face ridged or sharply carinate, deciduous together with the involucre which
becomes purplish in age.

Type: Herb. Calif. Acad. Sci. No. 220339, in sandy soil near the
beach, James Bay, JAMES ISLAND, *Howell No. 9635*, June 4, 1932.

In morphology, *E. atripliciformis* closely resembles *E. repens*
(Hook. f.) Rob. but it is adequately distinct in its more robust habit
and in the larger size of all its parts. The peculiar winged involucre
enveloping the solitary achene is reminiscent of the ripened fruit and
persistent bracts of certain western American species of *Atriplex*,
notably *A. canescens* (Pursh) James.

***Pectis glabra* Howell, spec. nov.**

Herba annua; caulibus 0.5-2.5 dm. longis, diffuse ramosis et decumbentibus,
glabris puberulisve, purpureo-fuscis; foliis linearibus, 0.5-2 cm. longis, 0.5-1.5 mm.
latis, glabris vel minute scabrido-ciliatis margine et basi, apicibus mucronatis vel
setigeris, margine 2 vel 3 setis remotis utrinque ciliata, subtus glanduloso-punctatis,

glandulis subbiseriilibus; capitulis in pedunculis bracteatis 0.5-2.5 cm. longis; bracteis involucribus 5, oblongo-oblanccolatis, serrulatis, obtusis subacutisve, 5 mm. longis, 1.5 mm. latis, purpurascensibus, glanduloso-punctatis, carinatis sub medio et rotundatis basi; ligulis 4-5 mm. longis, 1-1.5 mm. latis, luteis super, rufescentibus subter; floribus disci 8, corollis 3-3.5 mm. longis; acheniis 2-3 mm. longis, sparse pubescentibus superne, pappo radii nullo vel minute paleaceo-disciformi vel raro 1-2-setoso (in f. *setuloso* multisetoso), disci 20-30-setoso, setis gracilibus, inaequalibus, 2-3 mm. longis, saepius brevioribus quam corolla disci.

Annual herb; stems 0.5-2.5 dm. long, diffusely branching and spreading, glabrous or minutely puberulent, purplish-brown; leaves linear, tapering from the base to a mucronate or setigerous tip, 0.5-2 cm. long, 0.5-1.5 mm. wide, glabrous or minutely scabrous-ciliate on the margin and near the base, bearing 2 or 3 pairs of bristles on the margin, glandular-dotted, the glands nearly biserial; heads on slender bracteate peduncles terminating branches, 0.5-2.5 cm. long; involucrial bracts 5, oblong-oblanccolate, serrulate, obtuse or subacute, 5 mm. long, 1.5 mm. wide, purplish and gland-dotted, keeled below the middle and rounded at base; ligules 4-5 mm. long, 1-1.5 mm. wide, yellow above, ruddy-brown below; disk-flowers 8, corolla 3-3.5 mm. long; achenes 2-3 mm. long, lineate, sparsely hairy above; pappus of ray-achenes none or a minute paleaceous disk, or rarely 1 or more bristles, pappus of disk-achenes of 20-30 slender bristles, the bristles unequal, 2-3 mm. long, generally a little shorter than the disk-corolla.

Type: Herb. Calif. Acad. Sci. No. 220743, Sullivan Bay, JAMES ISLAND, *Howell No. 10040*, June 13, 1932.

Pectis glabra is most nearly related to *P. tenuifolia* Hook. f. from which it differs not only in its annual habit but in its smaller flower parts and shorter pappus. *Pectis tenuifolia* is apparently an evolutionary modification adapted to the rigorous conditions of its home on relatively fresh lava flows, while *P. glabra* is an annual adapted for rapid growth in loose alluvial and volcanic soils during a brief rainy season. Field observations and herbarium studies indicate beyond doubt that these plants do not represent different habitat aspects of the same species but rather two distinct entities admirably adapted for special situations.

***Pectis glabra* f. *calvescens* Howell, f. nov.**

Pappo acheniorum radii et disci nullo vel brevissimo et paleaceo-squamulato.

Pappus of both ray-achenes and disk-achenes none or reduced to minute paleaceous scales.

Type: Herb. Calif. Acad. Sci. No. 220740, Conway Bay, INDEFATIGABLE ISLAND, *Howell No. 9870*, June 8, 1932.

Plants of the type collection have achenes without pappus but in a collection made at Wreck Bay, Chatham Island, *Howell No. 8615*, a few minute paleaceous scales are frequently present on the disk-achenes.

***Pectis glabra* f. *pubescens* Howell, f. nov.**

Caulibus retrorse puberulis; foliis scabrido-pubescentibus supra et in costa subter; bracteis involucribus acutis vel breve acuminatis, subglabris; pappo acheniorum radii 1-2-paleaceo-aristato vel obsoleto.

Stems retrorsely puberulent; leaves scabrous-pubescent above and on the midrib below; pappus of ray-achenes of 1 or 2 paleaceous awns or obsolete.

Type: Herb. Calif. Acad. Sci. No. 220739, north side of INDEFATIGABLE ISLAND adjacent to South Seymour Island, *Howell No. 9897*, June 9, 1932.

***Pectis glabra* f. *setulosa* Howell, f. nov.**

Herba humilis foliosa; pappo acheniorum radii setoso et simili ei disci.

Low leafy herb; pappus of ray-achenes bristly and similar to that of disk-achenes.

Type: Herb. Calif. Acad. Sci. No. 220742, NORTH SEYMOUR ISLAND, *Howell No. 9991*, June 11, 1932.

Not only does this form differ from the species in the critical character described but it has a different aspect due to the more condensed habit and more leafy stems. In fact, it looks more like a glabrous form of *P. Hookeri* Rob. since the leaves are a trifle broader in proportion to length than is usual in *P. glabra*.

***Pectis Hookeri* f. *stellulata* Howell, f. nov.**

Pappo acheniorum disci brevi, paleaceo, squamulato vel disciformi, disco stellato-dentato vel brevi-setoso, radii simili vel nullo.

Pappus of disk-achenes reduced to a few small scales or to a minute stellate-dentate or short-bristly paleaceous disk; pappus of ray-achenes similar or none.

Type: Herb. Calif. Acad. Sci. No. 220741, JERVIS ISLAND, *Howell No. 9740*, June 6, 1932.

The following key, based on the collections of the Templeton Crocker Expedition of the California Academy of Sciences (except for data relating to *P. subsquarrosa* (Hook. f.) Sch. Bip. and *P. Anderssonii* Rob.), indicates characters by which the species and forms of *Pectis* in the Galapagos Islands may be distinguished:

- A. Pappus of disk-achenes of numerous straight bristles or reduced to minute scales or none; rays conspicuous; endemic species.
- B. Plants perennial, the lower stems distinctly woody.
- C. Leaves narrowly linear, glands more or less biserial.
- D. Heads terminating similar stems and branches; peduncles long *P. tenuifolia*
- D¹. Heads terminating short, fasciculate-leafy, lateral branches; peduncles short (ex char.) *P. subsquarrosa*
- C¹. Leaves linear-lanceolate, glands scattered irregularly (ex char.) *P. Anderssonii*
- B¹. Plants annual, the stems herbaceous throughout.
- E. Leaves and stems cinereous, hispidulous (see also *P. glabra* f. *pubescens*); leaves linear-oblong to lanceolate; pappus generally a little longer than the disk-corolla (except in *P. Hookeri* f. *stellulata*).
- F. Pappus of disk-achenes of numerous bristles *P. Hookeri*
- F¹. Pappus of disk-achenes reduced to a minute stellate-dentate or short-bristly paleaceous disk, rarely a longer bristle present *P. Hookeri* f. *stellulata*
- E¹. Leaves glabrous (except in *P. glabra* f. *pubescens*), mostly narrowly linear; pappus equalling or shorter than the disk-corolla.
- G. Pappus of disk-achenes present and conspicuous.
- H. Pappus of ray-achenes of 1 or 2 paleae or none.
- I. Leaves glabrous *P. glabra*
- I¹. Leaves pubescent *P. glabra* f. *pubescens*
- H¹. Pappus of ray-achenes of numerous bristles *P. glabra* f. *setulosa*
- G¹. Pappus of disk-achenes none or reduced to very minute scales or bristles *P. glabra* f. *calvescens*
- A¹. Pappus of disk-achenes generally present, of 2 or 3 divergent, curved awns; rays short and inconspicuous; widespread in the American tropics *P. linifolia*



PROCEEDINGS

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**THE TEMPLETON CROCKER EXPEDITION TO WESTERN
POLYNESIAN AND MELANESIAN ISLANDS, 1933**

No. 27

FISHES

BY

ALVIN SEALE

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FOREWORD

The Templeton Crocker Expedition of 1933 to the Polynesian and Melanesian islands of the Western Pacific returned with a collection of fishes numbering 1830 specimens representing 248 species. Eight of these seem to be new to science, and specimens of a number of rare species were taken.

Fishes were collected at the following islands:

PALMYRA ISLAND

SAMOAN GROUP

Tutuila Island at Pago Pago.

FIJI GROUP

Viti Levu Island at Suva.

SANTA CRUZ GROUP

Vanikoro Island at Tevai Bay,
Lomlom Island at Mohawk Bay,
Anuda (Cherry) Island,
Matema Island,
Tucopia Island.

October 23, 1935

SOLOMON GROUP

Rennell Island at Kungava Bay,
 Bellona Island,
 Santa Ana (Owa Reha) Island,
 Malaita (Mala) Island at Auki Harbor, Uras Cove,
 Tai Lagoon,
 Florida Island at Tulagi,
 Gavutu Island at Gavutu Harbor,
 Guadalcanar (Guadalcanal) Island at Aola Bay, Kau
 Kau,
 Sikaiana Island, Stewart Islands,
 Ugi Island,
 San Cristoval at Star Harbor.

The following species are described as new in this report:

Muraenichthys malaita (Echelidae).
Callechelys fijiensis (Ophichthyidae).
Cypselurus zaca (Exocoetidae).
Cypselurus crockeri (Exocoetidae).
Amia asaedæ (Apogonidae).
Abudefduf atrapinna (Pomacentridae).
Thalassoma herrei (Coridae).
Hypleurochilus samoensis (Blenniidae).

ELOPIDAE

Elops saurus Linnaeus. Ten-pounder

Pago Pago, Samoa (1)*, April 16, 41 mm. The young of this species probably has a larval transformation from young to adult similar to that of *Albula*. This specimen is almost translucent with a number of dark dots at the posterior edge of the opercle. The teeth are strong and well developed.

CHANIDAE

Chanos chanos (Forskål). Bangos. Milk Fish

Suva, Fiji (2), April 29, 98-99 mm.

CLUPEIDAE

Spratelloides delicatulus (Bennett). Sprat

Uras Cove, Malaita Island (1), May 27, 48 mm.; Tai Lagoon, Malaita Island (6), May 30, 28-45 mm.; Tai Lagoon, Malaita Island (12), May 29, 26-45 mm.; Kau Kau, Guadalcanar Island (1),

*Number in parenthesis indicates the number of specimens from the given locality.

May 22, 29 mm.; Auki, Malaita Island (4), May 25, 25–45 mm.; Santa Ana Island (68), June 30, 26–45 mm.; Rennell Island (1), June 12, 30 mm.; Pago Pago, Samoa (5), April 12, 28–31 mm.

Many of these little sprat were taken at night around the strong electric light lowered into the water.

Spratelloides gracilis (Schlegel). Graceful Sprat

Tulagi Island (12), May 19, 34–40 mm.; Anuda Island (2), August 15, 23–34 mm. This species has a bright silvery stripe on the side.

Dussumieria acuta Cuvier and Valenciennes
Sharp-nose Sprat

Pago Pago, Samoa (9), April 14, 45 mm.

Dussumieria hasseltii Bleeker. Hasselt's Sprat

Auki, Malaita Island (1), May 25, 24 mm.; Vanikoro Island, Santa Cruz group (3), July 12, 23–24 mm.

Sardinella sirm (Rüppell). Sardine

Pago Pago, Samoa (1), April 15, 51 mm.

Harengula gibbosa (Bleeker). Herring

Pago Pago, Samoa (35), April 16, 23–45 mm. In these young specimens the scutes are quite distinct. The origin of the anal is under the fourth dorsal ray. Anal rays 16.

Harengula melanura (Cuvier). Black-tail Herring

Uras Cove, Malaita Island (1), May 27, 115 mm. Bluish above, silvery on sides with 2–3 indistinct stripes, caudal broadly black.

Harengula pinguis Günther. Herring

Tai Bay, Malaita Island (3), May 29, 30–34 mm.

Harengula fimbriata (Cuvier and Valenciennes). Herring

Tai Lagoon, Malaita Island (18), May 30, 35–60 mm. In these young the origin of the dorsal is distinctly nearer the tip of snout than caudal fin. Origin of ventrals under fourth ray of dorsal. Depth 3.5 in length (without caudal). Color brownish above, otherwise silvery—a rather narrow line separating the two colors.

ENGRAULIDAE

Anchovia apiensis Jordan and Seale. Apia Anchovy

Pago Pago, Samoa (3), April 14, 38 mm.; Tai Bay, Malaita Island (2), May 29, 79-80 mm.; Tulagi Island (1), May 19, 43 mm.

Anchovia evermanni Jordan and Seale. Evermann's Anchovy
Suva, Fiji Islands (2), April 24, 81-86 mm.

Anchovia commersonii Lacépède. Anchovy

Tulagi Island (1), May 19, 32 mm.; Kau Kau, Guadalcanar Island (11), May 22, 32-33 mm.

Anchovia purpurea (Fowler). Anchovy

Kau Kau, Guadalcanar Island (13), May 21, 25-44 mm.

GONOSTOMIDAE

Diplophos pacificus Günther

Bellona Island (1), June 22, 43 mm. The type of this rare species was taken by the "Challenger" expedition near the mid-Pacific. It measured 37 mm. in length. This seems to be the second specimen taken. It agrees very well with Günther's description and figure. (Challenger Report, Vol. 31, pt. 2, p. 33, pl. 4, fig. B.)

ANGUILLIDAE

Anguilla australis Richardson. Australian Eel

One fine specimen from Tevai Bay, Vanikoro Island, May 6, 340 mm., also a fine series of larval specimens which seem to be of this species.

Anguilla mauritiana Bennett. Fresh-water Eel

Suva, Fiji Island (1), April 28, 460 mm.

MORINGUIDAE

Moringua javanica (Kaup). Java Worm Eel

Suva, Fiji Islands (3), April 30, 75-245 mm. These specimens have the dorsal and anal fins reduced to a mere fold of skin with a few rays at the tip of the tail only.

Depth about 70 in total length.

ECHELIDAE

Muraenichthys gymnopterus (Bleeker). Worm Eel

Pago Pago, Samoa (2), April 18, 65–127 mm.; Rennell Island (1), June 14, 52 mm.; Auki, Malaita Island (1), May 25, 112 mm. In this species the origin of the dorsal fin is nearer the origin of the anal than to gill openings.

Muraenichthys macropterus Bleeker

Suva, Fiji Islands (3), April 28, 48–80 mm.; Pago Pago, Samoa (2), April 18, 118 mm. In this species the origin of the dorsal fin is nearer the gill openings than to origin of anal.

Muraenichthys macrostomus (Bleeker)

Kau Kau, Guadalcanar Island (1), May 21, 77 mm.; Suva, Fiji Islands (1), April 23, 34 mm. In this species the origin of the dorsal fin is almost directly above or very slightly behind the origin of the anal.

Muraenichthys malaita Seale, sp. nov.

Plate 20, fig. 1

This species differs from all other members of the genus in having the origin of the dorsal fin posterior to the origin of the anal by more than the length of the head. Head 3.5 in body to anal pore, 9.5 in total length, depth about 3.8, snout projecting. Eye located above posterior half of mouth, its width 2.5 in length of snout, anterior nostril tubular, posterior one a slit on upper lip. Teeth small in two or more rows. No pectoral fin. Origin of anal anterior to middle of body. Origin of dorsal more than the length of the head behind origin of anal. Color yellowish with dark punctulations above.

Holotype: No. 5499. Mus. Cal. Acad. Sci., Ichthyol. **Malaita Island**. Length 116 mm.

Muraenichthys gymnotus (Bleeker)

Pago Pago, Samoa (3), April 13, 85–104 mm. Origin of dorsal posterior to origin of anal. *M. cookei* Fowler may be a synonym of this species.

OPHICHTHYIDAE

Leiuranus semicinctus (Lay and Bennett)
Half-banded Snake Eel

Suva, Fiji (1), April 26, 176 mm.; Uras Cove, Malaita Island (1), May 27, 150 mm. In this species the tip of the tail is pointed and bare; the upper jaw projecting, with tubular nostril. Body with numerous incomplete black bands.

Sphagebranchus bicolor (Kaup). Two-colored Snake Eel

Uras Cove, Malaita Island (2), May 27. Origin of dorsal on a line with the gill openings, which are ventral. Color dark above, light below, dark bands on the throat.

Sphagebranchus lumbricoides (Bleeker). Worm-like Eel

Suva, Fiji Islands (4), April 30, 165–202 mm. Origin of dorsal $\frac{1}{2}$ length of head posterior to gill openings.

Callechelys fijiensis Seale, sp. nov. Fiji Snake Eel

Plate 20, fig. 2

Suva, Fiji Islands (4), April 29, 1933. 298–350 mm. Head 10 in trunk, 21 in total length. Depth 3.5 in head, 38 in trunk, 68 in total length. Anal opening midway between tip of snout and tail. Origin of dorsal midway between gill opening and eye. No pectoral or vestige of same. Dorsal and anal not confluent around the bare pointed tail. Snout projecting, lower jaw short, extending slightly posterior of eye. Anterior nostril tubular, posterior nostril a tube extending down from upper lip. Teeth small, sharp pointed in a single row with a few additional teeth anteriorly. Color uniform brownish above, pale yellowish below. In life this eel is of a distinctly red color.

This species is related to *C. filaria* (Günther), differing in the entire absence of pectorals, arrangement of teeth and in color.

Holotype: No. 5500, Mus. Cal. Acad. Sci., Ichthyol., from **Suva, Fiji Islands**. Length 350 mm. Three paratypes, Nos. 5501, 5502, 5503.

MURAENIDAE

Gymnothorax boschi (Bleeker). Bosch's Moray

Rennell Island (2), June 13, 101-175. Head 6.7, depth 12. Teeth and coloring well shown in Dr. Bleeker's figure.

Gymnothorax chilospilus Bleeker. Moray

Rennell Island (1), June 13, 168 mm.

Gymnothorax marmorata Lacépède. Marbled Moray

Sikaiana Island (1), May 16, 123 mm.

Gymnothorax undulatus (Lacépède). Moray

Sikaiana Island (1), May 16, 323 mm. This is the form called *M. isingleenoides* by Dr. Bleeker and is well figured in his Atlas, Vol. 4, pl. 33, fig. 1.

Echidna nebulosa Ahl. Clouded Eel

Tulagi, Florida Island (1), June 26, 328 mm.; Suva, Fiji Islands (1), April 30, 134 mm. This species, well marked by its blunt teeth, is widely distributed over the Pacific.

Strophidon brummeri (Bleeker). Brummer's Moray

Suva, Fiji Islands (1), April 30, 398 mm. Dorsal fin very high, no rim to posterior nostril. Color uniform with black specks on anterior portion of head.

Larval Eels

This collection contains several fine specimens of larval eels representing a number of different species of which brief descriptions are given. All are flat, thin forms.

(a) Sikaiana Island (3), May 14, 77–88 mm. These have large canines in lower jaw. No pectorals. Two distinct rows of 17 round black dots along the middle of body, and an additional row of dots along ventral edge alternating with the median spots.

(b) Sikaiana Island (1), May 16, 100 mm. A row of 6 black spots along the ventral margin except on the posterior third of body, where they are on middle of sides and are 4 in number.

(c) Kau Kau, Guadalcanar Island (1), May 21, 45 mm. A single row of 8 large round spots along the middle of side from head to tail.

(d) Suva, Fiji Islands (1), April 28, 88 mm. Thickly pigmented with light brown spots entirely covering head and body. Perhaps it is the young of *G. flavomarginatus*.

(e) Ugi Island (1), June 23, 55 mm. Entirely white except the anterior portion of head, which is thickly pigmented with black.

(f) Aola Bay, Guadalcanar Island (1), May 23, 54 mm. White with a row of 26 small black dots near ventral surface and about 14 on the middle of side from head to tail. A very short deep larva, depth 5.5 in length.

(g) Star Harbor, San Cristoval Island (4), June 29, 54-59 mm. White without markings. Caudal large, no canine teeth.

SYNODONTIDAE

Saurus myops Bloch and Schneider. Lizard-fish

Tulagi, Florida Island (7), May 19, 40-45 mm.; Kau Kau, Guadalcanar Island (11), May 21, 30-45 mm.; Rennell Island (12), June 12, 40-46 mm.; Tai Lagoon, Malaita Island (1), May 30, 45 mm.

These are all larval forms but are easily distinguished by the black patches on the ventral surface as follows: 1 pair between pectorals and ventrals, 4 pairs between ventrals and anal.

Saurus variegatus (Lacépède). Variegated Lizard-fish

Tai Lagoon, Malaita Island (5), May 30, 37-45 mm.; Tulagi, Florida Island (1), May 19, 33 mm.; Santa Ana Island (1), June 30, 40 mm.; Kau Kau, Guadalcanar Island (4), May 21, 36-47 mm.; Aola Bay, Guadalcanar Island (1), May 18, 45 mm.; Rennell Island (4), June 12, 38-53 mm.; Suva, Fiji Islands (3), April 28, 40-46 mm.

The larval form of this species is distinguished by the presence of 2 pairs of dark patches between the pectorals and ventrals and 9 pairs between ventrals and anal.

MYCTOPHIDAE

Myctophum dumerili (Bleeker). Dumeril's Lantern-fish

Suva, Fiji (1), April 30, 99 mm. Anal photophores 4 + 5.

Myctophum evermanni (Gilbert). Evermann's Lantern-fish

Suva, Fiji (6), April 23, 19-56 mm. Anal photophores 8 + 5.

Myctophum punctatum Rafinesque. Punctated Lantern-fish

Vicinity of Suva, Fiji (1), September 29. Length 26 mm. Scales ctenoid, anal photophores 7 + 9.

Myctophum pristilepis (Gilbert and Cramer)

Solomon Island Lantern-fish

Kau Kau, Guadalcanar Island (4), May 22, 32–77 mm.; Sikaiana Island (8), May 11, 56–80 mm.; Bellona Island (1), June 22, 67 mm.; Rennell Island (1), June 17, 80 mm. Anal photophores 7 + 4.

Myctophum coccoi (Cocco). Cocco's Lantern-fish

Bellona Island (2), June 20, 60–65 mm. In this species the scales are smooth. The caudal peduncle is long and slim. Anal photophores 6 + 10 (6 + 11).

BELONIDAE

Tylosurus indica Le Sueur. Salt-water Gar

Bellona Island (1), June 20, 442 mm.; Pago Pago, Samoan Islands (1), April 14, 103 mm.; Kau Kau, Guadalcanar Island (1), May 21, 18 mm.

We give a short description of the fine large specimen from Bellona Island. Dorsal 2.21. Anal 2.20. Head 3.2 in length to end of vertebrae. Interorbital widening anteriorly; a patch of scales on its middle. Origin of ventrals midway between caudal and nostrils. No gill rakers. A distinct keel on tail. Posterior rays of dorsal about equal in length to first rays, the middle rays shorter.

Color, bluish above, silvery below. Upper half of dorsal, distal half of pectorals, and upper two-thirds of caudal purple. A wide purple membrane on lower jaw. This is the lower "lip" which, according to Weber and Beauford, is, in the young, "produced into a flap-like organ."

Tylosurus incisus (Cuvier and Valenciennes). Gar

Napani Atoll (2), May 8, 405–480 mm. Dorsal 2.18. Anal 2.21. No keel on tail. Opercle with scales. Caudal truncate. Origin of dorsal above second divided ray of anal. Blue above, silvery below. Fins white.

Athlennes hians (Cuvier and Valenciennes). Deep Gar

Suva, Fiji, April 25, 224 mm.; Aola Bay, Guadalcanar Island (1), May 18, 116 mm.; Kau Kau, Guadalcanar (2), May 22, 130–131 mm. The short upper jaw and very long lower is a feature of these young specimens.

HEMIRAMPHIDAE

Euleptorhamphus longirostris (Cuvier). Longjaw

Bellona Island (1), June 21, 332 mm. In this species the body is band like. Pectorals equal in length to the base of dorsal fin. Ventrals small. Length of lower jaw beyond upper is 3 in length of body without caudal.

Hemirhamphus far (Forskål). Halfbeak

Suva, Fiji (1), April 25, 152 mm. This species is easily distinguished by the nine black spots on each side.

Hemirhamphus convexus (Weber). Halfbeak

Bellona Island (1), June 20, 60 mm. This species has the forehead convex. The pectorals are equal to the length of the head. The upper jaw is twice as wide as long.

Hemirhamphus georgii Cuvier and Valenciennes. Halfbeak

Tulagi, Florida Islands (1), May 19, 85 mm.; Sikaiana Island (5), length 76–116 mm. This species has dorsal 16. Anal 17. Lower jaw, beyond tip of upper, one-third of total length. Origin of ventrals nearer caudal than head.

Hemirhamphus dussumieri Cuvier and Valenciennes
Dussumier's Halfbeak

Tulagi, Solomon Islands (1), May 19, 101 mm.; Vanikoro Island (3), July 7, 41–90 mm.; Tai Bay, Malaita (7), May 29, 27–30 mm.; Aola Bay, Guadalcanar Island (1), 57 mm.; Star Harbor, San Cristoval (1), June 29, 77 mm.; Anuda Island (1), August 15, 67 mm.

EXOCOETIDAE

The collection of flying fishes secured by Mr. Templeton Crocker is of special interest and value. It contains forty-two specimens representing eleven distinct species. Two of these seem to be new to science and three others are very rare, including the second specimens of the peculiar *C. bilobatus* and of *C. hexazona*, and the fourth specimen of *C. naresi* ever recorded.

Exocoetus volitans Linnaeus. Flying Fish

Suva, Fiji Islands (2), 64–68 mm. Dorsal 14, anal 14. Ventrals short, their origin nearer tip of snout than to base of caudal. Origin of anal in line with origin of dorsal. Pectorals blue with white tip.

Evolantia microptera (Cuvier and Valenciennes)

Short-fin Flying Fish

Suva, Fiji Islands (1), April 23, 111 mm. This species is easily distinguished by the short pectoral fins which do not extend to the short ventrals.

Parexocoetus brachypterus (Richardson)

Common Flying Fish

Without question two or more species of this genus are listed by most authors under the name *brachypterus*. Unfortunately, while our series is composed of 17 specimens, they are all young, the largest measuring but 90 mm., so that we are unable to clear up the matter. From Suva, Fiji, we have one specimen, measuring 90 mm., which has the dorsal 12, anal 13. Origin of ventral midway between end of vertebrae and tip of anal. Pectorals reaching anterior rays of anal only. Origin of anal on vertical with origin of dorsal. Pectorals white, ventrals gray in center, dorsal gray, anal white. Teeth on jaws, vomer, palatines and tongue. Two short barbels. Dorsal high, its depressed rays reaching well up on caudal. We also have five from Vanikoro Island, Santa Cruz group, May 6. Length 40–80. Dorsal 11, anal 11. Origin of ventrals midway between end of vertebrae and anterior margin of eye. No barbels. Two dark quarter bands under dorsal. Dorsal dark.

Bellona Island (1), has the dorsal 12, anal 13. Tulagi, Florida Island (10 very young), May 19, length 17–35 mm.; Sikaiana Island (1), May 16, length 40 mm.; Tai Bay, Malaita Island (1), May 29, length 40 mm. All the above have teeth on jaws, vomer, palatines, and tongue. The origin of the dorsal is on a line with origin of anal.

Cypselurus poecilopterus (Cuvier and Valenciennes)

Spotted-wing Flying Fish

Bellona Island (1), June 21, 143 mm. This species is easily distinguished by the numerous ovate black spots on the pectorals. Our specimen also has black spots on ventrals and dorsal. Teeth on jaws and on palatines, none on vomer or tongue. Dorsal, 12, anal 8, scales 44.

Cypselurus bilobatus Weber. Two-barbed Flying Fish

Suva, Viti Levu Island (1), April 23, 84 mm. Distinguished by two barbels almost equal to length of head, one from each corner of mouth. Dorsal 13, anal 11. Pectorals blue at base with ovate spots

on remainder of fin. Two broad black bands in front of ventrals on belly and sides. Origin of ventrals midway between end of caudal and anterior margin of eye.

Cypselurus oligolepis (Bleeker). Small-scaled Flying Fish

Bellona Island (1), June 20. A young specimen. 35 mm. Dorsal 11, anal 8. Origin of ventral midway between end of last caudal vertebra and posterior margin of preopercle. Origin of anal under fifth dorsal ray. Pectorals blue, ventrals and dorsal with dark markings. No barbels.

Cypselurus rondeletii (Cuvier and Valenciennes)
Rondelet's Flying Fish

Bellona Island (3), June 22, 24–36 mm. Dorsal 11, anal 13. Origin of ventrals midway between end of caudal vertebra and middle of eye. Origin of dorsal on a vertical through origin of anal. Ventrals and pectorals long, second dorsal ray unbranched (but this may be immature). Ventrals are too far back in Cuvier's drawing.

Cypselurus speculariger (Cuvier and Valenciennes)
Pacific Flying Fish

Bellona Island (1), taken with a night light five miles off shore June 20, 288 mm.

Easily distinguished by the wide white bar on the pectorals and the small number (10) dorsal rays.

Cypselurus simus (Cuvier and Valenciennes)
Hawaiian Flying Fish

Bellona Island (1), June 20, 354 mm. Dorsal 13, anal 11. Scales about 50. Fins uniformly pale except outer upper surface of dorsal which is grayish.

Cypselurus opisthopus (Bleeker). Solomon Island Flying Fish

Aola Bay, Guadalcanar Island (1), May 18, 220 mm. "Attracted by a submerged light." Dorsal 10, anal 9, scales 54. Teeth on jaws and palatines. Pectoral fin dark on upper two-thirds, lower third lighter, outer ventral rays grayish.

Cypselurus naresi (Günther). Barbed Flying Fish

Bellona Island (1), June 22, 180 mm. Attracted by a night light. This fish has a peculiar apron-like barbel which in our specimen is equal to the length of the head and as wide as the pupil of the

eye. Dorsal 11, anal 9. Color in alcohol, brownish above, silvery below. Pectoral dark with the upper and lower rays white. Ventrals black with a lighter inner border. Lower part of anal and upper portion of caudal grayish, dorsal and anal white.

This seems to be the fourth and largest recorded specimen of this species.

Cypselurus zaca Seale, sp. nov. Zaca Flying Fish

Plate 21, figs. 1 and 2

Head 4.1; depth 5.5. Dorsal 11, anal 9. Pectorals long extending to the middle of dorsal, the first, second, and third rays simple, unbranched and considerably shorter than the remaining upper or middle rays of the fin. Eye large, 2.5 in head, being equal to the medium width of the interorbital. Snout less than half width of eye. Lower jaw oblique, no barbel. Ventrals long, extending to posterior part of anal, their origin midway between end of caudal vertebrae and posterior margin of preopercle. Origin of anal posterior to origin of dorsal, its rays scarcely reaching base of caudal. Dorsal rays not reaching to caudal, caudal well forked, the lower lobe much the longest. Teeth small, none on vomer or palatines.

Color in life, blue above, silvery below and on sides, pectorals, ventrals, and tips of anal and dorsal grayish. Caudal white.

Color in alcohol bluish above, silvery on sides and below. Pectorals dark except webs of three lower rays which are white. Ventrals dark except the inner and outer rays which are white. Dorsal and anal dark at tip. Caudal slightly shaded with grayish, especially on the middle of lower lobe.

Holotype: No. 5504, Mus. Calif. Acad. Sci., Ichthyol., from **Suva, Fiji Islands**, April 23, 1933, 116 mm. Plate 21, fig. 1. *Paratype* No. 5505, Mus. Calif. Acad. Sci., Ichthyol., from Bellona Island, June 20, 1933, 142 mm. Plate 21, fig. 2. The latter specimen seems to have its pectorals malformed, therefore I have taken the one of smaller size for the type.

Cypselurus oxycephalus (Bleeker). Sharp-headed Flying Fish

Bellona Island (2), June 20, 63 mm. Dorsal 12, anal 12, no barbels. Origin of dorsal on a line with the origin of anal. Origin of ventrals midway between end of caudal vertebrae and posterior margin of eye.

Cypselurus crockeri Seale, sp. nov. Crocker's Flying Fish

Plate 22, fig. 1

Head 4.7 to end of caudal vertebrae; depth 5.7; dorsal 12; anal 8; about 35 scales in front of dorsal. Eye three in head being distinctly less than width of interorbital space which is concave; jaws equal. Teeth on jaws and palatines. Mouth and snout without projections or barbels. Maxillary ending on a line with posterior nostril. Pectoral fins placed on a line with upper third of eye, their tip extending to dorsal, their length at least two in total length of fish (without caudal). Origin of ventrals midway between end of caudal vertebrae and middle of base of pectoral, being decidedly nearer to caudal than to head, their tips extending almost to caudal base. Anal short, its origin under the fifth ray of dorsal, being midway between origin of ventrals and first false rays of caudal. Dorsal very high, when depressed its middle rays extending well up on the rays of upper caudal lobe. Caudal well forked, its lower lobe greater than length of head.

Color in life blue on back, silvery below. Pectoral, anal, ventral and dorsal fins black. Caudal gray on upper lobe, three red bars on lower lobe.

In alcohol dusky, grayish below and on sides. Pectorals dark with membranes between the five lower rays slightly lighter. Ventrals dark with two inner rays lighter, dorsal and anal dark, caudal with lower lobe crossed by three dark bars.

Holotype: No. 5506, Mus. Calif. Acad. Sci., Ichthyol. This flew on deck of the yacht *Zaca* near **Rennell Island** when at sea between Kungava Bay and Tuhangango, June 17, 1933.

Named in honor of Mr. Templeton Crocker in recognition of his keen interest in scientific research.

Cypselurus hexazona (Bleeker). Banded Flying Fish

Head 4; depth 4.8; eye 2.2 slightly greater than interorbital space, which is concave. Dorsal 12-13; anal 8-9. Lower jaw projecting. No barbels except in young. Pectorals extending to middle of dorsal. Origin of anal under sixth dorsal ray. Ventrals longer than head, extending to posterior of anal base, their origin being midway between end of caudal vertebrae and middle of eye. Dorsal not elevated, its longest ray much less than head. Caudal well forked. At least 24 scales in front of dorsal fin. The lateral line very low on body and with about 50 scales. Color in life, blue above, silvery below, and on lower half of sides. Pectorals with a wide white band through the center and white on outer portion of rays, some darker oval spots on posterior half of fin. Ventrals with large black and white areas of irregular shape. Caudal with black tip and a black

sub-marginal bar. Dorsal white with a black ovate area in center and three black spots at margin of fins. Anal white.

Color in alcohol dull silvery with six dark bands showing on sides of body, the first just posterior of eye, the second below pectoral base, third midway between pectoral and ventral, fourth above base of ventrals, fifth below origin of dorsal, sixth on the caudal base.

One specimen from Bellona Island, June 22, length 175 mm., and six young, length 25–65 mm. Young all have barbels and are banded on sides with the back uniform white.

If this is the young of some other species, as Weber and Beaufort¹ seem to think, it must maintain the bands for a considerable period, as our fish is apparently an adult. Our example has two more dorsal rays than the other known specimen, which was secured by Dr. Bleeker at Banka in 1853.

PLEURONECTIDAE

Platophrys pantherinus (Rüppell). Spotted Flounder

Matema Island, Santa Cruz Group (1), July 8, 182 mm.; Pago Pago, Samoa (1), April 18, 28 mm.; Sikaiana Island (2), May 16, 35–41 mm. In this species the pectoral rays are prolonged and reach to the caudal. Orbital ridge with blunt spines anteriorly. Interorbital space 4 in the head. Color variegated with dark green, anal rays 86. Eyes wide apart.

Platophrys mancus (Broussonet). Mancus Flounder

One larval unpigmented specimen from Pago Pago, Samoa, April 18, 35 mm.

CYNOGLOSSIDAE

Cynoglossus brachyrhynchus Bleeker. Tongue Fish

Kau Kau, Guadalcanar Island (4), June 21, 30–33 mm.

HOLOCENTRIDAE

Holocentrus opercularis (Valenciennes). Soldier Fish

Kungava Bay, Rennell Island (1), June 10, 230 mm. Color red with more or less distinct stripes. Spinous dorsal black with a row of white spots between the spines on the lower half of the fin, margin of the dorsal white. Eye large. Preopercle scarcely denticulate.

¹ Weber and Beaufort, Indo-Austral. Fishes, Vol. IV, p. 185.

Holocentrus spinifer (Forskål). Spiny Soldier Fish

Suva, Fiji Islands (1), April 25, 293 mm. Scales strongly denticulate. Preopercular spine large. Spinous dorsal uniform yellowish.

Holocentrus caudimaculatus Rüppell. Soldier Fish

Kungava Bay, Rennell Island (1), June 10, 137 mm. Fins uniform pale pinkish. A white saddle over caudal peduncle just back of soft dorsal fin.

Holocentrus diadema Lacépède. Crowned Soldier Fish

Pago Pago, Tutuila Island (2), April 18, 37-53 mm. Spinous dorsal fin black with a broken white line through its center.

Holocentrus sammara (Forskål). Soldier Fish

Auki, Malaita Island (8), May 25, 34-37 mm.; Tai Bay, Malaita Island (16), May 29, 34-36 mm.; Ugi Island (3), June 30, 32-39 mm.; Santa Ana Island (1), June 30, 36 mm.; Star Harbor, San Cristoval Island (4), June 29, 35-38 mm.; Tulagi, Florida Island (1), May 19, 14 mm.; Suva, Fiji Islands (2), April 23, 26-30 mm. In the adult there is always a large black spot on the anterior of the spinous dorsal extending to the 3-4 spine.

Holocentrus punctatissimus Cuvier and Valenciennes

Aola Bay, Guadalcanar Island (1), May 18, 110 mm. Color in alcohol silvery, with fine dark specks everywhere, and with opalescent lighter lines along each row of scales. Spinous dorsal pale, with some milky-white markings on membrane and a small dark spot at base of anterior dorsal spine.

Myripristis macrolepis (Bleeker). Squirrel Fish

(*M. melanostictus* of Weber and Beaufort)

Kau Kau, Guadalcanar Island (6), May 21, 38-41 mm.; Auki, Malaita Island (9), May 25, 36-40 mm.; Tai Bay, Malaita Island (2), May 29, 30-45 mm.; Sikaiana Island (1), May 10, 40 mm. Dorsal X15. Scales 29 to end of vertebrae. As shown in Bleeker's figure of this species, there is a small but distinct flat spine at the angle of the preopercle. The coloring in alcohol is silvery. The caudal peduncle is yellowish followed by a darker area on the base of caudal rays. The spinous dorsal is yellowish with slightly darker shading at margin. Tips of ventrals dark.

PLATACIDAE

Platax teira (Forskål). Leaf Fish

Santa Ana Island (1), July 4. Length 320 mm. A fine adult specimen caught while rod fishing. They were very abundant at this time and are considered a fine food fish. The young of this species float on their sides near the surface, and closely resemble leaves with which they are frequently associated, perhaps for protection. The writer has, by mistake, caught the leaf in a dip net and allowed the fish, which he thought was the leaf, to escape! This species would make a most interesting aquarium fish.

Platax orbicularis (Forskål). Round Leaf Fish

One fine adult from Santa Ana Island, July 4. Length 280 mm. This species is the same as *P. vespertillo* of Bloch and Bleeker. Their specimens are immature forms.

SYNGNATHIDAE

Corythoichthys fasciatus (Gray). Banded Pipe Fish

Suva, Fiji Islands (4), April 30, 67–95 mm.; Pago Pago, Samoa (15), April 19, 38–89 mm.; Auki, Malaita Island (2), May 25, 63 mm.; Ugi Island (2), June 23, 53 mm.; Star Harbor, San Cristoval (1), June 29, 40 mm.; Rennell Island (3), June 12, 40–52 mm.; Tulagi, Florida Island (6), May 24, 26–37 mm.

Dorsal 28. Rings 15 + 34. Body smooth. Banded with green except on under surface. 2 + 4 jet black marks back of the throat. Black lines on each side of the throat. Snout with paired black dots.

Corythoichthys crenulatus (Weber). Crenulated Pipe Fish

Sikaiana Island (1), May 16, 31–53 mm.; Star Harbor, San Cristoval Island (1), June 19, 52 mm.

Syngnathus spicifer (Rüppell). Pipe Fish

Pago Pago, Samoa (4), April 19, 95 mm.; Suva, Fiji Islands (2), April 30, 50–83 mm.; Aola Bay, Guadalcanar Island (6), May 23, 39–52 mm.; Tulagi, Florida Island (1), May 24, 92 mm. In this species the rings are 16 + 40. The body is smooth. Opercle with keel. Small black dots on sides of cheeks.

Syngnathus uncinatus (Weber). Pipe Fish

Kau Kau, Guadalcanar Island (3), May 21, 50–55 mm. These have a median denticulated keel on snout and also keels over each eye. Opercle with a single longitudinal keel from which radiate fine

lines. Color greenish with white cross bars on tail. This is the second time this species has been recorded.

Coelonotus leiaspis (Bleeker). Round Pipe Fish

Kau Kau, Guadalcanar Island (1), May 21, 69 mm.; Suva, Fiji Islands (1), April 30, 84 mm.

This species has no opercular keel. Origin of anal under anterior third of dorsal. Dorsal rays 52. Color green with about 6 white bands on the tail.

AULOSTOMIDAE

Aulostomus valentini (Bleeker). Coronet Fish

Rennell Island (1), June 17, 145 mm. Color bright yellow. Two black spots on caudal fin.

FISTULARIIDAE

Fistularia petimba Lacépède. Trumpet Fish

Pago Pago, Samoa (5), April 15, 150–170 mm.; Auki, Malaita Island (8), May 26, 109 mm.; Tulagi, Florida Island (1), June 26, 109 mm.; Star Harbor, San Cristoval (1), June 29, 160 mm.; Rennell Island (3), June 17, 139–155 mm.; Kau Kau, Guadalcanar Island (6), May 21, 85–166 mm.; Tai Lagoon, Malaita Island (5), May 30, 155–166 mm.; Santa Ana Island (1), July 3, 864 mm. The color of the adult specimen was brownish on back, white below. Dorsal, anal, caudal and pectorals uniformly yellowish.

ATHERINIDAE

Atherina uisila Jordan and Seale. Silversides

Pago Pago, Samoa (2), April 16, 80 mm.; Rennell Island (14), June 12, 38–48 mm.

Atherina lacunosa Forster. Silversides

Pago Pago, Samoa (37, young), 15–25 mm.; Vānikoro Island (1), July 12, 33 mm. These show a dark stripe on posterior half of body which fades out anteriorly.

Atherina forskåli Rüppell. Silversides

Suva, Fiji Islands (7), April 25, 67–75 mm.; Tulagi, Florida Island (10), June 25, 35–80 mm.; Aola Bay, Guadalcanar Island (5), May 18, 34–36 mm.; Sikaiana Island (2), May 12, 60–67 mm.;

Tai Bay, Guadalcanar Island (8), May 29, 29–69 mm.; Star Harbor, San Cristoval Island (2), June 29, 56–57 mm. These have 42 scales in the lateral series. The anal pore is located between the last fifth of the depressed ventrals. A distinct silvery stripe equal to width of pupil on each side.

Atherina valenciennesi Bleeker. Silversides

Tulagi, Florida Island (34), June 25, 34–69 mm.; Guadalcanar Island (1), May 29, 45 mm.; Malaita Island (1), May 25, 26 mm.; Aola Bay, Guadalcanar Island (3), May 18, 30 mm.; Vanikoro Island (3), July 12, 50–54 mm. The anal pore is located between the anterior third of depressed ventrals. There are 7–8 scales in advance of origin of dorsal.

Atherina temmincki Bleeker. Silversides

Tai Bay, Guadalcanar Island (2), May 29, 51–61 mm.; Mohawk Bay, Lomlom Island (1), July 7, 91 mm. Body cylindrical. Anal pore in line with origin of dorsal.

MUGILIDAE

Liza caeruleomaculata (Lacépède). Mullet

Kungava Bay, Rennell Island (1), June 9, 409 mm.; Pago Pago, Samoa (26), April 18, 31–47 mm.; Star Harbor, San Cristoval Island (1), June 29, 45 mm.; Tulagi, Florida Island (1), June 26, 48 mm. Anal III 9. There are 38 scales along the median line. Lips rather thick, no adipose eyelid. A black spot present in axil of pectoral.

Liza waigiensis (Quoy and Gaimard). Mullet

Kungava Bay, Rennell Island (2), June 9, 255 mm.; Matema Island (1), July 7, 177 mm. Anal III 8, scales 28. No adipose eyelid. Pectorals black.

Liza troscheli (Bleeker). Mullet

Suva, Fiji Group (17, young), April 25, 30–84 mm.

Liza ceramensis (Bleeker). Mullet

Malaita Island (4), May 26, 49–53 mm. Anal III 9, scales 29. No adipose eyelid. Upper lip thick. Origin of the dorsal much nearer caudal than to tip of snout.

SPHYRAENIDAE

Sphyraena forsteri Cuvier and Valenciennes. Barracuda

Santa Ana Island (1), June 30, 482 mm. Scales 116. Color silvery, darker above.

SCOMBRIDAE

Scomber microlepidotus Rüppell. Mackerel

Pago Pago, Samoa (3), April 16, 27-29 mm.

Scomber japonicus Houttuyn. Mackerel Scad

Aola Bay, Guadalcanar Island (6), May 18, 40-45 mm.; Kau Kau, Guadalcanar Island (3), May 21, 49-51 mm.

CARANGIDAE

Scomberoides sancti-petri (Cuvier). Mackerel Jack

Tulagi, Florida Island (6), May 19, 30-46 mm.

Caranx marginatus Gill. Cavalla

Tai Lagoon, Malaita Island (4), May 30, 204-215 mm.; Rennell Island (2), June 17, 323 mm.; Vanikoro Island (7), July 12, 20-41 mm.

This species resembles *Caranx hippos* but differs in having the breast fully scaled. Our specimens have dorsal VIII 22. Anal II I 16. Scutes 32. The breast is fully scaled. A small but distinct black spot at upper axil of opercle. A shaded dark blotch on lower rays of the pectoral.

This collection also contained six specimens of very young *Caranx* which may belong to this species. They were secured at Pago Pago, Samoa, April 14, from among the tentacles of the common Samoan Jellyfish. These have the posterior margin of the preopercle strongly toothed for its entire length. They may represent the genus *Carangichthys* of Bleeker.

Caranx ascensionis (Osbeck). Cavalla

Kau Kau, Guadalcanar Island (2), May 22, 29-30 mm.

Caranx sexfasciatus Quoy and Gaimard. Cavalla

Pago Pago, Samoa (1), April 18, 30 mm.; Rennell Island (1), June 9, 195 mm.; Bellona Island (1), June 20, 460 mm. Silvery with 5 indistinct dark bands. Dorsal VIII I 23. Anal II I 18. Teeth in jaws, vomer and palatines, canines anteriorly. Scutes 28.

Caranx affinis Rüppell. Cavalla

Suva, Fiji Islands (1), April 24, 104 mm. Opercular spot distinct, breast fully scaled. Caudal yellow.

Alectis ciliaris (Bloch). Thread Fin

Pago Pago, Samoa (1), April 18, 33 mm.; Aola Bay, Guadalcanar Island (2), May 23, 29–30 mm. The dorsal and anal filaments are about twice the depth of the body. Bands indistinct.

Trachurops crumenophthalma (Bloch). Big-eyed Scad

Vanikoro Island (1), July 13, 275 mm. A fleshy projection into the gill chambers and the fully plated lateral line are distinctive field markings.

Elagatis bipinnulatus (Quoy and Gaimard). Runner

One fine large specimen from between Malaita and Florida Islands, May 25, taken while trolling. This is a fine game fish distributed throughout the tropical Pacific.

APOGONIDAE

Apogon novemfasciatus Cuvier and Valenciennes
Cardinal Fish

Mohawk Bay, Lomlom Island (1), July 10, 62 mm.

Apogon savayensis Günther. Cardinal Fish

Mohawk Bay, Lomlom Island (2), July 10, 32–40 mm.

Apogon orbicularis Cuvier and Valenciennes

Tulagi, Florida Island (1), May 24, 15 mm. This species may be distinguished by the black ventrals, the dark oblique line from the dorsal to the ventral surface, and the black spots on posterior portion of body.

Apogon asaedae Seale, sp. nov. Cardinal Fish

Plate 23, fig. 1

Head 2.7 to end of vertebra. Depth less than head. Dorsal VII 9. Anal II 8. Scales 24 in lateral series. The lateral line complete. Teeth sharp pointed, in two or more rows. Teeth on the palatine. Preopercle smooth. Eye 3.7 in head. Maxillary ending under middle of eye, its distal end of greater width than pupil. Caudal forked. No elongated fins. Ventrals when depressed extending beyond origin of anal.

This fish is distinctively marked. The head is lighter in color than the body. There are four, closely placed, black bands radiating from the eye, the upper one extending on the nuchal region and uniting with its fellow, the second extending back along the edge of the opercle, the third obliquely across the cheeks and the fourth obliquely down and back from the eye.

The pectorals, ventrals and spinous dorsal are chiefly jet black. The basal-half of the soft dorsal and anal are black. The caudal is white.

Holotype: No. 5507 and paratypes Nos. 5508, 5509, 5510, Mus. Calif. Acad. Sci., Ichthyol.

Four specimens, length 20–21 mm., collected at **Pago Pago, Tutuila Island, Samoa**, April 14, 1933, by Toshio Asaeda, the skillful artist of the Crocker Expedition, for whom I take pleasure in naming this species.

Apogon lateralis Valenciennes. Cardinal Fish

Suva, Fiji Islands (1), April 20, 39 mm.

Foa fo Jordan and Seale. Samoan Cardinal Fish

Suva, Fiji Islands (16), April 30, 20–30 mm. These agree perfectly with the description and figure given by Jordan and Seale in Bull. U. S. Bureau Fisheries, 25, 1906, p. 248, fig. 42.

AMBASSIDAE

Ambassis interrupta Bleeker. Glass Fish

Auki, Malaita Island (7), May 26, 56–85 mm. In this species the second dorsal spine is very long with the point turned forward. The first and third anal spines are almost equal in length, the second is directed forward at tip. A black stripe on each caudal lobe, black on web of first dorsal spine, and on webs of first and third anal spines. Two rows of scales on cheeks.

Ambassis vaivasensis Jordan and Seale. Glass Fish

Suva, Fiji (12), April 24, 24–74 mm. Our specimens agree fully with Jordan and Seale's description and figure (Bull. U. S. Bur. Fish. 25, 1906, p. 254, fig. 47).

KUHLIIDAE

Kuhlia caudovittata (Lacépède). Island Bass

Suva, Fiji Islands (1), April 28, 70 mm. This species has caudal well forked and a single wide oblique black band on each lobe. The body is covered with irregular shaped dark spots. Soft dorsal and anal with spots.

Kuhlia taeniura (Cuvier and Valenciennes). Island Bass

Bellona Island (1), June 22, 41 mm. Body silvery, caudal with two oblique dusky bands and a central bar in middle of fin.

SERRANIDAE

Epinephelus merra Bloch. Honeycomb Bass

Rennell Island (8), July 8, 77–205 mm.; Sikaiana Island (1), May 16, 64 mm.; Mohawk Bay, Lomlom Island (1), July 10, 65 mm. Entire body except belly covered with distinct hexagonal spots.

Epinephelus corallicola (Valenciennes). Spotted Bass

Matema Island, Swallow Group (1), July 3, 295 mm. Scattered blue spots with dark margins on body and fins, except pectorals and ventrals, the latter fins being margined with dusky.

Cephalopholis urodelus (Cuvier and Valenciennes). Sea Bass

Tucopia Island (1), May 5, 296 mm. Body yellowish with small dark dots. Caudal rounded without bars. Dorsal IX 15.

Variola louti (Forskål). Sea Bass

Santa Ana Island (1), July 3, 380 mm.; Anuda Island (1), July 16, 280 mm. Dorsal spines nine. Caudal lobes elongated. Color red with blue spots.

Petrometopon pachycentron (Valenciennes). Black Sea Bass

Tulagi, Florida Island (1), June 26, 135 mm. Uniform dark brown. The dorsal, caudal and anal narrowly edged with white.

PSEUDOCROMIDAE

Pseudogramma polyacanthus (Bleeker). Chromid

Rennell Island (2), June 13, 35-41 mm. Maxillary extending posterior to eye. Large white spots over body. A large black spot on opercle.

PRIACANTHIDAE

Priacanthus cruentatus (Lacépède). Bigeye

Rennell Island (1), June 12, 1934, 53 mm. Dorsal and ventral fins mottled with black.

PEMPHERIDAE

Pempheris vanicolensis Cuvier. Cataluf

Anuda Island (1), August 15, 75 mm. No black spot at base of ventrals. Caudal with a black tip.

LUTIANIDAE

Lutianus marginatus (Cuvier). Marginate Snapper

Palmyra Island (2), April 3, 224-255 mm.; Pago Pago, Samoa (8, young), April 16, 34-45 mm. Dorsal X 15. Anal III 8. In the young the color is white with dark margin on the spinous dorsal fin.

Lutianus gibbus (Forskål). Long-nose Snapper

Tucopia Island, Santa Cruz Group (1), May 5, 283 mm.

Lutianus bohar (Forskål). Red Snapper

Star Harbor, San Cristoval Island (4), June 23, 20-25 mm.

Lutianus kasmira (Forskål). Blue and Gold Snapper

Anuda Island (1), July 16, 211 mm.

Lutianus semicinctus Quoy and Gaimard

Half-banded Snapper

Kau Kau, Guadalcanar Island (1), May 21, 30 mm. Even in these young the bands and the spot on base of caudal show distinctly.

Nemipterus metopias (Bleeker). Snapper

Auki Bay, Malaita Island (1), May 25, 213 mm. No teeth on vomer, palatine or tongue. 4-6 canines in each jaw, preopercle entire. 3 rows of scales on cheeks. Fins not elongated. Color uniform yellowish white, a pale line through base of dorsal fin.

LETHRINIDAE

Lethrinus leutjanus Lacépède. Plain Porgy

Anuda Island (1), July 16, 320 mm. Color uniform yellowish brown.

Lethrinus reticulatus (Valenciennes). Porgy

Kau Kau, Guadalcanar Island (1), May 21, 25 mm.

Pentapus aurolineatus (Lacépède). Yellow Striped Porgy

Santa Ana Island (1), July 3, 233 mm. A distinct silvery area at posterior exis of soft dorsal. A short silvery stripe at origin of lateral line, and another two scales below this. Three yellow stripes on sides. Eye large, greater than length of snout.

SPARIDAE

Monotaxis grandoculis (Forskål). Bigeye, Pargo

Stewart Island (1), May 11, 287 mm. Big molar teeth on sides of jaw. Eye very large. Angle of snout more than 45 degrees. Brown with 2-3 lighter bands over back.

KYPHOSIDAE

Kyphosus vaiigiensis (Quoy and Gaimard). Pilot Fish

Bellona Island (1), June 22, 45 mm.

GERRIDAE

Gerres poeti Cuvier and Valenciennes. Slipmouth

Mohawk Bay, Lomlom Island (1), July 10, 133 mm. Uniform silvery, with dark spots between dorsal rays at base of fin.

Gerres filamentosus Cuvier and Valenciennes. Slipmouth

Kungava Bay, Rennell Island (1), June 9, 164 mm. Silvery with 6-7 dark bands down the sides.

MULLIDAE

Upeneus vittatus (Forskål). Goat Fish

Vanikoro Island (1), July 13, 251 mm.; Sikaiana Island (4), May 10, 40-44 mm.; Ugi Island (1), June 23, 36 mm. This species has 4-5 oblique bands on the caudal, one of the bands of the lower lobe always of considerably greater width than others.

Upeneus tragula Richardson. Goat Fish

Star Harbor, San Cristoval Island (2), June 24, 25-27 mm.; Tulagi, Florida Island (2), May 19, 30-37 mm.; Aola Bay, Guadalcanar Island (1), May 23, 32 mm.; Sikaiana Island (1), May 10, 48 mm.; Ugi Island (1), June 23, 35 mm.; Sikaiana Island (4), May 10, 40-48 mm.; Uras Cove, Malaita Island (3), May 28, 40-43 mm.; Pago Pago, Samoa (4), April 16, 40-45 mm.

Pseudupeneus barberinus (Lacépède). Goat Fish

Tulagi Island (1), June 26, 40-43 mm.; Auki, Malaita Island (2), May 15, 45-48 mm.; Uras Cove, Malaita Island (3), May 27, 48-49 mm.; Ugi Island (4), June 23, 45-46 mm.; Santa Ana Island (1), May 23, 47 mm.; Aola Bay, Guadalcanar Island (1), May 23, 49 mm.; Tulagi, Florida Island (1), June 26, 40-43 mm.

This species may be distinguished by the black line from snout to near the caudal, and the black spot on the caudal peduncle.

Pseudupeneus bifasciatus (Lacépède). Goat Fish

Rennell Island (1), June 12, 92 mm.; Auki, Malaita Island (6), May 15, 45-47 mm.

Pseudupeneus pleurostigma (Bennett). Goat Fish

Ugi Island (1), June 23, 61 mm.; Santa Ana Island (1), June 30, 63 mm. A distinct round black spot on side below the interval of the two dorsal fins.

Pseudupeneus indicus (Shaw). Goat Fish

Mohawk Bay, Lomlom Island (1), July 10, 237 mm. Distinguished by the golden spot below hind portion of spinous dorsal, and the large black spot on side of caudal peduncle.

Mulloides samoensis Günther. Goat Fish

Kungava Bay, Rennell Island (2), June 9, 195-282 mm.

CIRRHITIDAE

Cirrhitus marmoratus Lacépède. Sleepers

Tulagi, Florida Island (1), June 25, 79 mm.

CHAETODONTIDAE

Chaetodon lunula (Lacépède). Butterfly Fish

Pago Pago, Samoa (23, young), April 16, 11–13 mm.; Star Harbor, San Cristoval Island (71, young), June 29, 10–12 mm.; Ugi Island (1), June 23, 19 mm.; Suva, Fiji Islands (8), April 26, 19–22 mm. The young all have the heavy spine below the opercle, and two large scalelike plates on the shoulders. All show the ocular band, and the dark area on the caudal peduncle.

Chaetodon flavirostris Günther. Butterfly Fish

Pago Pago, Samoa (2, young), April 18, 11 mm. These have a wide black orbital band which extends up on the nuchal region, and a rather wide black area posteriorly from the dorsal across the caudal peduncle to anal.

Heniochus varius (Cuvier and Valenciennes). Humpback

Pago Pago, Samoa (1), April 15, 40 mm.; Kau Kau, Guadalcanar Island (1), May 23, 31 mm. In this species the 4–5 dorsal spines are prolonged, these young show the beginning of the characteristic hump of the anterior profile.

ZANCLIDAE

Zanclus canescens (Linnaeus). Moorish Idol

Pago Pago, Samoa (2), April 16, 72–75 mm.

ACANTHURIDAE

Naso unicornis (Forskål). Unicorn Fish

Pago Pago, Samoa (3), April 15, 20 mm. These correspond closely to Garrett's figure in Günther's "Südsee" pl. IX, fig. E. There are three or four rows of indistinct spots on the sides.

Acanthurus lituratus Schneider. Surgeon Fish

Sikaiana Island (1), May 11, 246 mm. The upper and lower rays of caudal greatly prolonged. Color black, a line from eye down snout and around upper lip. Base of caudal spines in single yellow area.

Hepatus triostegus (Linnaeus). Striped Tang

Santa Ana Island (1), July 2, 167 mm.; Tai Lagoon, Malaita Island (1), May 29, 62 mm. The young show about 6 dark bands on sides.

Hepatus dussumieri (Cuvier and Valenciennes). Brown Tang

Uras Cove, Malaita Island (2), May 27, 27 mm.; Ugi Island (1), June 23, 28 mm.

Hepatus güntheri (Jenkins). Common Tang

One large specimen No. 0762. Length 448 mm.

Zebrasoma veliferum (Bloch). Bigfin Tang

Pago Pago, Samoa (1), April 14, 31 mm. Numerous dark bands over the body. It is well figured in Günther's "Südsee" pl. 76, fig. C, under the name of *A. flavescens*.

SIGANIDAE

Siganus rivulatus (Forskål). Rivulated Stinging Fish

Aola Bay, Guadalcanar Island (4), May 21, 34–36 mm. Characterized by 6 dark bands and diffused markings.

Siganus tetrazonus (Bleeker). Stinging Fish

Kau Kau, Guadalcanar Island (24), May 21, 21–40 mm.; Aola Bay, Guadalcanar Island (7), May 23, 23–35 mm.; Uras Cove, Malaita Island (1), May 28, 25 mm.

SCORPAENIDAE

Synanceja verrucosa Schneider. Ugly Mug

Sikaiana Island (1), May 16, 205 mm. This is probably the ugliest known fish.

Sebastapistes laotale Jordan and Seale. Scorpion Fish

Suva, Fiji Islands (1), April 30, 33 mm.; Mohawk Bay, Lomlom Island (1), July 10, 34 mm.

Scorpaenopsis novae-guineae (Cuvier). Scorpion Fish
Suva, Fiji Islands (1), April 24, 34 mm.

Scorpaenopsis cookii (Günther). Cook's Scorpion Fish
Rennell Island (1), June 13, 50 mm.

Sebastopsis guamensis (Quoy and Gaimard)
Guam Scorpion Fish
Rennell Island (1), June 13, 35 mm.

APLOACTIDAE

Aploactis milesii Richardson. Velvet Fish

One of these rare little fishes from Suva, Fiji Islands, April 24, 53 mm. No scales apparent, the skin being velvety. Origin of dorsal fin above orbit. Anterior dorsal spine longest.

CEPHALACANTHIDAE

Cephalacanthus orientalis (Cuvier and Valenciennes)
Sea Robin

Kau Kau, Guadalcanar Island (6), May 21, 10–12 mm. These are larval forms. The large black pectorals and the long slim ventrals are characteristic of the species.

POMACENTRIDAE

Premnas biaculeatus (Bloch)

Rennell Island (12, young), June 13, 29–39 mm.

Amphiprion percula (Lacépède). Anemone Fish

Sikaiana Island (1), May 16, 27 mm. Color markings, yellow with three white bands bordered with black.

Pomacentrus lividus (Schneider). Livid Damsel Fish

Sikaiana Island (3), May 16, 45–104 mm.; Star Harbor, San Cristoval Island (36), June 29, 10–12 mm.; Kau Kau, Guadalcanar Island (25), May 21, 9–12 mm.; Ugi Island, June 23, 10–12 mm.

This species has 12 dorsal spines, 2 anal spines. A broad naked preorbital and snout. Small blue dots on most of the scales and some larger blue spots on cheeks and head. No black spot in axil of fin.

Pomacentrus nigricans (Lacépède). Black Damsel Fish

Rennell Island (1), June 12, 115 mm.; Sikaiana Island (1), May 16, 37 mm. Color dark brown, a black spot on posterior axil of soft dorsal fin and at axil of pectorals. A blue line on sub-opercles. The preorbital is narrower than in *P. lividus*.

Pomacentrus prosopotaenia Bleeker. Spotted Damsel Fish

Sikaiana Island (1), May 14, 22 mm. This species has small blue dots on the scales, and a large black ocellus with white border at the posterior axil of the soft dorsal.

Pomacentrus bifasciatus Bleeker

Sikaiana Island (36, young), May 16, 10-14 mm.

Abudefduf uniocellatus (Bleeker). One-spot Damsel Fish
(Probably not of Quoy and Gaimard)

Mohawk Bay, Lomlom Island (5), July 10, 22-37 mm. These specimens are all a vivid blue with belly and throat lighter. No spots on scales, spinous dorsal as dark as the body, other fins yellowish white, the anal with a narrow terminal black line. A black line as wide as pupil through the eye uniting with its fellow around snout and extending to origin of lateral line. A large black ocellus occupies the bases of 3-4 dorsal rays, no dark spot in axil of this fin. A distinct black line from tip of snout midway between eyes to origin of dorsal fin.

Abudefduf septemfasciatus (Cuvier and Valenciennes)

Pago Pago, Samoa (1), April 18, 18 mm. Even in this very small specimen the dark stripe extending out on each caudal lobe is quite distinct.

Abudefduf atrapinna Seale, sp. nov. Black-fin Damsel Fish

Plate 22, fig. 2

Head 3. Depth 2. Dorsal XII 14. Anal II 12. Scales 32, 22 in lateral line which is incomplete. Teeth in a single series. Preopercle unarmed. Anterior dorsal spines the longest. Caudal forked.

Body yellowish. Each scale on upper half of body with a brown vertical mark, or with 3-4 dark dots. Upper two-thirds of pectorals jet black. Basal half of dorsal spines jet black. A large black ocellus on posterior portion of spinous dorsal and extending on to the rays. Soft dorsal with a black area at its base. Caudal, soft dorsal, and anal yellow. Ventrals yellow with black tips.

Type: No. 5511, Mus. Calif. Acad. Sci., Ichthyol. **Sikaiana Island**, 18 mm. *Paratypes*: Nos. 5512, 5513, Mus. Calif. Acad. Sci., Ichthyol. Tulagi, Florida Island, May 19, 16-18 mm.

Abudefduf azysron (Bleeker). Damsel Fish

Mohawk Bay, Reef Island (2), July 10, 49-64 mm. Characterized by the dark body and yellow on posterior of soft dorsal. Caudal yellowish with dark margin. Preopercle entire.

Abudefduf antjerius (Kuhl and Van Hasselt). Damsel Fish

Pago Pago, Samoa (2), April 18, 12 mm.; Mohawk Bay, Lomlom Island (2), July 7, 26-36 mm.; Tulagi, Florida Island (6), May 19, 18-20 mm.; Suva, Fiji Islands (1), April 28, 19 mm. Bluish, a wide blue line from tip of snout backward over the back to the black ocellus. Dorsal with black margin.

Abudefduf bonang (Bleeker). Three-eyed Damsel Fish

Kau Kau, Guadalcanar Island (63, young), May 22, 14-22 mm.; Sikaiana Island (3), May 16, 21-23 mm. Dorsal XIII 11. Anal II 12. Scales 27. 17 in lateral line which ends under posterior portion of dorsal. A black ocellus on base of last 5 dorsal spines, this mark impinging somewhat on the back. No black in axil of any fin.

Abudefduf sexfasciatus (Lacépède). Black-tail Damsel Fish

Suva, Fiji Islands (5), April 24, 43-64 mm.

Abudefduf glaucus (Cuvier). Glaucous Damsel Fish

Mohawk Bay, Lomlom Island (1), July 10, 52 mm.

Abudefduf leucozonus (Bleeker). Damsel Fish

Mohawk Bay, Lomlom Island (1), July 10, 30 mm. Brown in color with a white bar down on the side from 4-6 dorsal spines. A large black ocellus on posterior of spinous dorsal.

Dascyllus aruanus (Linnaeus). Coral Beauty

Rennell Island (3), June 12, length 38-44 mm.; Sikaiana Island (10), May 14, 22-46 mm.; Mohawk Bay, Lomlom Island (1), July 10, 52 mm. Color white with three black bands, caudal and pectoral white.

Dascyllus melanurus Bleeker. Coral Beauty

Rennell Island (1), June 12, 26 mm.; Sikaiana Island (7), May 14, 26-52 mm.; Mohawk Bay, Lomlom Island (1), July 10, 20 mm. Similar to preceding species, but with caudal chiefly black.

Chromis caeruleus (Cuvier). Sea Blue Fish

Aola, Lomlom Island (1), May 18, 68 mm.; Tulagi, Florida Island (13), May 16, 32-37 mm.; Rennell Island (1), May 21, 22 mm.; Pago Pago, Samoa (20), April 18, 16-22 mm. In these very young the preopercle is strongly toothed, the teeth are sharply pointed, the maxillary extends to below the anterior margin of the eye. Depth equal to length of head, 2.7 in total length (without caudal). Eye greater than snout. Dorsal XIII 12. Anal II 3. Scales 24. Color in life pale bluish green. Color in alcohol yellowish-white, fins uniform.

Chromis bitaeniatus Fowler and Bean

Rennell Island (1), May 21, 11 mm. It is of interest to note that this is the second specimen of the species ever secured. The type was from the Philippine Islands.

Chromis cinerascens (Cuvier)

Tulagi, Florida Islands (34), June 25, 15-21 mm.; Rennell Island (37), May 21, 20-22 mm.; Tai Bay, Malaita Island (22), May 29, 10-15 mm.; Sikaiana Island (14), May 16, 10-21 mm.; Mohawk Bay, Lomlom Island (1), July 7, 16 mm.; Star Harbor,

San Cristoval Island (1), June 29, 17 mm.; Kau Kau, Guadalcanar Island (25), May 21, 16–24 mm.

These young chromids are white in color, with a dark stripe from base of caudal to near the center of the body. The caudal is deeply forked. There are 14 dorsal spines. Seventeen scales in the lateral line which ends under the beginning of the soft dorsal.

CORIDAE

Hemigymnus melapterus (Bloch). Biglip

Sikaiana Island (1), May 11, 336 mm. Distinguished by the extraordinary broad lips, the light colored shoulder band, the mottled nose, and the dark body.

Coris gaimardi (Quoy and Gaimard). Gaimard's Wrasse

Sikaiana Island (1), May 16, 229 mm. Posterior part of body with bright blue spots, caudal golden.

Cheilinus undulatus Rüppell. Pig Fish

Sikaiana Island (1), May 16, 430 mm.

Thalassoma lunare (Linnaeus). Moon Wrasse

Palmyra Island (1), April 3, 210 mm. Distinguished by the elongated deep blue area on upper half of pectoral and the deeply lunated caudal with its sub-margin of deep blue.

Thalassoma herrei Seale, sp. nov. Wrasse Fish

Plate 23, fig. 2

Head 3.5 in length to end of caudal vertebrae. Depth 3.5. Dorsal VIII 13. Anal III 11. Scales 26, 12 in a cross series at origin of dorsal, 7 before dorsal. Lateral line complete, but bent on posterior portion of body. Teeth sharp, pointed, the anterior ones slightly enlarged, no posterior canines. Caudal fin truncate, equal in length to head.

Color in alcohol greenish, a large black blotch at the base of the anterior portion of soft dorsal, a second dark blotch at base of caudal, a red line through middle of soft dorsal. Pectorals with a deep blue area on the upper third of the fin as in *T. lunare*.

This is closely related to *T. lunare*, and in fact may be an immature stage of that species, but if so it has never been described or illus-

trated. It is easily distinguished from other species of *Thalassoma* by the large black spot on base of soft dorsal and at base of caudal.

Holotype: No. 5514, Mus. Calif. Acad. Sci., Ichthyol. **Tulagi, Florida Island**, June 26, 1933, 111 mm. Named in honor of Dr. Albert W. Herre in recognition of his extensive work on Pacific fishes.

Thalassoma schwanefeldii (Bleeker)

Sikaiana Island (1), May 14, 62 mm.

Pseudocheilinus hexataenia (Bleeker)

Sikaiana Island (2), May 14, 34-35 mm. These show but 6 white stripes; the black ocellus on upper portion of caudal peduncle is quite distinct. Lips crossed with 4-5 jet black lines.

Cirrhilabrus solorensis (Bleeker)

(Not *C. jordani* Snyder)

Sikaiana Island (1), May 14, 41 mm.

SCARIDAE

Callyodon bicolor (Rüppell). Black-speckled Parrot Fish

Sikaiana Island (1), May 11, 380 mm. Body, except back and front of head, profusely spotted with black dots usually 2-5 on each scale.

Scarichthys auritus (Valenciennes)

Suva, Fiji Islands (1), April 29, No. 1012, 60 mm.

GOBIIDAE

Ophiocara aporos (Bleeker). Golden Goby

Suva, Fiji Islands (2), April 24, 117-121 mm. Dorsal VI 9. Anal 11. Scales 28. Yellowish. Darker above. An irregular dark stripe on middle of side. A narrow oblique line back from eye.

Gnatholepis puntangoides (Bleeker)

Auki Harbor, Malaita Island (1), May 26, 101 mm. Dorsal VI 12. Anal 11. Scales 26. Dark brownish above, light below with 10–12 bars of color extending downward. Dorsal and caudal with dark spots, dorsal rays slightly elongated. 2 grooves divide cheeks into 2 rows of scales.

Gnatholepis deltoides (Seale)

Suva, Fiji Islands (1), April 24, 23 mm.

Gnatholepis anjerensis (Bleeker)

Suva, Fiji Islands (2), April 19, 17–19 mm.

Eleotris fusca (Bloch and Schneider)

Three from a lake on Rennell Island, August 6, 103–120 mm.

Glossogobius biocellatus (Cuvier and Valenciennes)

Auki, Malaita Island (1), May 26, 67 mm.

Eviota afelei Jordan and Seale

Rennell Island (1), June 12, 20 mm.

Zonogobius semidoliatus (Cuvier and Valenciennes)

Mohawk Bay, Lomlom Island (1), June 7, 30 mm. This dainty little species is beautifully marked with distinct bands on head and anterior of body.

Bathygobius fuscus (Rüppell)

Mohawk Bay, Lomlom Island (2), August 10, 29–32 mm. Distinguished by the notched tongue, the thread-like rays on upper base of pectoral and the color.

Gobius ornatus Rüppell

Bellona Island (1), June 20, 80 mm. Distinguished by the free silk-like rays on upper base of pectoral, the rounded tongue, rows of dark spots on sides, and dark lines on the dorsal and anal.

Rhinogobius neophytus (Günther)

Suva, Fiji Islands (3), April 28, 31 mm.

Rhinogobius criniger (Cuvier and Valenciennes)

Suva, Fiji Islands (1), April 24, 15 mm.

Gobiodon citrinus (Rüppell)

Rennell Island (16), June 13, 15–23 mm.

Gobiodon rivulatus (Rüppell)

Rennell Island (8), June 13, 25–38 mm.

Paragobiodon xanthosomus (Bleeker)

Rennell Island (11), June 13, 24–35 mm.; Sikaiana Island (16), May 14, 23–33 mm. Brown with red head.

Paragobiodon melanosomus (Bleeker)

Rennell Island (9), June 13, 15–23 mm. Color jet black.

ECHENEIDAE

Leptecheneis naucrates (Linnaeus). Shark-pilots

Bellona Island (1), June 20, 52 mm.

PARAPERCIDAE

Parapercis hexophthalma (Cuvier). Spotted Round Perch

Kungava Bay, Rennell Island (1), June 10, 156 mm. Upper surface and cheeks profusely spotted, a large black area on caudal. Five black ocelli with white borders located on short half-bands on lower half of side. A light colored area along middle of side from head to caudal.

BLENNIIDAE

Periophthalmus koelreuteri (Pallas). Mud Skipper

Vanikoro Island (1), May 6, 105 mm.; Mohawk Bay, Lomlom Island (1), July 10, 120 mm. Scales more than 80 in lateral series.

Petroscirtes tapeinosoma Bleeker. Eel Blenny

Sikaiana Island (2), May 16, 64 mm. Upper half of body dark. Pale blue below. A dark bar extending to tip of caudal on the sides, the bar broken up into numerous small sections. Teeth of upper jaw long; fixed canines in lower jaw.

Petroscirtes anema Bleeker. Blenny

Auki Bay, Malaita Island (9), May 26, 30–60 mm.

Identified as *P. anema* of Bleeker with reluctance as there seem very definite points wherein they differ from his description. Our specimens all show a fin count of dorsal 30, anal 20.

There are 3 black stripes on the body—the upper along the back and including the lower half of the dorsal fin. The second is from tip of snout through the eye to near middle of caudal, where it bends down to meet the up-curved end of the third dark stripe, which extends from opercle to this line. A definite bluish white stripe between the two lower black stripes. A jet black spot between 1–2 dorsal spines at its tip. Canines of lower jaw very large; upper canines small. Two distinct barbels on the chin, two small barbels just posterior of eye. Several distinct mucous pores on the head. Ventrals, anal, pectorals, caudal and outer half of dorsal white. Dorsal and anal with very narrow margin of black.

Petroscirtes filamentosus (Valenciennes). Filamentous Goby

Rennell Island (1), June 12, 56 mm. This species is easily distinguished by its elongated anterior dorsal spines. The markings of our specimen agree fully with Dr. Günther's figure.

Petroscirtes maroubrae (Ogilby). Barred Blenny

Tulagi Island (1), May 19, 19 mm.; Kau Kau, Guadalcanar Island (2), May 22, 35–37 mm. Color dark bluish, with about 7 black bars slightly less than the interspaces on body, these bands extend to tip of dorsal and anal fin; very distinct on dorsal, less distinct on body and anal. Base of pectorals black. No ocellus on head. No stripes on body.

Salarias quadricornis Kittlitz. Crested Blenny

Bellona Island (1), June 22, 90 mm.

Salarias meleagris Valenciennes

Bellona Island (4), June 22, 37-45 mm.

Salarias sealei (Bryan and Herre). Seale's Blenny

Mohawk Bay, Lomlom Island (1), July 10, 40 mm.

Salarias margaritatus (Kendall and Radcliffe)

Bellona Island (2), June 22, 52-55 mm.; Rennell Island (5), July 12, 25-50 mm. Although Fowler has united this species with *S. caesius* Seale our specimens would indicate that they may be distinct. This species, as well shown in Kendall and Radcliffe's figure, has the posterior axil of soft dorsal much farther from the caudal than has *S. caesius*, and the markings seem decidedly different. Our specimens have no color on the anal fin and are otherwise pale. Both species have canine teeth in lower jaw.

Salarias garmani Jordan and Seale. Blenny

Pago Pago, Samoa (1), April 19, 19 mm. Uniform white in color.

Enneapterygius pardochir Jordan and Seale. Blenny

Mohawk Bay, Lomlom Island (4), July 10, 20-26 mm.; Rennell Island (1), June 13. 22 mm.

Hypleurochilus samoensis Seale, sp. nov. Black-fin Blenny

Plate 23, fig. 3

Among the fishes secured by Mr. Templeton Crocker at Pago Pago, Samoa, April 18, were two small blennies which seem to merit description, although they may not yet be fully mature.

Head 4.1 in length to end of caudal vertebra, being about equal in length to the depth of the body. Dorsal XII 18. Anal 21. The dorsal is continuous without notch and free from the caudal. Its origin is above the origin of the pectorals. Origin of the anal on a

line with the origin of soft dorsal. Pectorals longer than head. Ventrals jugular, their tip extending to below the tenth dorsal spine. Caudal square, its length about equal to head. Eye large, its width greater than length of snout. Gill openings confined to short slits. Teeth pointed, 2 large posterior canines in lower jaw. A distinct spine projects back from the angle of the opercle (probably an immature feature). Color white with pectorals jet black on lower two-thirds, the upper third white, a dark area on opercle, some small black dots at base of fins.

Holotype: No. 5515, paratype No. 5516, Mus. Calif. Acad. Sci., Ichthyol. Two specimens from **Pago Pago, Tutuila Island, Samoa**, April 18, 14–16 mm.

Larval Forms of Blenniidae

Tulagi, Florida Island (11), May 19, 15–16 mm.; Rennell Island (15), June 17, 22–23 mm.; Kau Kau, Guadalcanar Island (14), May 22, 20–22 mm.; Ugi Island (4), June 23, 19–20 mm.

In our collection are a number of very small and immature forms of *Salarias* which it seems impractical to place definitely with any species although they seem very near to *Salarias lineatus*. These are white, without distinctive markings either of body or fins; they have dorsal XII 22. Anal 22–24.

BALISTIDAE

Balistes papuensis Macleay. Trigger Fish

Santa Ana Island (1), June 30, 25 mm.; Sikaiana Island (1), May 15, 30 mm.; Pago Pago, Tutuila Island (33), April 14–16, 25–35 mm.

Twenty specimens of young which we consider to be this species were collected at Pago Pago on April 14–16, from crevices of coral rocks. These have 5 rows of spinous scales on the caudal peduncle. Dorsal IV 25. Anal I 23.

All are pale greenish, darker above and with silvery sheen below. Entire body covered with scattered small brown spots which are round and smaller than pupil. First dorsal spine and ventral spines toothed. Fins all colorless.

Balistes flavimarginatus Rüppell. Trigger Fish

Kau Kau, Guadalcanar Island (1), May 21, 28 mm.; Uras Cove, Malaita Island (7), May 28, 30–36 mm.; Pago Pago, Tutuila Island (3, young), April 14, 20 mm.

These are similar to the above except that they have no brown spots. The color is greenish clouded with darker on upper two-thirds of body, a dark band through caudal. Five rows of enlarged spines on sides of tail. An indication of three darker indistinct lines between the eyes. Dorsal III I 23. Anal I 22.

Balistes conspicillum (Bloch and Schneider)
White-spotted Trigger Fish

One fine specimen from Sikaiana Island, May 16. 295 mm. Blackish with conspicuous white spots larger than eye on lower half of body. A white band over the snout.

Balistapus aculeatus (Linnaeus). Black-bar Trigger Fish

Palmyra Island (1), April 12, 178 mm.

Balistapus undulatus (Park). Red-line Trigger Fish

Kungava Bay, Rennell Island (1), May 31, No. 0651, 230 mm. No. 0728, probably from Anuda Island, July 16, 254 mm. Body covered with curved red or yellowish lines. Rather wide stripe around lips and extending back to below pectoral.

MONACANTHIDAE

Oxymonacanthus longirostris (Bloch and Schneider)
Long-nose File Fish

Pago Pago, Tutuila Island (1, young), April 18, 25 mm. About 5 indistinct black bars over the body, and a large round black spot on the tail.

Monacanthus howensis (Ogilby). Leather-jacket

Suva, Fiji Islands (1), April 25, 44 mm.; Kau Kau, Guadalcanar Island (6), May 22, 45-51 mm. Dark shadings on body. Three bands on posterior of body extending into the dorsal and anal fins. 5 distinct dark bands on tail.

OSTRACIIDAE

Ostracion cornutus Linnaeus. Cow Fish

Pago Pago, Tutuila Island, Samoa (1), April 15, 19 mm. This is the smallest specimen of this species we have seen. Color whitish, covered with scattered dark dots.

TETRODONTIDAE

Spheroides lunaris (Bloch and Schneider). Lunate Puffer

Suva, Fiji Islands (2), April 25, 36 mm.; Auki, Malaita Island (1), May 25, 54 mm.; Tulagi, Florida Island (3), May 19, 13–32 mm.

Canthigaster striolatus (Quoy and Gaimard). Puffer

Bellona Island (1), June 20, 32 mm.

Canthigaster margaritatus (Rüppell). Puffer

Rennell Island (1), June 12, 31 mm.; Suva, Fiji Islands (33), April 28, 20–23 mm.; Ugi Island (1), June 22, 23 mm.; Kau Kau, Guadalcanar Island (1), May 22, 15 mm.; Uras Cove, Malaita Island (1), May 28, 23 mm.

Tetrodon meleagris Bloch and Schneider. Puffer

Pago Pago, Samoa (1), April 15, 19 mm. So densely set with prickles as to look as if covered with fuzz, among which may be seen small white specks.

Tetrodon immaculatus Bloch and Schneider. Puffer

Pago Pago, Samoa (1, young), April 15, 30 mm.; Auki, Malaita Island (1), May 25, 8 mm.

Tetrodon manillensis Procé. Puffer

Suva, Fiji Islands (1), April 25, 119 mm. Gray with numerous narrow black lines from head to tail.

Tetrodon nigropunctatus Bloch and Schneider. Puffer

Suva, Fiji Islands (4), April 26, 10-18 mm.

Tetrodon hispidus Linnaeus. Puffer

Kau Kau, Guadalcanar Island (4), May 22, 21-23 mm.; Suva, Fiji Islands (30), April 28, 20-34 mm.

DIODONTIDAE

Diodon hystrix Linnaeus. Porcupine Fish

Rennell Island (1, young), June 12, 20 mm. Found in the mouth of a young *Priacanthus*.

ANTENNARIIDAE

Antennarius commersonii (Shaw). Fishing-frog

Bellona Island (4), June 22, 1.2 mm.

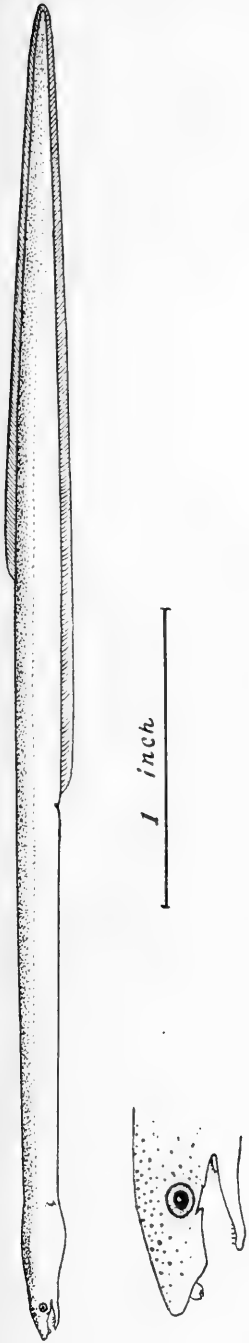


Fig. 1. *Muracnichthys malaita* Seale, sp. nov. Type

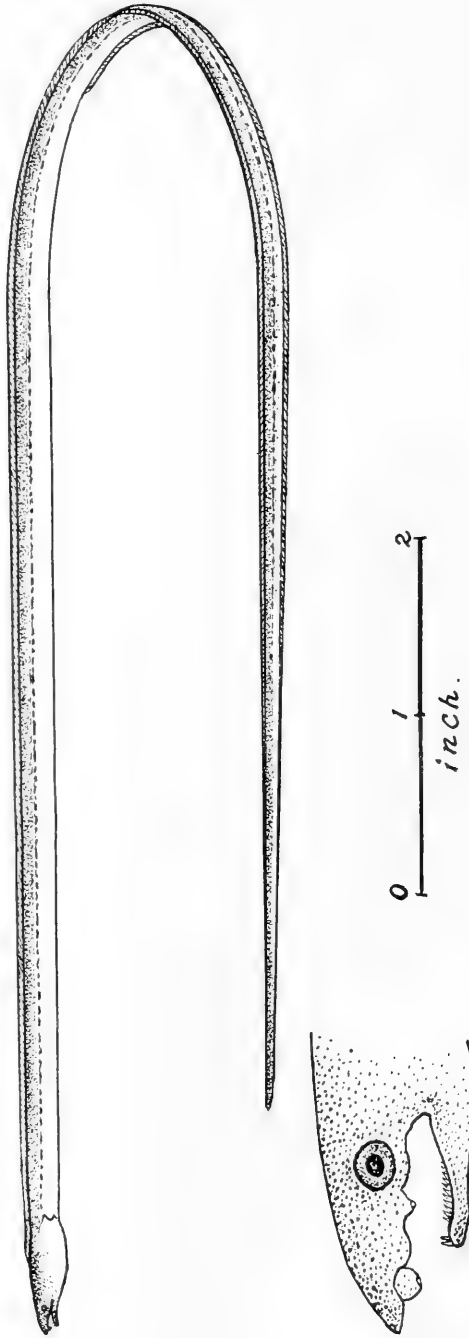


Fig. 2. *Callechelys fijienensis* Seale, sp. nov. Type

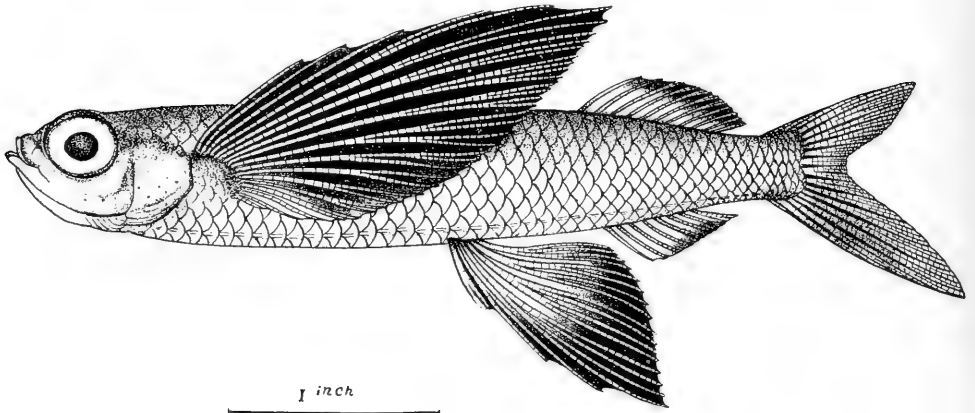


Fig. 1. *Cypselurus zaca* Seale, sp. nov. Type

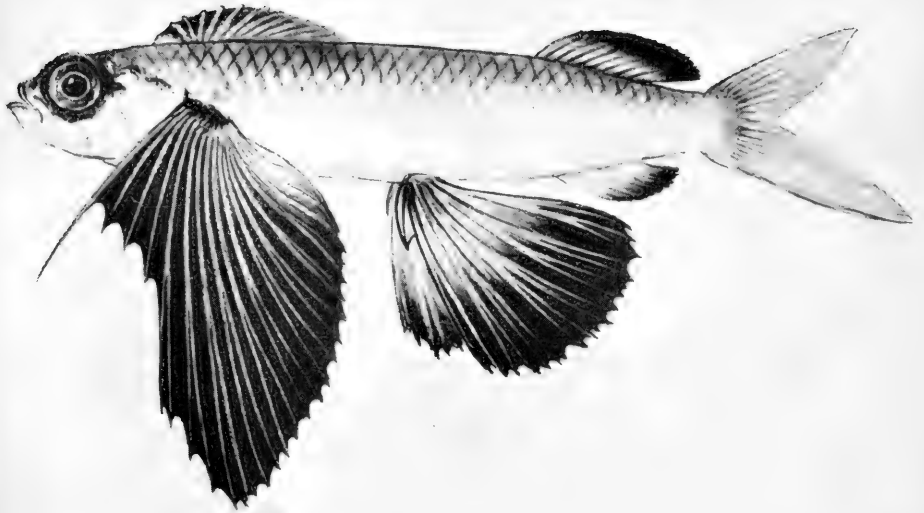


Fig. 2. *Cypselurus zaca* Seale, sp. nov. Paratype

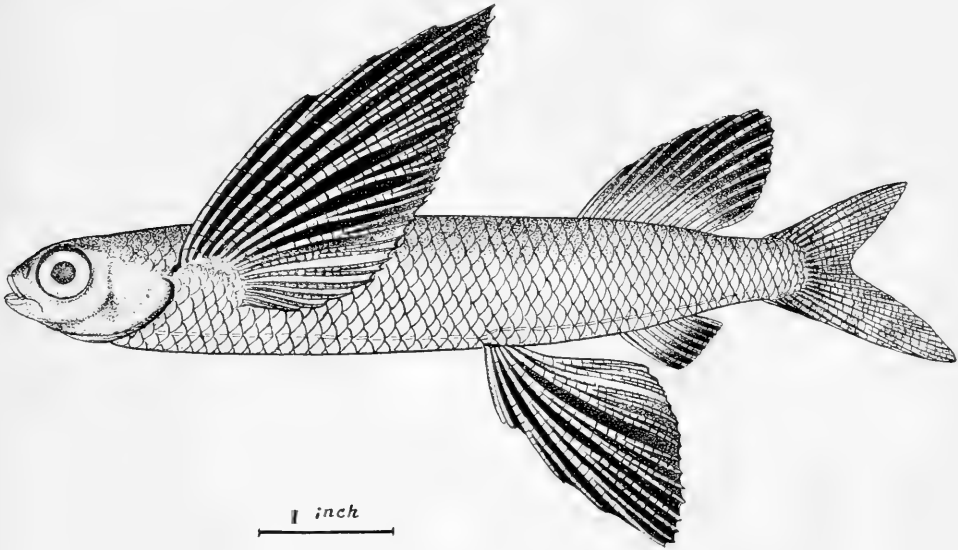


Fig. 1. *Cypselurus crockeri* Seale, sp. nov. Type

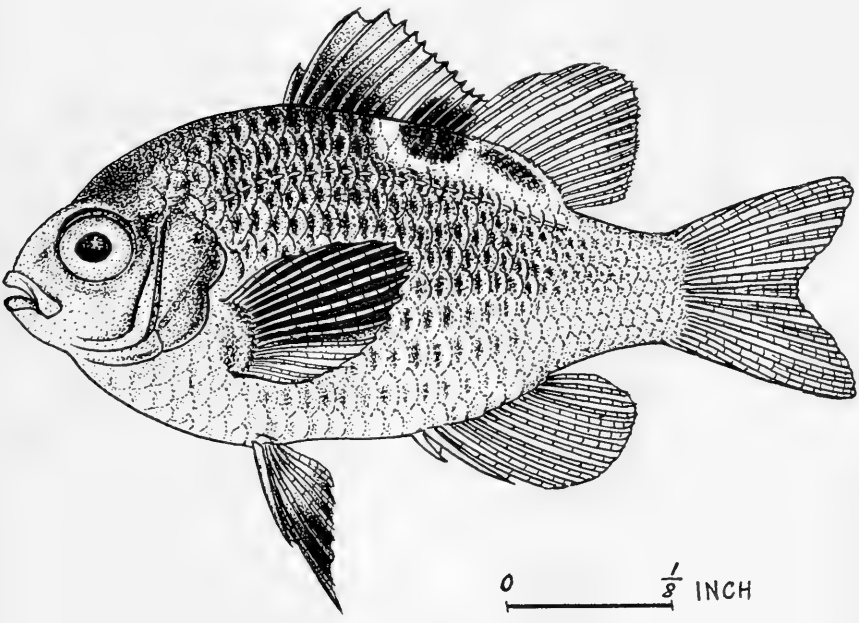


Fig. 2. *Abudefduf atrapinna* Seale, sp. nov. Type

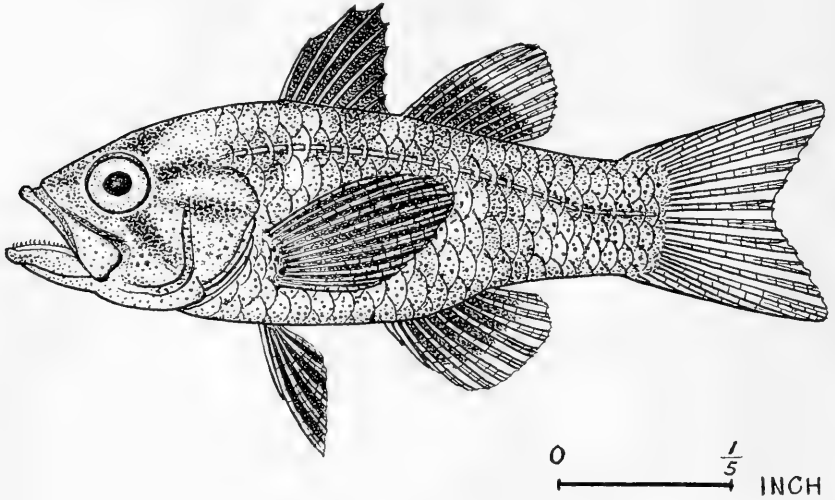


Fig. 1. *Apogon asaetae* Seale, sp. nov. Type

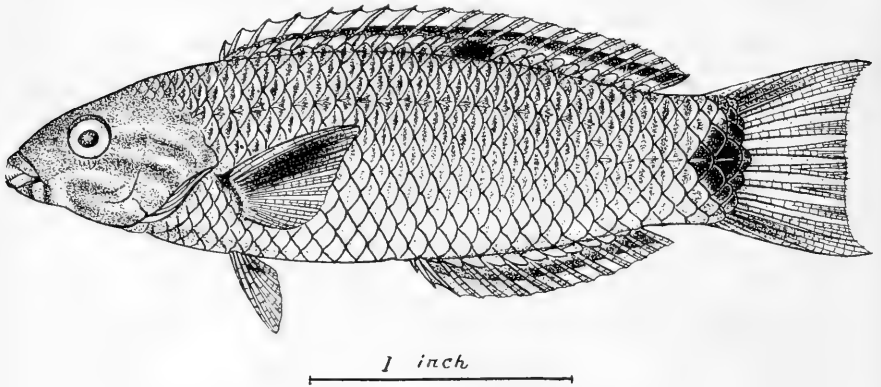


Fig. 2. *Thalassoma herrei* Seale, sp. nov. Type

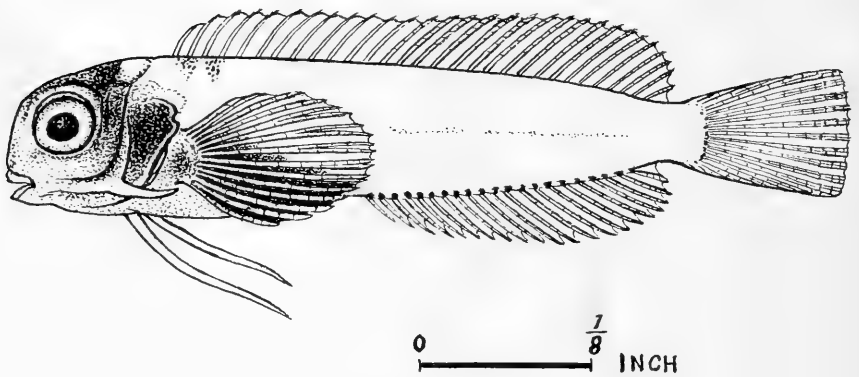


Fig. 3. *Hyleurochilus samoensis* Seale, sp. nov. Type

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THE TEMPLETON CROCKER EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES, 1932

No. 28

THE CARPENTER BEES OF THE GALAPAGOS ISLANDS

BY

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The only bee known from the Galapagos Islands is *Xylocopa darwini* Cockerell, which is endemic. It is very closely related to *X. carbonaria* Smith, which was described from Tapajos, Brazil, where it was collected by H. W. Bates. A specimen from Mexico appears to be referable to the same species. The presence of *Xylocopa* in the Galapagos Islands cannot be regarded as evidence in favor of a past continental connection, as these bees nest in wood, and may occasionally be carried across the sea in drifting trees. Enough collecting has been done in the islands to make it seem improbable that there are other endemic bees, though their absence is surprising, considering the varied character of the flora. The type material of *X. darwini* came from Chatham Island. Miss Cheesman (Trans. Ent. Soc. London, LXXVII, 1929, p. 143) described the male, and figured the coxa and trochanter. She found the species on all four islands visited, namely Charles, James, Indefatigable and Albemarle. Williams (Proc. Calif. Acad. Sci., 4 ser. Vol. II, Pt. 2, 1926, p. 356) had previously given a good account of the species, erroneously calling it *X. colona* Lepeletier, which is a species from Cayenne, the wings (female) moderately brown, with a beautiful shining golden color, and a noticeable violet reflection. Williams

tried to determine whether the specimens from the different islands were all alike. He examined the male genitalia and found them to "vary to a small extent." The most noticeable difference was in the color of the female wings, these showing a greenish-blue iridescence on Charles, Chatham and James islands, and a bluish-purple on Albemarle, Indefatigable and South Seymour.

Miss Cheesman, however, stated that the form of the female with greenish-blue iridescent wings occurred on Charles, James, Indefatigable and Albemarle, and that with bluish-purple iridescence on Charles, Indefatigable and Albemarle. Thus it did not seem possible to distinguish insular subspecies. I have thought it worth while to review the matter with the aid of the series obtained by Mr. Maurice Willows, Jr. on the Templeton Crocker Expedition, these specimens being in the collection of the California Academy of Sciences, along with those earlier recorded by Williams. In addition I have had access to a smaller series collected by John S. Garth on the Hancock Expedition, and now in the Los Angeles Museum.

The specimens may be divided into three groups, as follows:

- (1) Female wings dark, with greenish-blue iridescence; length of wings 17-17.5 mm.

Chatham Island. One male and four females (Williams); one female from Wreck Bay. Two females, Crocker Expedition.

Charles Island. Five males (Williams), four being from Post Office Bay. Nineteen females, variable in size, the wings 15.5 mm. to 17 mm. Special localities are Post Office Bay (Williams) and Cormorant Bay (Willows). The Willows specimens are larger than the average Williams ones.

- (2) Like the last but abdomen more densely and strongly punctured.

James Island. Two males (Williams). Eight females (Willows, Williams and Garth), the wings 16 to 18 mm. long.

Gardner Island (near Hood Island). Two females (Williams): Wing 16 mm.

- (3) Wings dark fuliginous, suffused with rosy; no red hair at tip of abdomen (none in var. 2, sometimes a little on var. 1).

S. Albemarle Island (Williams), five males and seven females. Female wings 16.5-17.5 mm. long.

There are also two males collected by Williams at Sappho Cove, Chatham Island. One female (Williams).

Indefatigable Island. Two males (Williams). Two females collected by Williams, one over 900 ft. alt., two collected by Willows. Length of female wings 16-18 mm.

The Williams specimens have the rosy wings typical of this variety, but one of the Willows specimens has the wings as in var. 1, and the other is intermediate, with much rosy purple.

In addition to the above, J. S. Garth obtained one female on Duncan Island; it has the wings 17.5 mm. long, labrum with three evident tubercles, tergites more densely punctured than in Charles Island specimens. The wings are violaceous, blackish beyond the cells, but outer margin violaceous. Compared with a James Island specimen, the second cubital cell is shorter, its sides on marginal less than half length of second intercubitus (over half length of second intercubitus on James Island specimen).

On comparing a cotype of *X. darwini* (Chatham Island) with a female collected by Garth on Charles Island, they appear different. The *X. darwini* cotype has subtranslucent strongly reddish wings, with feeble iridescence (style of *X. carbonaria* from Mexico); the Charles Island one has very dark, brilliantly blue-green wings. The abdomen is more closely punctured in the cotype. The abdomen is described as very closely punctured in the type of *X. carbonaria*.

Wishing to assemble all the available evidence, I asked Mr. Robert B. Benson to kindly look at the series in the British Museum. This he did, reporting as follows:

“I have looked over our long series of *Xylocopa darwini* from Galapagos Islands. Specimens from Charles Island certainly are less punctured than those from James, Indefatigable and Albemarle islands, but I am not able to recognize any differences in the size, as all forms seem to vary. In the wing coloring, likewise a lot seems to depend on whether the specimens are fresh or not, and I should not like to say that the Charles Island forms were darker than the others. Neither do I feel willing to say for certain that forms can be distinguished on wing iridescence until I have seen a very long series of perfect specimens from each of the islands. For example, we have forms from James Island with dark wings, showing green iridescence, and also with paler wings showing a purple iridescence.” (Litt. April 15, 1935.)

To a taxonomist, it would seem agreeable, and to accord with expectation, to find distinct if closely allied races inhabiting the several islands. But Miss Cheesman suggests that the bees occasionally wander from one island to another, and reports seeing a female out at sea, eight miles from Albemarle Island. We may conclude, I think, that there is a tendency to develop insular races, which is checked from time to time by the appearance of immigrants from the other islands. Hence the incipient races, differing in sculpture and wing-color sufficiently to deserve names, were they constant, but

actually too variable for precise definition. According to this view, one might expect that on the larger islands some localities would be inhabited by characteristic types, while at other points, owing to crossing with immigrants, the distinctions would fail to hold. This seems to accord with the facts, as shown for instance on Indefatigable Island, which from its central position might receive immigrants from several directions. To the biologist, these facts are full of interest and the carpenter bees may be said to have done their part, along with the rest of the fauna, to illustrate the processes of evolution.

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CALIFORNIA ACADEMY OF SCIENCES, 1932

No. 29

NEW AND NOTEWORTHY FISHES

BY

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The scientific collection of fishes consists of 3216 tagged specimens and perhaps as many more too small for individual tags, representing 92 families divided into 230 genera of which there are 304 species. The majority of these species having been previously recorded for the area in question, no mention will be made of them, and this report will be confined to the consideration of noteworthy extensions of range of known species and descriptions of these believed not to have been hitherto described.

Family TORPEDINIDAE: Electric Rays

1. *Narcine ommata* Clark, new species

Total length 160 mm.; body 140 mm.; width of disk 74 mm.; length of disk about the same; posterior end of slit-like vent equidistant from end of caudal and end of nasal flap. Spiracles comma-shaped, forming the posterior border of the eyes, the tail of the comma pointing forward along the lateral margin of the eye, their margins beset with low tubercles. Interorbital width 1.5 in snout. Dorsal fins nearly equal, origin of first nearly over end of ventral base. Caudal somewhat fan-shaped, its ventral edge nearly straight.

August 12, 1936

Color in spirits: Upper parts light brown, an irregular paler area across disk in front of eyes, with a dusky blotch each side of central anterior edge of disk. Leopard-like spots consisting of clusters of dots, one on each side of disk just over gill-slits; strongly marked ones in axils of pectorals, a faint one in middle of back between these; one on each side of mid-dorsal line of middle of ventrals, and one on each side middle of dorsals; a faint one on each side base of caudal. In middle of back an ocellated marking consisting of (1) small black dot at center; (2) rather narrow yellow ring; (3) broad black ring; (4) narrow bright halo; (5) row of black dots a little larger than central one, these each surrounded by a lighter margin. Color markings strikingly similar to those of *Discopyge ommata* Jordan and Gilbert, but ventral fins not united into a continuous disk below the tail as in *Discopyge*.

Holotype and only specimen: No. 5444 Mus. Calif. Acad. Sci. Ichthyol., obtained in dredging off the **Pacific coast of Central America, exact location unknown**, field tag having become loose in transit.

Family MURAENIDAE. The Morays

2. *Rabula rotchii* Clark, new species

Total length about 235 mm.; head 3.5 in trunk, depth about 14.7 in length; eye 1.5 in snout, over about middle of gape, which is about 2.5 in head; teeth all conical, those of both jaws and vomer largest and strongest in front; posterior nostril minute, close to eye and nearly above it; anterior nostril tubular, near end of snout. Dorsal posterior, its distance from vent less than head. Color, black, with numerous sharply marked white spots, smaller than pupil, scattered along sides of body in 3 rows. Species apparently most nearly related to *Rabula davisi* Fowler = *Rabula aquae-dulcis* Jordan and Davis, nec Cope, but differing in proportions and color. Named for the genial captain of the *Zaca*, Garland Rotch.

Holotype: No. 4964 Mus. Calif. Acad. Sci. Ichthyol., from tide-pools, **Black Beach Anchorage, Charles Island, Galapagos**, May 14, 1932.

Family BELONIDAE. The Needle-fishes

3. *Belone platyura* Bennett

A noteworthy extension of range of a species hitherto known to inhabit the region from the Red Sea to Hawaii. One specimen was secured at Gardner Bay, Hood Island, April 2, and 2 from off Cape San Lucas August 5. They agree with the description of *B. platyura* in the Hawaiian Report, Bull. U. S. Fish Comm. XXIII, part I, 1903, p. 122.

Family EXOCOETIDAE. The Flying-fishes

4. *Parexocoetus papilio* Clark, new species

Length of body 19 mm.; head 4.5 in body; depth 4.75; eye about 2.2 in head, about twice as long as the short snout; a short thickish black barbel one side of chin, doubtless the remainder of a pair; pectorals reaching to origin of dorsal;

ventrals broad, wing-like, reaching to middle of anal; dorsal elevated, its longest rays reaching beyond base of caudal, conspicuous by its dark tip; lower lobe of caudal much the longer, longer than head; lower jaw the longer, chin thick, mouth oblique. D. 9; A. 10, mouth small, teeth undeveloped. Scales undeveloped, but a somewhat more advanced specimen had faint signs of about 40. Body and pectorals mottled, the mottling in the form of bars; ventrals and dorsals black; caudal pale, with black dots along the rays of the long lower lobe; body coarsely punctate, but pale.

Holotype: No. 5262, Mus. Calif. Acad. Sci. Ichthyol., from **Braxilito Bay, Costa Rica**.

Four specimens were obtained from among schools of little flying fishes crowding about the submerged light at Braxilito Bay, July 1, and off Bat Islands the next evening. The holotype is from the former locality, the three paratypes 5496, 5496a, 5496b, from the latter. With the exception that they lacked its brilliant coloration our fishes remind one somewhat of Beebe's colored drawing of the "Butterflying Fish," plate II, opp. p. 68, of the "Arcturus Adventure," and there identified as *Cypselurus furcatus* Mitchill. Our little fishes, with their moderate pectoral fins, elevated dorsals, long ventrals and other characteristics represent the genus *Parexocoetus*, "small fishes of tropical coasts, widely distributed."

One of the paratypes, No. 5426 of our collection, 22 mm. long, standard length and favorable for examination, had pectorals with 14 rays, the first 3 unbranched, the 4th and 5th longest and forked at tip; middle rays of dorsal longest, reaching well beyond base of caudal; ventrals long, expanded, reaching nearly to end of anal base, their insertion about midway between gill-opening and base of caudal. Markings like those of holotype. The fin membranes of these little fishes are very frail, making examination without mutilation very difficult.

Family BOTHIDAE

5. *Monolene asaedae* Clark new species

Four specimens obtained, three, Nos. 4727 to 4729 inclusive being dredged from off Port Angeles Light July 14, and one, No. 4805, from Lat. 18° 14' N.; 103° 23' W., in 60 fathoms, July 17.

Exceedingly thin flat-fishes, translucent, the interneural and interhaemal areas set off sharply in their transparency from the rest of the body, the neural, interneural, haemal and interhaemal slender spines showing through. The gills and viscera also show through the thin skin, as do the muscular bands of the body. Fins all black; lateral line of left or colored side, which has a marked curve, running far out on pointed caudal, and hardly perceptible, if present at all, on right or blind side. Fugaceous scales nearly all lacking on left or colored side of all specimens where they appear to be cycloid; persistent on the blind side where they are markedly so. Outline of body ovate-lanceolate and much like that of a leaf. The following is a more detailed description of the specimen chosen as holotype:

Length of body 69 mm.; head 3.35 in body; depth 2.5, the greatest depth well forward, over about the end of the opercle, from which both dorsal and ventral

outlines proceed almost straight to the caudal; eye 3.5 in head; maxillary from tip of snout 3.5, reaching about to middle of pupil. D. 75; A. 61; scales 15-75-18; pectoral 2 in head, of 10 rays; interocular ridge narrow, rather high and sharp; chin with a symphyseal knob; teeth very small in a single row in jaws; a sharp but small spine before vent. Gill rakers 3+5, remote from each other, triangular, smooth, and rather short. Fin membranes naked.

Holotype: No. 4729, Mus. Calif. Acad. Sci. Ichthyol., dredged off Port Angeles Light, Oaxaca, Mexico.

Our No. 4727 has the dorsal rays 78, anal 56, and scales 14-67-13. Our specimens are all unlike either of the two species of *Monolene* described by Garman 1899 from the Pacific coast of Mexico, the only Pacific species heretofore described. Named for Toshio Asaeda, the clever and accomplished artist of the expedition.

Family CYNOGLOSSIDAE. Tongue-fishes

6. *Symphurus melanurus* Clark, new species

Total length 169 mm.; body 155 mm.; head 5.16 in body; depth 3.22; eye 6.5 in head; maxillary 4.2, reaching about to middle of eye; snout 4.2; D. 100, not counting half of caudal which is continuous with it, the fin beginning slightly in advance of eye, the first rays somewhat produced, the fin highest about middle of body, but always low, the longest rays about length of snout. A. 35, similar to dorsal. Scales ctenoid, in longitudinal series 89, transversely 39. Color uniform brown except dorsal and anal, which are pale anteriorly, gradually darkening posteriorly, the last third of each and the caudal black.

Holotype: No. 4401, Mus. Calif. Acad. Sci. Ichthyol., dredged off Acapulco, Mexico, 18° 49' N., 99° 05' W. July 15, 1932.

A paratype, No. 4423, 166 mm. long was partly dissected: Vertebrae 9 + 39 = 48; gillrakers minute tubercles, 0 + 10; lower pharyngeals narrow, with one irregular row of sharp teeth; upper pharyngeals rounded pads. An examination of 3 additional specimens gave D. 100 to 105; A. 83 to 87. Most nearly like *atricaudus*, from which it differs in having uniform coloration and fewer scales.

Family ACHIRIDAE. The Broad Soles

7. *Achirus zebrinus* Clark, new species

Total length 118 mm.; body 94 mm.; head 3.4 in body; depth 1.66; upper eye 5 in head; snout 4; mouth on colored (right) side extending to below pupil, short and much curved downward on blind side; lips on colored side much fringed; a hard blunt spine on upper lip. D. 53; A. 41; left V. 2, rudimentary; right V. 4, adnate to anal. Caudal rounded, with rough scales; dorsal and anal rays broad, densely clothed with rough scales, the dorsal rays divided into closely parallel branches. Scales 30-77-39 on blind side, about 75 on colored side, very rough ctenoid on colored side, those on blind side of head produced into filaments. Anterior dorsal and anal rays on blind side clad in similar filaments; scales of nape and chin enlarged, those of upper lip and chin developed into lacerate flabellae resembling

minute barbels. Teeth minute, in a small villiform patch on mandible of blind side. Gillrakers almost rudimentary.

General color blackish or dark brown with numerous narrow white bars about $\frac{1}{4}$ or $\frac{1}{4}$ as wide as interspaces, 13 crossing the body, 6 irregular and broken on head, those on the caudal becoming 9 horizontal parallels posteriorly.

Holotype and only specimen: No. 4448 Mus. Calif. Acad. Sci. Ichthyol., dredged in **15° 40' N., 93° 49' W.**

In general shape this fish reminds one of the common hog-choker of the Atlantic (*A. fasciatus*) but is somewhat shorter, and has many of the scales of the eyed side with hair-like appendages, as in *A. barnharti* or *A. mazatlanus*, but more irregularly scattered than in the last named species, from which it is strikingly distinguished by its zebra-like markings and the absence of a pectoral fin.

Family NOMEIDAE

8. *Nomeus gronovii* (Gmelin). Portuguese Man-of-War Fish; Harder; Pastor

A single specimen of what was identified as this species was taken at the surface around the light by means of a dipnet at Academy Bay, Indefatigable Island, on the night of May 3, by Frank Taiga. On account of its apparent rarity in the Pacific, as well as discrepancy of descriptions by various authors, our specimen, which was in a condition of extreme inanition when it died, is thus described:

Head large, 3.2 in body; depth at deepest portion (about the nape) 3.2; eye large 2.5 in head; snout 4.5; maxillary short, 3.5 in head, reaching anterior margin of orbit; D. XII, 26; A. II, 26; scales cycloid, 3-66-14, the lateral line high along back; cheeks scaly, nape with small scales. Pectorals 20, caudal rather deeply forked, the lobes sharp, about equal. A row of small incurved canine-like teeth in jaws; premaxillaries not protractile; gill membranes free from the isthmus; branchiostegals 6; pseudobranchiae well developed; gillrakers about X+14, slender, the longest about as long as the pupil. Color in spirits brownish.

The following is a description of the living fish shortly after capture and during its sojourn in an aquarium where attempts were being made to keep it alive. "A small slender dainty blue fish, rather compressed. Azure blue with darker blue bars on sides. A remarkable feature is the united ventral fins, which are a little in advance of the pectorals and are spread out in a fan-shaped form, more hyaline at base between rays, rays and distal margin deeper blue, forming the appearance of a lace collar." Next morning by daylight the following notes were added: "Middle line of back, pectoral and deeply forked caudal entirely dark blue; four blue blotches, narrowing downward, extend from back down on sides; rest of side silvery. Snouth blunt; eye large. The expanded (united) motionless ventrals seem to be used as a sort of parachute."

Of the genus *Nomeus*, to which the specimen appeared to belong, the original brief description of Cuvier fits very well. That of Goode and Bean enumerates among other particulars "caudal not deeply forked," and in this particular they are followed by Jordan and

Evermann. Goode and Bean's figure however, show the caudal of their specimen to be fairly well forked, and Meek and Hildebrand say "caudal fin forked, the lobes of about equal length." As to color, most descriptions give the color as brown, but Goode and Bean describe it as blue.

As to distribution, the species was originally described as "Tropical America," Jordan and Evermann give its range as "Tropical parts of the Atlantic and Indian Oceans in rather deep water swimming near the surface, very abundant in the Sargasso Sea, common north to Florida and Bermuda; occasionally farther; Woods Hole, Mass., also recorded by Eigenmann from Panama." Eigenmann's reference is to a collection of fishes in Cornell University, mostly from Brazil, in which he reports 5 specimens of *N. gronovii* from "rocky pools at Panama" (Ann. N. Y. Acad. Sci. 7, 1894: 629). The next record is that of Snodgrass and Heller who obtained "a few small specimens taken with Portuguese Men-of-War about Lat. 7° 26' N., Long. 100° 36' W., in open sea" considerably to the north and west of the Galapagos. Fowler reports 4 specimens in very poor condition in the Bishop Museum from Oahu, and one from Lat. 6° N. Long. 162° W. at surface, near Christmas Island. Our specimen was taken when and where there was an unusual assemblage of fishes about the light, with them a school of jelly-fishes and a small Portuguese Man-of-War.

It is difficult to imagine how the Portuguese Man-of-War and its companion fish, both feeble swimmers and confined to the surface of tropical waters, could find any passage-way from the Atlantic to the Pacific. Atlantic and Pacific specimens of both these species should be carefully compared.

Family PRIACANTHIDAE. The Catalufas

9. *Pseudopriacanthus lucasanus* Clark, new species

Holotype and only specimen: total length 73 mm.; body 56 mm.; head 2.4 in body; depth 2; eye 2 in head; snout 4.3; maxillary 2, oblique, extending nearly so far as to middle of pupil; interorbital width 4 in head, or about 2 in eye; D. X, 11, the spines strong and strongly fluted; A. II, 10, similar to dorsal; pectoral rays 16, the fin short, 1.5 in head; ventrals long, reaching beyond origin of anal. Scales small, very rough, 8-48-14. Teeth in several rows along edge of jaws, the outer somewhat enlarged, none on vomer or palatines; preorbital very narrow, rough; preopercle serrate, its arms straight at an obtuse angle; opercle narrow; branchiostegals 4; pseudobranchiae well developed; gillrakers long and numerous. Color bright yellow; the only touches of color except the yellow being the black tips of the caudal, ventral and anal, and soft dorsal fins.

Holotype: No. 2708, Mus. Calif. Acad. Sci. Ichthyol., from dredge haul among rocks off Cape San Lucas, Lower California, August 5, 1932.

Family OPLEGNATHIDAE. The Stonewall Perches

10. *Oplegnathus insigne* (Kner) Stonewall Perch

Three specimens collected, one young 15 mm. long, west side of Albemarle Island near the lava fields, May 22, with 5 black cross-bars almost identical in markings with young example No. 1, described by Snodgrass and Heller, and another still smaller and more faintly marked from about the light, Tagus Cove, May 26. The third specimen, 350 mm. long, was one of the most strikingly marked of all fishes taken on the cruise. The general color was dark brown, almost black, except the breast and belly, the body and fins being covered thickly with white spots and vermiculations a little narrower than the diameter of the pupil. The general appearance was so unusual that the only clue to the family was the remarkably thick upper lip with the teeth coalesced into a continuous but weakly serrate plate in each jaw, much like those of the parrot fish. The species was assumed to be that of dissimilarly marked specimens recorded for the region.

Family POMACENTRIDAE. The Demoiselles

11. *Demoisellea peregrina* Clark, new species

The following is a description of our largest and most mature specimen.

Total length 18 mm.; head 2.57 in body; depth 2; eye 2.3 in head; snout 3.6; maxillary reaching nearly to pupil. D. XIII, 13; A. II, 12; scales 3-27-9, ctenoid, 18 pores, the lateral line ending under the dorsal; a low sheath of scales along base of dorsal and anal, an enlarged axillary scale at base of ventral; fin membranes naked; preorbital narrow, entire, only partly sheathing the maxillary; preopercle entire; teeth in jaws minute, conical. Gill membranes free from the isthmus; branchiostegals 6; pseudobranchiae well developed; gillrakers slender, about as long as pupil. Soft dorsal and anal rounded, the rays higher than the spines, the longest (middle) of the dorsal reaching nearly to the end of the short caudal peduncle; caudal emarginate. Origin of ventrals under that of the pectorals, both fins about 1.4 in head, first ray of ventral produced, reaching anal.

Color a rather uniform brown, except pectoral, tip of soft dorsal, soft anal, and all of caudal, which are white.

Holotype: No. 5437, Mus. Calif. Acad. Sci. Ichthyol., attracted by submerged light, **Bat Islands, Costa Rica**, July 2, 1932.

Two examples were obtained among the small fishes crowding about the submerged light at Albemarle Island, May 29, and 14 from Bat Islands, July 2, along with the holotype.

12. *Eupomacentrus beebei* Nichols

A sharp lookout was kept for this brilliantly colored little fish, hitherto known from only one specimen, body length 15 mm., obtained by Beebe in 1923, described by Nichols, and illustrated in a colored plate in Beebe's "Galapagos; World's End."

One was obtained at the north end of Indefatigable Island, not far from Seymour Island, and in the vicinity of Eden Island, the type locality. A brilliant example was seen in a tidepool on Charles Island, but it escaped into a rock crevice, and eight were taken from tidepools along the west side of a lagoon near the lava fields of Albemarle Island between Iguana and Tagus Coves. As there was sufficient material at hand one specimen was partially dissected for a fuller description than any available.

Body length 15 mm.; head 2.5 in body; depth 1.9; eye 3 in head; D. X, 14; A. II, 11; pectoral rays 20; ventrals with an accessory scale between them; gill membranes free from isthmus; pseudobranchiae large, well developed; gillrakers rather slender, remote, X+10; scales 2-23 (19 pores)-9; lower pharyngeals a solid triangular piece with concave sides; intestine somewhat elongate, vertebrae 10+14=24.

The most striking feature about the little fishes is that the teeth are emarginate as in *Abudefduf*, but the preopercles are serrate as in *Eupomacentrus*; a connecting link between these two genera is thus suggested.

Family CORIDAE

13. *Julidio maculosus* Clark, new species

Total length 44 mm.; body 37 mm.; head 3.4 in body; depth 3.75; eye 3.6 in head; = snout; maxillary hidden under the rather narrow preorbital; interorbital slightly concave, its width nearly equal to diameter of eye; D. IX, 11, A. III, 9; the spines in both dorsal and anal difficult to distinguish from rays; scales 3-36-7, all thin and cycloid.

Ground color white, covered with large irregular black or deep brown blotches of irregular size, an irregular white line, about 2 scales wide, along middle of side dividing dorsal set of blotches from ventral; pectoral and caudal colorless, the other fins mottled, middle of dorsal with an ocellated oval black spot about as large as eye.

Holotype: No. 3156 Mus. Calif. Acad. Sci. Ichthyol., Conway Bay, Indefatigable Island.

More thorough examination was made of a paratype which was partially dissected with the following results: D. IX, 12; A. II, 14; anterior enlarged incisors 2/4, no posterior canines; vertebrae 9+16=25.

These strikingly piebald black and white wrasse fishes were all small, the longest being 43 mm. long. Two were obtained from tidepools along James Bay, James Island, June 4, ten from Conway

Bay, Indefatigable Island June 8, and four from tidepools of the same island the next day.

Family GOBIOIDIDAE

14. *Gobioides peruvianus* (Steindachner)

The fish tentatively identified with this and taken up near the head of Pedregal River, Honduras, was so far out of its previously recorded range "Shores of Ecuador and Peru, entering rivers" that it is deemed best to give a brief description.

Total length 350 mm.; head 6.5 in body; D. VI, 16; A. 16, the spines and rays hidden in thick membrane so that their character and exact count is uncertain; ventrals united into a cup-shaped sucker, as is common with gobies. An eel-shaped fish with minute eyes nearly on top of head; posterior nostril slit-like, midway between eye and tip of snout; anterior nostril round, small, near lip. Mouth very oblique, armed with a row of sharp fangs. Gill membranes united to isthmus.

Family CLINIDAE. The Scaled Blennies

Crockeridius, new genus

Blennies, apparently closely related to *Mnierpes* or to *Emnion*, genera rather midway between the Clinidae and the scaleless blennies. They differ from *Mnierpes* in having a small orbital tentacle and in dentition, and from *Emnion* in the character of the lateral line and in conformation of head. Type, *Crockeridius odysseus*, the genus named for Mr. Templeton Crocker.

15. *Crockeridius odysseus* Clark, new species

Total length 78 mm.; body 65 mm.; head 5.4 in body; depth 8; eye large and prominent, 3.5 in head; snout 4, the upper lip forming a peculiar upturned ridge; interorbital narrow, concave, less than half eye; maxillary to tip of snout and including projecting upturned lip 2.5 in head; gape not quite reaching to middle of pupil; cheeks puffed and tumid; gill membranes free from isthmus, forming a fold across it; branchiostegals 5. D. XXIV, 14, the spinous portion low and even, the spines a little shorter than diameter of eye and about 1.75 in length of rays; A. I, 26, similar in shape to soft dorsal, but membrane between rays incised to near base, leaving a triangular flap of membrane from tip of each ray posteriorly. Ventrals I, 3, the short spine and stout long first ray in a common integument, separated by a deep incision from the other two rays, the fin inserted a short distance behind gill-membrane fold and slightly in advance of origin of pectorals, their longest ray about 1.5 in head and their tips reaching about two-thirds way to vent; pectoral somewhat acutely rounded, with 13 rays, the longest about as long as head, the tips reaching to vent; caudal rays 13, the fin pointed and free from dorsal and anal, whose tips reach its base; caudal peduncle very short. Scales about 7-53-7, lateral line forming an arch of about 17 scales above the pectoral, thence descending to the middle of side. From the end of the curve it almost disappears, being represented by an occasional almost imperceptible ridge without any sign of tubes. Head, breast, and belly naked.

The scales are peculiar structures, hardly showing at all on moist specimens; on alcoholic specimens allowed to dry the scales curl up, resembling loosened patches of skin, so that it was at first thought they were the anterior flaps of scale pockets from which deciduous scales had been shed, as has been described and figured for *Emnion bristolae* Jordan (Proc. U. S. Nat. Mus., 19: 454, 1897). It is only by some effort that these seeming flaps of skin can be loosened and pulled from the body, when they show the fluting and radiating lines characteristic of the point of attachment of many scales.

Holotype: No. 2806, Mus. Calif. Acad. Sci. Ichthyol., from **pot-holes, Duncan Island, Galapagos**, June 7, 1932.

Details of dentition, gill structure, skeleton and the like were best made out by a dissection of one of the paratypes, (No. 2809) with the following results: Upper jaw with a row of stout canines and several rows of minute teeth behind them; lower jaw with only the row of canines; no teeth on palatines, a small patch of minute granules on vomer. Gills $3\frac{1}{2}$, a small slit behind the last; gillrakers a few wide-set short tubercles. Stomach short and curved, no cœcae noted; contents a small bristle-bearing worm. Another contained insect remains. Vertebrae 40.

The examination of a female revealed a large number of minute eggs. All our specimens are much alike in color, nearly black, the caudal marked with white spots producing a barred appearance.

The history and habits of this species are more remarkable than their appearance. The first example seen was noticed on the top of a rock along the shore of Wreck Bay, Chatham Island, April 18. It looked very much like a curled up salamander, with black, smooth, glistening skin and prominent beady, watchful eyes. Upon approaching with a dipnet it sprang into the water. From time to time about a dozen more were seen coiled up on rocks, and it was then ascertained that they were fish. They were seen from time to time making quick jumps from and over rocks into deeper water. From their alertness and activity and their unexpected position they were apparently the most elusive of fishes and probably absent in collections. Beebe had apparently caught glimpses of them, for he remarks (Galapagos, p. 112): "Blennies climbed out and flicked here and there upon tide-soaked rocks."

The capture of the first specimen was due to the skill of Frank Taiga, a Samoan with unusual ability in the capture of fishes. Several were seen curled up on a rock on the shore of Indefatigable Island at Academy Bay; by carefully stalking them from behind the rocks and making swift strokes with the landing net one after another was secured until we had 9 specimens. One, seen in a tide-pool, was of a beautiful emerald green color, but it escaped.

On a trip along the shore of Duncan Island, June 7, was discovered what appeared to be the home of the rock-springers. They seem to be neither ocean nor tidepool fishes but rather pot-hole inhabitants, living, along with suck-fishes (Gobiesocidae), in deep depressions back some distance from all but the highest tides. Un-

like the suck-fishes they have no means of attaching themselves firmly to rocks against the dash of surf. They showed great alacrity in climbing out of the steep sided pools and it was only by administering poison and keeping them down in the pools that they could be collected in such situations. They were indeed able to ascend the smooth vertical side of the enameled collecting can.

Later on (July 3), in small alga bottomed pools back from the shore of Murcielago Bay, near Bat Islands, the newly-born or newly-hatched young were found, their parents about the pool edges.

Notwithstanding their climbing ability it is apparently not by this means that they attain their positions on the tops of the rocks. They were observed, time after time, hurled from height to height by successive surges to their final perch where they lay, apparently panting for breath, awaiting the dashing spray. It is probable that their peculiar scale structure, presenting a great expansion of surface, is an adaptation for respiration by means of the skin, as in salamanders. It is probably only adventurous individuals which leave their native pools and pioneer down to the edge of the surging ocean, that one finds coiled upon rocks, and that is to these adventurers that the wide distribution of the species as well as its integrity is due.

Specific name for Ulysses in commemoration of the character of his arrival at the land of the Phæacians.

16. *Scartella atrimana* Clark, new species

Total length 18 mm.; body 16; head 3.2 in body; depth 3.55; eye 2.5 in head; snout 3.3; maxillary about 3.3, reaching to anterior border of eye; D. XII, 11, the second spine highest, others gradually decreasing, giving the spinous portion a wave-like form; A. 15 or II, 13, the spines hardly or not distinguishable from rays; V. I, 2, the small spine in the same integument as the first ray, rays in thick integument, not forked; P. 13; caudal truncate, well separated from dorsal and anal by a slender peduncle; no scales; a faint lateral line arching over the pectoral. Teeth a comb-like row, solid in jaws, acute. Branchiostegals 5; gill-membranes attached to isthmus a little below base of pectoral, but a peculiar fold across isthmus; pectoral broad and conspicuous, pointed, about 1.2 in head, its tip reaching to base of 4th anal ray; ventral inserted before pectoral, 1.5 in head, the tip reaching about $\frac{2}{3}$ way to anal; nostrils rather wide apart, the lower with a filament; a short simple supraocular filament; preopercle with a short, flat spine-like extension. Color: nape, upper part of head, cheeks, top of back up to middle of spinous dorsal with punctate blotches; lower part of pectoral black; a black spot in axil of pectoral; a small black spot in each anal ray; remainder of body cream color. Others agree fairly well with this.

Holotype: No. 3988, Mus. Calif. Acad. Sci. Ichthyol., about submerged light, Albemarle Island.

Paratype examined for fuller details gave gillrakers mere tubercles; pseudo-branchiae present, very small; vertebrae 8+16=24.

Our specimens differ from *S. brevirostris*, with which it was attempted to identify them, by general difference in physiognomy.

The interorbital space, instead of being narrow is rather broad, there being a brow-like projection above the eyes which are not notably high and close together. The caudal is truncate, at times with a very slight emargination. A feature that first catches the eye is the black of the lower half of the pectoral.

The following will indicate its abundance and distribution: Socorro Island, March 27, one; Postoffice Bay, Charles Island, April 23, one; Black Beach Anchorage, April 25, twenty-two; Academy Bay, Indefatigable Island, May 1, one; Tagus Cove, Albemarle Island, May 24 and 25, six; same island off Vilamil April 29, fifty-seven; James Bay, James Island, June 3, two; Braxilito Bay, July 1, seven; off Bat Islands, July 2, ten; Navidad Bay, July 18, one; Banderas Bay, July 20, one; and off Maria Madre, July 23, one. Total 100 specimens.

It is noteworthy that, although these specimens were taken over much of the area investigated and during much of the time of the investigation, there is little change of size or appearance of increased maturity.

Family CERDALIDAE

17. *Cerdale bilineatus* Clark, new species

Total length 39 mm.; body 35 mm.; head 7 in body; depth 10.1; eye 5 in head; gape very short, sub-vertical, not nearly reaching eye; lower jaw projecting, entering into the rounded profile. D. about XXII, 25, the spines gradually passing into simple but articulate rays, the low fin not notched, but apparently lower about the point of transition, the dorsal beginning a short distance behind nape. A. II, 26, beginning about middle of body; caudal rounded, its rays about 5, 18, 5, free from dorsal and anal. Ventrals apparently I, 2, or 2, the spine uncertain, one ray forked, its longest part about 1.5 in head, the fin inserted under origin of pectorals; pectorals acutish, of 9 rays, a little longer than ventrals. Gill opening a small pore before base of pectorals. Teeth a double row of strong rounded incisors in jaws. Apparently 3 branchiostegals. Most of the body naked, but with small circular non-imbricate scales scattered along middle of sides. Color, a long narrow black line along each side of dorsal beginning near tip of snout, a somewhat broader line extending from the very tip of snout across cheek and along middle side to tip of caudal. Near its posterior end there is a dusky extension like a blot passing down over the end of base of anal.

Holotype: No. 3245, Mus. Calif. Acad. Sci. Ichthyol., **Indefatigable Island**, June 9.

Examples were occasionally seen among rocks in the tidepools, exceedingly elongate, brightly striped fishes, very active and flexuous and able to escape the landing net, so that only the holotype was captured. The color markings were strikingly similar to that of *Petroscirtes tapinosonoma* of which we secured a few specimens, but the fish was much more elongate.

The reader will at once be struck by the great disparity between the number of species (304) taken during the expedition and the

species discussed (17) in this report. All of the 3216 specimens represent a valuable addition to our scientific collection, even the ones too immature for certain identification; for juvenile forms are too little known, and further collecting may, in time, make their position certain. Along with the specimens are 150 colored drawings representing about 170 species, and a few duplicates showing color variations, drawn from life by the artist, Toshio Asaeda, which it is hoped may be published some time in the future.

The greater number of species not mentioned in the report for lack of space have been already reported for the region under discussion, and the mere giving of a list of names would add nothing to our knowledge, and as the area covered does not represent a definite biological area, a check-list would be of little significance. A few additional notes may be of interest.

(1) Although no living hammerhead sharks, *Sphryna zygaena*, were seen during the cruise, a great pile of skins and remains were seen on the beach of Isabel Island, where they had apparently been tried out for oil.

(2) A great school of rays, probably eagle rays, were seen swimming at the surface in shallow water near Hood Island, their expanded ventrals beating the water surface and making a striking spectacle. No specimens were taken, however.

(3) A large specimen of the spotted eagle ray, *Stoasodon narinari*, was seen at the shore of Wreck Bay, and a pair were seen at North Seymour, but none was taken.

(4) Our collection indicates that the flying fishes, of which we secured a goodly number, may need revision. A species described as *callopterus*, distinguished by having the pectorals covered with small, round, dark spots, is said to be "common at Panama, but not yet seen elsewhere" (Jordan and Evermann 1896). Beebe reported it at Hood Island under that name, remarking that "about one in every 50 had wings densely covered with round black spots," (Arcturus Adventure, p. 106). At Braithwaite Bay, Socorro Island, Revillagigedos, we found some specimens with many, some with a fair number, some with few, and some with no black spots, all apparently the same species. They were crowded with eggs which oozed out at a touch (March 28). It was at first thought that the black spots were characteristic of one of the sexes, but examination showed it not to be the case. Toshio Asaeda made a beautiful drawing of one of the spotted-winged specimens. Extensions of range, hitherto unrecorded but to be more or less expected, is that of *Petrosirtes tapeinosoma* Bleeker, from the South Seas to the Galapagos, where one was captured in a tidepool of Indefatigable Island near Seymour Island, June 9, and three more at Sullivan Bay, James Island, June 13. One might possibly expect in the colder, deeper waters an extension of members of a fauna found nearer the surface farther north; and so we found by dredging about San Nicolas and San Martin Islands numerous examples of *Chitonotus pugetensis*,

whose range had been given as San Francisco to Puget Sound, *Icelinus quadriseriatus* in colder deeper water as far as Cape San Lucas and Cedros Island, its previous range reported as "off San Francisco, between Point Reyes and Golden Gate."

Our collection is unusually rich in the little cling-fishes, or Gobiessocidae, of all ages and sizes, as these had been previously neglected and the tidepools were thoroughly searched for them. These minute creatures are difficult of identification, and there was a natural hesitancy upon deciding upon any of them being new.

A noteworthy event of the cruise was the receipt of a radiogram from San Francisco by the *Zaca*, in search of a surgeon to care for a man who had been attacked by what appears to have been a kingfish, or Wahoo, *Acanthocybium solandri*, which was at first reported as a barracuda. The *Zaca* left Wreck Bay and travelled back all night until about 8:30 next morning, when we made connections with the tuna boat where the accident occurred. According to accounts the fish had leaped up two fathoms above the water surface and gashed the man's throat, which was attended to promptly on our arrival. The boat contained anchovies for bait, and they were in the habit of grinding up tuna for "chum" to attract fish to their nets. It is probable the odor of ground fish or anchovies had maddened the kingfish. Anyone noting the Wahoo's arrowy dashes after fish fry or observing the row of sharp incisors could easily understand how such an accident might occur.

In reporting upon the scientific collection, the collection of living fishes brought back to the Steinhart Aquarium is naturally ignored, as the identification is in many cases uncertain and the certainty of the place of collection soon lost. Among them, however, was a handsome snake eel, *Quassiremus evionthas* (Jordan and Bollman), the only specimen known except the type described in Proc. U. S. Nat. Mus. 1889: 154, from Hood Island, Galapagos.



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ERRATA

- Page 3. Line 5 from top: for pp. 3-9 read pp. 3-12.
 Page 83. Line 5 from top: for recollected read re-collected.
 Page 89. Last Line: for *Andersson* read *Anderssoni*.
 Page 168. Line 14 from bottom: for *violens* read *violenta*.
 Page 178. Line 9 from bottom: for *Formicidae* read *Formicinae*.
 Page 221. Line 5 from bottom: for *corralloides* read *coralloides*.
 Page 233. Line 15 from bottom: for *Captain* read *Mr.*
 Page 345. Line 12 from bottom: for *Beauford* read *Beaufort*.
 Page 346. Line 2 from top: for *Hemiramphidae* read *Hemirhamphidae*.





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