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I

PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. II
Part Two

1918-1926

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XII

A REVIEW OF THE ALBATROSSES, PETRELS, AND DIVING PETRELS

BY LEVERETT MILLS LOOMIS

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INTRODUCTION

The present paper consists of six parts. Part I is a brief sketch of the men and writings that have been prominent in the advancement of our knowledge of the Tubinares. Part II treats of the geographic distribution of the group. Numerous distribution areas are recognized. Part III has a wider scope. The causes of bird migration are considered from the view point of the migratory movements of the Tubinares. Part IV relates to the variations of these birds in color, size, and external structure. Part V deals with their classification and nomenclature. Part VI is a repository of facts upon which the conclusions in the three preceding parts are largely based. It presents the results of my study of extensive series of the Tubinares and the outdoor observations upon this group made by Mr. Edward Winslow Gifford, Mr. Rollo Howard Beck, and Dr. Alexander Sterling Bunnell during the ocean expeditions sent out by the California Academy of Sciences.

In the preparation of this paper I have received much assistance from institutions and individuals. For the loan of specimens I am indebted to Mr. Outram Bangs, Mr. A. C. Bent, Dr. Joseph Grinnell, Dr. Leonard C. Sanford, Mr. John E. Thayer, the State of Oregon Fish and Game Commission, through Mr. Stanley G. Jewett, the Bernice Pauahi Bishop Museum, through Mr. John F. G. Stokes, the Department of Zoology of Leland Stanford Junior University, through Prof. John O. Snyder, the Museum of Vertebrate Zoology of the University of California, through Dr. Joseph Grinnell, the Carnegie Museum, through Mr. W. E. Clyde Todd, and the United States National Museum, through Dr. Charles W. Richmond. I am also under obligations to Mr. L. R. Reynolds for the photographs of museum specimens reproduced in the accompanying illustrations, to Mr. Samuel Levi for the original drawing of the homolographic chart, to Mr. Edward Winslow Gifford for the great series of measurements, and lastly to my friend of many years, Mr. Ransom Pratt, who has read most of the manuscript of this paper during its preparation, and has made many suggestions that have added to the clearness of the statements.

I

HISTORIC SKETCH

The Pre-Couesian Period: to 1866

Prior to the publication of Dr. Coues's monograph in 1864 and 1866, the literature pertaining to the albatrosses, petrels, and diving petrels was at best fragmentary. The impress of Linnæus upon the group in the tenth and twelfth editions of his *Systema Naturæ* is very slight; only five of the eight specific names proposed by him are tenable. Johann Friedrich Gmelin, "an industrious, indiscriminate compiler and transcriber," in 1789 in volume one, part two, of his edition of the *Systema Naturæ* considerably increased Linnæus's list. The source of Gmelin's information was mainly the third volume of Dr. John Latham's *General Synopsis of Birds,* published in 1785. In this work Latham did not apply "the principles of binary nomenclature," and therefore his names of species have no standing in technical ornithology. In his *Index Ornithologicus,* which appeared in 1790, Latham bestowed Latin binomial names upon his birds. Nevertheless, only one name survives in the group we are considering, for he was forestalled by Gmelin, who followed the Linnæan system of naming, thereby gaining a foothold in the nomenclature.

Latham's name is inseparably connected with the ornithology of Captain James Cook's three voyages, and the present narrative would be incomplete without some further allusion to these voyages. On the first voyage, which lasted from 1768 till 1771, Cook was accompanied by Sir Joseph Banks and his four assistants, Dr. Daniel Carl Solander (a disciple of Linnæus) and three artists, one of whom was Sydney Parkinson, in whose honor Parkinson's Petrel in later years was named. Parkinson made the drawings of the birds and Solander wrote the descriptions and selected the names. Banks and Solander returned in safety, but Parkinson and the other artists died on the voyage. Solander after his return to England elaborated his original notes on the albatrosses and petrels into extensive Latin descriptions ready for the printer, but he died in 1782, leaving them unpublished. Recently these manuscript descriptions have been discovered in the British Museum

by Mr. Gregory M. Mathews, and published by him in the second volume of his *Birds of Australia.* Since the time of Mr. George Robert Gray the manuscript had apparently been lost sight of by ornithologists. Neither Mr. Salvin nor Dr. Godman knew of its existence. On Cook's second voyage (1772-1775) Dr. Johann Reinhold Forster was naturalist, his son Johann Georg Adam Forster (commonly called George Forster) bird artist, and Dr. Anders Sparrman assistant to the elder Forster. In 1785, Forster published his *Mémoire sur les Albatros* in Tome X of *Mémoires de Mathématique et de Physique, présentés a l'Académie Royale des Sciences* [Paris], describing three species. Although catalogued by Carus and Engelmann in their *Bibliotheca Zoologica* and quoted from that work by Dr. Coues in his *Third Instalment of American Ornithological Bibliography,* this memoir was overlooked by nomenclators until 1902 when Mr. C. Davies Sherborn drew attention to it in his *Index Animalium.* Owing to disagreements between the British Government and Forster, the larger results of Forster's work on the voyage remained unpublished during his lifetime. In 1844, under the editorship of Dr. Martin Hinrich Lichtenstein, the results finally appeared in *Descriptiones Animalium.* Priority of technical names was lost in most instances by this long delay. On his third voyage (1776-1780), Cook was accompanied by two artists, William W. Ellis and John Webber. Ellis appears to have made all of the bird drawings on this voyage.

Parkinson's drawings and Solander's manuscript, George Forster's drawings, and Ellis's drawings passed into the possession of Sir Joseph Banks. The specimens obtained on the second voyage went in part to the British Museum, and those on the third voyage, at least, to the collection of Sir Joseph Banks. "Some found their way into the Leverian Museum" (J. E. Gray, Dieffenbach's *Travels in New Zealand,* Vol. II, p. 178). The Leverian Museum was the private museum of Sir Ashton Lever, established in London during the latter part of the eighteenth century, and finally dispersed by auction in 1806. In our particular field, Latham based his descriptions largely upon the collections of the British Museum, of the Leverian Museum, and of Sir Joseph Banks, availing himself of the fruits of Cook's voyages. Even for the time,

Latham's descriptions are vague, for he did not possess in a high degree the gift of recognizing the distinguishing characters of species. In consequence, some of Gmelin's species founded on Latham's descriptions are indeterminable. In the present paper but ten are admitted. Of the specimens described by Latham, only one is now in the possession of the British Museum (cf. Sharpe, *Hist. Coll. Nat. Hist. Depts. Brit. Mus.*, Vol. II, pp. 79, 172). However, the bird drawings of Cook's voyages, long known as the Banksian drawings, are preserved in the British Museum, and together with Solander's manuscript and Forster's descriptions shed a side light upon the identity of the Gmelinian species under review. It should be noted that Latham did not limit the scope of his *General Synopsis* to classification and nomenclature. Under "place and manners" he included the geographic range and habits of the species.

In 1816 and 1817, Louis Jean Pierre Vieillot reviewed the group in the *Nouveau Dictionnaire d'Histoire Naturelle* (Tomes I and XXV, under Albatros and Pétrel), following closely in the footsteps of Gmelin and Latham. Leach's Petrel and the White-bellied Petrel are formally introduced into technical nomenclature. Three years later, in 1820, appeared Dr. Heinrich Kuhl's *Beiträge zur Kenntniss der Procellarien* in part first of his *Beiträge zur Zoologie und vergleichenden Anatomie*. Twenty-seven species and nominal species of petrels and one diving petrel are treated in this monograph. The Capped Petrel and Wilson's Petrel receive technical christening, unwittingly, however, for Kuhl attributed the designation of the former to Forster and of the latter to Banks, basing his identification upon the Banksian drawings. James Francis Stephens in 1826 in Volume XIII of Shaw's *General Zoology* instituted two genera and provided a technical name for the Slender-billed Fulmar. He also adopted a generic name (*Pachyptila*) proposed by Johann Karl Wilhelm Illiger in 1811 in his *Prodromus Systematis Mammalium et Avium*. As a whole, Stephens's treatment of the group falls short of that by his predecessors.

John Gould early became interested in the group. In Volume II of his *Handbook to the Birds of Australia* (1865), he remarks on page 421: "Having paid much attention to

these birds during my passages to and from Australia, my researches were rewarded by my obtaining a knowledge of nearly forty different species, most of which are peculiar to the southern hemisphere, and many of them frequenters of the Australian seas." In the *Proceedings of the Zoological Society of London,* parts for 1840, 1843, and 1844, he described two albatrosses and four petrels. In 1844 he published in the *Annals and Magazine of Natural History* an article *On the Family Procellaridæ, with descriptions of Ten new Species.* Only two of the alleged new species were really new. The descriptions of three other species, however, antedate descriptions that appeared in the *Proceedings of the Zoological Society* for 1844. Life histories are given in his illustrated folio *Birds of Australia* (Vol. VII) and in the *Handbook* before mentioned.

George Robert Gray, long in charge of the bird collection of the British Museum, described four of the species recognized in the present paper, a description appearing in each of the following publications: Dieffenbach's *Travels in New Zealand,* Volume II, 1843; *Proceedings of the Zoological Society of London* for 1853; *Catalogue of the Birds of the Tropical Islands of the Pacific Ocean,* 1859; *The Ibis* for July, 1862. Furthermore, Gray devoted five pages of the third volume of his sumptuously illustrated *Genera of Birds* to a review of the group.

In 1848 appeared Volume VIII of the *United States Exploring Expedition - - - Mammalogy and Ornithology* by Titian Ramsey Peale, a naturalist of the expedition. Five petrels were described as new; one of them, however, had been described previously by J. R. Forster.

In his *Avium Systema Naturale* (1852), Dr. Heinrich Gottlieb Ludwig Reichenbach instituted a number of genera, five of which are adopted in the present review.

Prince Charles Lucien Jules Laurent Bonaparte, at the close of his long career as an ornithologist, presented a classification of the group in *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences* [Paris], Tome XLII, 1856, and in *Conspectus Generum Avium,* Tomus II, 1857. Five of the generic names proposed by him are used in the present connection.

In 1863 in *Muséum d'Histoire Naturelle des Pays-Bas,* 4me Livraison, Dr. Hermann Schlegel published a systematic monograph of forty pages on the *"Procellariae,"* describing two new species and limiting the number of genera to three, thereby following a course opposite to that of Bonaparte.

With Bonaparte and Schlegel closed the Pre-Couesian Period in the study of the albatrosses, petrels, and diving petrels. The quarried stones were now ready to be built into a lasting foundation by a master builder.

The Couesian Period: 1866-1896

Plate 1

The monograph that defines the preceding and the present period was written by a young man who had not attained his twenty-fourth year, Dr. Elliott Coues, an Assistant Surgeon in the United States Army. This monograph was published in five parts in the *Proceedings of the Academy of Natural Sciences of Philadelphia,* as follows:

A critical Review of the Family Procellaridæ: Part I., embracing the Procellarieæ, or Stormy Petrels, March, 1864, pp. 72-91.

A Critical Review of the Family Procellaridæ:—Part II.; Embracing the Puffineæ, April, 1864, pp. 116-144.

A Critical Review of the Family Procellariidæ:—Part III; embracing the Fulmareæ, March, 1866, pp. 25-33.

Critical Review of the Family Procellariidæ:—Part IV; Embracing the Æstrelateæ and the Prioneæ, May, 1866, pp. 134-172.

Critical Review of the Family Procellariidæ;—Part V; embracing the Diomedeinæ and the Halodrominæ. With a General Supplement, May, 1866, pp. 172-197.

Although young in years, Dr. Coues was highly equipped for monographic work in ornithology. He was well grounded in anatomy and was familiar with the Latin, French, and German languages. He had been trained in the Bairdian methods, and already had had experience in monographing groups of birds. He had access to the books and specimens of "the Philadelphia Academy and the Smithsonian Institu-

ELLIOTT COUES AT TWENTY-ONE

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tion," the specimens including the Gould Australian collection and the spoils of the United States Exploring Expedition, reported upon by Peale. In the first three parts of his monograph, Dr. Coues was under the spell of Bonaparte's great name, but in the two final parts he emancipated himself from this influence. The vulnerable points in the monograph are chiefly of the kind incident to lack of specimens and outdoor observation. Dichromatism was mistaken for age variation, and inconstant characters were sometimes misconstrued to be constant ones. Seasonal variation due to wear of plumage, however, was clearly understood. Although other monographs have since appeared, the influence of this monograph has not ceased. It "must always be consulted," remarks Mr. Salvin, "by those wishing to master the intricacies of this complicated subject." Dr. Coues's connection with the group did not wholly terminate with the publication of his monograph. He edited the "Ornithology" and was joint author of the "Oölogy" of Dr. Jerome Henry Kidder's *Contributions to the Natural History of Kerguelen Island* (I, 1875, II, 1876), and he identified the birds of Dr. Thomas H. Streets's *Contributions to the Natural History of the Hawaiian and Fanning Islands and Lower California* (1877). In *Remarks on certain Procellariidæ* (*The Auk,* 1897), he introduced the system of classification for the higher groups followed in the present paper, and in the fifth edition of his *Key to North American Birds,* printed in 1903 nearly four years after his death, he devoted upwards of twenty-six pages to the "Order Tubinares: Tube-nosed Swimmers."

In 1870, in *Fauna Vertebrata nell' Oceano,* Professor Enrico Hillyer Giglioli gave an account of the species of "Procellariadee" observed by him during the voyage of the Italian corvette *Magenta* round the world, including five supposed new species originally described by himself and Count Tommaso Adlard Salvadori in 1868 in Volume XI of *Atti della Società Italiana di Scienze Naturali.* In 1876, in Volume I of Mr. George Dawson Rowley's *Ornithological Miscellany,* appeared two articles from the pen of Mr. Osbert Salvin, entitled *Critical Notes on Procellariidæ,* the first dealing with Parkinson's drawings and the second with the petrels described as new by Giglioli and Salvadori in the paper cited

above. The closing year of the decade saw the publication of Volume 168 of the *Philosophical Transactions of the Royal Society of London,* containing an article by Dr. Richard Bowdler Sharpe on the birds of Kerguelen Island, with field notes by Rev. A. E. Eaton, and a shorter article by Mr. Howard Saunders on the birds' eggs obtained on that island. In 1881, Mr. Osbert Salvin published in the *Voyage of H. M. S. Challenger, Zoology,* Volume II, his final report *On the Procellariidæ collected during the Expedition;* twenty-three species being noticed. In Volume IV of the same publication, followed Mr. William Alexander Forbes's *Report on the Anatomy of the Petrels (Tubinares) collected during the Voyage.* The year 1887 was marked by the appearance of Mr. Robert Ridgway's *Manual of North American Birds,* in which most of the species of the Order Tubinares were considered. In 1888, Sir Walter Lawry Buller brought out Volume II of the second edition of his illustrated *History of the Birds of New Zealand,* with its life histories of numerous Tubinarine species. The same year Mr. Osbert Salvin contributed in *The Ibis* a third instalment of his *Critical Notes on the Procellariidæ,* foreshadowing the close of the Couesian Period.

The Salvinian Period: 1896-1910

Plate 2

The advent in 1896 of the twenty-fifth volume of the *Catalogue of the Birds in the British Museum,* embracing Mr. Howard Saunders's monograph on the "Gaviæ (Terns, Gulls, and Skuas)" and Mr. Osbert Salvin's monograph on the "Tubinares (Petrels and Albatrosses)," ushered in the Salvinian Period. With far greater facilities than those at the command of his predecessor, Mr. Salvin was able to simplify the whole subject and give it a new impetus. The shortcomings of this monograph, as in the preceding one, were due chiefly to lack of specimens and outdoor observation.

The year 1901 witnessed the publication of Mr. Archibald James Campbell's *Nests and Eggs of Australian Birds,* and 1905 Sir Walter Lawry Buller's *Supplement to the Birds of New Zealand,* each containing life histories of numerous antip-

Osbert Salvin

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F. D. Godman

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odean species of the group under consideration. Also, this period was fruitful in reports of Antarctic and sub-Antarctic exploration. Of special importance are Mr. William Eagle Clarke's *Ornithological Results of the Scottish National Antarctic Expedition* (*The Ibis,* 1905, 1906, 1907), Dr. Einar Lönnberg's *Contributions to the Fauna of South Georgia* (1906), Dr. Anton Reichenow's extended paper in the *Deutsche Südpolar-Expedition* (IX Band, Zoologie, I Band, 1908), and Dr. Edward Adrian Wilson's account in the *National Antarctic Expedition - - - Natural History* (Vol. II, Zoology, 1907). Dr. Wilson accompanied both of the expeditions commanded by Captain Scott, and lost his life in the ill-fated return from the South Pole. Some of the best ornithology that has ever been written about the albatrosses and petrels is to be found in his report.

Mr. Salvin projected an elaborate, illustrated monograph, but he passed away on the 1st of June, 1898, without carrying his plan into effect.

The Godmanian Period: 1910-19—

Plate 3

Dr. Frederick Du Cane Godman, Mr. Salvin's lifelong friend and collaborator in the monumental *Biologia Centrali-Americana,* assumed the task of writing the projected monograph, and with the assistance of Dr. Richard Bowdler Sharpe brought it to a successful conclusion. The *Monograph of the Petrels (Order Tubinares),* issued in five parts (1907-1910), marks a decided advance, creating a new period in the rise and progress of our special subject.

At this point the sketch must be brought to a close, for it has reached the contemporaneous events which fall within the scope of the succeeding parts of this paper.

II

GEOGRAPHIC DISTRIBUTION

General Considerations

THE TUBINARES frequent all the oceans of the world. Only a few species, however, breed both in the Northern and Southern hemispheres. The Southern Hemisphere is the stronghold of the group; fully twice as many species breed there as in the Northern Hemisphere. The Pacific Ocean, likewise, is much more prolific in species than the Atlantic and Indian oceans. The Pelecanoididæ, the albatrosses of the genera *Thalassarche* and *Phœbetria,* and the Fulmarinæ and Oceanitinæ, with the exception of the Fulmar and White-faced Petrel, are peculiar to the Southern Hemisphere. The majority of the Thalassidrominæ and three of the five albatrosses of the genus *Diomedea* are peculiar to the North Pacific. At least half a dozen species breed on the coasts of the Antarctic Continent, namely, the Giant, Slender-billed, and Antarctic[1] fulmars and the Cape, Snowy, and Wilson's petrels. In Arctic regions, the Fulmar breeds as far north as Franz Josef Land and Melville Island, and the Storm Petrel as far north as the Lofoten Islands, Norway. Notable examples of diversity in distribution in intermediate latitudes are presented in the Wedge-tailed Shearwater and White-faced, Bulwer's, and Harcourt's petrels. The known breeding range of the Wedge-tailed Shearwater extends from the Seychelle and Mascarene islands in the Indian Ocean, Australia, and the Kermadec Islands in the southwestern Pacific to the Revilla Gigedo, Hawaiian, and Volcano islands in the North Pacific, and the breeding range of the White-faced Petrel extends from Australian and New Zealand seas to Tristan da Cunha in the South Atlantic and the Cape Verde and Salvage islands in the North Atlantic. Bulwer's and Harcourt's petrels have a more discontinuous distribution. Bulwer's Petrel is known to breed on the Madeira, Salvage, Canary, and Hawaiian islands, and Harcourt's Petrel on the Azores, Madeira, Salvage, Cape Verde, Galapagos, and Hawaiian islands.

[1] Cf. Mawson, Home of the Blizzard, v. 2, pp. 117, 260.

The ancestral line of the Tubinares extends back into the Miocene Period, and the causes affecting the distribution of the group involve past conditions as well as present ones. The preponderance of species in the Southern Hemisphere and on the Pacific Ocean, the restriction of the Pelecanoididæ and certain other groups to Southern seas, and the dual hemisphere distribution of the Wedge-tailed Shearwater and White-faced Petrel are not explained solely by existing conditions. There is an historic background. In the remote past Tubinarine species became established in their habitats and have been able to hold them against all competition. Their success is perhaps due chiefly to the isolated character of their breeding stations, where predaceous land mammals are absent and food is plentiful. The discontinuous distribution of Harcourt's and Bulwer's petrels ceases to be an enigma when viewed from the standpoint of a water way between North and South America, which geologists tell us existed as late as the Miocene Period.

The fact is not lost sight of that temperature is a factor in the geographic distribution of birds. The apparent restriction of certain Tubinares in the Southern Hemisphere to the zone lying approximately south of the isotherm of 15° C. for January perhaps indicates a temperature control. It should be borne in mind, however, that temperature on the ocean is affected not only by latitude, but by periodic winds, warm and cold currents, and apparent upwelling of cold bottom water, and it may be that these persistent phenomena, instead of exercising temperature control, serve merely as boundaries, marking the frontiers of habitats established in ages long past.

Barren areas in the sea and areas having a food-supply also determine distribution. In the former bird-life is wanting and in the latter it may abound, as in the south polar seas, where there exists an extraordinary abundance of food in summer and autumn.[1]

[1] Cf. Clarke, Ibis, 1907, pp. 328, 329.

Distribution Areas

Plate 4

For the Tubinares, I recognize three different grades of distribution areas, namely, *superarea, area,* and *subarea,* based on the species at their breeding stations. A superarea or an area is distinguished by characteristic species, and a subarea by a peculiar association of any of the breeding species of an area.

Superareas

Two superareas are admitted, one embracing the Southern Hemisphere seas and all Galapagos waters, the other the Northern Hemisphere seas exclusive of Galapagos waters. The former is designated the *Southern Superarea* and the latter the *Northern Superarea.* The subjoined lists show the characteristic species. The preponderance of Southern Superarea species and the paucity of those common to both superareas are apparent from a glance in these lists.

Species breeding only in the Southern Superarea

Diomedea exulans
Diomedea irrorata
Thalassarche melanophris
Thalassarche bulleri
Thalassarche cauta
Thalassarche culminata
Thalassarche chlororhynchos
Phœbetria palpebrata
Macronectes giganteus
Priocella antarctica
Thalassoica antarctica
Petrella capensis
Halobæna cærulea
Pachyptila vittata
Pagodroma nivea
Bulweria macgillivrayi
Pterodroma axillaris
Pterodroma leucoptera
Pterodroma brevipes
Pterodroma nigripennis
Pterodroma cooki
Pterodroma externa
Pterodroma cervicalis
Pterodroma lessoni
Pterodroma incerta
Pterodroma neglecta
Pterodroma rostrata
Pterodroma magentæ
Pterodroma macroptera
Pterodroma aterrima
Pterodroma solandri
Pterodroma inexpectata
Pterodroma brevirostris
Procellaria æquinoctialis
Procellaria parkinsoni
Priofinus cinereus
Puffinus gravis
Puffinus creatopus
Puffinus gavia
Puffinus carneipes
Puffinus griseus
Puffinus tenuirostris
Puffinus bulleri
?Oceanodroma markhami
Oceanodroma hornbyi
Oceanites oceanicus
Oceanites gracilis
Pealea lineata
Garrodia nereis
Fregetta melanogaster
Fregetta grallaria
Fregetta albigularis
Fregetta mœstissima
Pelecanoides urinatrix
Pelecanoides garnoti

WRANGELL
ALEUTIAN IS
BONIN IS
VOLCANO IS
HARCUS I
WAKE I.
LADRONE IS
MARSHALL IS
CAROLINE IS
PHOENIX IS.
SEYCHELLE IS
CHAGOS ARCH
NEW HEBRIDES
SAMOAN
NEW CALEDONIA
NORFOLK I
KERMADEC
LORD HOWE I
CHATHAM
BOUNTY IS
SHAPES IS
STEWART I
ANTIPODES
AUCKLAND IS
CAMPBELL I
MACQUARIE I
KERGULLEN IS
CROZET IS
PRINCE EDWARDS IS
HEARD I.

BRITISH IS.
AZORES
MADEIRA IS.
SALVAGES
CANARY IS.
BERMUDA IS.
BAHAMA IS.
WEST INDIA IS.
CAPE VERDE IS.
REVILLA GIGEDO IS.
GALAPAGOS IS.
MARQUESAS IS.
PURA PURA I.
TRINIDAD I.
ST. AMBROSIO I.
ST. FELIS I.
MASA TUERA I.
JUAN FERNANDEZ
TRISTAN DA CUNHA IS
GOUGH I.
FALKLAND IS.
SOUTH GEORGIA I.
SANDWICH IS.
BOUVET I.
SOUTH SHETLANDS
SOUTH ORKNEYS
SKETCH CHART
OF THE
OCEANS
HOMOLOGRAPHIC PROJECTION

Species breeding only in the Northern Superarea

Diomedea nigripes
Diomedea albatrus
Diomedea immutabilis
Fulmarus glacialis
Bulweria bulweri
Pterodroma hypoleuca
Pterodroma hasitata
Pterodroma caribbæa
Puffinus kuhli
Puffinus puffinus
Puffinus opisthomelas
Puffinus auricularis
?Puffinus leucomelas
Halocyptena microsoma
Thalassidroma pelagica
Oceanodroma macrodactyla
Oceanodroma leucorhoa
Oceanodroma homochroa
Oceanodroma tristrami
Oceanodroma melania
Oceanodroma furcata

Species breeding in Both Southern and Northern Superareas

Pterodroma phæopygia
Pterodroma mollis
Pterodroma parvirostris
Puffinus obscurus
Puffinus nativitatis
Puffinus chlororhynchus
?Oceanodroma tethys
Oceanodroma castro
Pelagodroma marina

Areas

Three areas are recognized in the Southern Superarea, namely, *Circumpolar Area, Indo-Pacific Area,* and *South Atlantic Area,* and two in the Northern Superarea, namely, *North Pacific Area* and *North Atlantic Area.* The boundaries are necessarily more or less tentative, owing to our imperfect knowledge of the breeding stations of many species.

The *Circumpolar Area* lies chiefly between parallels 78° S. and 40° S., and includes Tristan da Cunha, but not Chatham, South, or Stewart islands, New Zealand, or Tasmania. Its northern boundary coincides well with the isotherm of 15° C. for January. The climatic conditions are Antarctic and sub-Antarctic. The following are apparently characteristic species:

Thalassarche melanophris
Thalassarche bulleri
Thalassarche culminata
Phœbetria palpebrata
Macronectes giganteus
Priocella antarctica
Thalassoica antarctica
Petrella capensis
Halobæna cærulea
Pagodroma nivea
Pterodroma lessoni
Pterodroma brevirostris
Procellaria æquinoctialis
Puffinus gravis
Oceanites oceanicus

The *Indo-Pacific Area* embraces approximately the Indian and Pacific oceans south of the Equator and north of the isotherm of 15° C. for January, including the immediate vicinity of Stewart, South, and Chatham islands, New Zea-

land, and the entire Galapagos Archipelago. Characteristic species appear to be the following:

Diomedea irrorata
Bulweria macgillivrayi
Pterodroma axillaris
Pterodroma leucoptera
Pterodroma brevipes
Pterodroma nigripennis
Pterodroma cooki
Pterodroma externa
Pterodroma cervicalis
Pterodroma rostrata
Pterodroma aterrima
Pterodroma solandri
Pterodroma inexpectata
Procellaria parkinsoni
Puffinus creatopus
Puffinus bulleri
Oceanodroma hornbyi
Oceanites gracilis
Pealea lineata
Fregetta albigularis
Fregetta mœstissima
Pelecanoides garnoti

The *South Atlantic Area* comprises the South Atlantic Ocean north of the isotherm of 15° C. for January. Its characteristic species remain to be determined.

The *North Pacific Area* includes the Indian and Pacific oceans north of the Equator (exclusive of Galapagos waters), and extends through Bering Strait into the Arctic Ocean. The characteristic species are:

Diomedea nigripes
Diomedea albatrus
Diomedea immutabilis
Pterodroma hypoleuca
Puffinus opisthomelas
Puffinus auricularis
?Puffinus leucomelas
Halocyptena microsoma
Oceanodroma macrodactyla
Oceanodroma homochroa
Oceanodroma tristrami
Oceanodroma melania
Oceanodroma furcata

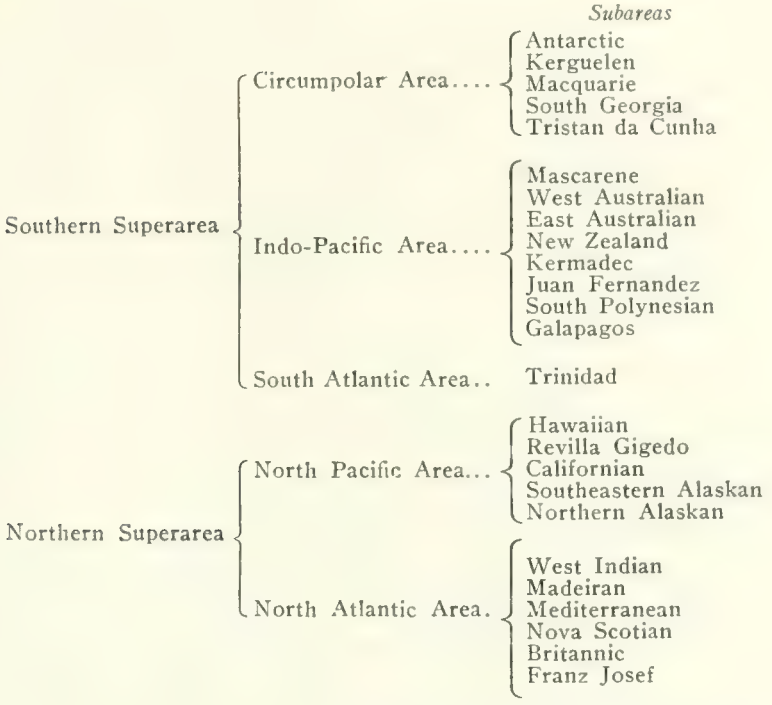
The *North Atlantic Area* covers the North Atlantic Ocean and portions of the Arctic Ocean. The following species are characteristic of this area:

Pterodroma hasitata
Pterodroma caribbæa
Puffinus kuhli
Puffinus puffinus
Thalassidroma pelagica

Fulmarus glacialis, Bulweria bulweri, and *Oceanodroma leucorhoa* are common to the North Pacific and North Atlantic areas.

Subareas

The subjoined synopsis indicates the subareas thus far recognized by me. They are, however, largely tentative, for our knowledge of the breeding stations of many species is still very imperfect.



The *Antarctic Subarea* occupies the region between latitude 78° S. and 60° S., and has a polar climate. The following species are known to breed within its bounds:

Macronectes giganteus
Priocella antarctica
Thalassoica antarctica
Petrella capensis
Pagodroma nivea
Oceanites oceanicus
Fregetta melanogaster

The *Kerguelen Subarea* includes the Kerguelen Group and Heard, Crozet, and Prince Edwards islands. Sub-Antarctic conditions prevail. Breeding species are:

Diomedea exulans
Thalassarche melanophris
Thalassarche culminata
?Thalassarche chlororhynchos
Phœbetria palpebrata
Macronectes giganteus
Petrella capensis
Halobæna cærulea
Pachyptila vittata
Pterodroma lessoni
Pterodroma macroptera
Pterodroma brevirostris
Procellaria æquinoctialis
Oceanites oceanicus
Garrodia nereis
Fregetta melanogaster
Pelecanoides urinatrix

The *Macquarie Subarea* embraces the Macquarie, Campbell, Auckland, Antipodes, Snares, and Bounty islands. The climate is sub-Antarctic, especially in the more southerly islands. The following species breed in this subarea:

Diomedea exulans
Thalassarche melanophris
Thalassarche bulleri
Thalassarche cauta
Thalassarche culminata
Phœbetria palpebrata
Macronectes giganteus
Pachyptila vittata
Pterodroma lessoni
Procellaria æquinoctialis
Priofinus cinereus
Puffinus gavia
Garrodia nereis
Pelagodroma marina
Pelecanoides urinatrix

The *South Georgia Subarea* comprises the sub-Antarctic South Georgia, Falkland, Sandwich, and Bouvet islands. Breeding species are:

Diomedea exulans
Thalassarche melanophris
Phœbetria palpebrata
Macronectes giganteus
?Petrella capensis
Pachyptila vittata
Pagodroma nivea
Procellaria æquinoctialis
Oceanites oceanicus
Garrodia nereis
?Fregetta melanogaster
Pelecanoides urinatrix

The *Tristan da Cunha Subarea* is restricted to the Tristan da Cunha Group and Gough Island, and lies in the zone south of the isotherm of 15° C. for January. The following are said to breed in this subarea:

Diomedea exulans
Thalassarche culminata
?Thalassarche chlororhynchos
Phœbetria palpebrata
Macronectes giganteus
Pachyptila vittata
Pterodroma mollis
Puffinus gravis
Puffinus obscurus
Pelagodroma marina
Pelecanoides urinatrix

The *Mascarene Subarea* consists of the Mascarene, Seychelle, and Chagos archipelagoes. *Pterodroma aterrima, Puffinus obscurus,* and *Puffinus chlororhynchus* breed within its bounds.

The *West Australian Subarea* embraces the north, west, and south coasts of Australia from the Gulf of Carpentaria to Victoria. The following, at least, breed in this subarea:

Pterodroma macroptera
Puffinus obscurus
Puffinus carneipes
Puffinus tenuirostris
Puffinus chlororhynchus
Pelagodroma marina

The *East Australian Subarea* is the complement of the West Australian, embracing Tasmania and the coasts of Vic-

toria, New South Wales, and Queensland. Among its breeding species are:

Thalassarche cauta
Pachyptila vittata
Pterodroma leucoptera
Puffinus tenuirostris
Puffinus chlororhynchus
Pelagodroma marina
Pelecanoides urinatrix

The *New Zealand Subarea* includes North, South, Stewart, and Chatham islands, New Zealand. The breeding species are mainly the following:

Diomedea exulans
Pachyptila vittata
Pterodroma axillaris
Pterodroma cooki
Pterodroma macroptera
Pterodroma inexpectata
Procellaria parkinsoni
Puffinus gavia
Puffinus obscurus
Puffinus carneipes
Puffinus griseus
Garrodia nereis
Pelagodroma marina
Pelecanoides urinatrix

The *Kermadec Subarea* comprises the Kermadec, Norfolk, and Lord Howe islands. Breeding species are:

Pterodroma nigripennis
Pterodroma cervicalis
Pterodroma neglecta
Pterodroma solandri
Puffinus obscurus
Puffinus carneipes
Puffinus chlororhynchus

The *Juan Fernandez Subarea* has within its bounds Juan Fernandez, Masafuera, St. Felix, and St. Ambrosio islands. Breeding species are:

Pterodroma cooki
Pterodroma externa
Pterodroma neglecta
Puffinus creatopus

The *South Polynesian Subarea* comprehends the tropical islands of the central Pacific south of the Equator. Breeding species appear to be:

Bulweria macgillivrayi
Pterodroma brevipes
Pterodroma rostrata
Pterodroma parvirostris
Puffinus obscurus
Puffinus nativitatis
Puffinus chlororhynchus
Pealea lineata
Fregetta albigularis
Fregetta mœstissima

The *Galapagos Subarea* is conterminous with the Galapagos Archipelago. Its breeding species are:

Diomedea irrorata
Pterodroma phæopygia
Puffinus obscurus
Oceanodroma tethys
Oceanodroma castro
Oceanites gracilis

The *Trinidad Subarea* is limited to Trinidad Islet (latitude 20° 30′ S., longitude 29° 15′ W.). *"Pterodroma arminjoniana"* (=*P. neglecta?*) is the only species of Tubinares reported as breeding.

The *Hawaiian Subarea* includes the Hawaiian, Marcus, Volcano, and Bonin islands. It harbors the following breeding species:

Diomedea nigripes
Diomedea immutabilis
Bulweria bulweri
Pterodroma hypoleuca
Pterodroma phæopygia
Puffinus auricularis
Puffinus nativitatis
Puffinus chlororhynchus
Oceanodroma castro
Oceanodroma tristrami

The *Revilla Gigedo Subarea* is coextensive with the Revilla Gigedo Islands. *Puffinus auricularis* and *Puffinus chlororhynchus* breed there.

The *Californian Subarea* comprises the islets off the coast of Lower California and Southern and Middle California. The species known to breed in this subarea are the following:

Puffinus opisthomelas
Halocyptena microsoma
Oceanodroma macrodactyla
Oceanodroma leucorhoa
Oceanodroma homochroa
Oceanodroma melania

The *Southeastern Alaskan Subarea* extends along the coastal islets from Middle California (latitude 41° N.) to the Aleutian Islands. *Oceanodroma leucorhoa* and *Oceanodroma furcata* are the breeding species.

The *Northern Alaskan Subarea* includes the Aleutian Islands and the Bering Sea and Arctic Alaskan islands. The breeding species are:

?Diomedea albatrus
Fulmarus glacialis
Oceanodroma leucorhoa
Oceanodroma furcata

The *West Indian Subarea* consists of the West India and Bermuda islands. *Pterodroma hasitata, Pterodroma caribbæa,* and *Puffinus obscurus* are the breeding species.

The *Madeiran Subarea* embraces the North Atlantic Islands, namely, Cape Verde and Canary archipelagoes, Salvages, Madeira Group, and Azores. Breeding species are:

Bulweria bulweri
Pterodroma mollis
Puffinus kuhli
Puffinus puffinus
Puffinus obscurus
Oceanodroma castro
Pelagodroma marina

The *Mediterranean Subarea* covers the breeding stations of the Mediterranean Sea. Within its bounds breed *Puffinus kuhli, Puffinus puffinus,* and *Thalassidroma pelagica.*

The *Nova Scotian Subarea* reaches northward from Maine and Nova Scotia to southern Greenland. *Oceanodroma leucorhoa* is apparently the sole breeding species.

The *Britannic Subarea* extends from the British Isles and vicinity to the Lofoten Islands, Norway. Within its confines the following species breed:

Fulmarus glacialis	Thalassidroma pelagica
Puffinus puffinus	Oceanodroma leucorhoa

The *Franz Josef Subarea* is confined to the eastern hyperborean breeding stations of *Fulmarus glacialis.*

III

MIGRATION[1]

While the literature of ornithology abounds in references to the albatrosses and petrels as ocean wanderers, but little has been said of them as birds of passage, although they exemplify every cardinal aspect of bird migration, including certain phases that are wanting in birds whose lives are more intimately connected with the land. Some species are apparently stationary, never venturing far from their breeding stations; others perform migrations that stop short of the Equator; others still are transequatorial migrants; others, breeding in the Tropics and subtropics, migrate in a direction not towards, but away from the Equator, breaking all the time-honored book rules for bird migration.

Migration in the Southern Hemisphere

The species of albatrosses and petrels breeding in the Southern Hemisphere far outnumber those breeding in the Northern. Their migration, too, dwarfs the complementary migration of the northern species, and exhibits similar diversity in the direction and extent of the fly-lines. Among the longest are the transequatorial lines of the Sooty Shearwater and among the shortest is the line of the Snowy Petrel of Antarctic regions.[2]

Transequatorial migration has often been misinterpreted. Even within the last three years a well-known writer upon the petrels has hinted that the nesting grounds of the Sooty Shearwaters visiting the ocean off California would ultimately be discovered north of the Equator.[3] The condition of the plum-

[1] Read in part at the thirty-third stated meeting of the American Ornithologists' Union, held in San Francisco, May 18-20, 1915.

My former papers on bird migration were published as follows:

Auk, 1891, v. 8, pp. 50-55; 1892, v. 9, pp. 28-39; 1894, v. 11, pp. 26-39, 94-117.

Proc. Calif. Acad. Sci., 1895, 2d ser., v. 5, pp. 179-210; 1896, v. 6, pp. 2-14; 1900, 3d ser., Zool., v. 2, pp. 278-316; pp. 350-354.

[2] Cf. Wilson, Nat. Antarct. Exp., N. H., v. 2, Aves, pp. 90, 91.

[3] Mathews, Birds Austr., v. 2, p. 98; cf. pp. 14, 90, 103.

In the Ibis for July, 1915, pp. 588, 602, 603, 608, Messrs. Mathews and Iredale state positively that the Sooty Shearwater breeds on Pescadores Islands. Nevertheless, they offer no better evidence than the mere fact that among myriads of these shearwaters occurring in the Northern Hemisphere two individuals, with the base of the bill somewhat denuded of feathers, were taken by a collector from holes during the month of May. It is well known that superannuated sea birds often retreat to the land and that a denuded state of the base of the bill is highly characteristic of such birds.

age and genital organs in these birds proves that they are migrants from the south. On their arrival in spring they are in worn plumage and their genital organs are small. During the succeeding months they undergo a complete and protracted moult, and at the time of the departure of the hosts in autumn they are in fine feather with the genital organs in a high state of erotic development. Furthermore, the period of absence from California waters coincides with the breeding season in the South Temperate Zone. In a former paper I have also dwelt on this phase of bird migration.[1]

The following South Temperate Zone petrels are known to occur regularly in the North Temperate Zone during their exodus-migration:[2] Great Shearwater, Cooper's Shearwater, Flesh-footed Shearwater, Sooty Shearwater, Slender-billed Shearwater, Buller's Shearwater, and Wilson's Petrel. In the same category probably belongs the Mottled Petrel, and perhaps Stejneger's Petrel, for both have been secured in numbers in the North Temperate Zone. The following have been taken there in one or more instances, and may finally prove to be regular migrants from the south with fly-lines that ordinarily fall short of the Tropic of Cancer: Spectacled Albatross, Culminated Albatross, Sooty Albatross, Giant Fulmar, Slender-billed Fulmar, Cape Petrel, Black-tailed Shearwater, Hornby's Petrel, Black-bellied Petrel, and White-bellied Petrel. Such shorter transequatorial migration appears to obtain in the Neglected Petrel, Juan Fernandez Petrel, and Cook's Petrel, all of which have been found more or less numerously on the northeastern Pacific within the Tropics. Parkinson's Petrel reaches Galapagos waters, and may yet be discovered to extend its exodus-migration across the Equator.

Migration confined to the Southern Hemisphere is well exemplified in the Blue Petrel, Antarctic Fulmar, and Snowy Petrel.[3]

In the Galapagos Albatross exodus-migration in a direction not towards, but away from the Equator seemingly prevails.

[1] Proc. Calif. Acad. Sci., 1900, 3d ser., Zool., v. 2, pp. 303-305.

[2] As migration occurs in every month of the year and in breeding birds of both hemispheres, it is apparent that fall and spring migration and southward and northward migration are inadequate terms; hence exodus-migration and return-migration are substituted for them (cf. Proc. Calif. Acad. Sci., 1900, 3d ser., Zool., v. 2, pp. 352-354).

[3] Cf. Mon. Petrels, p. 283; Wilson, Nat. Antarct. Exp., N. H., v. 2, Aves, pp. 83, 90.

MIGRATION IN THE NORTHERN HEMISPHERE

The migratory movements of the Northern Hemisphere species of albatrosses and petrels are counterparts of those occurring in the Southern Hemisphere species. Transequatorial migration is represented in Leach's Petrel, and apparently in the Least Petrel, Storm Petrel, Kuhl's Shearwater, and Manx Shearwater, and migration restricted to the Northern Hemisphere is represented in the Fulmar, and probably in the Short-tailed Albatross. The Ashy Petrel, Black Petrel, and Fork-tailed Petrel have definite migratory movements, but their southern limits have not been reported. After breeding on Lower California islands, Black-vented Shearwaters migrate northward along the coast, some of them as far at least as Vancouver Island, their fly-line thus extending about fifteen hundred nautical miles. Black-footed Albatrosses have an eastward and westward exodus-migration as well as a northern one, the two movements covering the North Pacific area above the Tropic of Cancer. In the Southern Hemisphere the general dispersion of Wandering Albatrosses furnishes somewhat of a parallel.

REMOTE CAUSE OF MIGRATION

Bewildered by the varied migratory movements, the mind is prone to create complications where none exist, and to lose sight of the fact that in each bird, migration is simply an exodus, followed by a return movement to breeding grounds. Migration in one hemisphere is a complement of migration in the other. Exodus-migration in Southern Hemisphere species and return-migration in Northern Hemisphere ones adjust the bird population of the world to southern winter and northern summer, and exodus-migration in Northern Hemisphere species and return-migration in Southern Hemisphere ones adjust the bird population to northern winter and southern summer.

The diversity of the migratory movements evidences that the adjustment of the bird population to the seasons was brought about under stress during a long period of time, the movements in each species being the outcome of a prolonged struggle. Even in the present age the adjustment sometimes

fails. An extraordinary cold wave in a warm temperate region causes great destruction of bird life, suddenly contracting the food area to a degree unprovided for in the ordinary course of migration.[1]

In brief, it is maintained that bird migration is the adjustment of the bird population of the world to the seasons, and that with the unfolding of the seasons came the unfolding of bird migration, the evolution of the seasons being the remote cause of bird migration.[2]

IMMEDIATE CAUSE OF MIGRATION

Food

Immediate failure of food plays an important part in the supplemental movements of exodus-migration.[3] These movements may be due to absolute shortage in the food store in the usual winter quarters, or they may be due to the normal fluctuations of the snow and ice line in the territory where winter and summer contend for the mastery, covering up the food-supply of birds that habitually feed on the ground or in the water, forcing them to retreat to a warmer area and to abide there until the snow and ice recede.[4]

The northward migration of Black-vented Shearwaters, after breeding in the subtropics, can not be attributed to immediate failure of food, for species of similar feeding habits, like Townsend's Shearwater and the Wedge-tailed Shearwater, find abundant food in the ocean area deserted by the Black-vented Shearwaters. Neither is the tropical migration of the Least Petrel to be explained on the score of immediate failure in the food-supply.

Long ago, Gilbert White commented on the early exodus-migration in warm temperate regions. In the letter on the Swift, addressed to Daines Barrington, he says: "But in nothing are swifts more singular than in their early retreat. They retire, as to the main body of them, by the 10th of

[1] Cf. Wayne, Auk, v. 16, pp. 197, 198; Clarke, Studies in Bird Migration, v. 1, p. 167.

[2] Season is here used in an historical and not in an astronomical sense. A glacial period would be a phase of the evolution of the seasons.

[3] Variability in abundance due to deflection in the fly-lines of species that form colonies or are restricted in their distribution to small island-like areas is not to be confounded with supplemental migration—cf. Auk, v. 11, pp. 33-39.

[4] Cold has not been emphasized as a factor in supplemental migration, for the species involved apparently thrive in spite of cold if proper food is plentiful.

August, and sometimes a few days sooner; and every straggler invariably withdraws by the 20th: while their congeners, all of them, stay till the beginning of October, many of them all through that month, and some occasionally to the beginning of November. This early retreat is mysterious and wonderful, since that time is often the sweetest season in the year. But, what is more extraordinary, they begin to retire still earlier in the more southerly parts of Andalusia, where they can be nowise influenced by any defect of heat, or, as one might suppose, defect of food. Are they regulated in their motions with us by a failure of food, or by a propensity to moulting, or by a disposition to rest after so rapid a life, or by what? This is one of those incidents in natural history that not only baffles our researches, but almost eludes our guesses!"[1]

In the Western Hemisphere, Cooper's Shearwater of the Eastern Pacific, the Scarlet Tyrant of Argentina,[2] and the Louisiana Water-Thrush of the South Carolina highlands[3] are typical examples of this early exodus-migration.

Immediate failure of food is obviously not the cause of early exodus-migration in warm temperate regions, for in the later movements in these regions the transients from higher latitudes, in certain species, far outnumber the breeding representatives that had previously taken their departure, evincing that the food-supply had suffered no diminution. In resident species, the replacing of the breeding birds of a locality by individuals of the same species from higher life zones bears directly upon this point.

In the return-migration, it is also apparent that immediate failure of food is not the cause of the evacuation of the warmer areas of either hemisphere. Sooty Shearwaters might linger in force in the North Temperate Zone with the Black-vented Shearwaters if present supply of food alone was concerned.[4]

Viewed in the light of the foregoing facts, it is evident that failure of food is not the immediate cause of a large part of migration.

[1] In this relation, see migration reports Bull. Brit. Orn. Club on the early exodus movements of the Swift.

[2] Cf. Hudson, Argentine Ornithology, v. 1, p. 154.

[3] Auk, v. 9, p. 34.

[4] It is sometimes urged as a cause of return-migration that a special food is required for nestlings, which can be obtained only at the breeding stations. The fallacy of this argument is particularly obvious when applied to transequatorial migration.

Inheritance

In the attempts to explain bird migration, inheritance has often been made to bear the whole burden of the matter. It has even been held that young birds but a few weeks from the nest possess faculties that enable them, without the guidance of their seniors, to perform journeys to definite destinations, in some instances thousands of miles distant. This belief arose from a partial knowledge of the facts of migration, like the belief in transformation and hibernation[1] at an earlier period; it was assumed that the young weak-winged birds that drop out of the ranks migrate alone, arrested migration thus being mistaken for migration. Even at this late day, the magic words, sense of direction, instinct, "inherited but unconscious experience," linger in the literature as answers to the questions: How, and why do birds migrate?

The novel experiments of Dr. John B. Watson with Noddy and Sooty Terns at the Dry Tortugas here demand attention. Dr. Watson sums up the results of his experiments as follows: "I think that these tests are significant. The return from Cape Hatteras is really startling. Cape Hatteras is hundreds of miles outside the range of distribution of the noddy and sooty terns. If my statement that the birds rarely leave the islands for distances greater than 15 knots for purposes of feeding corresponds with the facts, it becomes extremely improbable that they could have formed visual associations throughout such a vast territory as that described in these experiments. While these experiments are not in any way crucial, the facts obtained from them are extremely difficult for current theories of distant orientation to explain."[2]

In penning this paragraph Dr. Watson evidently lost sight of a preceding paragraph in his paper, in which he says: "Nearly all of the statements concerning the habits of these birds, like my own, refer to the nesting season. So far as I know to the contrary, almost nothing is known of their life outside of this period. Many of the reactions during the nesting season could be understood more easily if we knew the complete history of their life-cycle."[3]

[1] Curiously enough, this old belief has recently been given credence; cf. Condor, 1917, pp. 7, 8, 26.
[2] Pap. Tort. Lab. Carn. Inst. Wash., 1908, v. 2, p. 230.
[3] L. c., p. 191.

As is well known to the student of migration, water birds nesting in the Tropics and subtropics are inclined after breeding to invade outlying areas higher in latitude. Examples in other groups than the albatrosses and petrels are found in Xantus's Murrelet, Heermann's Gull, Elegant Tern, and California Brown Pelican. The Sooty Tern has even wandered as far north as Maine. With the North American Continent on the west and the Gulf Stream with its varied phenomena on the east, it would be no great feat for a Sooty Tern to wing its way over familiar waters intervening between Cape Hatteras and the nesting station on the Dry Tortugas.

Since the above was written, Dr. Watson has published another extended paper on the homing of Noddy and Sooty Terns of the Dry Tortugas.[1] As in his first paper, his conclusions are reached without definite data concerning the distribution and movements of these terns after the breeding season, and without any data whatsoever concerning the route followed by the captive birds after their liberation at various remote points on the Gulf of Mexico. The birds were liberated, and some of them arrived at their breeding station. Between these two events no observations were made, and therefore it was not determined what did, or did not, guide the birds in their return passage. The coast-line, the Gulf Stream, the great volume of fresh water that pours into the Gulf of Mexico from the Mississippi and other rivers, the temperature of the surface water inshore and offshore, the trade-winds, and the land- and sea-breezes are a part of the every day life of birds frequenting the Gulf of Mexico, and there is no evidence that these physical phenomena do not direct the birds in their local and migratory movements. Observance of birds actually migrating is the real key to how birds find their way.

The evidence does not warrant the assumption that migratory birds are endowed with extraordinary faculties. The facts show that birds possess in an eminent degree the faculty to remember places and direction, that they have great visual powers, and that they keenly sense slight differences in temperature, and that migratory birds probably have in addition to these heritages an innate desire for travel (*wanderlust*).[2]

[1] Pap. Dept. Mar. Biol. Carn. Inst. Wash., 1915, v. 7, pp. 5-60.
[2] See Proc. Calif. Acad. Sci., 2d ser., v. 6, p. 13, footnote; 3d ser., Zool., v. 2, p. 315.

Thus equipped, a young Black-vented Shearwater reared on Natividad Island, Lower California, would have to learn when and where to go if he took part in the exodus-migration leading northward to the latitude of Vancouver Island, British Columbia. Return-migration would be a simpler task, for the young shearwater would have less to learn.

Some writers, clouding the issue, have separated return-migration from exodus-migration, and have held that desire for procreation and special physiological demands as to temperature during reproduction are paramount causes. Desire for procreation does not prompt sedentary species to migration; nor does a waning desire prompt birds-of-the-year to exodus-migration; nor do special temperature requirements prompt the transequatorial migrants that leave regions having a temperature similar to the temperature at the breeding stations. Above and behind the alleged physiological incentives are paramount causes. Without previous experience, the young Sooty Shearwater performs an exodus-migration to the North Temperate Zone and a return-migration to the South Temperate Zone.

It is not in return-migration, but in exodus-migration in a direction opposite to the Equator, in early exodus-migration in warm temperate regions, and in transequatorial migration that we find the supreme test for all explanations of the cause of bird migration.

Education

Guidance by Old Birds.—Arrested migration has been the chief stumbling-block in the way of philosophers who have sought to interpret bird migration. Most reports on migration relate not to migrating birds, but to birds that have halted by the way. No real conception of migratory movements can be gained unless the birds are observed actually *in transitu*. Viewing arrested exodus-migration from very different bird-watching stations, some have reached the conclusion that the young-of-the-year migrate earlier than the adults, and others that the adults migrate earlier than the young-of-the-year.[1] When

[1] Cf. Gätke, Heligoland as an Ornithological Observatory, 1895, p. 102; Stone, Proc. Acad. Nat. Sci. Phila., 1896, p. 110; Dwight, Ann. N. Y. Acad. Sci., 1900, v. 13, pp. 127, 129; Clarke, Studies in Bird Migration, 1912, v. 1, pp. 26, 142, 196, 308, v. 2, p. 55.

migration is studied on the ocean, the cause of these diametrically opposite conclusions is apparent, for upon the ocean the veil is removed and birds are seen in the act of migrating.[1] Extensive migratory movements of old and young birds occur in broad daylight at a slight elevation above the surface of the water. Young birds, weak of wing, drop out of such movements in the exodus-migration, and are often the first birds seen by the observer stationed on or near the land, the offshore flights wholly escaping notice. It is held, therefore, that the preponderance of young-of-the-year, early or late in the exodus-migration, merely evidences that they have stopped by the way, and will later join experienced travelers and resume the journey.[2]

Guidance by Physical Phenomena.—The series of observations made by myself on the ocean in the vicinity of Point Pinos, California, demonstrate that the shearwaters passing that headland in the return-migration are guided in their course by the landmarks.[3] Repeated observations showed that the low fogs deflected their migratory movements toward the land, and when the land as well as the sea was hidden by the fog the migratory hosts became bewildered and lost their way, and when the fog lifted and the landmarks became visible again they immediately resumed their journey, manifesting that they were not endowed with a mysterious sense of direction, but were dependent upon physical phenomena for guidance.[4] The last link in the chain of evidence proving guidance by physical phenomena will be forged when return-migration to breeding stations on islands remote from continents has been studied by a trained student of migration. In the meantime there is no valid justification for lapsing into superstition under the guise of science. We know that the oceans have areas of abundant food where birds are numerous and areas

[1] See my migration papers in Proc. Calif. Acad. Sci.; cf. Clarke, Studies in Bird Migration, v. 2, pp. 6, 11-15; Patten, Zoologist, 1913, pp. 189, 190.

[2] It should be borne in mind that the latitudinal limit of the range of a species is not necessarily the longitudinal limit of its fly-line, and that the mere presence of the young near the upper limit of the breeding range is far from being conclusive proof that the young were reared in the locality.

[3] Consult my detailed account, Proc. Calif. Acad. Sci., 3d ser., Zool., v. 2, particularly pp. 281, 284, 285, 307-309.

[4] In the vicinage of Point Pinos, breeding cormorants, fishing offshore, had no difficulty in finding their way through the fog back to their rookeries, nor did my boatman experience any difficulty in finding his way through the fog from the ocean to Monterey; both had kept their bearings. The shearwaters migrating down the coast, however, had no opportunity of determining their position by local landmarks, and in consequence lost their way. In this connection, see Cooke, Bull. No. 185, U. S. Dept. Agric., pp. 27-29.

where food is wanting and birds absent, and we know that there are prevailing ocean and air currents. It is in these currents, I believe, that we shall find the chief physical phenomena guiding birds in their return-migration to islands remote from continental areas, on the ocean prevailing water and air conditions supplementing landmarks. It is a significant fact that the southern limit of the Black-footed Albatross's range coincides well with the northern limits of the northeast trade-winds.[1]

In accordance with the facts set forth above, it is asserted that the example[2] of the adults would suffice to teach the way to a young Black-vented Shearwater, or Black-footed Albatross, imbued with a desire for travel and keenly alive to physical phenomena; migration being the result of individual experience, at most only the tendency to migration being inherited.

Habit

After the way had been learned by the bird-of-the-year and a probable innate desire for travel had developed into migration, the habit of migration would be formed and become second nature in each bird, holding it true to time and place.

The force of habit is thus succinctly stated by Dr. C. Lloyd Morgan: "In its early days the developing animal is reading the paragraph of life. Every sentence mastered is built into the tissue of experience, and leaves its impress on the plastic, yet retentive brain. By dint of repetition, the results of acquisition become more and more firmly ingrained. Habits are generated; and habit becomes second nature. The organism which to begin with was a creature of congenital impulse and reaction becomes more and more a creature of acquired habits. It is a new being, but one with needs not less imperious than those with which it was congenitally endowed."[3]

[1] See part VI, also Barrett-Hamilton, Ibis, 1903, p. 320, and Salvin, Voy. Chall., Zool., v. 2, pt. 8, p. 147.

Furthermore, winds prevailing for the time being may afford a means of guidance to low-flying migrants journeying across narrow seas; cf. Clarke, Studies in Bird Migration, v. 1, pp. 172, 173, 176-178, v. 2, pp. 12, 28, 29.

[2] In some instances, at least, direct leadership seems to be exercised. In a former paper (Proc. Calif. Acad. Sci., 2d ser., v. 5, p. 198) I cited an instance where a Sooty Shearwater apparently ordered a flank movement in a whole column of Sooty Shearwaters. The intelligence of migrants, I believe, is generally much underrated; in supplemental movements, at least, there appears to be an appreciation of the necessity for migration.

[3] Nature, 1898, v. 57, p. 329.

Summary of Conclusions

It is maintained:

1. That bird migration had its origin in the evolution of the seasons, and that it is now the adjustment of the bird population of the world to the seasons.

2. That a large part of migration occurs independently of an immediate failure of food; that inheritance involves at most an innate desire for travel; that the young learn to migrate through the example of the adults; that the adults are guided by physical phenomena over areas that experience has rendered familiar; that migration in its finality becomes in each bird an impelling habit: *therefore, a bird that has passed the stage of dependency migrates because it was born of a race of migrants, and has followed the example of its elders until migration has become second nature.*

In short, it is contended that the causes of bird migration are ascertainable facts and not impenetrable mysteries lying beyond the domain of scientific enquiry.

IV

VARIATION

AGE AND SEASONAL VARIATION

Natal Down.—Mr. Pycraft has described at some length the double natal down occurring in the Tubinares.[1] He designates the outer segment the protoptyle generation and the inner segment the mesoptyle generation. As alternative names, I suggest primary natal down and secondary natal down. The following diagram emphasizes these distinctions:

Natal down or neossoptyles { Primary natal down or protoptyles / Secondary natal down or mesoptyles

The specimens in double natal down examined by me belong to fifteen species, namely, Black-footed Albatross, Galapagos Albatross, Laysan Albatross, White-breasted Petrel, Sunday Island Petrel, Black-vented Shearwater, Townsend's Shearwater, Dusky Shearwater, Guadalupe Petrel, Harcourt's Petrel, Leach's Petrel, Ashy Petrel, Black Petrel, Fork-tailed Petrel, Garnot's Diving Petrel.

Mr. Pycraft's statement that it is extremely difficult to distinguish the two generations of natal down in the albatrosses[2] is not corroborated in the three albatrosses mentioned above, the generations being well defined in each of them.

If the primary and secondary natal down are not concolor, the wearing off of the primary natal down changes the color aspect of the nestling.

Postnatal Plumages.—In certain species of Tubinares the juvenal plumage[3] is similar in color to the adult one, as in the Sunday Island Petrel; in certain other species the color of these plumages differs widely, as in the Short-tailed Albatross. Much remains to be learned in this group respecting the stages of plumage in the progress to maturity.

Moult.—So far as I am aware, the moult of the Tubinares has received but casual attention from ornithologists, Dr. Dwight, the leading American authority on the moult of birds, and other moult specialists having confined their investigations

[1] Godman's Mon. Petrels, pp. xvii, xviii.
[2] Godman's Mon. Petrels, p. xviii.
[3] In part, I have followed Dr. Dwight's terminology of plumages and moults.

to different orders. In the preparation of part VI of the present paper, I have studied the moult in over two thousand specimens of albatrosses and petrels. This series, however, was collected without reference to moult, and in consequence is deficient in many respects. Specimens taken from day to day and studied in the flesh would have yielded far better results.

In some species at least, the postnuptial moult of the Tubinares begins before the birds leave their nesting grounds, as in the Galapagos Albatross and Townsend's Shearwater. Of the duration of this moult in individuals, I have no definite information, but in certain species, as in the Sooty Shearwater, I have found it protracted over most, if not all, of the year. Throughout its course very different stages are manifested in specimens of the same species taken on the same day. This diversity is accounted for in part by the fact that the individuals of Tubinarine species differ to a greater or less extent in the time of their breeding, even in temperate regions. As no two birds are exactly alike, it is self-evident that moulting in any species must vary more or less in different individuals independent of their age, the state of their health, or the time of their breeding.

Owing to the protraction of the postnuptial moult period, I have been unable to determine positively from the material at my command whether there occurs or not a limited prenuptial or a deferred limited postjuvenal moult. It is apparent that the Tubinares offer a most inviting field for moult study.

Wear of Plumage.—The changes wrought by fading and abrasion are so great in the Tubinares that the descriptions of certain species are incomplete unless they describe both worn and fresh plumages. Through wear, deep brown becomes decidedly paler, as in the Antarctic Fulmar[1]; dark gray browns, as in the Sooty Shearwater; washing or frosting vanishes, unvailing a darker color, as in Cook's Petrel; blooms fade, as in the storm petrels; light tips are lost, causing uniformity in coloration, as in the Mottled Petrel; dark tips disappear, sometimes exposing basal white and enlarging white areas, as in the Black-footed Albatross. Even before the postnuptial moult ends, the destructive changes in the new plumage are apparent, as in Cooper's Shearwater. Obviously, specimens taken at

[1] Wilson, Nat. Antarct. Exp., N. H., v. 2, Aves, p. 83.

breeding stations can not be relied upon implicitly to furnish typical examples of geographic or other variations in color.

Bill.—There is considerable variation in the size and proportions of the bill in certain species of Tubinares. In part it appears to be caused by age, as in the Black-footed Albatross and Short-tailed Albatross. Whether the bill variations in the breeding specimens of the Galapagos Albatross, described in part VI, are due to age or to individual variation is not clear. The color of the bill, too, varies with age in some species. Our knowledge on this point, however, is very deficient, and information regarding it is greatly to be desired, especially in the genus *Thalassarche*.

Sexual and Individual Variation

The sexes in the Tubinares are alike in the color of their plumage, so far as I have ascertained, but differ in certain species in size; for example, the dimensions of the females average somewhat less than those of the males in the Black-footed Albatross, Short-tailed Albatross, and Fulmar.

In parts V and VI numerous instances of apparent individual variation in the color, form, and size of the Tubinares are commented upon. The variation in size is so great that many species overlap in their dimensions. A specially notable example of variation in form occurs in Cooper's Shearwater; the tarsus is not invariably compressed and sharp in front, an alleged generic character thus proving inconstant. A common variation in color is the intrusion of white in dark areas and of a dark color in white areas.

In some cases, owing to lack of proper specimens, I am unable to distinguish individual from dichromatic and age variation, as in the extension of the color of the sides of the neck across the jugulum in numerous specimens of the Dark-rumped Petrel and in the variability in the relative length of the first primary in the Christmas Island Shearwater. Because of the difficulty in determining maturity, it is a question whether age variation in birds is not sometimes mistaken for individual variation.

As shown in the subjoined table, supernumerary rectrices are perhaps not so exceptional as to justify their classification under abnormal instead of individual variation.

No.	Sex	Species	No. of Rectrices
C. A. S.			
1288	♂	*Diomedea nigripes*	Fourteen
1237	♀	*Diomedea irrorata*	Thirteen
1003	♂	*Pterodroma phæopygia*	Thirteen
1004	♂	" "	Fourteen
1138	♂	*Pterodroma inexpectata*	Thirteen
9308	♂	*Puffinus creatopus*	Thirteen
854	♂	*Puffinus obscurus*	Fourteen
9577	♂	*Puffinus griseus*	Thirteen
9743	♂	*Puffinus tenuirostris*	Fourteen
Univ. Calif.			
18682	♂	*Puffinus bulleri*	Fourteen
18685	♂	" "	Thirteen

Dichromatism

Dual coloration is a dominant condition in many Tubinares. In the nestling of the Galapagos Albatross (see plates 9, 10, 11 and description in part VI), in the Giant Fulmar, Fulmar, Short-footed Petrel, Neglected Petrel, and Wedge-tailed Shearwater the bicoloration has been proven to be dichromatic. In the following species, dwelt upon at length in parts V and VI, the character of the variation remains to be fully determined: Wandering Albatross, Sooty Albatross, Cape Petrel, Dark-rumped Petrel, Downy Petrel, Cooper's Shearwater, Manx Shearwater, Black-vented Shearwater, Forster's Shearwater, Dusky Shearwater, Sooty Shearwater, Slender-billed Shearwater, Leach's Petrel (including "Kaeding's" and "Socorro" petrels), White-bellied Petrel, and Diving Petrel. The status of the Caribbean Petrel is also in question.

Long ago it was pointed out by Dr. Stejneger[1] that there exists a difference in the geographic range of the light and dark phases of the Fulmar during the breeding season. There is also a geographic distribution in the phases of the Wedge-tailed Shearwater. In the Hawaiian Archipelago the light phase prevails almost exclusively, but on San Benedicto Island, Revilla Gigedo Group, only a minority are of the light phase. The light phase of the Red-footed Booby, on the contrary, is the dominant form in the Revilla Gigedo Group, and on the Galapagos Islands the dark phase is in the ascendency. Fur-

[1] Bull. U. S. Nat. Mus. No. 29, 1885, p. 93.

thermore, the Wedge-tailed Shearwater appears to be represented only by the dark phase on the Kermadec Islands. According to Dr. Edward A. Wilson, the percentage of Giant Fulmars of the light phase increases with the latitude, the greatest number being observed where the ice conditions are persistent.[1] It is evident that the geographic distribution of the light and dark phases of the Tubinares is independent of climatic conditions.

In part VI I have described an instance of complete melanism in the Black-vented Shearwater. This specimen and extreme white specimens of the same species have an appearance similar to that of the light and dark phases of the Wedge-tailed Shearwater (plates 15, 17). If such sporadic melanism, through the virility of an individual, persisted on an island, at the outset there might be a melanism restricted to relatively few individuals, as in the dichromatism of the Wedge-tailed Shearwater in the Hawaiian Archipelago. Later, if the melanistic phase largely swamped the light phase, the result might be as in the Wedge-tailed Shearwater on San Benedicto Island. Ultimately, if the melanistic phase supplanted the light phase, the situation might be like that in the Wedge-tailed Shearwater on the Kermadec Islands. In brief, if sporadic melanism became an inherited character, there would result a persistent melanism, or dichromatism.

Geographic Variation

The isolation of the Tubinares at the breeding stations favors colony peculiarities; for example, in the dark phase of the Wedge-tailed Shearwater breeding on the Kermadec Islands the bill is generally grosser than in the dark phase of this species breeding on San Benedicto Island, Revilla Gigedo Group. According to the tables of measurements in part VI, the "Socorro Petrels" of the Los Coronados Islands, Lower California, average greater in their dimensions than the "Socorro Petrels" of the San Benito Islands, about 250 nautical miles to the southward. In the shearwater, and perhaps in the storm petrel, the geographic variation is overshadowed by dichromatic variation. The Dark-rumped Petrel in the Gala-

[1] Nat. Antarct. Exp., N. H., v. 2, Aves, p. 96.

pagos and Hawaiian archipelagoes apparently exemplifies geographic variation in both color and size. As of other variations in the Tubinares, our knowledge of geographic variation is far from being complete, and all the facts respecting its extent will not be known until series of specimens from all the breeding stations of each species have been thoroughly studied.

Recent systematists appear to be unaware of the wide range of variation existing in the species of the Tubinares and have considerably augmented the synonymy of the group by mistaking unstable for stable characters.

V

CLASSIFICATION AND NOMENCLATURE

General Observations

Species.—Bird species are realities, not concepts, and their identification is not in any way dependent upon a knowledge of their distribution. A bird species presents a peculiar assemblage of characters that separates it from all other bird species as absolutely as one island is separated from all other islands. A bird species may vary but little, as the Laysan Albatross, or it may have a wide range of variation, as the Wedge-tailed Shearwater; for it is not degree of variation, but absence of intergradation that gives specific value to characters.

Groups of Species.—In nature, groups of bird species abound, but there is not sufficient coördination among them to permit any arrangement that is not largely arbitrary. Under such conditions, it is not surprising that systems have multiplied, and that there exists to-day much diversity of opinion respecting taxonomic values. These points are well illustrated in the following schemes of classification of the albatrosses, petrels, and diving petrels:

Mr. Evans (*Cambridge Natural History*, Vol. IX; essentially Dr. Gadow's Scheme in Bronn's *Thier-Reichs*)

Order Procellariiformes Suborder Tubinares Procellariidæ { Diomedeinæ; Oceanitinæ; Procellariinæ; Pelecanoïdinæ }

Mr. Salvin (Monographs of Mr. Salvin and Dr. Godman)

Order Tubinares { Procellariidæ { Procellariinæ; Oceanitinæ }; Puffinidæ { Puffininæ; Fulmarinæ }; Pelecanoididæ; Diomedeidæ }

Dr. Coues (*Auk*, 1897, p. 314)

Order Tubinares
- Diomedeidæ
- Procellariidæ
  - Fulmarinæ
  - Puffininæ
  - Procellariinæ [=Thalassidrominæ]
  - Oceanitinæ
- Pelecanoididæ

Dr. Coues's classification of these higher groups appears to me to be the most satisfactory, and I have therefore adopted it in the present paper. It is well to recall that Dr. Schlegel treated[1] the albatrosses, petrels, and diving petrels as three genera, designating them respectively, *Diomedea, Procellaria,* and *Halodroma.*

In genera, I have followed, with one exception (*Thalassogeron*), the conventional genera of the monographs of Mr. Salvin and Dr. Godman. I feel, however, that too many have been recognized, especially monotypic ones founded on minor structural characters of species. Subgenera are given no place whatsoever. Where convenience ceases in a classification that is largely arbitrary, it is maintained that no vantage ground is gained by burdening the memory with a multitude of minor divisions and subdivisions.

While I believe that both superficial and deep-seated characters should be utilized in the definition of higher bird groups, I heartily agree with Dr. Reichenow[2] that the genealogy of birds is a subject to be considered apart from bird classification.

The Subspecies Question.—In theory, subspecies are incipient species; in fact, subspecies are attempts to forecast the future of geographic variation, which no one can foresee. Naturally, much difference of opinion has arisen in the application of the subspecies theory. Some ornithologists would differentiate all discernible geographic variation into subspecies; others would make selections and have "practical subspecies." Under the first method the separations become so fine that even typical examples can scarcely be determined.

[1] Mus. Pays-Bas, v. 6, Procell., 1863, pp. 39, 40.
[2] Die Vögel, v. 1.

Under the second method the separations rest largely on the shifting sands of individual opinion. It is obvious that the subspecies theory has complicated, not simplified, the study of birds. Nevertheless, the theory has served a highly useful purpose; it has revealed to ornithologists geographic variation, which is a variation within the limits of the species. In the present paper geographic variation is considered in connection with the other variations of species, the subspecies theory being discarded as a theory that has outlived its usefulness.[1]

Systematic Account

In the succeeding pages the sequence of the species has been considerably changed from that followed by Mr. Salvin and Dr. Godman in their monographs, but it still remains largely provisional. Departures have also been made from the nomenclature employed by these authors, particularly in names where the law of priority was not enforced. Furthermore, numerous names of supposed species recognized by Dr. Godman have been consigned to synonymy. In certain doubtful cases, names have been put in limbo with a query, as the surest means of hastening a final decision as to their standing.

In the analytical keys to the species I have employed structural characters wherever available, thus avoiding repetition by eliminating color variations. I am reminded by long experience as a student of ornithology that artificial keys to birds often fail to unlock. Much care has been bestowed on the present keys, but in some of the species I have been hampered in the determination of distinguishing characters by lack of specimens; in consequence the keys must be regarded, in a measure, as tentative.

In part VI will be found the synonymy and comments on nomenclature of the species that are mentioned only by name in the present part. The synonymy relates to the monographs of Dr. Coues, Mr. Salvin, and Dr. Godman.

With the exception of the few diving petrels, all of the specimens were measured by Mr. Edward Winslow Gifford. The method of measurement is described in detail in the foreword of part VI.

[1] Cf. Auk, 1903, v. 20, pp. 294–299.

TUBINARES: TUBE-NOSED SWIMMERS

Key to the Families

Nasal tubes not united, separated by culmen.....**Diomedeidæ**
Nasal tubes united, not separated by culmen
Tubes horizontal, or nearly so.....**Procellariidæ**
Tubes vertical .....**Pelecanoididæ**

DIOMEDEIDÆ: ALBATROSSES

Key to the Species

Tail rounded and ramicorn without longitudinal groove
Latericorn not decidedly widest at base and upper mandible not compressed at base
Feathers at base of lower mandible extending beyond base of nasal tubes .....*Diomedea exulans*
Feathers at base of lower mandible not extending beyond base of nasal tubes
Cervix dark
Bill dark .....*D. nigripes*
Bill light .....*D. albatrus* (young)
Cervix not dark, being yellow, or white more or less tinged with yellow
Lores not dark
Breast and abdomen white.....*D. albatrus* (old)
Breast and abdomen closely vermiculated with gray or brown and white .....*D. irrorata*
Lores dark
Lower parts white .....*D. immutabilis*
Latericorn decidedly widest at base and upper mandible compressed at base
Culminicorn and latericorn not separated basally by membrane .....*Thalassarche melanophris*
Culminicorn and latericorn separated basally by membrane
Basal width of latericorn less than one and a half times basal width of culminicorn .....*T. bulleri*
Basal width of latericorn more than one and a half times basal width of culminicorn
Culminicorn rounded basally
Latericorn light .....*T. cauta*
Latericorn dark .....*T. culminata*
Culminicorn pointed basally.....*T. chlororhynchos*
Tail wedge-shaped and ramicorn with longitudinal groove.....
.....*Phœbetria palpebrata*

Diomedea exulans *Linnæus:* WANDERING ALBATROSS

COUES—*Diomedea exulans*, V, 175, 187.
SALVIN—*Diomedea exulans*, 440, 441; *Diomedea regia*, 440, 443; *Diomedea chionoptera*, 440, 443.
GODMAN—*Diomedea exulans*, liii, 309, pl. 89; *Diomedea regia*, liii, 319, pl. 90; *Diomedea chionoptera*, liii, 322, pl. 91.

Mr. Salvin has interpreted an extreme white phase, long attributed to *Diomedea exulans*, to be an undescribed species,

christening it *"Diomedea chionoptera."*[1] An albatross (No. 11342) in the Academy's collection, obtained from a French sailor on the bark *Guerveur* and said by him to have been captured during January, 1908, in latitude 48° S., longitude 50° W., agrees with Mr. Salvin's description of *"D. chionoptera,"* save in the coloration of the back, which is not free from faint vermiculations. This specimen also has irregular traces of gray on the tail, evidencing that it is not in the highest plumage; being merely in a transitional stage. Another specimen (No. 11341 C. A. S.) from the same locality has the appearance of an immature bird. The crown is heavily clouded with sooty brown, the hind neck is obscurely vermiculated, the back is distinctly vermiculated, and the white of the inner webs of the primaries is concealed. No. 15548 U. S. Nat. Mus. is intermediate between the two Academy specimens, the three examples forming a succession terminating in the high *"D. chionoptera"* plumage.

No. 11341: Wing 670 mm.; tail 207; culmen 160; depth of upper mandible 41.5; width of upper mandible 40.6; tarsus 108; middle toe and claw 158.

No. 11342: Wing 670 mm.; tail 215; culmen 167; depth of upper mandible 42.3; width of upper mandible 44.8; middle toe and claw 169.

In supporting the claim of *"D. chionoptera"* for recognition, Dr. Godman infers that the nestlings of *"D. chionoptera"* are white and that those of *D. exulans* are gray.[2] The adults being indistinguishable, such a condition would prove only that a dichromatism exists in the young, as in *Diomedea irrorata.*

Diomedea regia Buller is also considered to be a mere variation. The characters propounded for the supposed adult are fairly midway between those Mr. Salvin assigns to *D. exulans* and to *"D. chionoptera."*

The explanation of the diverse plumages of *Diomedea exulans,* I believe, is to be found in dichromatism and age variation, there being a dark phase and a light phase which coalesce in maturity, somewhat as in *Diomedea irrorata.*

Recently Mr. Gregory M. Mathews has revived *Diomedæa epomophora* Lesson, relegating to its synonymy *Diomedea*

[1] Monograph, p. 443.
[2] Cf. Mon. Petrels, pp. 310, 315, 319, 320, 325.

regia Buller, and dilating on the shape of the bill as a diagnostic character.[1] The extensive series now under review show that the individuals of Tubinarine species are subject to much variation in the form and size of the bill.

A later candidate for recognition is *Diomedea sanfordi* Murphy,[2] separated from *D. exulans* on the basis of variation in one specimen. Especial value is attached to the shape of the nasal tubes. This character, however, is a highly variable one in the *Diomedeæ*.

Diomedea nigripes *Audubon:* BLACK-FOOTED ALBATROSS

Diomedea albatrus *Pallas:* SHORT-TAILED ALBATROSS

Diomedea irrorata *Salvin:* GALAPAGOS ALBATROSS

Diomedea immutabilis *Rothschild:* LAYSAN ALBATROSS

Thalassarche melanophris[3] (*Temminck*): SPECTACLED ALBATROSS

COUES—*Diomedea melanophrys,* V, 181, 188; *Diomedea Gilliana,* V, 181, 188.
SALVIN—*Diomedea melanophrys,* 441, 447.
GODMAN—*Diomedea melanophrys,* liv, 339, pl. 97; (?) *Diomedea platei,* liv, 346, pl. 98A.

As indicated in the Key to the Species, the basal width of the latericorn and that of the upper mandible divide the rounded-tailed albatrosses into two distinct groups, and these I have recognized as genera.[4] By this arrangement, *Thalassarche* Reichenbach becomes available as the name of the second genus of the family, *Thalassogeron* Ridgway sinking into a synonym.

I am of the opinion that *Diomedea platei* Reichenow is the young of *T. melanophris.* In the albatrosses much remains to

[1] Birds Austr., v. 2, p. 259.
[2] Bull. Amer. Mus. Nat. Hist., 1917, v. 37, pp. 861–864.
[3] "*Diomedea melanophris* 'Boies' is Temminck's original spelling in the Planches Col., Vol. v, 1838 (livraison 77, April, 1828), text to pl. 456, but it is '*melanophrys*' on p. 103 of Tabl. Méth. (1838) of the same work."—Dr. Richmond in letter.
[4] In this connection, see Coues, monograph, V, p. 174; Giglioli, Fauna Vertebr. Oceano, pp. 49, 56-59; Godman, Mon. Petrels, pp. lii, 354; Mathews, Birds Austr., v. 2, pp. 264-266.

be learned respecting the plumage and bill coloration during the progress towards maturity.

Thalassarche bulleri (*Rothschild*): BULLER'S ALBATROSS

SALVIN—*Diomedea bulleri*, 441, 448.
GODMAN—*Diomedea bulleri*, liv, 344, pl. 98.

In the four specimens of *T. bulleri* under examination, the culminicorn is separated basally from the latericorn by a membrane that is wider than the membrane in some specimens of *T. cauta*. At the frontal feathers, however, the membrane in *T. bulleri* is very narrow, at most being scarcely more than a line.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24376 [1]	Otago, N. Z..	♂	512	202	120	32	28.5	79	119
24377 [1]	" " ..	♂	510	198	122	29	28	81	121
24378 [1]	" " ..	♀	503	187	118	28.3	26	75	110
18170	New Zealand.	—	520	198	120	28	26.5	77.8	114

Thalassarche cauta (*Gould*): SHY ALBATROSS

COUES—*Diomedea cauta*, V, 183, 188.
SALVIN—*Thalassogeron cautus*, 449; *Thalassogeron salvini*, 449, 450; *Thalassogeron layardi*, 449, 450.
GODMAN—*Thalassogeron cautus*, liv, 348, pl. 99; *Thalassogeron salvini*, lv, 351, pl. 100; *Thalassogeron layardi*, liv, 353.

The characters attributed to *Thalassogeron salvini* Rothschild and *Thalassogeron layardi* Salvin appear to be merely variations occurring within the bounds of *T. cauta*.[2]

MEASUREMENTS (in millimeters)

No. (Carnegie Museum)	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24380	Otago, N. Z..	♂	580	226	132	32.5	32	86	133
24381	" " ..	♂	570	223	122	29	30	80	123
24379	" " ..	♀	570	228	125	32.6	32.6	84	124
24382	" " ..	♀	570	210	121	28	29	75	120
24383	" " ..	♀	550	205	129	30	27.6	82	132

[1] Carnegie Museum.
[2] Cf. Godman, Mon. Petrels, p. 353; Mathews, Birds Austr., v. 2, p. 293.

Thalassarche culminata (*Gould*): CULMINATED ALBATROSS

Thalassarche chlororhynchos (*Gmelin*): YELLOW-NOSED ALBATROSS

COUES—*Diomedea chlororhyncha*, V, 184, 188; *Diomedea olivaceirostris*, V, 186, 188.
SALVIN—*Thalassogeron chlororhynchus*, 449, 451.
GODMAN—*Thalassogeron chlororhynchus*, liv, 357, pl. 102; *Thalassogeron carteri*, lv, 361, pl. 102A.

Thalassogeron carteri Rothschild is apparently based upon an immature stage of *T. chlororhynchos*.[1]

Phœbetria palpebrata (*J. R. Forster*): SOOTY ALBATROSS

PROCELLARIIDÆ: FULMARS, PRIONS, SHEARWATERS, AND PETRELS

Key to the Subfamilies

Tail not forked, chord of wing not under 5.75 in. (146 mm.), and tarsus not longer than middle toe and claw
  Lower mandible not hooked at end, or if hooked, inside of edge of upper mandible lamellate ..... **Fulmarinæ**
  Lower mandible hooked at end and inside of edge of upper mandible not lamellate ..... **Puffininæ**
Tail not forked and chord of wing under 5.75 in. (146 mm.); or tail forked; or tarsus decidedly longer than middle toe and claw
  Tarsus not twice length of femur, and basal joint of middle toe shorter than the next two joints ..... **Thalassidrominæ**
  Tarsus fully twice length of femur, and basal joint of middle toe not shorter than the next two joints ..... **Oceanitinæ**

FULMARINÆ: FULMARS AND PRIONS

Key to the Species

Wing not under 16 in. (406 mm.) ..... *Macronectes giganteus*
Wing under 16 in. (406 mm.)
  Inside of edge of upper mandible without lamellæ
    Nasal tubes separated from unguis by a space much less than half the length of the nasal tubes ..... *Fulmarus glacialis*
    Nasal tubes separated from unguis by a space much more than half the length of the nasal tubes
      Bill not depressed and lateral outline not convex from base to unguis
        Head extensively white ..... *Priocella antarctica*
        Head dark ..... *Thalassoica antarctica*
      Bill depressed, except terminally, and lateral outline convex from base to unguis ..... *Petrella capensis*
  Inside of edge of upper mandible with lamellæ, at least basally
    Tail slightly rounded, white at tip ..... *Halobæna cærulea*
    Tail more or less wedge-shaped, dark at tip ..... *Pachyptila vittata*

[1] Cf. Godman, Mon. Petrels, pp. 361, 362; Mathews, Birds Austr., v. 2, pp. 287, 288; Salvadori, Ibis, 1914, p. 504.

Macronectes giganteus (*Gmelin*): Giant Fulmar

Fulmarus glacialis (*Linnæus*): Fulmar

Priocella antarctica (*Stephens*): Slender-billed Fulmar

Thalassoica antarctica (*Gmelin*): Antarctic Fulmar

Coues—*Thalassoica antarctica*, III, 31, V, 192.
Salvin—*Thalassœca antarctica*, 392.
Godman—*Thalassœca antarctica*, xliii, 161, pl. 42.

Petrella capensis (*Linnæus*): Cape Petrel; Pintado Petrel

Halobæna cærulea (*Gmelin*): Blue Petrel

Coues—*Halobæna cærulea*, IV, 163, 171.
Salvin—*Halobæna cærulea*, 431.
Godman—*Halobæna cærulea*, I, 281, pl. 81.

The description fails to show that *Halobaena murphyi* Brooks[1] signifies more than a variation in the size and form of the bill in *Halobœna cœrulea*.

Pachyptila vittata (*Gmelin*): Prion

Coues—*Æstrelata desolata*, IV, 155, 171, in part; *Pseudoprion Banksii*, IV, 166, 172; *Pseudoprion turtur*, IV, 166, 172; *Pseudoprion ariel*, IV, 166, 172; *Pseudoprion brevirostris*, IV, 167; *Prion vittatus*, IV, 169, 172.
Salvin—*Prion vittatus*, 432; *Prion banksi*, 432, 434; *Prion desolatus*, 432, 434; *Prion ariel*, 432, 436.
Godman—*Prion vittatus*, li, 285, pl. 82; *Prion banksi*, li, 289, pl. 83; *Prion desolatus*, li, 293, pl. 84; *Prion brevirostris*, li, 297, pl. 85.

I have searched the literature in vain for a description of constant characters separating *"P. banksi," "P. desolata,"* and *"P. brevirostris"* from *P. vittata*. So far as the evidence shows, the variations upon which these supposed species rest are inconstant and therefore are not of specific significance; as absence of intergradation, not degree of variation, gives specific value to characters. The series before me is a meager one, but it strengthens the conviction that the variations are all within the limits of a single species. Ample series from

[1]Bull. Mus. Comp. Zool., 1917, v. 61, p. 146.

breeding stations alone will determine the precise nature of the variations.

In one specimen the first primary of one wing is longer than the second primary, but in twelve other specimens the first primary (fully grown) is equal to or shorter than the second.

Mr. T. Iredale has apparently shown that *Prion* Lacépède is indeterminable, and in consequence has revived *Pachyptila* Illiger,[1] which I have used in the present connection.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24355 [2]	Otago, N. Z.	♂	200	105	35.5	14.2	21.6	32.8	43.9
151110 [3]	Chatham Is.	♂	216	103	35.9	14.5	20.1	33.2	41.6
17913	Otago, N. Z.	♂	...	89	35	12	15.7	35	41.4
124679 [3]	Hen and Chickens Is., N. Z.	♂	191	94	27.2	10.7	13.1	29	36
24356 [2]	Cape Farewell, N. Z.	♂	184	87	27	10.9	13.8	31.3	37.2
24357 [2]	" " "	♂	185	90	23.3	8.1	12	30	36.5
24358 [2]	Well, West Coast, N. Z.	♂	175	88	22.4	8	10.9	27.8	36.3
124678 [3]	Otago, N. Z.	♂	190	97	22.6	8.9	11.5	32.4	42.5
208736 [3]	Montevideo, Uruguay	♂	179	84	26.5	8.2	11	34.6	38
210723 [3]	" "	♂	188	84	27	8	10.5	34.6	42
68926 [3]	Kerguelen I.	♂	189	88	25.4	10.2	12.8	32	38
24354 [2]	Pitt I., Chatham Is.	♀	205	103	34.7	14.2	21.5	34	40.5
151111 [3]	Chatham Is.	♀	181	88	22	8	11	29.5	35.2
24359 [2]	Nelson, N. Z.	♀	169	86	23.3	7.8	9.5	29	37.1
124680 [3]	Hen and Chickens Is., N. Z.	—	184	85	27.9	10	12.5	31	34.9
159485 [3]	South Africa	—	...	87.5	25.7	9	12	29.8	35

PUFFININÆ: SHEARWATERS AND PETRELS

Key to the Species

Nostrils separated by a thin partition
- Hind claw very large; plumage white ..... *Pagodroma nivea*
- Hind claw small; plumage of upper parts not white
  - Breast and abdomen dark; tail more than half as long as wing
    - Greater wing-coverts grayish brown, forming a distinct bar ..... *Bulweria bulweri*
    - Greater wing-coverts sooty brown, not forming a distinct bar ..... *B. macgillivrayi*
  - Breast and abdomen white
    - Upper tail-coverts not white
      - Jugulum white, sometimes partially obscured by gray
        - Lower tail-coverts white
          - Under wing-coverts inwardly more or less white
            - Wing under 10 in. (254 mm.)
              - Axillaries black ..... *Pterodroma axillaris*

[1] Austral Avian Record, v. 2, pp. 25–27.
[2] Carnegie Museum.
[3] U. S. National Museum.

Axillaries white
Pileum and cervix extensively dark gray, blackish brown, or black, contrasting with the gray of the back
Under wing-coverts extensively dark-colored; no white on exposed inner webs of primaries.. ..... *P. hypoleuca*
Under wing-coverts extensively white; inner webs of primaries more or less white
Sides of jugulum gray..*P. P. leucoptera, longirostris*
Sides of jugulum black..*P. brevipes* (light phase)
Pileum, cervix, and back light gray, darkening with wear
Inner web of first primary with little or no white; inner margin of wing with a very broad dark band .....*P. nigripennis*
Inner webs of primaries conspicuously white..*P. cooki*
Wing not under 10 in. (254 mm.)
First primary extensively white on inner web; dark color of tail forming definite tips to outer feathers..*P. externa*
First primary with little or no white on inner web
White cervical collar, clouded with gray; dark color of tail not forming definite tips to outer feathers .....*P. cervicalis*
No white cervical collar.....*P. phæopygia*
Under wing-coverts dark, with or without white margins
Cervix and back slaty gray.....*P. mollis* (light phase)
Cervix and back light ashy gray.....*P. lessoni*
Lower tail-coverts dark, at least at tips of longer ones; inner webs of primaries extensively white..*P. neglecta* (light phase)
Jugulum decidedly dark-colored; cervix and back brown or black
Inner webs of primaries not white
Lower tail-coverts brown, or chiefly so.....*P. incerta*
Lower tail-coverts white, or chiefly so
Throat uniformly dark-colored, or more or less mottled with white
Culmen not under 1.2 in. (30 mm.).....*P. rostrata*
Culmen under 1.2 in. (30 mm.).....*P. parvirostris*
Throat white .....*P. magentæ*
Inner webs of primaries largely white..... .....*P. neglecta* (intermediate phase)
Upper tail-coverts white.....*P. hasitata*
Breast and abdomen dark; tail less than half as long as wing
Upper tail-coverts white.....*P. caribbæa*
Upper tail-coverts not white
Bill wide at gape
Inner webs of primaries not white
Cervix and back sooty brown
Culmen not under 1.2 in. (30 mm.).....*P. macroptera*
Culmen under 1.2 in. (30 mm.).....*P. aterrima*
Cervix and back slaty gray.....*P. mollis* (dark phase)
Cervix black, back ashy gray.....*P. brevipes* (dark phase)
Inner webs of primaries more or less white
Lower tail-coverts dark
Back and scapulars dark brown...*P. neglecta* (dark phase)
Back and scapulars "slate-grey with dark edgings to the feathers".....*P. solandri*
Lower tail-coverts chiefly white; back gray or slate-gray, with or without paler edgings to the feathers..... .....*P. inexpectata*
Bill much compressed; general aspect of plumage slaty gray; no white on primaries.....*P. brevirostris*

Nostrils separated by a thick partition

Nasal tubes not bevelled; nostrils only partially visible from above

Back, breast, and abdomen dark

Chin white.....*Procellaria æquinoctialis*

Chin dark.....*P. parkinsoni*

Back gray; breast and abdomen white.....*Priofinus cinereus*

Nasal tubes bevelled anteriorly; both nostrils visible from above

Tail not decidedly wedge-shaped

Lower parts white, or chiefly so

Wing not under 11 in. (279 mm.)

Pileum dark brown .....*Puffinus gravis*

Pileum gray

Lower tail-coverts wholly, or almost entirely white.....
.....*P. kuhli*

Lower tail-coverts largely dark-colored.....
.....*P. creatopus* (light phase)

Wing under 11 in. (279 mm.)

Lower tail-coverts largely dark-colored

Upper parts and dark color of lower tail-coverts brown; wing not under 8.8 in. (223 mm.).....
.....*P. puffinus* (brown-backed phase)

Upper parts and dark color of lower tail-coverts dark brown or black

Upper parts dark brown; axillaries narrowly and evenly tipped with white; wing not under 8.8 in. (223 mm.)
.....*P. opisthomelas*

Upper parts black; axillaries not narrowly and evenly tipped with white.....*P. auricularis*

Upper parts dark brown; wing under 8.8 in. (223 mm.); tail decidedly more than twice the length of exposed culmen.....*P. obscurus* (brownish-backed phase)

Lower tail-coverts wholly, or almost entirely white

Upper parts sooty black or blackish brown

Fore-neck not invaded by dark color of sides of neck; axillaries white, subterminally dark gray or sooty black; wing not under 8.8 in. (223 mm.).....
.....*P. puffinus* (black-backed phase)

Fore-neck more or less invaded by dark color of sides of neck; axillaries brown..*P. gavia* (brownish-backed phase)

Upper parts bluish black or plumbeous

Tail less, or but little more, than twice the length of exposed culmen.....*P. gavia* (bluish-backed phase)

Tail decidedly more than twice the length of exposed culmen; wing under 8.8 in. (223 mm.).....
.....*P. obscurus* (bluish-backed phase)

Lower parts white obscured by gray....*P. creatopus* (dark phase)

Lower parts white obscured by brown.....
.....*P. puffinus* (extreme brown phase)

Lower parts dark

Latericorn light-colored.....*P. carneipes*

Latericorn not light-colored

Breast and abdomen dark gray

Exposed culmen over 1.4 in. (36 mm.).....*P. griseus*

Exposed culmen not over 1.4 in. (36 mm.); bill at base relatively, sometimes actually, wider than in *P. griseus*
.....*P. tenuirostris*

Breast, abdomen, and under wing-coverts dark brown...
.....*P. nativitatis*

Tail decidedly wedge-shaped
Breast and abdomen dark.....*P. chlororhynchus* (dark phase)
Breast and abdomen white
Lower tail-coverts dark .....*P. chlororhynchus* (light phase)
Lower tail-coverts white
Inner webs of primaries extensively white.....*P. bulleri*
Inner webs of primaries not extensively white....*P. leucomelas*

Pagodroma nivea (*G. Forster*): SNOWY PETREL

COUES—*Pagodroma nivea,* IV, 160, 171.
SALVIN—*Pagodroma nivea,* 419.
GODMAN—*Pagodroma nivea,* xlviii, 254, pl. 73.

Procellaria nivea George Forster, *Voyage round the World,* 1777, Vol. I, pp. 96, 98, antedates *Procellaria nivea* Gmelin; cf. Mr. Gregory M. Mathew's *Birds of Australia,* Vol. II, p. 174.

Bulweria bulweri (*Jardine & Selby*): BULWER'S PETREL

COUES—*Æstrelata Bulweri,* IV, 158, 171.
SALVIN—*Bulweria bulweri,* 420.
GODMAN—*Bulweria bulweri,* xlviii, 257, pl. 74.

Messrs. Mathews and Iredale state that they "separate the Pacific-breeding Bulwer's Petrel on account of its stronger bill."[1] It will be noticed that no such superiority in size is manifested in the subjoined measurements.

[1] Ibis, 1915, p. 607

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
23422 [1]	Tenerife I., Canary Is.	♂	204	113	22.9	7.4	9.5	28	30.5
23424 [1]	" "	♂	201	113	22	7.9	9.1	26.1	29.8
23425 [1]	" "	♂	204	114	21.1	7.4	9.3	26	29
23428 [1]	Santa Ursula, Tenerife I., Canary Is.	♂	207	112	23	8	9.7	26.1	31.5
23433 [1]	Tenerife I., Canary Is.	♂	210	114	22.8	8	9.5	26.1	30.6
189409 [2]	Necker I., Hawaiian Arch.	♂	201	113	21.7	8	10.5	27.8	29.8
189411 [2]	" " "	♂	193	107	22.5	7.5	10	24	27.6
189412 [2]	" " "	♂	198	109	22.8	7.5	9.9	26.3	30.9
189413 [2]	" " "	♂	202	114	22.3	7.4	10.3	26.6	30.8
5653 [3]	Bird I., Hawaiian Arch.	♂	190	111	21.5	7.5	10.4	26.1	30.6
5654 [3]	" " "	♂	199	121	22.8	7.2	9.4	26.8	30
5655 [3]	" " "	♂	200	110	22	7 8	10 5	27	31.2
5657 [3]	Necker I., Hawaiian Arch.	♂	202	117	21	7.6	10.5	24.9	29.4
5658 [3]	" " "	♂	199	108	21.3	8	10.2	26.7	28.8
5659 [3]	" " "	♂	199	115	21.5	7.8	9.8	26.3	29
23423 [1]	Tenerife I., Canary Is.	♀	207	114	23	7.9	10	27.3	30
23426 [1]	Santa Ursula, Tenerife I., Canary Is.	♀	202	110	22.4	8	9.7	25.9	29.9
23427 [1]	Santa Ursula, Tenerife I., Canary Is.	♀	210	114	23.4	7.9	10	26	31.2
23429 [1]	Santa Ursula, Tenerife I., Canary Is.	♀	202	107	22.5	8	10	28.2	31
23430 [1]	Santa Ursula, Tenerife I., Canary Is.	♀	201	109	22.3	7.8	9.7	27.2	30.4
23431 [1]	Santa Ursula, Tenerife I., Canary Is.	♀	202	109	22.2	7.9	10.6	25.6	28.7
23432 [1]	Santa Ursula, Tenerife I., Canary Is.	♀	207	114	22.4	8	9.6	26.4	30.8
189407 [2]	Necker I., Hawaiian Arch.	♀	200	117	22.4	7.1	10	25.9	28.4
189408 [2]	" " "	♀	203	112	21	7.7	10	26	29.8
189410 [2]	" " "	♀	204	117	22	7.4	9.6	25.5	29.5
5656 [3]	Bird I., Hawaiian Arch.	♀	196	111	21.5	7.5	9.9	26.1	27.8

Bulweria macgillivrayi (*Gray*): MACGILLIVRAY'S PETREL

COUES—*Æstrelata Macgillivrayi*, IV, 159, 171.
SALVIN—*Bulweria macgillivrayi*, 420, 421.
GODMAN—*Bulweria macgillivrayi*, xlviii, 260, pl. 75.

Whether the variations existing in this supposed species are constant or not, is still an open question. So far as I have ascertained, a second specimen is yet to be taken.

[1] Carnegie Mus.
[2] U. S. Nat. Mus.
[3] Stanford Univ.

Pterodroma axillaris (*Salvin*): CHATHAM ISLANDS' PETREL

SALVIN—*Œstrelata axillaris*, 399, 418, pl. 7.
GODMAN—*Œstrelata axillaris*, xlvi, 252, pl. 72.

Mr. Gregory M. Mathews has apparently demonstrated that *Pterodroma* Bonaparte has line priority over *Æstrelata* Bonaparte.[1]

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24346 [2]	Chatham Is.....	♂	215	93	24	8	10.3	30	37.1
24347 [2]	" "	♀	214	93	24	8.5	10.5	30	35.8
208604 [3]	" "	—	220	94	23.4	8.2	11	28.3	37.9
208605 [3]	" "	—	216	92	23.4	8	10.5	30.5	38

Pterodroma hypoleuca (*Salvin*): WHITE-BREASTED PETREL

SALVIN—*Œstrelata hypoleuca*, 398, 409.
GODMAN—*Œstrelata hypoleuca*, xlvi, 212, pl. 58.

In some examples of *P. hypoleuca* the tail is more than half as long as the wing (see subjoined measurements), and is graduated for more than one third of its length. Evidently, the tail characters can not be entirely depended upon to distinguish *Bulweria* from *Pterodroma*.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
189403 [4]	Laysan I., Haw. Arch.	♂	215	114	25.8	8.9	10.9	28.3	35.4
23470 [5]	" " "	♂	230	115	25.7	8.9	10.7	29.5	37
9270 [6]	" " "	♂	223	114	25.9	9	11	26.8	34.9
9274 [6]	" " "	♂	231	116	25	9.8	11.6	29	37.6
9272 [6]	" " "	♀	225	105	25.2	8	10.7	28	36
9273 [6]	" " "	♀	224	113	26.3	9.2	11.3	29	36.5
5663 [7]	" " "	♀	226	114	25.6	8.6	10.5	28.8	36
5664 [7]	" " "	♀	233	117	25.8	8.4	11.5	28.4	35.9

[1] Birds Austr., v. 2, pp. 131, 132; cf. B. O. U. List, 2d ed., p. 398.
[2] Carnegie Mus.
[3] U. S. Nat. Mus.
[4] U. S. Nat. Mus.
[5] Mus. Vertebr. Zool., Univ. Calif.
[6] Coll. J. E. Thayer.
[7] Stanford Univ.

Pterodroma leucoptera (*Gould*): WHITE-WINGED PETREL

SALVIN—*Œstrelata leucoptera*, 399, 416.
GODMAN—*Œstrelata leucoptera*, xlv, 243, pl. 69.

I am unable to determine the status of *Æstrelata longirostris* Stejneger and *Procellaria leucoptera* Gould without comparing the type of the former with a series of the latter from its type locality, Port Stephens, New South Wales, Australia.

The specimens of *P. P. axillaris, hypoleuca, longirostris* (provisionally determined), *brevipes, nigripennis,* and *cooki* at my disposition show no intergradation.

Pterodroma longirostris (*Stejneger*): STEJNEGER'S PETREL

Pterodroma brevipes (*Peale*): SHORT-FOOTED PETREL

Pterodroma nigripennis (*Rothschild*): KERMADEC PETREL

SALVIN—*Œstrelata nigripennis*, 398, 409.
GODMAN—*Œstrelata nigripennis*, xlvi, 214, pl. 59.

In No. 151108 U. S. Nat. Mus. light gray vermiculations extend across the jugulum, forming a faint band about half an inch in width. Another specimen has a similar but narrower band, and another still, indications of one.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24325 [1]	Kermadec Is....	♂	227	100	24.6	8.9	10.5	29	36.7
151108 [2]	" "	♂	231	99.5	24	8.3	11	29.2	37.3
24324 [1]	———————....	♀	227	101	24.1	8.3	10	29	36.3
24326 [1]	Kermadec Is....	♀	235	102	24.3	8.7	11	28.5	35.3
174640 [2]	" "	—	227	95	24.9	9	11.1	29.5	34.2

Pterodroma cooki (*Gray*): COOK'S PETREL

Pterodroma externa (*Salvin*): JUAN FERNANDEZ PETREL

[1] Carnegie Mus.
[2] U. S. Nat. Mus.

Pterodroma cervicalis (*Salvin*): Sunday Island Petrel

Salvin—*Œstrelata cervicalis*, 398, 411, pl. 6.
Godman—*Œstrelata cervicalis*, xliv, 223, pl. 63.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24330 [1]	Kermadec Is....	♂	318	137	—	—	18.5	37.4	51
24327 [1]	" "	♀	320	127	37	13	16.6	40.5	52
24329 [1]	" "	♀ [3]	313	134	36	12.4	16.8	37.8	48.9
151107 [2]	" "	—	308	135	35	13.2	18	37.4	51.2
174639 [2]	" "	—	321	138	36.1	13.5	17	39.3	51.8

Pterodroma phæopygia (*Salvin*): Dark-rumped Petrel

Pterodroma mollis (*Gould*): Downy Petrel

Coues—*Æstrelata mollis*, IV, 150, 170.
Salvin—*Œstrelata mollis*, 398, 406.
Godman—*Œstrelata mollis*, xlvi, 197, pl. 54; *Œstrelata fœa*, xlvi, 201.

I do not concur with Dr. Godman in his acceptance of *Œstrelata fœa* Salvadori; for it has not been established that the gray band across the fore-neck is a stable character in the light phase of *Pterodroma mollis*. In *Pterodroma nigripennis*, *Pterodroma phæopygia*, and *Puffinus auricularis* the jugular band is certainly inconstant.

Pterodroma lessoni (*Garnot*): Lesson's Petrel

Coues—*Adamastor sericeus*, II, 122, 142; *Æstrelata Lessoni*, IV, 142, 170; *Priof[inus]sericeus*, V, 192.
Salvin—*Œstrelata lessoni*, 398, 401.
Godman—*Œstrelata lessoni*, xliv, 181, pl. 48.

Pterodroma incerta (*Schlegel*): Schlegel's Petrel

Coues—*Æstrelata incerta*, IV, 147, 170.
Salvin—*Œstrelata incerta*, 398, 405.
Godman—*Œstrelata incerta*, xlvi, 195, pl. 53.

[1] Carnegie Mus.
[2] U. S. Nat. Mus.
[3] Juv.

Dr. Godman remarks in his monograph that "it is by no means unlikely that *Œ. incerta* may be only the dark phase of *Œ. lessoni*."[1]

With the light of the manuscript description of *Procellaria sandaliata* Solander, Mr. T. Iredale identifies *Procellaria incerta* Schlegel as a synonym of *Procellaria alba* Gmelin.[2] However, a specimen (No. 24332 Carnegie Mus.) of an intermediate phase of *Pterodroma neglecta* (Schlegel) from the Kermadec Islands agrees well with Latham's description of his White-breasted Petrel, upon which *Procellaria alba* Gmelin was based. In view of this discrepancy, I am of the opinion that Dr. Schlegel's type specimens (extant in the Leyden Museum) and original descriptions of *P. incerta* and *P. neglecta* are a surer means of determining the names of the two birds in question than the eighteenth century descriptions; in consequence, *Pterodroma incerta* (Schlegel) and *Pterodroma neglecta* (Schlegel) are retained.

Pterodroma neglecta (*Schlegel*): NEGLECTED PETREL

Pterodroma rostrata (*Peale*): THICK-BILLED PETREL

COUES—*Æstrelata rostrata*, IV, 144, 170.
SALVIN—*Œstrelata rostrata*, 398, 404.
GODMAN—*Œstrelata rostrata*, xlvi, 190, pl. 51.

Pterodroma parvirostris (*Peale*): SMALL-BILLED PETREL

Pterodroma magentæ (*Giglioli & Salvadori*): MAGENTA PETREL

SALVIN—*Œstrelata magentæ*, 407.
GODMAN—*Œstrelata magentæ*, xlvi, 203, pl. 55.

The status of *Pterodroma rostrata, P. parvirostris,* and *P. magentæ* can be satisfactorily determined only when a series of specimens showing the alleged specific characters has been collected and studied.

[1] Mon. Petrels, p. 196.
[2] Ibis, 1913, p. 132; cf. Mathews and Iredale, Ibis, 1913, p. 231, Mathews, Birds Austr., v. 2, pp. 149–151.

It is yet to be demonstrated that *Æstrelata oliveri* Mathews & Iredale,[1] based upon one specimen, is distinct from *P. parvirostris*. The assumed specific characters belong to a class that often proves to be inconstant when a series of specimens is examined.

Pterodroma hasitata (*Kuhl*): CAPPED PETREL

COUES—*Æstrelata hæsitata*, IV, 139, 170.
SALVIN—*Œstrelata hæsitata*, 398, 402.
GODMAN—*Œstrelata hæsitata*, xliv, 184, pl. 49.

Pterodroma caribbæa *Carte:* CARIBBEAN PETREL

COUES—*A*[*strelata*] *carribæi*, IV, 171, 159.
SALVIN—*Œstrelata jamaicensis*, 398, 403.
GODMAN—*Œstrelata jamaicensis*, xlvii, 187, pl. 50.

As ornithologists have examined but few specimens of *Pterodroma hasitata* and *Pterodroma caribbæa*, it remains to be absolutely determined whether the latter is, or is not, a dark phase of the former. Thorough search offshore in West Indian waters would likely be rewarded by a comprehensive series of these birds, for it seems improbable that all their breeding places could have been invaded by imported enemies.

Dr. Godman has clearly set forth the fact that under the rules of nomenclature *Procellaria jamaicensis* Bancroft is a *nomen nudum*.[2]

Recently, Mr. G. K. Noble has revived *Procellaria diabolica* Lafresnaye[3] on the strength of certain discrepancies in size, in the shape of the nasal tubes, and in the dark cap occurring in nine specimens, which of late have been referred to *Pterodroma hasitata* (Kuhl). The meager series at Mr. Noble's command does not justify this revival. Extensive series show that the range of variation is wide in Tubinarine species. For example, in a large series of *Pterodroma phæopygia* from the

[1] Austral Avian Record, 1914, v. 2, p. 113.
[2] Mon. Petrels, p. 188.
[3] Bull. Mus. Comp. Zool., 1916, v. 60, pp. 370–374.

Galapagos Islands variations occur similar to those described by Mr. Noble, and also greater variations.

I apprehend that *Æstrelata cahow* Nichols & Mowbray[1] will prove to be a variation of *Pterodroma hasitata.*

Pterodroma macroptera (*A. Smith*): Long-winged Petrel

Coues—*Æstrelata macroptera,* IV, 155, 171; *Æstrelata fuliginosa,* IV, 157, 171.
Salvin—*Œstrelata macroptera,* 398, 399.
Godman—*Œstrelata macroptera,* xlvii, 176, pl. 46.

Pterodroma aterrima *Bonaparte:* Mascarene Petrel

Coues—*Æstrelata aterrima,* IV, 158, 171.
Salvin—*Œstrelata aterrima,* 398, 401.
Godman—*Œstrelata aterrima,* xlviii, 179, pl. 47.

None of the three monographers has tested by a series of specimens the characters assigned to *P. aterrima.*

Pterodroma solandri (*Gould*): Solander's Petrel

Coues—*Æstrelata Solandri,* IV, 148, 170.
Salvin—*Œstrelata solandri,* 398, 410.
Godman—*Œstrelata solandri,* xlvii, 219, pl. 61.

Gould's type (preserved in the British Museum) and original description seem to me to be a more certain means of determining the specific name of this species than the Latham and Gmelin descriptions cited by Mr. Gregory M. Mathews.[2] Hence, *Pterodroma solandri* (Gould) is retained and *Pterodroma melanopus* (Gmelin) rejected.

Pterodroma inexpectata (*J. R. Forster*): Mottled Petrel

Pterodroma brevirostris (*Lesson*): Short-billed Petrel

Coues—*Æstrelata grisea,* IV, 148, 170; [*P. brevirostris,* IV, 156].
Salvin—*Œstrelata brevirostris,* 398, 409.
Godman—*Œstrelata brevirostris,* xlvii, 216, pl. 60.

[1]Auk, 1916, v. 33, p. 194.
[2]Cf. Birds Austr., v. 2, pp. 142–147.

Procellaria æquinoctialis *Linnæus:* White-chinned Black Petrel

Coues—*Majaqueus æquinoctialis,* II, 118, 142; *Majaqueus conspicillatus,* II, 118, 142.
Salvin—*Majaqueus æquinoctialis,* 395.
Godman—*Majaqueus æquinoctialis,* xliii, 169, pl. 44.

Procellaria parkinsoni *Gray:* Parkinson's Petrel

Priofinus cinereus (*Gmelin*): Black-tailed Shearwater

Puffinus gravis (*O'Reilly*): Great Shearwater

Coues—*Puffinus major,* II, 132, 144.
Salvin—*Puffinus gravis,* 369, 373.
Godman—*Puffinus gravis,* xli, 90, pl. 25.

Puffinus kuhli (*Boie*): Kuhl's Shearwater

Coues—*Adamastor gelidus,* II, 121, 142, V, 192, in part; *Puffinus Kuhlii,* II, 128, 143; *Priof*[*inus*] *gelidus,* V, 192 in part.
Salvin—*Puffinus kuhli,* 369, 375.
Godman—*Puffinus kuhli,* xli, 94, pl. 26; *Puffinus edwardsi,* vi, xli, 99.

Of two specimens of this species, one has the anterior edge of the tarsus sharp for nearly its entire length, while the other has scarcely any sharp anterior edge. In a specimen of *Puffinus creatopus* (No. 16238 C. A. S.) the tarsus is thicker than in either of the two *P. kuhli,* and is wholly without a sharp anterior edge. In another *P. creatopus* (No. 9394 C. A. S.) the tarsus is more compressed, and has a very sharp anterior edge. Clearly, the form of the tarsus is not a reliable character in these two species.[1]

Puffinus creatopus *Coues:* Cooper's Shearwater; Pink-footed Shearwater

Puffinus puffinus (*Brünnich*): Manx Shearwater

Coues—*Puffinus anglorum,* II, 134, 144; *Puffinus Yelcuanus,* II, 137, 144.
Salvin—*Puffinus anglorum,* 369, 377; *Puffinus yelkouanus,* 369, 379.
Godman—*Puffinus anglorum,* xli, 104, pl. 28; *Puffinus yelkouanus,* xli, 107, pl. 29.

[1] Cf. Mathews and Iredale, Ibis, 1915, pp. 584, 592.

In the second edition of the *B. O. U. List, Puffinus yelkouan* (Acerbi) is treated as a subspecies of *Puffinus puffinus,* and is therefore included in the above synonymy. The variations distinguishing the two phases appear to be dichromatic as well as geographic.

So close is the resemblance of the light phase of *P. opisthomelas* to "*P. yelkouan*" that I am unable to define fully their distinctive characters without a more adequate series of "*P. yelkouan*" for comparison.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
23418 [1]	Bigbury Bay, Devonshire, Eng.	♂	242	78	35.7	8.5	14	45	50
23420 [1]	South Wales	♂	233	77	34.5	8.3	14	43.3	49.2
23421 [1]	Old Head of Kinsale, co. Cork, Ireland	♂	236	73	35.3	8	14.5	43.7	48
23419 [1]	Bigbury Bay, Devonshire, Eng.	♀	244	76	38.1	8.4	12.5	45	50
113660 [2]	New Brunswick, Can.	♀	237	79	36.1	8	12	44.1	51
74307 [2]	Bosporus	♂	236	71	34.2	8.2	12.8	45	49.5
115493 [2]	S. Antioco, Sardinia	♂	...	66 [3]	40.5	8.7	13.1	44.3	51.2
115492 [2]	Nice	♀	240	68	37	7.8	13.2	44	49

Puffinus opisthomelas *Coues:* BLACK-VENTED SHEARWATER

Puffinus auricularis *C. H. Townsend:* TOWNSEND'S SHEARWATER

Puffinus gavia *(J. R. Forster):* FORSTER'S SHEARWATER

COUES—*Æstrelata gavia,* IV, 154, 171.
SALVIN—*Puffinus gavia,* 369, 381.
GODMAN—*Puffinus gavia,* xlii, 120, pl. 32.

It is maintained by Mr. Gregory M. Mathews that the words "*supra coerulescenti-nigra*" in the original description of *Procellaria gavia* J. R. Forster[4] prove that the description does not relate to the shearwater we are considering, but to the small bluish-backed one frequenting New Zealand seas,

[1] Carnegie Mus.
[2] U. S. Nat. Mus.
[3] Rectrices worn.
[4] Descr. Anim., p. 148.

commonly known by the name of "*Puffinus assimilis.*"[1] Mr. Mathews also maintains that the present species was nameless, and he has christened it *Puffinus reinholdi*[2] and *Reinholdia reinholdi.*[3] However, the length of the bill in Forster's description (*"in fronte* 1½" *unc., "ad angulum faucis* 2" *unc.*) appears to be less typical of *"P. assimilis"* than of the present species. Moreover, in some specimens of the present species the sooty black of the upper parts has a bluish cast in certain lights. In fine, the evidence thus far presented against the specific name *gavia* is not deemed conclusive. The characters of *Reinholdia* occur in some examples of *Puffinus puffinus.* See table of measurements of that species.

The dark coloration of the lower parts of certain specimens of *P. gavia,* said by Dr. Godman to be peculiar to the female,[4] occurs in the male as well as in the female, and is perhaps dichromatic.

MEASUREMENTS (in millimeters)

No. (Carnegie Mus.)	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
24305	Well, West Coast, N.Z.	♂	222	65	39.5	7.7	12.9	41.9	50
24306	Wanganui Heads, N.Z.	♂	216	66	36.2	7.3	12.5	40.3	48.2
24315	Nelson, N. Z.	♂	217	67	35	7	12.5	42	46.8
24314	" "	♀	216	66	33	7.5	13.5	42.6	51

NOTE.—Since the above was written, *Cinathisma cyaneoleuca* Hull has been described.[5] According to Mr. Gregory M. Mathews it " is undoubtedly the same as *Reinholdia reinholdi byroni* Mathews."[6] This being the case, Mr. Mathews's contention respecting the identity of *Procellaria gavia* J. R. Forster wholly breaks down, the species having a brown as well as a bluish phase.

Puffinus obscurus (*Gmelin*): DUSKY SHEARWATER; LEAST SHEARWATER

[1] Birds Austr., v. 2, pp. 53, 54, 68, 69.
[2] Birds Austr., v. 2, pp. 74, 76.
[3] Austral Avian Record, v. 1, p. 107.
[4] Mon. Petrels, p. 123.
[5] Emu, 1916, v. 15, pp. 205, 211, pl. 32.
[6] Austral Avian Record, 1917, v. 3, p. 77.

Puffinus carneipes *Gould:* Flesh-footed Shearwater

Puffinus griseus (*Gmelin*): Sooty Shearwater

Puffinus tenuirostris (*Temminck*): Slender-billed Shearwater

Puffinus nativitatis *Streets:* Christmas Island Shearwater

Puffinus chlororhynchus *Lesson:* Wedge-tailed Shearwater

Puffinus bulleri *Salvin:* Buller's Shearwater

Puffinus leucomelas (*Temminck*): Streaked Shearwater

Coues—*Puffinus leucomelas,* II, 130, 144.
Salvin—*Puffinus leucomelas,* 369, 370.
Godman—*Puffinus leucomelas,* xl, 72, pl. 21.

THALASSIDROMINÆ: Storm Petrels

Key to the Species

General color dark
- Tail wedge-shaped.....*Halocyptena microsoma*
- Tail nearly even or slightly rounded.....*Thalassidroma pelagica*
- Tail forked
  - Upper tail-coverts more or less white
    - Tail slightly forked; upper tail-coverts white.....*Oceanodroma tethys*
    - Tail deeply forked; upper tail-coverts very broadly tipped with black.....*O. macrodactyla*
    - Tail at least slightly forked; tips of upper tail-coverts black; lateral rectrices definitely white at base for nearly an inch, or more.....*O. castro*
    - Tail decidedly forked; tips of upper tail-coverts more or less dark gray, becoming white with wear; lateral rectrices not definitely white at base for nearly an inch .....*O. leucorhoa*
  - Upper tail-coverts not white
    - A pale area on under wing-coverts.....*O. homochroa*
    - No pale area on under wing-coverts
      - Pileum and throat not sooty black
        - Wing under 6.7 in. (170 mm.).....*O. leucorhoa* (dark phase)
        - Wing not under 6.7 in. (170 mm.)
          - Upper tail-coverts with a drab patch.....*O. tristrami*
          - Upper tail-coverts without a drab patch.....*O. markhami*
      - Pileum and throat sooty black.....*O. melania*

General color not dark; tail forked
- Bluish gray above and below.....*O. furcata*
- White below, with dark jugular band.....*O. hornbyi*

Halocyptena microsoma *Coues:* Least Petrel

Thalassidroma pelagica (*Linnæus*): Storm Petrel

Coues—*Procellaria pelagica,* I, 80, 90, V, 192; *Procellaria lugubris,* I, 80, 90, V, 192; *Procellaria melitensis,* I, 81, 90, V, 192.
Salvin—*Procellaria pelagica,* 343.
Godman—*Procellaria pelagica,* xxxv, 1, pl. 1.

Oceanodroma tethys (*Bonaparte*): Galapagos Petrel

Oceanodroma macrodactyla *W. Bryant:* Guadalupe Petrel

Oceanodroma castro (*Harcourt*): Harcourt's Petrel

Oceanodroma leucorhoa (*Vieillot*): Leach's Petrel

Oceanodroma homochroa (*Coues*): Ashy Petrel

Oceanodroma tristrami *Salvin:* Tristram's Petrel

Salvin—*Oceanodroma fuliginosa,* 347, 352; *Oceanodroma tristrami,* 347, 354.
Godman—*Oceanodroma tristrami,* xxxvi, 20.

The drab patch of the posterior surface of the upper tail-coverts, corresponding somewhat to the white patch in *Oceanodroma macrodactyla,* appears to be a constant character, for it is present in each of the five specimens before me—three adults and two hornotines from the Leeward Islands, Hawaiian Archipelago. Like the types of *O. macrodactyla,* two of the adults and the hornotines have a cap of dark neutral gray investing most of the crown, the occiput, and the upper cervix, and contrasting with the deep neutral gray of the lower cervix and interscapulars. One of the hornotines (No. 5652 Stanford Univ.) exhibits the "mottled appearance" mentioned in the original description of the species, published in Mr. Salvin's monograph. *Cymochorea owstoni* Mathews & Iredale falls within the limits of variation in the Hawaiian specimens, the fifth one agreeing with the description[1] of this nominal species.

[1] Ibis, 1915, p. 581.

Dr. Walter K. Fisher has recorded a wing-measurement of 150 mm.,[1] taken from one of the hornotines mentioned above (No. 189406 U. S. Nat. Mus.). On lifting the under wing-coverts of this specimen, I find that the four outermost primaries are still in the sheath. Doubtless, the primaries were in a similar stage in the short-winged specimens reported by Prof. Homer R. Dill.[2] According to the original account, the "wing-feathers" of the lost type were "not quite fully grown."

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
23468[3]	Laysan I., Haw. Arch....	♂	182	100	39	17	27.9	29.4
23469[3]	" " "	♂	192	100	34	18.3	27.7	30
211224[4]	Near Midway I., Haw. Arch.....	♀	184	110	44	17.7	26.3	28

Oceanodroma markhami (*Salvin*): MARKHAM'S PETREL

Oceanodroma melania (*Bonaparte*): BLACK PETREL

Oceanodroma furcata (*Gmelin*): FORK-TAILED PETREL

Oceanodroma hornbyi (*Gray*): HORNBY'S PETREL

OCEANITINÆ: LONG-LEGGED STORM PETRELS

Key to the Species

Basal joint of middle toe at most only slightly flattened, and shorter than remainder of toe and claw
- Upper tail-coverts white
  - Breast and abdomen dark.....*Oceanites oceanicus*
  - Lower breast and abdomen white.....*O. gracilis*
  - Breast and sides white with dark streaks.....*Pealea lineata*
- Upper tail-coverts not white
  - No white on head.....*Garrodia nereis*
  - Forehead, lores, and superciliary stripe white..... *Pelagodroma marina*

[1] Bull. U. S. Fish Com. for 1903, p. 27.
[2] Bull. No. 42 Biol. Surv., U. S. Dept. Agric., pp. 18, 19.
[3] Mus. Vertebr. Zool., Univ. Calif.
[4] U. S. Nat. Mus.

Basal joint of middle toe greatly flattened, and not shorter than remainder of toe and claw
Upper tail-coverts white
Tail nearly even
Jugulum sooty black; the middle of the breast and abdomen more or less sooty black; sides white.....
.....*Fregetta melanogaster*
Jugulum dark gray; breast and abdomen white.....
..... *F. grallaria*
Tail decidedly forked; lower parts white with a dark jugular band .....*F. albigularis*
Upper tail-coverts not white; lower parts dark.....*F. mœstissima*

Oceanites oceanicus (*Kuhl*): WILSON'S PETREL

Oceanites gracilis (*Elliot*): GRACEFUL PETREL

Pealea lineata (*Peale*): PEALE'S PETREL

COUES—*Oceanites lineata*, I, 83, 91.
SALVIN—*Pealea lineata*, 364.
GODMAN—*Pealea lineata*, xxxvii, 57, pl. 16.

Garrodia nereis (*Gould*): GRAY-BACKED PETREL

COUES—*Procellaria nereis*, I, 81, 90.
SALVIN—*Garrodia nereis*, 361.
GODMAN—*Garrodia nereis*, xxxvii, 59, pl. 14.

Pelagodroma marina (*Latham*): WHITE-FACED PETREL

Fregetta melanogaster (*Gould*): BLACK-BELLIED PETREL

COUES—*Fregetta melanogastra*, I, 87, 91.
SALVIN—*Cymodroma melanogaster*, 364.
GODMAN—*Cymodroma melanogaster*, xxxviii, 59, pl. 17.

In their monographs Mr. Salvin and Dr. Godman rank *Thalassidroma tropica* Gould as a synonym of *Thalassidroma melanogaster* Gould, ignoring the page priority of the former name. However, Dr. Godman states, on the authority of Dr. R. Bowdler Sharpe, that "the name of *C. tropica* carries a certain amount of doubt with it."[1] Obviously, *melanogaster* (a determined name) should not be superseded by *tropica* unless all reasonable doubt is removed from *tropica*.[2]

[1] Mon. Petrels, p. 61.
[2] Cf. Mathews, Birds Austr., v. 2, pp. 34, 35.

Fregetta grallaria (*Vieillot*): WHITE-BELLIED PETREL

Fregetta albigularis (*Finsch*): WHITE-THROATED PETREL

COUES—*Fregetta tropica*, I. 85, 91, in part.
SALVIN—*Cymodroma albigularis*, 364, 367.
GODMAN—*Cymodroma albigularis*, xxxviii, 68, pl. 19.

Fregetta mœstissima *Salvin*: SAMOAN PETREL

SALVIN—*Cymodroma mœstissima*, 364, 367.
GODMAN—*Cymodroma mœstissima*, xxxviii, 71, pl. 20.

PELECANOIDIDÆ: DIVING PETRELS

Key to the Species

Nasal tubes, jointly, shaped somewhat like a twin ellipse, and not very prominent ..... *Pelecanoides urinatrix*
Nasal tubes, jointly, heart-shaped and very prominent..... *P. garnoti*

Pelecanoides urinatrix (*Gmelin*): DIVING PETREL

COUES—*Pelecanoides urinatrix*, V, 190; *Pelecanoides Berardii*, V, 190.
SALVIN—*Pelecanoides urinatrix*, 437; *Pelecanoides exsul*, 437, 438.
GODMAN—*Pelecanoides urinatrix*, li, 299, pl. 86; *Pelecanoides exsul*, lii, 304, pl. 87.

The gray barring on the throat and jugulum of three Kerguelen Island specimens bears a strong resemblance to that in the gray-throated phase of *Puffinus opisthomelas*. A fourth Kerguelen specimen (68929 U. S. Nat. Mus.) has the gray chiefly restricted to the jugulum, in this respect nearly approaching the grayest specimen from New Zealand seas (No. 24361 Carnegie Mus.; Auckland Is.). Dr. Einar Lönnberg has suggested that the explanation of the white and gray phases (recognized in nomenclature as *P. urinatrix* and "*P. exsul*") is perhaps to be found in dichromatism.[1] The variation is certainly not sexual, and is apparently not due to age, for an Auckland Island specimen (No. 24362 Carnegie Mus.) going out of the natal down has the definitive feathers of the fore-neck immaculate white, while a New Zealand specimen (No. 24365 Carnegie Mus.), likewise going out of the natal down, has gray on the definitive feath-

[1] Contr. Fauna South Georgia, p. 74.

ers of the jugulum. As the specimens before me from New Zealand seas are not so conspicuously gray as the Kerguelen ones, it may be that geographic variation also enters as a factor, dichromatism being modified by geographic variation.

In the majority of the specimens I have examined, the first is the longest primary.

Pelecanoides georgica Murphy & Harper is not recognized, for the description fails to demonstrate the stability of the alleged specific characters.[1]

MEASUREMENTS (in millimeters)

No.	Locality	Phase	Sex	Chord of Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
68927 [2]	Kerguelen I.	Gray	♂	123	40	17	27	33
68928 [2]	"	"	♂	118	39	15	25	30
68931 [2]	"	"	♀	118	39	16	25	33
68929 [2]	"	"	—	116	38	17	25	31
24361 [3]	Auckland Is.	Intermediate	♂	112	39	14.5	23	29
24360 [3]	Mangare I.	"	♀	110	39	16	23	28.5
24364 [3]	Stephens I., N. Z.	"	♀	123	42	17	27.5	32.5
24363 [3]	" "	"	♂	135	45	17	27	34.5
151112 [2]	Chatham Is.	"	♂	114	39	16	24	31
17914	Otago, South I., N. Z.	"	♂	114	39	16	25	29.5
124682 [2]	Near Dunedin, N. Z.	White	—	115	39	16	23	29.5

Pelecanoides garnoti (*Lesson*): GARNOT'S DIVING PETREL

COUES—*Pelecanoides Garnoti*, V, 190.
SALVIN—*Pelecanoides garnoti*, 437, 439.
GODMAN—*Pelecanoides garnoti*, lii, 307, pl. 88.

The accompanying tables of measurements manifest that the length of the wing, supposed by Mr. Salvin and Dr. Godman to be a diagnostic character, can not be implicitly relied upon to distinguish *P. garnoti* from *P. urinatrix*.

MEASUREMENTS (in millimeters)

No. U.S. Nat. Mus.	Locality	Sex	Chord of Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
15464	Callao, Peru	♂	132	39	20.1	31	35.5
32106	Valparaiso	—	137	42	20	32	38
212020	San Gallan I., Peru	♂	127	37	20	33	37
212022	Independencia Bay, Peru	—	136	40	21	34	39
212023	Ballestas, North I., Peru	♀	126	39	19	32	35

[1] Cf. Bull. Amer. Mus. Nat. Hist., 1916, v. 35, p. 66.
[2] U. S. National Museum.
[3] Carnegie Museum.

Tabular Summary

DIOMEDEIDÆ ..... 11 species
- Diomedea *Linnæus* ..... 5 species
- Thalassarche *Reichenbach* ..... 5 "
- Phœbetria *Reichenbach* ..... 1 "

PROCELLARIIDÆ ..... 73 species

FULMARINÆ ..... 7 species
- Macronectes *Richmond* ..... 1 species
- Fulmarus *Stephens* ..... 1 "
- Priocella *Hombron & Jacquinot*.... 1 "
- Thalassoica *Reichenbach* ..... 1 "
- Petrella *Zimmermann* ..... 1 "
- Halobæna *Bonaparte* ..... 1 "
- Pachyptila *Illiger* ..... 1 "

PUFFININÆ ..... 45 species
- Pagodroma *Bonaparte* ..... 1 species
- Bulweria *Bonaparte* ..... 2 "
- Pterodroma *Bonaparte* ..... 24 "
- Procellaria *Linnæus* ..... 2 "
- Priofinus *Hombron & Jacquinot*.... 1 "
- Puffinus *Brisson* ..... 15 "

THALASSIDROMINÆ ..... 12 species
- Halocyptena *Coues* ..... 1 species
- Thalassidroma *Vigors* ..... 1 "
- Oceanodroma *Reichenbach* ..... 10 "

OCEANITINÆ ..... 9 species
- Oceanites *Keyserling & Blasius*..... 2 species
- Pealea *Ridgway* ..... 1 "
- Garrodia *Forbes* ..... 1 "
- Pelagodroma *Reichenbach* ..... 1 "
- Fregetta *Bonaparte* ..... 4 "

PELECANOIDIDÆ ..... 2 species
- Pelecanoides *Lacépède*..... 2 species

Total 86 species

VI

REMARKS ON THE SPECIES OF THE PACIFIC OCEAN ADJACENT TO NORTH AMERICA AND THE GALAPAGOS ISLANDS

Plates 5-17

Material.—This part of the paper is based primarily upon the results of the Expedition of the California Academy of Sciences to the Galapagos Islands during 1905 and 1906 in the schooner *Academy*. The Expedition was planned and organized by myself in my official capacity as Director of the Museum of the California Academy of Sciences. Mr. Rollo Howard Beck was placed in command of the Expedition and its marked success was due chiefly to his sound judgment, strength of character, great physical endurance, and skill as a collector and preparator. In the preparation of the bird skins he was assisted by Mr. Edward Winslow Gifford and Mr. J. S. Hunter. Mr. Gifford kept the ornithological diary, and the portions relating to the albatrosses and petrels are incorporated in substance in the following pages. His observations were recorded with great attention to detail and add much to our knowledge. The Expedition sailed from San Francisco on June 28, 1905, and returned November 29, 1906. On the outward voyage stops were made at various islands along the west-coast of Lower California and at San Benedicto, Socorro, Clipperton, and Cocos islands. A year and a day were spent at the Galapagos Islands and in the immediate vicinity. No stops were made during the homeward voyage. Owing to calms and unfavorable winds, it consumed sixty-five days. The ornithologists availed themselves of every opportunity to collect albatrosses and petrels at sea. During calms Mr. Beck was continually out in a skiff, and secured numerous specimens that are rare in collections.

The Galapagos Expedition material has been supplemented by specimens and notes taken by Mr. Beck off Point Pinos, California, at intervals between March 1, 1903, and July 13, 1910, while employed as chief field assistant of the California Academy of Sciences.

In some instances I have included observations made by Mr. Alexander Sterling Bunnell and Mr. Beck while on the Expedition of the California Academy of Sciences to the Revilla Gigedo Islands, Mexico, in the schooner *Mary Sachs*. The Expedition left San Francisco April 25 and returned August 13, 1903. It was planned and organized by myself, as Director of the Museum of the Academy. Unfortunately, all the specimens obtained were destroyed in the San Francisco conflagration of April, 1906.

During the autumn of 1911 I visited the principal museums of the United States and examined the albatrosses, petrels, and diving petrels in their collections. Many specimens have been lent to me by museums and individuals for comparison, and acknowledgment of this assistance has been made in my introductory remarks.

The specimens of albatrosses and petrels in the museum of the California Academy of Sciences number over two thousand, and at the time of this writing constitute the largest collection of these birds in the United States.

To bring to the work in hand fresh impressions of the bird life of the sea, I revisited Monterey, California, in December, 1912, and made numerous excursions in a gasoline launch to the ocean off Point Pinos.

Measurements.—With the exception of the few diving petrels, treated in part V, all the specimens were measured by my young friend, Mr. Edward Winslow Gifford, formerly Assistant Curator of the Department of Ornithology in the California Academy of Sciences and now Associate Curator of the Anthropological Museum of the University of California. Over thirteen thousand measurements were taken by him, forming a series unparalleled in the albatrosses and petrels. Unless otherwise stated, all measurements refer to specimens in the collection of the California Academy of Sciences. In measuring the wing from the carpal joint to the tip of the longest primary, the primaries were flattened against the surface of the rule, giving a dimension greater than the chord. The length of the culmen is the chord of the exposed culmen, and was taken with dividers. The depth of the upper mandible is the distance between the base of the exposed cul-

men and a point directly below it on the tomium, and the width of the upper mandible is the diameter at the base of the exposed sides of the mandible; the former dimension being taken with dividers and the latter with a 15 cm. caliper square. The length of the tail is approximate, and was obtained by inserting one point of the dividers into the base of the tail between the two middle rectrices and extending the other point to the end of the longest rectrix. In some instances the total length and the extent are given. They were taken in the flesh by the collectors, and have been copied by Mr. Gifford from the labels of the specimens.

Colors.—In determining colors, I have been guided by Mr. Ridgway's *Nomenclature of Colors* and his *Color Standards and Color Nomenclature.*

Synonymy.—The synonymy relates to the monographs of Dr. Coues, Mr. Salvin, and Dr. Godman, referred to at length in part I.

Diomedea nigripes *Audubon:* Black-footed Albatross

Coues—*Diomedea nigripes,* V, 178, 187; *Diomedea gibbosa,* V, 180, 187.
Salvin—*Diomedea nigripes,* 440, 445; *Diomedea gibbosa,* 455.
Godman—*Diomedea nigripes,* liv, 332, pll. 94, 95.

In his monograph Mr. Salvin includes *Diomedea gibbosa* Gould as one of the doubtful species yet to be identified,[1] overlooking Dr. Streets's remarks on the subject published nineteen years before.[2] All the characters of plumage ascribed to *"D. gibbosa"* were found by Dr. Streets in specimens of *Diomedea nigripes* captured at sea between Honolulu and San Francisco.

The eighty-one examples of *D. nigripes* in the collection of the California Academy of Sciences confirm the statements of Dr. Streets and also explain the peculiarities of bill set forth by Gould in the original description.[3] At one extreme of the series are birds having the abdomen and upper and lower tail-coverts dark, at the other are birds having these parts

[1] P. 455; cf. Sharpe, Hand-List, v. 1, p. 128, footnote.
[2] Bull. U. S. Nat. Mus. No. 7, p. 31.
[3] Ann. and Mag. N. H., 1844, v. 13, p. 361.

more or less white. A male (No. 10003, Monterey Bay, Calif., Aug. 2, 1907) typically exemplifies *"D. gibbosa"*. The abdomen and upper and lower tail-coverts are white, partially clouded on the abdomen by the gray tips of some of the feathers. The white of the head is much extended. The upper mandible is "swollen and raised" and "rises high up on the forehead." In another male (No. 10004, Monterey Bay, Calif., July 18, 1907) the bill is even more swollen, but the white of the abdomen and upper tail-coverts is obscured by the dark tips of the feathers. Like variations in the form of the bill occur in *D. irrorata*.

In some of the specimens new white feathers with dark tips have made their appearance beneath the surface in the posterior white areas. At first glance these sprouting feathers seem to be new dark ones appearing amongst the old white feathers. A similar stage in the moult evidently misled Mr. Salvin into the belief that dark birds are the adults.[1] In reviewing the British Museum material, Dr. Godman states in general terms that he fails to find support for Mr. Salvin's conclusion.[2]

While it is believed that the white coloration is due to advancing maturity and not to dichromatism, the specimens in the Academy's collection do not fully complete the chain of evidence. Judging from those in hand, the white of the abdomen and tail-coverts probably appears first at the base of the feathers, then extends with successive moults, finally prevailing over the dark color. Both on the head and the posterior parts the wear of the feathers assists in enlarging the white areas. The basal portions of the tail also probably whiten in the progress towards maturity. A Laysan Island female (No. 5615 Stanford Univ.), passing from the natal down into the definitive feathers, exhibits no trace of white on the abdomen and tail-coverts.

Although seven months of the year are represented in the dates of capture, the Academy's series is not strong except in July and November specimens; of the former there are eighteen and of the latter fifty-five. Three June specimens and the July ones are undergoing a moult that is apparently postnuptial.

[1] Monograph, p. 446.
[2] Mon. Petrels, p. 334.

In the November specimens, moulting is still progressing, old feathers are more or less prominent, and in some instances new feathers have begun to fade. Twelve of the November specimens are much worn and bleached, having lagged far behind in the renewal. In fresh plumage, the forehead, back of the white frontal feathers, is light gray, shading into sooty gray on the crown, occiput, cervix, and sides of neck; the jugulum is lighter sooty gray, changing into pale drab-gray on the breast, cheeks, and throat, finally becoming very pale gray on the chin; the sides are dark drab-gray and the interscapulars are sooty gray with slightly lighter margins. Authors as a rule have overlooked this fresh plumage, and have described faded birds of a brownish cast. No. 1288 C. A. S. has fourteen instead of twelve rectrices.

In this species there is a lack of uniformity in the order of renewal of the primaries; a fact which Dr. Stone has already brought to the attention of ornithologists.[1]

The appended table exhibits the dimensions in millimeters of twenty-eight males and forty-nine females. Owing to loss of primaries in moulting, the wing measurement was not taken in five males and six females.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum...	♂	533	162	113	30.3	34.5	94.5	130
Minimum...	♂	488	130	102	26.6	30	87.2	116.9
Mean.....	♂	515	144	108.3	28.8	31.7	91	123.5
Maximum...	♀	530	150	110.4	29.9	33	93	129
Minimum...	♀	485	130	94.4	26	27.1	80.9	109
Mean.....	♀	506	141	101.2	27.8	29.8	85.6	117.6

As in *Diomedea irrorata,* the females average smaller than the males.

During the southward voyage of the schooner *Academy,* Black-footed Albatrosses ceased being common about latitude 28° N. The last, two individuals, were seen July 21, 1905, in latitude 23° 32′ N., longitude 113° 4′ W. On the home voyage, they were picked up again on November 1, 1906, in latitude 26° 24′ N., longitude 126° 23′ W. On November 18,

[1] Proc. Acad. Nat. Sci. Phila., 1900, pp. 14, 15.

latitude 35° 14′ N., longitude 132° 49′ W., they were particularly common, a score or more often being in attendance on the *Academy;* eighteen were caught with hook and line. During the Revilla Gigedo Expedition, in 1903, the last one on the passage south was seen May 9 off Natividad Island, about latitude 27° N. On the return voyage the first were met with July 19, in latitude 24° N., longitude 122° W. Mr. A. W. Anthony reports a solitary individual in May in the vicinity of Clarion Island, about latitude 19° N.[1] It therefore appears that the southern boundary of this albatross's range on the American side of the Pacific is near the Tropic of Cancer.

Inshore in the latitude of middle California, Black-footed Albatrosses are apparently of irregular occurrence, but offshore they seem to be present the year round, indicating that all the individuals of the species do not occupy the breeding stations at the same time of the year.

Diomedea albatrus *Pallas:* Short-tailed Albatross

Coues—*Diomedea brachyura,* V, 177, 187; (?) *D. leptorhyncha,* V, 178, 187.
Salvin—*Diomedea albatrus,* 440, 444.
Godman—*Diomedea albatrus,* liii, 326, pl. 92.

It has not been satisfactorily determined how far south this albatross ranges, several other albatrosses having been confounded with it. Dr. Brewer's account of this species in *The Water Birds of North America* clearly relates to three albatrosses, the Short-tailed, the Black-footed, and the Laysan.

Off Point Pinos, California, I found the Short-tailed Albatross quite common in December, 1894, and January, 1895,[2] and again during the latter half of September, 1896.[3] It seems, nevertheless, to be of irregular occurrence in that vicinity, for it escaped the observation of Mr. R. H. Beck during several seasons between 1903 and 1910, and was not met with by myself during December, 1912. Its presence off Southern California is well authenticated. However, in some instances the Laysan Albatross may have been mistaken for

[1] Auk, v. 15, p. 317.
[2] Proc. Calif. Acad. Sci., 2d ser., v. 6, p. 25.
[3] Proc. Calif. Acad. Sci., 3d ser., Zool., v. 2, p. 319.

the boreal bird. Several years ago I examined in the Field Museum of Natural History two specimens of the Short-tailed Albatross (No. 33501 and No. 33502) from "San Martin, Lower California," and in the Carnegie Museum a single specimen (No. 21881) from "Rosario Bay, L. C."

The eggs are apparently unknown. Dr. Godman in his *Monograph of the Petrels* ascribes a dozen time-honored specimens from the Bonin Islands to this species, but the Bonin Islands are within the range of the Laysan Albatross. It is probable that the breeding grounds will be found above latitude 50° N., for Dr. Dall has reported "the mutilated carcass of a very young one, in August, at Atka."[1]

When at the United States National Museum in 1911, I failed to find the skull upon which *Diomedea leptorhyncha* Coues was founded, the specimen having been mislaid or lost.

The records of the occurrence of the Wandering Albatross in the region embraced by the present section of this paper are not satisfactory.

Diomedea irrorata *Salvin:* GALAPAGOS ALBATROSS

Plates 6-12

SALVIN—*Diomedea irrorata*, 440, 445, pl. 8.
GODMAN—*Diomedea irrorata*, liv, 330, pl. 93.

Mr. Gifford's observations tend to show that this albatross is absent from the immediate vicinage of the Galapagos Islands for a portion of the year, particularly December, January, and February. As the type and a second specimen (No. 212017 U. S. Nat. Mus.) were obtained on the coast of Peru in December,[2] it is not improbable that this species has a migration in the Southern Hemisphere corresponding to that of the Black-vented Shearwater in the Northern Hemisphere, a migration after the breeding season in a direction not towards, but away from the Equator.

Mr. Gifford's notes in substance are as follows: They were rather common at sea in the southern portion of the archi-

[1] Proc. Calif. Acad. Sci., v. 5, p. 277.
[2] The type is a male and was secured by Admiral A. H. Markham at Callao Bay (P. Z. S., 1883, p. 430). The U. S. National Museum specimen is a female and was taken by Dr. Robert E. Coker at Lobos de Tierra.

pelago, but elsewhere offshore only occasional individuals were met with. Two were seen June 22, 1906, about forty miles south of Charles Island, two September 14, 1906, near Tower Island, in the Northern Hemisphere, two September 23, 1905, about seventy-five miles southeast of Chatham Island, and one near Brattle Island on October 30, 1905. These outlying birds roughly define the range as noted by Mr. Gifford. Away from the Galapagos Islands, there are apparently no records of occurrence save those mentioned above from the Peruvian coast.[1]

The first visit to the rookery on Hood Island was made during the last week in September, 1905. Many addled eggs and many adult birds in worn plumage were found, but only one young-of-the-year, a male passing out of the down. Every time the parent snapped its bill, this youngster would bow its head until its bill touched the ground. Salutations seemed to be the vogue. Whenever one bird passed another, each would snap its bill, apparently in greeting. When the sun was hot, the albatrosses often sought shelter in the shade of the bushes, sitting flat on the ground. A single instance of revival of the erotic ardor was witnessed. The apparent absence of the young-of-the-year during this visit is surprising, particularly as the Webster-Harris Expedition met with them in numbers during the last week of October, 1897.[2]

As before mentioned, a hiatus apparently occurred after the season of reproduction, not a single albatross being seen between November and May. A visit to Hood Island during the first week of February, 1906, revealed only addled eggs and feathers.

The last week of June, 1906, thousands were breeding on the southern part of Hood Island, occupying the open spaces among the bushes and rocks (plates 6-8), from the shore back to an elevation of three or four hundred feet. Some shared the nesting quarters of the Man-o'-war-birds (plate 6). Generally they had no neighbors except an occasional booby. The season for fresh eggs was nearly over, only two being taken;

[1] Since the account of this species was completed, additional occurrences off Peru have been reported—see Paefsler, J. f. O., 1913, v. 61, pp. 42, 45; 1914, v. 62, p. 277.
[2] Nov. Zool., v. 6, p. 99.

but eggs in an advanced stage of incubation and birds a week or two old were abundant. The single egg was laid on the bare ground, usually in a slight depression.

The nestlings sat bolt upright or lay stretched out on the ground. When the sun was out they moved about a little. The old birds were very solicitous in the care of the young, sheltering them during drizzling weather and warning off Galapagos Hawks or human intruders by snapping the bill threateningly.

The breeding grounds appear to be restricted wholly to Hood Island, no evidence of breeding being discovered on any of the other islands.

The curious albatross pastime, variously styled billing, fencing, and dancing, was of constant occurrence on Hood Island in September, 1905, and June, 1906; although the view was obstructed by rocks and bushes, a glance anywhere over the rookery always revealed one or more pairs in action. Standing opposite one another, each bird threw its head up, the bill in this position being nearly or quite vertical, then the pair bowed, then fenced for perhaps a minute, using the bills as foils. Other features were often added, which did not seem to have any regular order. In these the birds usually performed alternately. While one was doing the stunt, the other assumed a statuesque pose, standing very erect, intently watching the performance. At its conclusion, the two joined in a fencing bout. Then the second bird performed, and afterwards the fencing was repeated, and so on to the finale. The additions were as follows: 1. Bird touched ground beside it with bill; 2. Mouth was opened very wide; 3. Bill was pointed straight upward and a moaning note uttered; 4. Bird reached around and touched wing with bill. Occasionally a third bird took part at the beginning, but one soon dropped out. Sometimes two birds go through the fencing exercise with one or both sitting (plate 7). Often when a person bows to an albatross immediately after a performance, the bow will be returned.

When disturbed, these albatrosses displayed signs of anger by raising the feathers of the head, notably those over the eyes

(plate 8), and by viciously snapping the bill. On one occasion when a bird was being chased, its mate left the egg and followed in pursuit for fifteen or twenty yards, menacing with its bill.

Unlike the Black-footed Albatross of northern waters, this species usually gave the schooner *Academy* a wide berth. One day when anchored at Barrington Island in July, two or three individuals came to the vessel, attracted by some seal fat that was being thrown overboard. Only one, however, overcame its caution sufficiently to alight and feed.

In walking, the gait was slow and the head was swayed from side to side, in a way keeping time with their steps. They were often seen standing with their tarsi flat on the ground, as ostriches are wont to do in confinement.

"The adults have a hoarse croaking note which seemed to be used in anger and in talking to the young and to each other. Often an adult would look down at its young and utter several hoarse notes." Another note was a sort of moan uttered when alone or when in company with another bird and usually with neck outstretched and bill pointing upwards. The young, a few days old, had a kind of chuckle which was given in a rather high key.

At Hood Island the stomachs of the adults were often empty. Many were filled with a greenish or a brownish oily fluid about the consistency of milk. When molested, the old and young ejected this fluid; in several instances old birds also disgorged the remains of squid. The young were fed by regurgitation, the lower mandible of the parent serving as a sort of dish. Internal parasites were found in the alimentary tract of adults.

The Expedition brought back seventy-seven specimens of this albatross, sixty-five adults and eight nestlings in the skin, two adults in the flesh in formalin, and two skeletons of adults. With the exception of an adult male from the vicinity of Barrington Island, taken July 10, 1906, all were obtained on Hood Island between September 24 and October 3, 1905, and between June 23 and July 3, 1906.

The eight nestlings exhibit a definite dichromatism; a light phase, typically manifested in No. 1180, female, June 28, and

a dark phase, typically manifested in No. 1185, male, June 30. The general aspect of the former is light drab-gray; that of the latter dark drab, medially lighter below and varied with dull cream color above, especially anteriorly (plates 9, 10). Both specimens are densely clothed in primary natal down. The secondary natal down is beginning to appear on the lower parts. Obviously, the dual coloration is not caused by the wearing off of a terminal segment of down. The specimens are also in the egg tooth stage. Their dimensions are: light phase, culmen 34.7 mm., tarsus 20, middle toe and claw 27.5: dark phase, culmen 39.3 mm., tarsus 22, middle toe and claw 30.5. No. 1183, June 25, is similar to No. 1180.

No. 1181, extreme light phase, male, June 30, is considerably larger than the specimens described, the culmen measuring 55 mm., tarsus 35.6, middle toe and claw 45. The secondary natal down is well advanced, and the primary natal down is much worn on the lower parts, particularly on the abdomen, which is nearly bare. This specimen was prepared by Mr. Beck especially to show the natal down of the upper parts as it appears in life (plate 11). On these parts and on the jugulum and sides of neck the primary natal down is united apically into tufts, the apex of each tuft appearing as if it had been twirled between the fingers. In color the tufts are light drab-gray, subterminally creamy white, and often apically dark brown. The creamy white predominates on the jugulum, sides of neck, and anterior upper parts, and the dark brown is most conspicuous on the top of the head, cervix, and sides of the neck. The chin, throat, lores, and circumocular region are nearly naked. Posterior to the jugulum, the worn primary natal down of the lower parts is light drab-gray. On most of the areas the secondary natal down is lighter than the basal part of the primary natal down.

Of the other June and July nestlings, No. 1182 is in the light phase, and Nos. 1184 and 1205 are intermediate, the former inclining to the dark and the latter to the light phase. All have entered the double-down state.

No. 1204 (dark phase, male, September 25, culmen 98 mm., tarsus 73, middle toe and claw 90.3) is passing from the natal

down into the postnatal plumage. On the upper parts, hidden beneath the natal down, dark mouse gray scapulars and white postnatal down have made their appearance. On the breast and sides contour-feathers like those of the darker breeding birds are emerging at the base of the secondary natal down. The chin is nearly bare and the throat rather sparsely covered with dark brown natal down, interspersed with filoplumes, which are also present on the sides of the head. The bill is similar in shape to that of an adult, but in all the other nestlings it is strongly decurved. According to Mr. Gifford, the color of the bill in nestlings was dark olive, tipped with a lighter tint of olive. Heretofore, nestlings of this species have been undescribed.

There is considerable variation in the general form and proportions of the bill in the series of breeding albatrosses taken on Hood Island during the eight days ending July 2, 1906. For example, the basal width of the upper mandible in Nos. 1199 and 1221 (both males) is respectively 35.2 mm. and 31 mm., and the depth of the concavity of the culmen in Nos. 1208 and 1225 (both females) is respectively 6.5 mm. and 2.5 mm. (plate 12). It is evident that the value of structural bill characters in the albatrosses can be fully determined only by the study of extensive series.

The plumage of the breeding birds varies considerably in color and differs somewhat from the descriptions in the books. There is no "slight shade of grey on the sides of face and over the eyes," as is stated by Dr. Godman to be the case in the type.[1] It may be that this gray coloration is peculiar to the fresh plumage. The white of the head and neck is more or less tinged with yellow, intensified on the anterior portion of the jugulum. In several specimens the forehead is decidedly yellow. The yellow wash of top of head, cervix, and side of neck varies; in some specimens it is Naples yellow, in others buff-yellow, and in others still both colors are present. The scapulars and interscapulars are plain smoky-brown in certain specimens. The light and dark markings of the upper back, sides

[1] Mon. Petrels, p. 331.

of breast, and upper and lower tail-coverts are much coarser in some examples than in others. Their relative prominence also varies, giving the surfaces as a whole a lighter or darker appearance. The general aspect of the lower parts is lighter in some specimens and darker in others. In the extreme light manifestation, the breast, abdomen, and sides are finely vermiculated with white and gray, growing darker laterally and posteriorly. In the extreme dark style the vermiculations are coarser and the flanks and abdomen are nearly uniform dark gray. The tail is smoky-brown, becoming white on the concealed portion. "The colors of the naked parts of the adults in life were as follows: Bill yellow; bare skin in interramal space azure blue; iris dark brown; orbital ring black; feet pale bluish" (*Gifford*). No. 1237 C. A. S. has thirteen rectrices.

One specimen, obtained June 28, is in good feather, and is apparently just finishing a moult. In two other summer specimens the plumage is in fair condition, but in the rest of them it is worn. The autumn specimens are generally much worn, and many of them are replacing the feathers of the breast and abdomen, the postnuptial moult having commenced.

In the subjoined table are the dimensions in millimeters of twenty-two males and forty females.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum...	♂	593	158	160	33.6	36	103	138
Minimum...	♂	550	137	142	30.3	31	91	125
Mean.....	♂	568	147	151.4	31.7	33.5	95	131.8
Maximum...	♀	586	150	156.8	32.7	34	99.9	135
Minimum...	♀	510	129	134.2	28	29.5	87	116
Mean.....	♀	547	139	141.4	30.5	32	92	125

In the flesh the length of five males in millimeters was 890, 890, 905, 920, 935 and of four females 850, 865, 870, 870. The extent in a single male was 235 cm. and in a female 232 cm.

It is apparent from the measurements given above that the females average smaller than the males.

DETAILED MEASUREMENTS (in millimeters) OF SPECIMENS TAKEN ON HOOD ISLAND DURING THE EIGHT DAYS ENDING JULY 2, 1906

No.	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
1174	♂	570	150	156.5	33.6	32.1	93	131.6
1199	♂	579	146	146	31	35.2	97	128.4
1201	♂	570	156	150	31.2	32.5	93	130
1209	♂	559	146	149.8	32.2	33	91	129.9
1213	♂	565	145	158.8	32.1	32.9	95.5	135.5
1214	♂	575	158	151	31.4	33.3	94	133
1221	♂	593	148	148	31	31	97	131
1223	♂	565	143	154	31.5	33.9	93.2	129.7
1230	♂	566	145	157	31.1	34.6	94	127
1233	♂	585	153	155	31.9	34.4	97.8	136.8
1234	♂	577	142	156	31.6	33.7	97	138
1239	♂	582	152	154	32.2	34	103	137
1243	♂	550	144	149	33	33.9	94	125
1246	♂	575	153	160	30.3	33.4	94.5	130
1175	♀	552	139	147	31.2	31.6	93.5	127.4
1179	♀	558	148	134.8	29.8	30.9	93	125.5
1190	♀	556	136	140	30	30	91.5	123
1195	♀	544	136	143.3	29.9	31.4	88.5	124
1196	♀	538	140	140.6	31.6	33	94.3	131
1197	♀	542	137	137.3	30.3	32.6	91	124
1200	♀	540	139	142	31.9	33.5	91.5	122.5
1202	♀	552	134	142	31.2	31.9	93	126.3
1208	♀	560	144	143	31	32.5	92.9	128.2
1211	♀	540	134	138	29.6	31.2	89.8	124
1225	♀	536	139	148.8	31	32.7	92	122.1
1226	♀	551	139	136.3	29.8	33.2	92.4	122
1235	♀	538	139	145.9	31.6	31.1	94.4	126.9
1236	♀	543	136	139	30.1	32	90	126
1237	♀	555	134	141.2	30.1	32.3	90.9	124
1238	♀	535	140	137.3	30.4	32.6	89.5	121.4
1242	♀	558	142	138	30.1	33.4	88.3	121.5
1244	♀	565	146	142.9	32.6	31.3	91.3	128.6
1245	♀	556	142	144.8	30.9	30.6	93	131.4

Eight badly bleached eggs of this species were preserved in addition to the two fresh ones previously referred to. All were collected on the same day, June 27. They exhibit considerable variation in form, ranging from nearly oval to elliptical oval, elliptical ovate, and elongate ovate. The two fresh specimens have a dull whitish ground. The larger end of each is irregularly capped with more or less confluent spots, lines, and blotches of cinnamon-rufous and bay. The remainder of the shell is speckled with the same colors. The specimens measure in millimeters: 99.6 x 65.5; 103.4 x 72; 105.4 x 67.5; 107.4 x 68.6; 108.1 x 70.5; 108.4 x 64.4; 108.7 x 66.5; 108.8 x 69.6; 111.7 x 69; 112.5 x 68.7.

Diomedea immutabilis *Rothschild:* LAYSAN ALBATROSS

SALVIN—*Diomedea immutabilis*, 440, 446.
GODMAN—*Diomedea immutabilis*, liv, 336, pl. 96.

Since Mr. Anthony's announcement[1] of the capture of a specimen on March 17, 1897, "between San Geronimo Island and Guadalupe Island," Lower California, information concerning the presence of this species in North American waters has not been forthcoming.

None were encountered by the Galapagos Expedition on the way south, late in June and early in July, 1905, but during the homeward voyage, in 1906, two males in worn livery were taken. One of them, which was the first individual met with, was shot on November 3 in latitude 26° 51′ N., longitude 126° 52′ W.; the other was shot on November 14 in latitude 33° 7′ N. and longitude 134° W., off southern California. According to Mr. Gifford's observations, nine others were seen. The last one was noted on November 24 in latitude 37° 55′ N., longitude 132° 37′ W. "It circled about astern a good many times over three or four Black-footed Albatrosses that were resting on the water." While it is possible that some of the white albatrosses seen may have been the Short-tailed, a mistake could hardly have been made in those closest at hand.

If pelagic birds occurring on the high sea a few hundred miles offshore are to be considered Californian, then the Laysan Albatross should hereafter be included in the list of California birds.

Dr. Tarleton H. Bean has reported the Spectacled Albatross (*Thalassarche melanophris*) from the northeast Pacific on the strength of a solitary white albatross seen by him on October 31, 1880, in latitude 40° 30′ N., longitude 142° 23′ W.[2] This position is within the probable range of the Laysan Albatross, which was undescribed at the time of Dr. Bean's writing, and which is sufficiently like the Spectacled Albatross in color to be mistaken for it. Without comment, Dr. Godman relegates the record to the synonymy of *D. immutabilis*.

In two males and a female (Nos. 5611, 5613, 5610 Stanford Univ.), obtained during the latter part of May on Laysan

[1] Auk, v. 15, p. 38.
[2] Proc. U. S. Nat. Mus., v. 5, p. 170.

Island, the top of head, cervix, and sides of neck are tinged with yellow, and the malar region, auriculars, chin, and throat are more or less tinged with gray. The yellow is faintly indicated in the two November males of the Expedition (Nos. 1315, 1316). These peculiarities of coloration are not noted in the original description of the species or in the other descriptions consulted.

The five specimens of *D. immutabilis* mentioned above yield the following measurements in millimeters:

No.	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
1315	♂	491	136	100	25.3	27	81.5	110.4
1316	♂	474	133	111.9	26.1	28.9	80	107
5611[1]	♂	500	150	108	27	30.4	84.8	116
5613[1]	♂	493	151	108.5	28.2	33	84.8	119.5
5610[1]	♀	495	146	102	27.1	31.5	82	112

Thalassarche culminata (*Gould*): Culminated Albatross

Coues—*Diomedea culminata*, V, 183, 188.
Salvin—*Thalassogeron culminatus*, 449, 451; *Thalassogeron eximius*, 449, footnote.
Godman—*Thalassogeron culminatus*, liv, 354, pl. 101; *Thalassogeron eximius*, liv, 360.

Audubon says: "A skin of this bird was sent to me by Dr Townsend, who procured it in the Pacific Ocean, not far from the mouth of the Columbia River."[2] This specimen is preserved in the United States National Museum; its catalogue number being 2726.

Dr. Brewer remarks: "Dr. Cooper has, however, seen a skull answering to the description of that of this species in the collection of the Academy of Natural Sciences in San Francisco. It was taken by Dr. W. O. Ayres from a dead specimen found on the outer beach near the Golden Gate."[3] This skull, wanting the lower jaw, was in the research collection lost by the Academy in the Conflagration of April, 1906. Its label established its identity as the Ayres specimen. The culmini-

[1] Stanford Univ.
[2] Orn. Biog., v. 5, p. 326.
[3] Water Birds N. A., v. 2, p. 359; cf. Cooper, Proc. Calif. Acad. Sci., v. 4, p. 12.

corn and latericorn were largely intact, enabling me to corroborate the original identification. Dr. Ayres was one of the earlier members of the Academy and well-known in his day as an ichthyologist.

"A specimen of this Albatross said to have been procured in the Bay of Panama by Mr. Bridges is in the collection of the British Museum."[1]

Capt. R. Paefsler has recently recorded the occurrence of this species in latitude 5° 1′ S., longitude 81° 1′ W.[2]

So far as I am aware, there are no other records for the region under consideration.

Gould's type (now in the Academy of Natural Sciences of Philadelphia) and original description appear to me to be a surer means of determining the specific name of the present species than J. R. Forster's original *D. chrysostoma* description, which is not altogether definite when *T. bulleri* is considered.[3] Forster's *chrysostoma* is therefore rejected and Gould's *culminata* retained.

The original account and plate[4] clearly manifest that *Thalassogeron eximius* Verrill was based primarily upon a misunderstanding of the bill characters of *T. culminata* and *T. chlororhynchos.* The account states that the supposed new species is more closely related to *T. chlororhynchos* than to *T. culminata,* while figure 2 of the plate plainly shows that the culminicorn is rounded at the base as in *T. culminata,* and not pointed as in *T. chlororhynchos.*[5] The color characters assigned are of the sort occurring commonly in variations that are not of specific import. *"T. eximius"* is therefore consigned to the synonymy of *T. culminata.*

Thalassogeron desolationis Salvadori has apparently no better support than such shadowy characters as variation in the length of the outer toe and in the width of the membrane at the base of the culminicorn.[6]

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[1] Biol. Centr.-Amer., Aves, v. 3, p. 438; refer also to Salvin's monograph, p. 451. According to Dr. Dall, Thomas Bridges was in Panama in 1855 (Memorial Sketch, Proc. Calif. Acad. Nat. Sci., 1866, v. 3, pt. 3, p. 236).

[2] "Den 13. Mai in Paito in 5, 1° S 81, 1° W: *Oceanites tethys, Puffinus griseus, Thalassogeron culminatus* viele." J. f. O., 1913, v. 61, p. 50.

[3] Cf. Mém. Math. et Phys. prés. Acad. Roy. Sci. [Paris], 1785, v. 10, p. 571, pl. 14; Mathews, Birds Austr., v. 2, p. 278.

[4] Trans. Conn. Acad. Art. Sci., v. 9, pp. 440-443, pl. 8.

[5] Cf. Salvadori, Ibis, 1914, p. 504.

[6] Cf. Salvadori, Ibis, 1914, p. 506; orig. descr., Boll. Mus. Zool. Anat. comp. Univ. Torino, 1911, v. 26, No. 638, p. 2.

Phœbetria palpebrata (*J. R. Forster*): SOOTY ALBATROSS

COUES—*Phœbetria fuliginosa*, V, 186, 188.
SALVIN—*Phœbetria fuliginosa*, 453.
GODMAN—*Phœbetria fuliginosa*, Iv, 363, pl. 103; *Phœbetria cornicoides*, Iv, 367.

"The skin from which I made my drawing of this species was prepared by Dr Townsend, who procured the bird near the mouth of the Columbia River."[1]. This historic record of Audubon appears to be the only one which comes within the limits defined in the present part of this paper. The specimen mentioned is now housed in the United States National Museum; bearing the catalogue number 2718.

Dr. Godman recognizes two species in the genus *Phœbetria*. Of the lighter of these supposed species, he states: "It may at once be distinguished by its grey-brown back and underside; the groove, too, in the under mandible is smaller and narrower and in most specimens is of a pale blue."[2] The gray aspect of the plumage is not necessarily of specific significance; that it is not a mere color phase remains to be proved. The variation in the bill is not more singular than that displayed in *Diomedea albatrus*,[3] *Diomedea nigripes*, and *Diomedea irrorata*. As shown in part IV, distribution is a factor in dichromatism.

Macronectes giganteus (*Gmelin*): GIANT FULMAR

COUES—*Ossifraga gigantea*, III, 32.
SALVIN—*Ossifraga gigantea*, 422.
GODMAN—*Macronectes giganteus*, xlix, 261, pl. 76.

So far as known to me, there is but a single record supported by a specimen for the region in question. It is by Audubon, and is as follows: "A specimen of the Gigantic Fulmar, shot at some distance from the mouth of the Columbia River, has been sent to me by Dr Townsend, along with those of the other species of the same genus described in this volume, and which it resembles in form and proportions."[4] The specimen is now in the United States National Museum, catalogued as No. 2743.

[1] Orn. Biog., v. 5, p. 116.
[2] Mon. Petrels, p. 367.
[3] Cf. Shufeldt, Auk, v. 2, p. 175.
[4] Orn. Biog., v. 5, p. 330.

Mr. Cassin, in his report on the birds of the Wilkes Expedition, says: "This large species was frequently observed during the voyage of the Expedition, and is entitled to be regarded as a bird of North America, specimens in the collection having been obtained on the coast of Oregon."[1] I found no specimen in the United States National Museum substantiating this statement. Dr. Richmond, after kindly examining the Museum archives for me, writes, "I can find no record of *Macronectes giganteus* from Oregon in our catalogues. There are records of three specimens collected by the U. S. Exploring expedition; two of them have no localities given in the catalogues, and the third is from Orange Bay, Tierra del Fuego."

In conversation with Dr. Cooper, several years before his death, I learned that his notice[2] of the occurrence of the Giant Fulmar near Monterey, California, was not based upon examples actually in hand, but merely upon birds seen in the vicinity of the whale fishery, and that his identification was inadequate, the style of the nasal tubes not being noted. In all probability, the birds observed were Black-footed Albatrosses, which are not mentioned by him as being among those species attracted by the scraps from the "try-works" of the whale fishery.

Fulmarus glacialis (*Linnæus*): Fulmar

Coues—*Fulmarus glacialis*, III, 27; *Fulmarus pacificus*, III, 28; *Fulmarus Rodgersii*, III, 29.
Salvin—*Fulmarus glacialis*, 424, 425; *Fulmarus glupischa*, 424, 427; *Fulmarus rodgersi*, 424, 427.
Godman—*Fulmarus glacialis*, xlix, 265, pl. 77; *Fulmarus glupischa*, 1, 270, pl. 78; *Fulmarus rodgersi*, 1, 273, pl. 79.

On the home voyage of the Expedition, the first Fulmar was secured on November 9 off Lower California in latitude 30° 30′ N., longitude 130° 55′ W. According to Mr. Gifford's notes, Fulmars were observed almost every day thereafter up to the 26th, in latitude 36° 43′ N., longitude 129° 31′ W. Seventeen specimens were preserved. All of them are of the dark phase.

In the vicinity of Point Pinos, California, individuals have been noted by Mr. Beck or myself in nearly every calendar

[1] U. S. Expl. Exp., 1858, p. 407.
[2] Amer. Nat., v. 4, p. 758.

month. The July and August birds, however, appear to be mere loiterers out of health. Visitors from the breeding grounds do not begin to arrive in force before October. In November and during winter they often become very common, but they are extremely irregular, and even a season may pass with few or none being met with. Usually the dark phase greatly outnumbers the light. In 1904, Mr. Beck found Fulmars common as late as April 15.

The Academy's series of two hundred and fifty-seven Pacific specimens, chiefly from the vicinage of Point Pinos, California, throws considerable light on the various plumages assumed by this species.

It is made evident by this series that *Fulmarus rodgersi* Cassin is merely a nominal species. The intergradation is complete between birds of the light phase having the upper parts smoky gray, lighter on top of head and hind neck, and birds having mantle, tail, and inner webs of primaries almost wholly white.

In my second paper on California water birds, attention was called to an extreme example of the light phase from San Francisco Bay having the mantle entirely white.[1] According to Dr. Godman, "occasionally pure white individuals are met with"[2] on the North Atlantic, evidencing that the whitening of the mantle is not confined to birds breeding in the vicinity of Bering Strait.

As specimens of the Academy's series grade from apparently immature birds into those with the white mantle, it is probable in the light phase that the whiter birds are the more aged. This, however, can not be proved conclusively from available material, collected as it has been on the ocean remote from breeding stations, with no examples showing the transition from the natal down to the definitive feathers. In short, it apparently remains to be determined by specimens whether the birds of the light phase grow whiter with age or whether they pass from the natal down to the various aspects of that phase without intermediate stages; with age eliminated, there would then remain dichromatism and geographic variation as possible factors.

[1] Proc. Calif. Acad. Sci., 2d ser., v. 6, p. 27.
[2] Mon. Petrels, p. 267; see also pl. 77.

In the Academy's series, the coloration in the dark phase ranges from dark mouse gray to smoke gray above, and from drab-gray to pale smoke gray below. In the light phase the coloration ranges from nearly uniform white to olive-gray above, and from all white to white suffused with gray below. Between pale examples of the dark phase and dark examples of the light phase are intermediates not readily assignable to either phase. Whether the connecting birds are immature or not is an open question.

In extreme light birds, the white of the mantle is increased by bleaching and wearing off of the gray tips of the feathers. Faded examples of dark birds are not uncommon in fall and winter, the fulmar grays apparently not being very resistant. No. 9983 C. A. S., dark phase, is somewhat albinistic, having a large irregular white patch on the posterior portion of the crown.

Many specimens, at least, have a series of distinct striæ on the inner side of the upper mandible.

In the following table are given the dimensions in millimeters of two hundred and thirty-two Pacific specimens, eighty males and one hundred and fifty-two females.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	323	124	40.7	14.4	20.5	51.8	71
Minimum	♂	285	106	34.6	11.8	15.3	43	58
Mean	♂	307	114	37.8	13	17.5	46.5	63.5
Maximum	♀	322	122	40	13.8	18.6	48	67.2
Minimum	♀	280	99	32.5	10.5	14.1	39.5	52.1
Mean	♀	302	112	36	12.2	16.5	43.8	61.1

Inasmuch as the females average smaller than the males, it is obvious that Mr. Anthony in proposing *"Fulmarus glacialis columba,"* based on the dimensions of six females, mistook sexual variation for geographic variation.[1]

Forty typical examples of the two phases show the following measurements in millimeters.

Light phase: Ten males; wing 299-322 (314); tail 113-122 (117); culmen 36-40.6 (38.6); depth of upper mandible 12.2-

[1] Cf. Auk, v. 12, p. 107.

14 (13.3); width of upper mandible 16-18.9 (17.4); tarsus 46.6-51.8 (48.8); middle toe and claw 60.2-71 (65.7).

Dark phase: Ten males; wing 293-319 (306); tail 106-121 (113); culmen 36.1-39.7 (38.4); depth of upper mandible 12.2-14.1 (13.1); width of upper mandible 15.5-18.7 (17.2); tarsus 43-49 (45); middle toe and claw 58-68.1 (63.7).

Light phase: Ten females; wing 304-318 (312); tail 107-122 (116); culmen 34.6-39.1 (36.5); depth of upper mandible 11.8-13.8 (12.6); width of upper mandible 15.8-18.6 (17); tarsus 44-46.7 (45.3); middle toe and claw 61.4-64 (62.6).

Dark phase: Ten females; wing 288-312 (301); tail 107-116 (112); culmen 34.9-37.8 (36); depth of upper mandible 11-13.6 (12.2); width of upper mandible 14.9-17 (15.9); tarsus 41.2-46 (43.1); middle toe and claw 58-65 (61.7).

As shown in the foregoing measurements, the dark phase averages somewhat smaller than the light phase.

Priocella antarctica (*Stephens*): SLENDER-BILLED FULMAR

COUES—*Thalassoica glacialoides*, III, 30, V, 192.
SALVIN—*Priocella glacialoides*, 393.
GODMAN—*Priocella glacialoides*, xliii, 165, pl. 43.

In their monographs Mr. Salvin and Dr. Godman treat *Fulmarus antarcticus* Stephens and *Procellaria glacialoides* A. Smith as being synonymous, but they ignore the priority of the former name over the latter one.

Audubon's account shows that Dr. Townsend, so far as positively known, captured but a single specimen of the Slender-billed Fulmar off the Oregon coast, and that the manuscript note appended to this specimen applied also to the Fulmar.[1] "Within a day's sail from the mouth of the Columbia River," is given as the position where the specimen of the Slender-billed Fulmar was taken. Several years ago I examined this specimen at the United States National Museum along with other Townsend Tubinares preserved in that institution.

Mr. Cassin, in his Wilkes Expedition report, makes the following statement: "The only specimen in the collection of the

[1] Cf. Orn. Biog., v. 5, pp. 331, 333.

Expedition is labelled as having been obtained on the coast of Oregon."[1] Concerning the status of this specimen in the United States National Museum, Dr. Richmond writes me as follows: "There is one *Priocella glacialoides* recorded from Oregon, No. 15707 (ex U. S. Expl. Exped.), but I cannot find the specimen in our skin series. It may have been sent away years ago—possibly to the Boston Soc. of Nat. History. We sent between 200 and 300 Exploring Exped. specimens to that Society in the '60s, but I have not been able yet to find a record of the individual specimens. We have, of course, Audubon's type of *Proc. tenuirostris* (U. S. N. M. No. 2032)."

In his monograph, Mr. Salvin lists a specimen from "Mazatlan, Coast of Mexico."[2]

Dr. Cooper, as reported by Dr. Brewer, does not make it clear that he ever met with this species off the coast of California.[3]

Petrella capensis (*Linnæus*): CAPE PETREL; PINTADO PETREL

COUES—*Daption capensis*, IV, 162, 171.
SALVIN—*Daption capensis*, 428.
GODMAN—*Daption capensis*, 1, 276, pl. 80.

Petrella Zimmermann ex Bartram apparently supersedes *Daption* Stephens.[4]

Colonel Pike's specimen from "the coast of California, opposite Monterey,"[5] formerly in the collection of Mr. George N. Lawrence and now No. 45965 in the American Museum of Natural History apparently represents the most northerly occurrence on record for the eastern side of the Pacific.

Dr. Frederic A. Lucas, in an article entitled *Notes of a Bird Catcher*, says: "On the Pacific coast it seems to range much farther north, for in July we left them outside the harbor of Valparaiso, and in September they were common in latitude 11° south. Captain Carey, of the ship 'Calhoun,' informed me that a few followed that vessel nearly to Acapulco, 16° N."[6]

[1] U. S. Expl. Exp., 1858, p. 410.
[2] P. 394.
[3] Cf. Water Birds N. A., v. 2, pp. 374, 384.
[4] Mathews, Auk, 1914, pp. 88, 90, 91; Richmond, Proc. U. S. Nat. Mus., 1917, v. 53, p. 614.
[5] Ann. Lyc. N. H. N. Y., v. 6, p. 7.
[6] Auk, v. 4, p. 4.

Thorough work in the more southerly portions of the ocean area we are considering would probably develop "Cape Pigeons" in considerable numbers after their breeding season.

The color variations of this species are perhaps largely dichromatic, the dark-throated and dark-mantled birds representing a dark phase and the pied-throated and pied-mantled birds a light phase.

Pterodroma longirostris (*Stejneger*): STEJNEGER'S PETREL

SALVIN—*Œstrelata longirostris*, 418.
GODMAN—*Œstrelata longirostris*, xlv, 250.

My identification of the specimens mentioned below is provisional; for I have yet to examine the type of *Æstrelata longirostris* Stejneger and a series of *Procellaria leucoptera* Gould from the type locality.

This petrel, heretofore known only from Asiatic seas, was one of the finds of the Expedition. It was not encountered until the home voyage was nearly over, when five specimens were captured by Mr. R. H. Beck—a male on the 14th of November in latitude 33° 6′ N. and longitude 134° W. and two females and two males on the 19th of November in latitude 35° 40′ N. and longitude 133° 10′ and 14′ W. In his notes, Mr. Gifford reports having seen one each day on the 15th, 16th, and 18th.

Stejneger's Petrel may prove to be an interhemisphere migrant, breeding south of the Equator and visiting the North Pacific during the exodus-migration.

The five specimens are having a renewal that does not include the primaries. These flight-feathers show but little wear, conveying the impression that a limited prenuptial moult is in progress.

Mr. Gifford states in his notes that the unfeathered parts in life had the following colors: "Bill black; iris dark brown; orbital ring black; tarsus flax flower blue; inner toes same color on upper side, with black joints; outer toe and under side of middle one black; webs whitish with dark streakings."

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
1143	♂	.....	.....	211	89	24.6	6.8	8.8	25.4	34.8
1144	♂	.....	.....	214	89	24.5	7	8.8	26.3	34.3
1145	♂	.....	.....	213	99	25.1	7	9.5	26.9	33.9
1141	♀	292	698.5	215	96	24.8	7.1	9	25	34.1
1142	♀	.....	.....	214	92	25 7	7.1	9 3	26 8	34 3

Pterodroma brevipes (*Peale*): Short-footed Petrel

Coues—*Æstrelata Cookii*, IV, 152, 154, 170, in part; *Æstrelata desolata*, IV, 155, 171, in part.
Salvin—*Œstrelata brevipes*, 398, 408.
Godman—*Œstrelata brevipes*, xlv, xlvi, 209, pl. 57.

Three males and five females of the light phase were shot by Mr. R. H. Beck on June 11, 1906, in latitude 4° 20′ S., longitude 93° 30′ W., a position almost directly north of the type locality in the Antarctic, latitude 68° S., longitude 95° W.

The known range of the species is extended by these captures to the Eastern Pacific. Further observation may disclose that its exodus-migration is a southward one, extending from the Torrid to the South Frigid Zone.

In his notes, Mr. Gifford states that these gadfly petrels were common on June 11, as many as fifteen birds being observed in a single flock; that one was seen on the 12th, and none afterwards.

I have compared two representative specimens of the Expedition series with the type (No. 15459 U. S. Nat. Mus.) and find that they agree with it in all essential particulars.

There is but little variation in the eight Expedition specimens. Four have the whole of the inner web of the outer tail feather pure white; the others have the terminal half of it more or less freckled with gray. In some the black of the head and hind neck shows a tendency to invade the gray of the back. A complete moult is well under way in all.

"Colors of naked parts: Bill black; iris dark brown; orbital ring black; skin in interramal space whitish, with dark stripes; tarsus and basal portion of inner toes and webs bluish white, remaining portion and entire outer toe dusky" (*Gifford*).

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
1111	♂	.....	.....	234	97	25	7.9	10	27	39.1
1113	♂	.....	.....	230	95	27	8.5	11.6	27.4	37.5
1115	♂	305	.....	231	93	24.3	8	11.4	27	36.8
1109	♀	320	.....	.....	96	25.9	8.4	11.5	28.6	38.9
1110	♀	305	760	231	94	25.1	8.1	11	27.3	35.2
1112	♀	.....	.....	225	97	24.5	8.1	11	27.7	38.5
1114	♀	305	740	227	94	26.2	9	12	28	39.1
1116	♀	320	755	231	96	26	8.5	11.6	28	38

Pterodroma cooki (*Gray*): COOK'S PETREL

SALVIN—*Œstrelata cooki*, 399, 417; *Œstrelata defilippiana*, 399, 417.
GODMAN—*Œstrelata cooki*, xlv, 247, pl. 71; *Œstrelata defilippiana*, xlv, 245, pl. 70.

Cook's Petrels were common during the afternoon of July 22, 1905, in latitude 22° 25′ N., longitude 112° 40′ W. The *Academy* was becalmed at the time and they were attracted to its vicinity by a school of small fish. Mr. R. H. Beck shot nineteen, of which eleven were skinned and five preserved in alcohol. During the next two days there was a strong northeasterly wind and a single individual only was noted. On the 25th another was seen, the last one for the entire voyage.

This petrel is apparently a Southern Hemisphere species that has an exodus-migration that extends north of the Equator.

Aestrelata defilippiana Giglioli & Salvadori appears to be merely a synonym, for no constant differences are found that separate Eastern from Western Pacific birds. In most of the Expedition specimens the dark marking at the eyes is more prominent than in two New Zealand ones (No. 24341 Carnegie Mus.; No. 109193 U. S. Nat. Mus.). Dr. Godman's statement that the general color is paler and the bill shorter and stouter[1] in Eastern Pacific examples is not sustained in the material before me. As these petrels darken with wear, much stress should not be placed on superficial tones unless the birds are in fine feather.

All the Expedition specimens are passing through a complete moult, donning apparently a post-breeding garb.

[1] Mon. Petrels, p. xlv.

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
1146	♂	.....	.....	.....	87	27	7.6	11.3	28.5	37.2
1148	♂	315	735	.....	91	28	7.8	10.1	28.9	39.5
1149	♂	310	720	.....	92	27.5	8	10.5	29.5	38.3
1151	♂	320	690	.....	90	28.8	7.9	10	29	38.9
1152	♂	.....	.....	.....	90	27	8	10.6	27.7	39
1155	♂	.....	.....	.....	97	28.3	7.9	10.7	29.2	39.2
24341 [1]	♂	.....	.....	237	92	27	8	9.8	28.5	37
1147	♀	.....	.....	.....	93	28.5	7.4	9.6	29	40
1150	♀	315	698	.....	91	27.4	7.9	9.7	27.8	38.9
1153	♀	.....	.....	.....	90	27.4	7.4	9.4	28.4	39
1154	♀	.....	.....	234 [3]	92	27.4	7.9	10.4	27.3	37
1156	♀	.....	.....	.....	94	27.4	7.8	11	28	40.4
109193 [2]	♀	.....	.....	234	90	28.1	7.3	9.7	30	39.5

Pterodroma externa (*Salvin*): Juan Fernandez Petrel

Salvin—*Œstrelata externa*, 398, 411.
Godman—*Œstrelata externa*, xliv, 221, pl. 62.

Fifteen specimens were shot by Mr. R. H. Beck; a male on August 8, 1905, twenty miles northwest of Clipperton Island, and nine males and five females on the 4th and 5th of October, 1906, in latitude 14° 24′ to 14° 28′ N. and longitude 107° to 107° 5′ W.

Like numerous other petrels breeding in the South Temperate Zone, this species apparently extends its exodus-migration beyond the limits of the Southern Hemisphere.

In unworn plumage, the feathers of the upper parts are washed as well as edged with gray; the wings, too, are more or less washed with gray, and extensively edged with grayish white. In one of the males the top of the head is ornamented with numerous silvery white filoplumes.

In the August specimen a complete moult is well under way and in twelve of the October specimens it has reached the final stages. The two remaining October specimens (perhaps birds-of-the-year) are in somewhat worn plumage and show but little active feather growth. In several specimens a temporary white collar has been developed where loose feathers have fallen out exposing the basal white of the cervix.

[1] New Zealand; Carnegie Museum.
[2] New Zealand; U. S. National Museum.
[3] Distal primary not fully grown.

Mr. Gifford remarks in his notes that the bill and orbital ring are black, the iris dark brown, the lower parts of the feet black and the remaining parts pinkish white.

Six specimens of *Pterodroma cervicalis*, two of them emerging from the natal down, and the Expedition series of *Pterodroma externa* show the following differential characters:

P. externa	*P. cervicalis*
Cap dark brownish gray, fading into grayish brown in worn plumage.	Cap brownish black.
No definite cervical collar.	Definite cervical collar white, clouded with gray.
First primary extensively white on inner web.	First primary with little or no white on inner web.
Only indications of dark band on inner edge of wing.	Dark band, varied with white, on inner edge of wing.
Dark color of tail (except outermost web) brown, washed with gray in fresh plumage and forming definite tips to outer feathers.	Dark color of tail gray, not forming definite tips to outer feathers, and fading into grayish brown in worn plumage.
Shafts terminally black or dark brown in all the tail feathers.	Shafts not terminally black or dark brown in all the tail feathers.

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
1117	♂	470	1092	336	150	37.4	14	18	37.4	55.9
1118	♂	457	1074	328	146	38.4	12.9	17.1	36.1	54.8
1120	♂	435	1015	.....	146	39.9	13.7	17	36	50.5
1123	♂	444	1029	.....	138	36.9	12.9	17	33.1	49
1125	♂	.....	.....	316	133	38	13.4	18	35.7	52.1
1126	♂	.....	.....	313	138	.....	12.6	17.4	34.3	52.2
1127	♂	444	1054	320	134	39.1	12.8	17.7	37	50
1128	♂	437	1067	314	145	37	14.2	19	37.6	50.6
1129	♂	432	1041	309	139	36.5	12.7	17.1	37	53.9
1130	♂	457	1054	327	145	39.1	13.8	18.5	35	51
1119	♀	449	1067	320	138	38.3	13.4	18.1	37	52.2
1121	♀	439	1067	316	132	37.5	12.9	16.1	36.1	53
1122	♀	444	1054	323	135	36.2	12.3	15.5	33.4	47.7
1124	♀	.....	.....	.....	134	39	12.8	16.8	35.9	49.8
1131	♀	432	1041	313	138	35.3	12.9	16.4	34.6	50

Pterodroma phæopygia (*Salvin*): Dark-rumped Petrel

Salvin—*Œstrelata phæopygia*, 398, 407.
Godman—*Œstrelata phæopygia*, xlvi, 207, pl. 56.

From Mr. Gifford's notes it appears that Dark-rumped Petrels were first met with by the Expedition on July 31, 1905, in latitude 14° N., longitude 110° W. Early in the morning the vessel sailed by a large flock of birds, composed chiefly of these petrels, Wedge-tailed Shearwaters, and Noddies. At midday a similar flock was encountered. On August 1, latitude 13° 28′ N., longitude 108° 52′ W., three males and three females were taken. During the cruise south of latitude 14° N. Dark-rumped Petrels were prominent in the bird life of the sea, occurring from the vicinity of Clipperton Island, eastward to within a few miles of the Ecuador coast, and southward to latitude 4° 25′ S., longitude 93° 30′ W., the most southerly position attained by the Expedition. On the voyage north the last Dark-rumped Petrel was seen September 29, 1906, in latitude 9° 22′ N., longitude 98° 25′ W.

Whether the great stretch of ocean between Clipperton Island and the Hawaiian Archipelago is frequented by these petrels is not definitely known. It may be that the Hawaiian birds are isolated at all seasons from the birds occurring off the American coast.

Mr. Gifford's Galapagos notes are condensed in the following paragraphs:

Dark-rumped Petrels were present during the entire year in the archipelago. They were inclined to shun the quiet bays and coves and frequent the open sea. At times they were very common. The largest gatherings were seen off Iguana Cove, Albemarle Island, in April and off Indefatigable Island in July. They breed on Indefatigable Island in the humid uplands—a foggy zone of forests and dense undergrowth. Similar situations on James and Albemarle islands are probably inhabited by breeding colonies. Protracted rainy weather, dense vegetation requiring the constant use of the machete, and lack of time prevented a thorough exploration of their breeding haunts. Nevertheless, Mr. Beck succeeded in securing a male and a fresh egg on July 22, 1906, from a burrow in the forest on the northwestern side of Indefatigable Island at an elevation of

eleven hundred feet. The burrow had been driven through the fern and vine roots, that reinforced the soil, to the length of about four feet, where it terminated, fourteen inches below the surface, in a chamber lined with dry leaves.

An egg, ready to be deposited, was taken from the oviduct of a bird shot on June 7 at sea about forty miles south of Albemarle Island. In April, off Iguana Cove, specimens were obtained showing considerable enlargement of the reproductive organs.

During the breeding season they were active over the land at night. A party from the *Academy* in camp near the summit of James Island on August 7 were kept awake by their incessant call-notes, uttered as the birds flew about just above the tree tops. At Indefatigable Island they congregated close inshore at dusk and circled over the water in loose flocks, from which individuals were constantly ascending in great spirals to the height of several hundred feet, when they headed inland. In the interior of the island they were particularly prominent during two hours after sunset and during two hours before sunrise, there being an evening flight to the land and a morning flight away from it. While members of the Expedition were in the forest belt of Indefatigable Island in November, these petrels were frequently seen and heard in the nighttime as they flew overhead, but in January none were met with on the island, the land apparently having been forsaken for the sea.

Usually their call-notes consist of four parts, "kee-kee-kee-koo," the first three uttered quickly and the last drawn out. Sometimes the order is reversed and sometimes the "koo" is omitted. Occasionally the call-notes were heard in the daytime. A low guttural note was detected on one occasion when several hundred of these birds were following the vessel picking up the turtle fat that had been thrown overboard. These petrels were very fond of this fat and it was used to decoy them within gunshot. Remains of pteropods and cœlenterates were found in their stomachs.

At sea their manner of flying did not differ from that of other representatives of the genus met with on the Expedition. In dead calms they flew near the surface of the water, and two or three wing strokes were succeeded by a sailing flight of a

hundred feet or more. One September day when a strong wind was blowing several were seen "sweeping along in great arcs, seldom flapping their wings." In flying over the land to their breeding grounds, they flap their wings continually, but in returning to the water they change their mode of flight, two or three wing beats being followed by a long sail.

The fact is worthy of record that a small centipede, belonging to a species inhabiting the humid belts of the Galapagos Islands, was found among the feathers of a Dark-rumped Petrel taken in latitude 3° 9′ S., longitude 91° 41′ W.[1]

In the fresh plumage of both sexes, the feathers of the back and scapulars have a more or less grayish aspect, and are tipped in a varying degree with grayish white or light gray. Fading and wearing off of the tips of the feathers produce a uniform dark aspect quite different from the fresh plumage, at first glance suggesting a double form of coloration. The dark cap, so characteristic of some of the *Pterodromæ*, is not wanting in the present species. It is especially conspicuous in birds in new attire. In certain specimens (notably No. 932 C. A. S.) the upper tail-coverts are tipped with grayish white. The greater and middle wing-coverts in some instances are more or less washed with ash-color and edged with grayish white (e. g. No. 970 C. A. S.). In a male (No. 947 C. A. S., June 18, 1906) the dark color of the sides of the neck is extended across the jugulum in irregular transverse bars of gray, forming a band about an inch and a fourth in width. The sides are heavily barred with gray, becoming nearly uniform on the flanks; the back, too, appears to be exceptionally dark. The jugular and lateral markings occur in a lesser degree in numerous other Expedition specimens of both sexes, obtained at various times of the year. Whether dichromatism, age, or individual variation is illustrated in these peculiarities is not made clear in the Academy's series. The under tail-coverts in some cases have indications of gray mottling. The white on the inner web of the primaries varies in extent; for example, on the first primary in No. 937 C. A. S., male, July 18, 1906, it is concealed, while on the first primary in No. 1027 C. A. S., male, June 11, 1906, it extends for an inch and three

[1] Cf. Bryan, Occ. Papers B. P. B. Mus., v. 2, no. 1, p. 109; Dill, Bull. No. 42 Biol. Surv., U. S. Dept. Agric., p. 11; Wallace, Island Life, p. 246, footnote; Hyatt and Pilsbry, Manual of Conchology, 2nd ser., pp. xiv, xv.

eighths beyond the under primary-coverts. No. 956 C. A. S., male, June 16, 1906, has numerous grayish white filoplumes on the occiput and posterior portion of the crown. A few other specimens are similarly, but more sparsely, adorned. A redundancy of rectrices occurs in Nos. 1003 and 1004 C. A. S., the former having thirteen rectrices and the latter fourteen.

The life colors of the naked parts are described by Mr. Gifford as follows: "Bill black; iris dark brown; orbital ring black; skin in interramal space flesh-colored; tarsus pinkish white; toes and webs black, basally pinkish white."

The Expedition series of one hundred and eighty-one specimens is distributed as follows: January, nine specimens; April, thirty-seven; May, thirty-six; June, forty; July, twelve; August, eleven; September, four; October, thirty-two.

Judging from the specimens at my disposition, the postnuptial moult in the Galapagos birds generally begins in October and ends before April. The thirty-seven April specimens (secured in 1906 on the 23rd and 24th) show signs of abrasion, manifesting that destructive changes have begun. May, June, and July specimens (procured in 1906) and September ones (procured in 1905) display increasing wear. In some May individuals considerable renewal is taking place. The thirty-two October specimens (all taken on the 14th in 1905) are in worn livery. Most of them are beginning to renew the feathers of the breast. In many the replacement is also commencing on the back and in some on the head. The nine January birds (all shot before the end of the first week in 1906) have suffered much from wear and tear. In the majority, the innermost primaries are being moulted along with the head, neck, and body plumage, indicating a later stage in the restoration. In the eleven August specimens (obtained in 1905 between the 1st and 8th of the month at sea in latitude 13° and 10° N.) the renewal is more advanced, involving, in some cases at least, both primaries and rectrices. As the specimens taken in the immediate vicinity of the archipelago exhibit a different cycle in moulting, it may be that these August birds hail from other breeding stations than the Galapagos Islands. However, the possibility is not lost sight of that they may be young of the previous year undergoing

a deferred postjuvenal moult. Unfortunately, the state of the generative organs is not recorded on the labels.

Mr. William Alanson Bryan has revived[1] *Œstrelata sandwichensis* Ridgway, maintaining that eight males and twelve females from Molokai Island have dimensions and color characters which separate them specifically from birds from the Galapagos Islands. Through the courtesy of the Board of Directors of the Bernice Pauahi Bishop Museum, I am able to compare the Molokai specimens with those of the Expedition, and to test the value of the assumed specific characters.

In order that the personal factor in the measurements may be maintained, Mr. Gifford has remeasured the Molokai specimens and the results, in millimeters, are summarized in the following table:

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	286	142	32.1	12	15.9	36.3	50
Minimum	♂	280	122	29	11	13.8	32.3	45.3
Mean	♂	283	133	31.1	11.5	14.8	34.5	47
Maximum	♀	292	138	32.1	11.4	15.9	35.5	48
Minimum	♀	274	127	29.5	10.3	13	33	42
Mean	♀	283	132	30.8	11	14.4	34.2	46.2

Comparison with the measurements of the Expedition specimens, given beyond, shows that the maximum dimensions of the Molokai overlap the minimum dimensions of the Expedition specimens, demonstrating that size in the present instance is not a constant character and therefore not of specific significance. The supposed color characters are also illusive. One of the Molokai specimens (No. 4677 B. P. B. Mus.) exhibits considerable gray on the axillaries and the wide immaculate frontal band occurs in some of the Expedition birds. The outer rectrices are fairly matched in certain examples of the two series. The feathers of the back and scapular region are worn in the Molokai specimens, and hence do not afford a good basis of comparison. It is apparent that the evidence does not sustain the contention that the Hawaiian Dark-rumped Petrels are specifically distinct from the Galapagos Dark-rumped Petrels.

[1] Occ. Papers B. P. B. Mus., 1908, v. 4, No. 2, pp. 52, 53.

Below are tabulated the measurements in millimeters of one hundred and sixty-six Expedition specimens, ninety-eight males and sixty-eight females.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	323	155	35.6	12.8	16.4	38.7	54
Minimum	♂	291	126	31	10.8	13.5	33.1	48
Mean	♂	306	142	33.6	11.9	14.9	35.5	50.6
Maximum	♀	316	150	35.9	12.4	15.5	37.4	53
Minimum	♀	287	130	31	10.6	13	32.5	46.8
Mean	♀	305	140	33.3	11.5	14.4	35.3	50

Length in flesh: Twenty-four males, 395 - 425 mm. (412); twenty-two females, 390 - 425 mm. (407.5).

Extent: Seventeen males, 100 - 105 cm. (102.2); thirteen females, 98 - 108 cm. (102.1).

It will be seen from the above measurements that the females do not differ materially in size from the males.

The two eggs referred to above are dull white; the one taken from the oviduct is ovate in form, and the other elliptical ovate. They measure respectively: 61.4 x 44.1 mm. and 61.5 x 39 mm. Heretofore the egg of this species appears to have been undescribed.

Pterodroma neglecta (*Schlegel*): NEGLECTED PETREL

COUES—*Æstrelata neglecta*, IV, 147, 170.

SALVIN—*Œstrelata neglecta*, 399, 412; (?) *Œstrelata arminjoniana*, 399, 413; (?) *Œstrelata trinitatis*, 399, 413; (?) *Œstrelata heraldica*, 399, 414.

GODMAN—*Œstrelata neglecta*, xlvii, 226, pl. 64; (?) *Œstrelata arminjoniana*, xlvii, 229, pl. 65; (?) *Œstrelata trinitatis*, xlviii, 232, pl. 66; (?) *Œstrelata heraldica*, xlvii, 234, pl. 67.

Aestrelata trinitatis Giglioli & Salvadori, *Aestrelata arminjoniana* Giglioli & Salvadori, and *Œstrelata heraldica* Salvin are included in the above synonymy with a query, for their specific distinctness from *Pterodroma neglecta* has not been satisfactorily established.[1]

From the description and plate, I infer that *Æstrelata chionophara* Murphy[2] is merely an albinistic example of *"Aestrelata arminjoniana."*

[1] Cf. Iredale, Ibis, 1914, p. 435, and keys and descriptions in monographs of Salvin and Godman.

[2] Auk, 1914, v. 31, p. 13, pl. 2.

During the homeward voyage of the *Academy* a male and a female of the light phase of the Neglected Petrel were taken by Mr. Beck, the former on October 4, 1906, in latitude 14° 24′ N., longitude 107° 5′ W., and the latter on October 12, 1906, in latitude 15° 40′ N., longitude 110° 12′ W. According to Mr. Gifford's notes, individuals of the dark phase were occasionally seen during the homeward voyage in latitude 7° to 15° N.

This petrel apparently belongs to the class of Southern Hemisphere petrels that regularly cross the Equator in the exodus-migration.

Both of the specimens mentioned above are having a complete renovation of plumage. It is much more advanced, however, in the male than in the female.

In a white-headed example from Sunday Island (No. 24336 Carnegie Mus.) the brown of the under wing-coverts is largely dominated by white and in the Expedition female the white of the lower tail-coverts is much extended, the exposed brown prevailing only at the tips of the longer feathers.

MEASUREMENTS (in millimeters)

No.	Locality	Phase	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
24336 [1]	Sunday Island	Light	..	286	102	31.3	11.3	13.7	36.5	52.4
1132	14°24′ N., 107°5′ W.	do.	♂	293	106	30	11	14	35	50
1133	15°40′ N., 110°12′ W.	do.	♀	283	104	30.9	10.3	13.2	32.9	50.7
24337 [1]	Sunday Island	do.	..	300	102	29	10.9	13.4	36	51.7
174638 [2]	Herald Islet	do.	♂	295	104	32.5	11.9	14.7	38	50.3
24331 [1]	Kermadec Islands	do.	..	301	107	30.5	10.8	14.7	38.8	53
24334 [1]	Sunday Island	Intermediate	♂	295	103	28.8	9.5	14.5	36.1	50.5
24332 [1]	Kermadec Islands	do.	..	298	104	30.3	11.4	15.3	37	54.1
124672 [2]	Sunday Island	do.	..	281	101	30.9	10.8	14	38	53.8
24335 [1]	Sunday Island	do.	♂	288	101	29.1	10	14.3	37.5	52.3
24333 [1]	Kermadec Islands	Dark	..	296	106	31.9	12	14.4	37	53.4
24338 [1]	Sunday Island	do.	..	286	100	31.7	11.7	14.7	38.2	55.7
124676 [2]	Sunday Island	do.	..	303	104	29	11	14.1	37.2	49

[1] Carnegie Museum.
[2] U. S. National Museum.

Pterodroma parvirostris (*Peale*): Small-billed Petrel

Coues—*Æstrelata parvirostris*, IV, 146, 170.
Salvin—*Œstrelata parvirostris*, 398, 405.
Godman—*Œstrelata parvirostris*, xlvi, 193, pl. 52; *Œstrelata wortheni*, xlvi, 205.

Dr. Godman's detailed description of the type of *Œstrelata wortheni* Rothschild tallies so well with two specimens of *P. parvirostris* from Christmas Island (Nos. 67317 and 67331 U. S. Nat. Mus.) that I am constrained to place *"Œ. wortheni"* in the synonymy of *P. parvirostris*. Singularly, Dr. Godman's description of *P. parvirostris* agrees rather closely with his description of *"Œ. wortheni."*[1]

The type of *"Œ. wortheni"* was taken in latitude 3° S., longitude 118° 45′ W. on January 2, 1901, by Mr. R. H. Beck.[2] I know of no other instance of the occurrence of the present species in the sea area under consideration.

No. 67317 U. S. Nat. Mus.: Wing 282 mm.; tail 111; culmen 28; depth of upper mandible 10; width of upper mandible 12.5; tarsus 32.1; middle toe and claw 45.5.

No. 67331 U. S. Nat. Mus.: Wing 285 mm.; tail 112; culmen 28; depth of upper mandible 10; width of upper mandible 12.1; tarsus 32.5; middle toe and claw 46.

Pterodroma inexpectata (*J. R. Forster*): Mottled Petrel

Coues—[*Æstrelata gularis*], IV, 150, 151.
Salvin—*Œstrelata gularis*, 399, 414; *Œstrelata fisheri*, 415; *Œstrelata scalaris*, 416.
Godman—*Œstrelata gularis*, xlv, 236, pl. 68; *Œstrelata fisheri*, xlv, 239; *Œstrelata scalaris*, xlv, 241.

In the run northwards, Mr. R. H. Beck shot four males and three females on November 19, 1906, in latitude 35° 40′ N., longitude 133° 10′ and 14′ W. Mr. Gifford states in his notes that five or six were seen on the 18th of November, one or two on the 20th, two on the 21st, two or three on the 22nd, one or two on the 23rd, three or four on the 24th, one or two on the 25th, and finally one on the 26th in latitude 36° 43′ N. and longitude 129° 31′ W. He describes the flight as rapid and erratic.

[1] Mon. Petrels, pp. 194, 205.
[2] Bull. Brit. Orn. Club, v. 12, p. 63.

The Mottled Petrel is a wide-ranging species, breeding in the Southern Hemisphere and visiting the Northern Hemisphere after the period of reproduction.

There is considerable variation in the extent of the white and in the aspect of the gray in the seven Expedition specimens. In No. 1135 the white extends from the bill almost to the abdomen, while in No. 1136 it ends on the anterior part of the breast and is much obscured by gray, the chin and throat alone being immaculate. In the whole series there is an intrusion of gray on the lower tail-coverts, very slight, however, in No. 1134. The extremes in the gray coloration are represented in No. 1139 and No. 1134; the former is slate-gray above and dark mouse gray below and the latter gray above and mouse gray below. The ashy white tips of the feathers of the upper parts have suffered more or less from wear in all the specimens of the series. No. 1138 has thirteen rectrices.

A male from the collection of Dr. Leonard C. Sanford, taken near Kiska Island, Alaska, June 17, 1911, by Mr. R. H. Beck, is undergoing a complete moult, which is apparently about over on the body. The worn outer primaries still remain, but the inner ones are being replaced. Six of the Expedition specimens show some feather replacement; in several it involves the tail. According to Mr. Gifford, the sexual organs were small in the seven Expedition birds.

Mr. Gifford reports the colors of the unfeathered parts as follows: "Bill and orbital ring black; iris dark brown; tarsus and base of toes and webs very light bluish; remaining portions of webs and toes black. One specimen had tarsi, toes, and webs all black."

Procellaria gularis Peale is apparently a synonym of *Procellaria inexpectata* J. R. Forster, for Forster's description covers well the essential characters of Peale's type (No. 15706 U. S. Nat. Mus.) and antedates Peale's description.[1] *Pterodroma inexpectata,* therefore, appears to be the proper name of this species. Although aware of the priority of *inexpectata,* Mr. Salvin and Dr. Godman preferred to use in their monographs the later specific name, *gularis.*

[1] Cf. Forster, Descr. Anim., 1844, pp. 204, 205; Peale, U. S. Expl. Exp., 1848, p. 299.

Besides the type of *"Procellaria gularis,"* I have examined the type of *Œstrelata fisheri* Ridgway (No. 89431 U. S. Nat. Mus.) and that of *Æstrelata scalaris* Brewster (No. 5224 Coll. W. Brewster). The type of *"Œstrelata fisheri"* is a worn, faded, and rather weak-billed example of *Pterodroma inexpectata.* The white-headed aspect is caused chiefly by wear and accidental loss of feathers, exposing the white bases. The feathers of the upper parts of the body are much worn, accounting for the absence of the whitish margins characteristic of the fresh plumage of *Pterodroma inexpectata.* The weak appearance of the bill is largely due to mutilation, the basal portion of the unguis having been torn off and the nasal tubes flattened. The color above is darker than in No. 1134 and lighter than in No. 1139 of the Expedition collection. The markings of the pileum and nape and the extension of the white of the rectrices, greater wing-coverts, and secondaries break down through an intermediate New Zealand specimen (No. 24345 Carnegie Mus.). The type of *"Æstrelata scalaris"* is merely a bird in fresher plumage than the other types. The supposed differences in the nasal tubes do not exceed the normal variation occurring in *Pterodroma inexpectata.*

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
						Depth	Width		
1134	35° 40′ N., 133° 10′ W.	♂	260	95	25.9	9.3	11	31.4	46
1136	35° 40′ N., 133° 14′ W.	♂	259	105	26.5	8.8	11.4	30.5	41.2
1137	35° 40′ N., 133° 10′ W.	♂	254	105	26.2	9.5	11.5	30.4	42.5
1138	do.	♂	261	102	26.5	9.7	11.5	30.1	42.5
224[1]	Preservation Inlet, N. Z.	♂	256	97	27.9	9.7	12	31.9	44.8
226[1]	do.	♂	250	101	27	9.9	11.6	33	43.1
228[1]	do.	♂	260	103	26.1	9.9	11.5	31.2	43.5
14222[1]	do.	♂	257	104	26	9.5	12.5	32	42.6
14224[1]	do.	♂	256	100	28.1	10	13.5	33.5	44.8
14225[1]	do.	♂	259	102	26.8	9.7	12.2	32.5	46.7
24343[2]	Auckland Isd.	♂	258	102	27	10.4	12.7	35	46.4
24345[2]	Otago Coast	♂	247	100	28	10	11.5	31.8	42.3
9674[3]	Preservation Inlet, N. Z.	♂	255	103	27.4	10	12.2	35	44.9
....[4]	Off Kiska I., Alaska	♂	267	105	26.6	9.5	11.6	33.5	45
....[4]	Preservation Inlet, N. Z.	♂	247	102	25.9	9.3	11.2	30.7	42.5
151109[5]	Snares Isl.	♂	259	107	27	10	11.4	32.5	40.7
1135	35° 40′ N., 133° 10′ W.	♀	257	100	27.1	9.1	11	30.1	42.2
1139	do.	♀	259	97	27.1	9.4	12.7	31.2	46
1140	35° 40′ N., 133° 14′ W.	♀	244	96	27.8	9	11	31	42.7
225[1]	Preservation Inlet, N. Z.	♀	257	104	26.1	9.2	11.9	31	42.7
227[1]	do.	♀	258	102	27	9.6	11.9	32.2	43
229[1]	do.	♀	259	97	27.5	9.7	12.5	35	47
14227[1]	Preservation Inlet, N. Z.	♀	254	97	26.5	9.9	11.2	33.9	42.8
24344[2]	Auckland Isd.	♀	248	99	28.4	10.2	12.5	32.1	43
1802[3]	Preservation Inlet, N. Z.	♀	253	96	26.2	9	11.5	32	41.2
....[4]	do.	♀	252	97	26.3	9	11.6	31.9	41.3
89431[6]	St. Paul, Kodiak Id., Alaska	♂	256	98	27.9	9	11.7	32.9	43

Length in flesh.—No. 1134; 343 mm.: No. 1137; 349 mm.: No. 1138; 343 mm.: No. 1135; 343 mm.: No. 1139; 353 mm.

Extent.—No. 1134; 819 mm.: No. 1137; 825 mm.: No. 1138; 819 mm.: No. 1135; 838 mm.: No. 1139; 845 mm.

[1] Coll. John E. Thayer.
[2] Carnegie Museum.
[3] Coll. Outram Bangs.
[4] Coll. L. C. Sanford.
[5] U. S. National Museum.
[6] Type of *"Œstrelata fisheri;"* U. S. National Museum.

Procellaria parkinsoni *Gray:* Parkinson's Petrel

Coues—[*Majaqueus Parkinsoni*], IV, 157, V, 192.
Salvin—*Majaqueus parkinsoni*, 395, 397, pl. 5.
Godman—*Majaqueus parkinsoni*, xliv, 174, pl. 45.

Among the surprises of the Expedition was the discovery in Galapagos waters of Parkinson's Petrel, a species supposed to be peculiar to New Zealand and Australian seas. Three specimens were shot by Mr. R. H. Beck—a female, October 14, 1905, five miles north of Chatham Island; a male, May 4, 1906, near Charles Island; a male, June 18, 1906, latitude 2° 40′ S., longitude 91° 20′ W.

A complete renewal of plumage is in progress in the May and June specimens. The October specimen is in worn attire and is replacing the feathers of the head and body, perhaps undergoing a belated moult rather than a prenuptial one.

According to Mr. Gifford, the colors of the unfeathered parts are as follows: "Bill chiefly pale blue (covered in places with scaly straw yellow epidermis), black along sutures, on culmen between nasal tubes and unguis, and at tip; orbital ring black; iris dark brown; skin in interramal space dark brown; feet black, webs silver-veined."

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
925	♂	445	1190	.....	103	43.9	13	16.5	50.5	70
926	♂	.....	.....	345[1]	106	42.7	13.4	16.5	50	70
927	♀	430	1220	345	104	38.6	12.8	16.1	48.6	69.2

Priofinus cinereus (*Gmelin*)*:* Black-tailed Shearwater

Coues—*Adamastor cinereus*, II, 119, 142; *Priof*[*inus*]*cinereus*, V, 192.
Salvin—*Priofinus cinereus*, 390, 455.
Godman—*Priofinus cinereus*, xliii, 155, pl. 41.

Whether the present species is more than a casual visitor in the region we are considering is yet to be ascertained, Colonel Pike's well-known specimen apparently remaining unique. Lately I reëxamined this specimen, which is now in the possession of the American Museum of Natural History, and copied the following data from the labels attached to it:

[1] Distal primary not fully grown.

First label: "Adamastor typus Bonap. Puffinus cinereus Gm.? California off Monterey. Procellaria hasitata 'Kuhl' Gould. B. Austr. vii pl. 47. Presented by N. Pike."

Second label: "Coll. Geo. N. Lawrence. Puffinus cinereus, Gm. California coast. 651. Presented by N. Pike Esq."

The American Museum catalogue number is 45967.

It may be well to recall the fact that the description of this specimen served as a description of the species in Dr. Coues's monograph.[1]

Dr. S. Kneeland's record[2] of the occurrence of this shearwater "in considerable numbers" off the coast of California is based on mistaken identification; the birds he saw were undoubtedly Black-footed Albatrosses.

As no mention is made of *Puffinus creatopus,* it is highly probable that the species observed by Capt. R. Paefsler in latitude 17° 4′ N., longitude 101° 6′ W. was *Puffinus creatopus* and not *Priofinus cinereus.*[3]

Puffinus creatopus *Coues:* Cooper's Shearwater; Pink-footed Shearwater

Plate 13

Coues—*Puffinus creatopus,* II, 131, 144, V, 192.
Salvin—*Puffinus creatopus,* 369, 376.
Godman—*Puffinus creatopus,* vi, xli, xlii, 101, pl. 27.

Dr. Cooper was the first writer to give vernacular names to this species, designating it Red-footed Puffin and Red-footed Shearwater.[4] Later, it was called Flesh-footed Shearwater and Pink-footed Shearwater, names also applied to *Puffinus carneipes.* Recently, Dr. Godman has proposed a new name, Coues's Shearwater.[5] A more appropriate appellation, however, is the one adopted in the headline above in honor of the discoverer of the species, Dr. James Graham Cooper.

Cooper's Shearwater is a South Temperate Zone species whose exodus-migration is protracted beyond the Tropic of Cancer. Off Point Pinos, California, it is common from May

[1] See II, p. 120, footnote.
[2] Amer. Nat., v. 5, pp. 312, 313.
[3] "Den 16. April in 17, 4° N 101, 6° W: viele *Puffinidae—Procellaria cinerea* ähnlich." J. f. O., 1913, v. 61, p. 49.
[4] Proc. Calif. Acad. Sci., v. 4, 1868, p. 11; 1870, p. 69.
[5] Mon. Petrels, p. vi.

to November. Scouts arrive early (Mr. Beck's earliest record being four shot and four others seen, February 27, 1907) and stragglers linger on into December. So far as I know, the species has not been reported north of Point Arena, California.[1] According to Mr. Gifford, during the voyage of the *Academy* this shearwater dropped out of sight on July 22, 1905, in latitude 22° 25′ N. and longitude 112° 40′ W., and was not met with again, its migration-route being inside of the schooner's course.

Dr. Godman has called attention to "a dusky phase of plumage,"[2] but the extremes of coloration are greater than he surmised. In the light extreme, the general color aspect from bill to crissum is white uninterrupted by gray, while in the dark extreme this aspect is superficially gray. In the darkest of the one hundred and thirty-nine specimens before me (No. 16059 C. A. S., male; plate 13) the chin, throat, and jugulum are heavily barred with gray and grayish white, and the rest of the lower parts is densely clouded with gray; the sides of the head, neck, and body and the lower tail-coverts are without white variations; the lining of the wings and axillaries are dark brownish gray, the former variously varied and the latter slightly tipped with grayish white. Only three other specimens of the series are of this extreme dark phase. One of them (No. 18557 Mus. Vertebr. Zool. U. C., female) is not quite so dark below as No. 16059; the remaining two (Nos. 15759 and 15760 C. A. S., males) are still lighter, and grade through intermediates of all sorts into six extreme examples of the light phase, of which No. 9387 C. A. S., female (plate 13), is typical. In this specimen the concealed portions of the longer primaries are white; the lining of the wings presents chiefly a white surface, and white rather predominates on the shorter lower tail-coverts; the abdomen is immaculate, save a few faint indications of gray near the crissum. It is a notable circumstance that growing feathers in both phases are like the worn ones they are replacing.

[1] Since the completion of this paper, the following has been communicated to me by Mr. Stanton Warburton, Jr., of Tacoma, Washington: "Shearwaters were first seen [by me] off the coast of Clallam County, Washington, June 28, 1917. Both the Pink-footed and the Sooty were common there, the Sooty being the most common. On the 29th, a pair of each was collected. On the 30th, off the coast of Grays Harbor County, Washington, about thirty miles, one Black-footed Albatross was seen, as well as quite a few of both the above kinds of shearwaters."

[2] Mon. Petrels, p. 103.

The precise nature of the double coloration in this species is not positively determinable from the material at hand. However, the burden of proof lies with age and geographic variation, not with dichromatism, a dominant condition in some Tubinares. Transitional specimens showing the passage from the natal down to the definitive feathers would reveal the whole matter at a glance, settling it beyond a peradventure.

In fresh plumage, the interscapulars, scapulars, and inner secondaries are usually washed with gray and margined with grayish white, the latter producing a decided scaled appearance. In the extreme dark birds the margins incline to pale brown or brownish white. Fresh primaries and rectrices are sometimes heavily frosted with gray, rendering their black shafts very conspicuous. Gray and grayish white filoplumes occur in numerous specimens on the pileum and auriculars, and less frequently on the cervix. No. 9308 C. A. S. has thirteen fully developed rectrices, six on the right side and seven crowded ones on the left.

The Academy's series of one hundred and thirty-eight specimens, obtained north of the Tropic of Cancer, is distributed throughout the year as follows: February 27, four specimens; April 25 and 29, nine; May, twenty; June, thirty-three; July, twenty; August, eight; September, thirteen; October, twenty; November, nine; December, two.

The four specimens of February 27 are in process of a complete moult, apparently postnuptial. In two of them, it affects the head and body generally and the upper and lower tail-coverts, but does not involve the primaries and wing-coverts, which are old and worn. The replacement of a middle and a lateral rectrix in one of the specimens appears to be normal renewal. The two remaining specimens (both in poor feather) are sprouting the inner primaries and greater and lesser wing-coverts as well as renewing the plumage of the head and body and the lower tail-coverts.

In the birds of April 25 and 29 (all in worn plumage) the moult has made but relatively little headway; in only one example has it reached the inner primaries. Probably the April birds were later breeders and later migrants than the February ones and therefore later in their moulting.

Twelve of the twenty May specimens were taken on the first day of the month and are in about the same stage of wear and restoration as the April ones, which is also true of a specimen shot on the 15th. In one secured on the 18th, the moult has extended to the greater and lesser wing-coverts and the six inner primaries. Three specimens procured on the 27th, 28th, and 29th show further progress. Only the outer four old primaries are left and the new inner ones are pushing out beyond the secondaries, which are also involved in the moult. A middle and a lateral rectrix are being renewed in one of the specimens. Three others, obtained on the same days, have lagged behind, two retaining the outer five old primaries and one all of them.

The thirty-three June examples (none of them hornotines) exhibit considerable diversity in the extent of the moult, but as a whole marked advancement has been made over April and May renewals. Three of five examples secured on the 27th retain four worn outermost primaries while two obtained on the 22nd and 25th have moulted all of the primaries except the first. Generally the replacement has progressed in the wing-coverts and in the tail and secondaries.

In most instances, the twenty specimens of July (2nd to 18th) have kept pace with the season in their feather renewal. Nine of them, obtained on the 18th, have moulted all of their primaries. However, abraded feathers elsewhere are not wanting as an index of age. A specimen of the 7th, one of the 8th, and two of the 10th have retained the first of the old primaries and another of the 8th also the second on the right wing. Three specimens, shot on the 2nd, 10th, and 18th respectively, have the outer two old primaries left and two specimens of the 8th the outer three and one specimen of the 7th the outer six. In the most advanced specimens all the rectrices have been moulted. Already the new greater and middle wing-coverts show wear, and this before the moult has been completed. It may truly be said that such birds are never in full feather.

None of the eight August specimens (shot on the 2nd, 22nd, 23rd, 27th, and 30th) have completed the moult of the upper and lower parts of the head and body, but the old primaries and rectrices have been cast. Destructive changes are already

rife, and the discrimination of the plumage generations is rather perplexing in some instances.

Continued, but ununiform, progress is manifested in the feather renewal of the September series, which is distributed as follows: 2nd, one specimen; 8th, two; 9th, two; 14th, one; 18th, one; 22nd, one; 23rd, five. Viewed superficially, certain specimens appear to be in full plumage. Closer examination, however, reveals the presence of old feathers, worn new ones, and growing feathers. In only five cases has the first primary outgrown the second one. According to Mr. Beck, incipient erotic enlargement of the generative organs was displayed in a male and female of the 23rd, indicating the approach of the season of reproduction.

The twenty specimens of October (4th to 25th), seven of November 4, and two stragglers of November 30 and two of December 9 complete the material under consideration. The primaries, except in two specimens, are in a good state of preservation, but the greater, middle, and lesser wing-coverts as a rule are much worn. Mr. Beck reports functional activity of the testes in three such specimens, taken October 21 and November 4 and 30; in each, feather replacement is nearly or quite at a standstill. In some of the other October and November specimens slight renewal is in progress, particularly on the breast and abdomen. In a December straggler, having slightly worn primaries, growing contour-feathers occur beneath the surface on the jugulum, breast, abdomen, side of neck, cervix, and dorsal region. Rectrices are also being replaced in this December specimen, in one of November 4, and in four October specimens, shot on the 4th, 15th, and 21st.

The progressive character of the renewal during the months preceding October tends to show that the later feather growth is the culmination of a protracted moult rather than the beginning of a definite new one. Nevertheless, it may be that a postnuptial merges into a limited prenuptial moult and that there is a deferred limited postjuvenal one.

The following table summarizes the measurements in millimeters of ninety-three males and thirty-seven females—all from the North Temperate Zone. The wing-measurements are only approximately correct, the distal primary being worn or not fully grown in some instances.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	351	127	46.1	13.7	19.4	53.9	72.9
Minimum	♂	320	103	40	11	16.2	47.4	64
Mean	♂	333	114	43.4	12.2	17.9	50.2	67.8
Maximum	♀	344	123	43.9	12	18.5	52.2	70.5
Minimum	♀	318	110	39.9	11	16.5	47.1	63.2
Mean	♀	330	116	41.9	11.5	17.4	49.8	66.6

From the above, it appears that sexual variation in size plays an unimportant part in this species.

Puffinus opisthomelas *Coues:* BLACK-VENTED SHEARWATER

Plates 14-16

COUES—*Puffinus opisthomelas*, II, 139, 144.
SALVIN—*Puffinus opisthomelas*, 369, 380.
GODMAN—*Puffinus opisthomelas*, xli, 109, pl. 30.

Examination of the type of *Puffinus opisthomelas* Coues (No. 16991 U. S. Nat. Mus.) and the type of *Puffinus auricularis* C. H. Townsend (No. 117540 U. S. Nat. Mus.) shows that each of these types represents a distinct species and that the small white-breasted shearwater occurring commonly off California is *Puffinus opisthomelas* Coues, of which *Puffinus couesi* Mathews[1] is a synonym.[2]

After breeding on Lower California islands, Black-vented Shearwaters migrate northward along the coast as far at least as Vancouver Island, their fly-line thus extending about fifteen hundred nautical miles.

In the vicinage of Point Pinos, California, neither Mr. Beck nor myself has met with these shearwaters in May and June. Stray individuals occasionally appear at the end of July, but ordinarily the first arrivals come in August and sometimes not before September. They are irregularly abundant through autumn and more or less common thereafter until the close of April. I found them common through December, 1912, but they were extremely wary and I only succeeded in securing fifteen specimens, several of which exhibited great functional

[1] Cf. Birds Austr., v. 2, p. 67.
[2] In the Auk for October, 1917, pp. 472, 473, Mr. Oberholser has also reached this conclusion.

enlargement of the testes. In following "the feed" when the sea was calm, they would dive from wing, flying directly into the water, disappearing wholly from view. When resting on the placid surface, they took wing readily, differing in this respect from the Murres and Rhinoceros Auklets, with which they were sometimes associated. In coming down the wind during a strong breeze, they changed their rapid wing strokes and short sail to an undulating sailing flight, much elevated for a shearwater.

The Galapagos Expedition first encountered Black-vented Shearwaters on July 2, 1905, off San Miguel Point, Lower California. On the 7th they were abundant off Banda Point, and the last were seen on the 14th near West Benito Island. At Natividad Island on the 19th, only deserted burrows closed by cobwebs were noted. In 1903, the Revilla Gigedo Expedition found them breeding sparingly on San Benito Islands on May 6 and abundantly on Natividad Island on May 9. No nestlings were discovered, only incubated eggs.

Like Cooper's Shearwater, the present species has a double style of coloration. In the extreme dark phase, the gray predominates over the fore-neck, strongly contrasting with the white of the rest of the lower parts (plate 14). It also interrupts the white lining of the wings and is much extended on the axillaries and sides of the body. In No. 9491 C. A. S. the gray in faint spots invades the breast and abdomen, becoming less distinct posteriorly. In the extreme light phase, the fore-neck is immaculate white (plate 14), the lining of the wings displays few if any traces of gray, and the axillaries and sides of the body have the gray much restricted. White nearly supplants the dark color on the shorter lower tail-coverts in Nos. 9474 and 9516 C. A. S. Between the dark and light extremes of the two phases, lies the great majority of the Academy's one hundred and thirty-nine specimens.

The explanation of the double form of coloration prevailing in this shearwater is apparently found in dichromatism rather than in age variation, for in the worn breeding plumage of both phases the growing feathers on the fore-neck are like the old ones they are replacing. Specimens passing from the natal down into the definitive feathers would present conclusive evidence.

New scapulars and interscapulars are blackish brown, margined with brownish gray. In some instances the lower eyelid is more or less white. Many specimens have gray or grayish white filoplumes on the occiput and some have them also on the auriculars and cervix.

It should be borne in mind that the brown aspect increases with wear, gray assuming a brownish shade and blackish brown becoming wholly brown. A description of this species should therefore cover both fresh and faded plumages. Abrasion in the dark phase eliminates the terminal white and lessens the subterminal gray of the feathers of the fore-neck, giving it at first a darker, and afterwards a lighter appearance.

A peculiarly significant example of melanism is found in a female of this species (No. 18691 Mus. Vertebr. Zool. U. C.) taken at Monterey Bay, California, December 19, 1910, by Mr. R. H. Beck. The entire lower surface is mouse gray, whitening toward the bases of the feathers and deepening superficially on the fore-neck, malar region, and sides of neck and body—areas of intensity of color in the dark phase. The under coverts of the wings and the axillaries are mouse gray, varying in tone. There is no departure from the normal coloration on the upper parts, and the size and proportions conform throughout with ordinary specimens. The dimensions are as follows: Wing about 240 mm.; tail 75; culmen 37.2; depth of upper mandible 8.4; width of upper mandible 13.4; tarsus 45; middle toe and claw 54. That dichromatism in the Tubinares had its origin in melanism is strongly suggested by this specimen (see plates 15, 17). Another example of melanism occurs in a male Murre (No. 18072 C. A. S.) obtained by Mr. John Rowley on Southeast Farallon Island, California, on May 30, 1911. In this specimen the jugulum, breast, and sides are fuscous and all the under coverts of the wings are deep mouse gray (plate 16).

No. 22013 Carnegie Mus., June 28, 1897, is in worn double-down. Both segments are mouse gray in color, becoming lighter on the median lower parts of the body. No. 22012 Carnegie Mus., June 28, 1897, is going out of the natal down. The scapulars, primaries, secondaries, and wing-coverts are emerging from the sheath and definitive feathers are appearing on the lower parts at the base of the secondary down. In coloration it agrees with the preceding specimen.

With the exception of four July (1905) specimens from the ocean off Banda Point, Lower California, the Academy's series was taken as follows in the vicinity of Point Pinos, California: August, 1907, four specimens; September, 1907, eighteen, 1909, one; October, 1907, twenty-two; November, 1907, thirteen; December, 1909, one, 1912, fifteen; January, 1908, eleven, 1910, two, 1913, one; February, 1907, twelve; March, 1907, eighteen; April, 1907, seventeen.

The four July birds are in faded brown dress. One of them, obtained on the 5th, is acquiring new feathers on the throat, jugulum, breast, abdomen, lower tail-coverts, crown, occiput, cervix, and dorsal region. Of the remaining three, all secured on the 7th, two are not quite so forward and one is further advanced, its five inner primaries and greater and lesser coverts being in process of renewal along with feathers of the pileum, cervix, dorsal region, upper tail-coverts, and under surface, including lower tail-coverts.

Much diversity exists in the moult of the four August specimens; none of which are hornotines. A specimen taken on the 7th has dropped all of the primaries except the distal one. Corresponding progress has been made in the wing-coverts, tail, and upper and lower parts. An example shot on the 10th has lagged behind. Seven worn outermost primaries and all of the old rectrices are in place, with feather growth active beneath the surface on the upper and lower tail-coverts, throat, jugulum, breast, abdomen, pileum, cervix, scapulars, interscapulars, and greater and lesser wing-coverts. A bird of the 30th has shed all the old primaries, while another of the same day has kept three of them on the right wing and two on the left.

September specimens also show unequal advance in their feather renewal. Thirteen retain old primaries as follows: One of the 30th, the first primary; two of the 18th and one each of the 23rd, 25th, and 27th, the two outer primaries; two of the 4th and one each of the 18th, 23rd, 25th, and 27th, the three outer; one of the 2nd, the four outer. The worn condition of the old primaries plainly indicates that these birds are not young-of-the-year. Of the remaining six examples, one of the 2nd, one each of the 4th and 25th, and three of the 27th have moulted all of the old primaries, prominent age-marks.

However, left-over feathers elsewhere furnish proof of maturity in three instances.

A general renewal is progressing in the twenty-two October birds. Seven (two of the 7th, one each of the 11th and 18th, two of the 23rd, and one of the 30th) have doffed all of the old primaries, but in no case has a new distal primary attained full growth. Two birds of the 30th have kept the outer two old primaries while three of the 3rd have retained only the first, further illustrating the absence of uniformity in the progress of the moult.

Of the thirteen November examples, five have failed to cast the old primaries as follows: One of the 13th, the first on the left wing; one of the 6th and two of the 15th, the first; one of the 22nd, the outer three. In the other eight examples new primaries have replaced the old. The first, however, has not overtaken the second, save in a single instance on the left wing.

Growing feathers occur to some extent in all of the December specimens, in nine of them even in the tail. In only four (one each of the 6th and 14th and two of the 26th) does the first primary still fall far short of the second.

Most of the January birds are in good plumage, although they display, with two exceptions, more or less replacement under way on the body and in some cases on the head and neck. Three are behind all the others in the rehabilitation of the wings and tail. One of these tardy individuals, shot January 2, 1908, has retained ten old rectrices and the old distal primary. Another, taken January 3, 1913, has the distal primary about three fourths grown and six rectrices in various stages of development. In the remaining one, obtained January 2, 1908, the distal primary equals the second, and six rectrices are being renewed.

February specimens also show moult. One taken on the 25th is replacing three rectrices and numerous feathers on the upper and lower parts. Another of the 25th is renewing fewer feathers on the head, neck, and body and but two rectrices. Most of the others exhibit some growing feathers above and below. Already disintegration is very apparent.

March and April specimens show increasing wear and the final disappearance of growing feathers. Some of the laggards in much worn attire may be hold-overs.

The above review of specimens demonstrates the existence of a protracted postnuptial moult in this species. I can not positively affirm from the specimens at hand whether there is, or is not, a limited prenuptial moult or a deferred limited postjuvenal one.

In unworn plumage the white phase of *Puffinus opisthomelas* and *Puffinus auricularis* present, in the material before me, the following distinguishing characters:

P. opisthomelas	*P. auricularis*
General aspect above dark brown.	General aspect above black.
Sides of neck mottled with gray, more or less brownish in shade.	Sides of neck more or less mottled with black.
Sides brownish gray (often discontinuous), posteriorly the feathers narrowly tipped with white.	Sides white, sometimes slightly dark gray posteriorly, but feathers not narrowly tipped with white.
Brown predominant in the dark color of the lower tail-coverts.	Black predominant in the dark color of the lower tail-coverts.
Axillaries subterminally dark brownish gray, narrowly and evenly tipped with white.	Axillaries sometimes subterminally dark gray, unevenly tipped with white.

Puffinus auricularis, like *Puffinus opisthomelas,* browns with the wear of the feathers. The measurements of the two species overlap.

The extreme and average dimensions of sixty-two males and forty-one females of *Puffinus opisthomelas* are set forth in millimeters in the annexed table. As the distal primary is worn or not fully grown in some cases, the wing-measurements are only approximately accurate.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	254	84	39.5	9	15.6	45.5	55.8
Minimum	♂	234	74	34.8	7.8	11.6	39.4	49
Mean	♂	244	78	37.3	8.4	14	43	52
Maximum	♀	252	83	38.5	8.6	15.5	45.9	54.5
Minimum	♀	235	71	33.3	7	11.5	39.4	48
Mean	♀	243	79	35.7	7.7	13.4	42.3	51.4

Taking the above tabulation as a criterion, the males have but little advantage over the females in size.

Puffinus auricularis *C. H. Townsend:* Townsend's Shearwater

Salvin—*Puffinus auricularis,* 369, 380.
Godman—*Puffinus auricularis,* xli, 112, pl. 31; *Puffinus newelli,* xli, 115.

Unlike its congener the Black-vented Shearwater, Townsend's Shearwater appears to be non-migratory, remaining the year round in the general vicinage of its breeding grounds. In the passage south in 1905, the first representatives of the species logged by Mr. Gifford were three individuals in latitude 19° 37′ N. and longitude 111° 11′ W. on July 25, and the last were two in the vicinity of Clipperton Island on August 9. On the return voyage in 1906, the first one was noted in latitude 12° 19′ N. and longitude 104° 3′ W. on October 2, and the last in latitude 19° 53′ N. and longitude 118° 1′ W. on October 25.

There are only four specimens in the Expedition collection, and all are from the high sea. To supplement this meager series, I have borrowed the following: from the Carnegie Museum fourteen adults and five young in down collected on the Revilla Gigedo Islands; from the Bishop Museum the type of *Puffinus newelli* Henshaw from Maui Island and also a specimen obtained on Kauai Island; and from the U. S. National Museum the type of *Puffinus auricularis* C. H. Townsend.

A study of the material enumerated shows that there are no constant characters differentiating the Hawaiian from the Revilla Gigedo birds. Both belong to one species, *Puffinus auricularis.* The lower tail-coverts are extensively white in three Expedition and three Revilla Gigedo examples. The mottling on the side of the neck is present in the Kauai specimen, and in one of the Revilla Gigedo specimens it is continued across the jugulum in a band about seven eighths of an inch in width. The axillaries in all except the Kauai bird exhibit indications of dark color, in two Revilla Gigedo individuals forming conspicuous subterminal patches. Examples in fresh plumage from Revilla Gigedo waters are as black as the two Hawaiian birds. It is largely this black coloration that separates *Puffinus auricularis* from the closely allied *Puffinus opisthomelas.* (Concerning the relationship of these

two species, see the account of the latter.) As shown in the accompanying table, the measurements of the specimens of *P. auricularis* from the Revilla Gigedo and Hawaiian archipelagoes overlap.[1]

The following are the colors of the naked parts as taken in the flesh by Mr. Gifford: "Upper mandible blackish with bluish spot on each side near base; lower mandible blackish above sulcus and at tip, blue below sulcus; orbital ring black; iris dark brown; feet pinkish white, with some black on toes and edges of webs."

The five downy young from the Carnegie Museum exhibit several stages in the development of plumage. No. 21943, May 1, 1897, and No. 21938, April 30, 1897, are in the protoptyle state, and in color are dark smoke gray, becoming grayish white on the lower parts. No. 21951, May 23, 1897, is more advanced, the mesoptyles having appeared. The coloration is the same as in the preceding. No. 21937, April 30, 1897, is still older and has the protoptyles much worn. It is like the others in color, the dark smoke gray and grayish white reaching to the very base of the mesoptyles. No. 21954, May 25, 1897, is passing out of the natal down into the definitive feathers. The protoptyles have almost disappeared. Vestiges of grayish white ones remain on the jugulum. As the mesoptyles all appear to be dark smoke gray, perhaps a double coloration existed in this bird, the protoptyles being light and the mesoptyles dark on the lower parts.

The adults from the Clarion and San Benedicto colonies (taken between the 1st and 31st of May) are in worn plumage and almost without exception show feather renewal in progress beneath the surface, apparently the beginning of a postnuptial moult. Three Expedition birds (obtained on the 9th and 12th of October) are finishing a complete moult.

[1] Obviously, *Puffinus bannermani* Mathews & Iredale (Ibis, 1915, p. 594) is a variation of *Puffinus auricularis* C. H. Townsend, which Messrs. Mathews and Iredale confuse with *Puffinus opisthomelas* Coues. See my account of this latter species.

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
811	♂	345	721	.....	74	33	8.4	12.2	42.9	49.1
21947[1]	♂	.....	.....	224	79	32	8	12.6	42.4	47.9
21949[1]	♂	.....	.....	222	77.8	31.9	8	12	43	48.8
21953[1]	♂	.....	.....	236	77	35	8.3	12.9	46	50.1
810	♀	368	775	242	77	33.4	8	11.1	43.5	49.1
812	♀	.....	.....	.....	75	31.2	7	12.2	41.2	46.4
813	♀	363	.....	238	81	32.4	7.8	11.9	40.7	46.8
21936[1]	♀	.....	.....	226	78	31	8	12.3	42.6	48.5
21939[1]	♀	.....	.....	230	78	31	8	12.5	43.5	49.2
21941[1]	♀	.....	.....	239	80	35	8	12	44.9	50
21944[1]	♀	.....	.....	230	76	32.1	7.5	11.5	44	49.5
21945[1]	♀	.....	.....	228	71	32	8	12	43.2	48.1
21946[1]	♀	.....	.....	229	79	31.2	7.6	11.5	44	48.2
21948[1]	♀	.....	.....	227	78	32	8.4	12.5	44.4	49.8
21950[1]	♀	.....	.....	224	79	30.9	7.8	12.1	41.2	46.2
117540[2]	♀	.....	.....	229	80	30	7.5	12.3	43.5	48.5
1100[3]	....	.....	.....	240	80	33.8	9	13.7	46.5	51.6
4292[4]	....	.....	.....	221	77	33	8	12.5	46	47

Puffinus obscurus (*Gmelin*): DUSKY SHEARWATER; LEAST SHEARWATER

COUES—*Puffinus obscurus*, II, 137, 144; *Puffinus nugax*, II, 141, 144; [*Puffinus*] *assimilis*, V, 192.

SALVIN—*Puffinus obscurus*, 369, 382; *Puffinus assimilis*, 370, 384; *Puffinus persicus*, 369, 381, pl. 4; (?) *Puffinus elegans*, 370, 385.

GODMAN—*Puffinus obscurus*, vi, xlii, 126, pl. 34; *Puffinus subalaris*, xli, 117; *Puffinus auduboni*, xlii, 129; *Puffinus assimilis*, xlii, 133, pl. 35; *Puffinus bailloni*, xlii, 138; *Puffinus persicus*, xlii, 124, pl. 33; (?) *Puffinus elegans*, xlii, 136, pl. 36.

Following Lord Rothschild and Dr. Hartert,[5] I have grouped under *Puffinus obscurus* several book species, believing them to be merely variations of a single widely distributed and essentially non-migratory species. The material before me confirms that the intergradation is complete between the brownish-backed and bluish-backed birds and that they are not separable as distinct species. Perhaps the explanation of the dual coloration is to be found in dichromatism, more or less modified by geographic variation. *Puffinus persicus* Hume has been included in the synonymy, as it is

[1] Carnegie Museum.
[2] Type of *Puffinus auricularis;* U. S. National Museum.
[3] *"Puffinus newelli;"* Bishop Museum.
[4] Type of *"Puffinus newelli;"* Bishop Museum.
[5] Nov. Zool., v. 6, pp. 194-197.

not upheld in the descriptions by constant characters, also *Puffinus elegans* Giglioli & Salvadori with a question, its status being open to doubt.

I do not agree with Mr. Gregory M. Mathews in his rejection of Gmelin's *obscura* as the specific name of this species.[1] The Leverian Museum specimen (preserved in the Imperial Museum at Vienna[2]) and Latham's description seem to me to be a sufficient warrant for retaining the name. The two inches difference in length, stated by Latham to exist between the Leverian and the other specimen at his command, may have been due in part to the make-up of the specimens. However, the discrepancy does not exceed the limits of geographic variation in this species. Even the variation in eighteen Galapagos females, measured in the flesh, reaches 25 mm. Furthermore, the length of the bill, measured along the cutting edge, in some specimens equals Latham's dimension: "Bill an inch and a half."

According to Mr. Gifford, the Dusky Shearwaters of the Galapagos colony apparently do not wander far from their birthplace. None were seen beyond latitude 5° 30′ N., longitude 87° 5′ W. and latitude 2° 29′ S., longitude 90° 4′ W. Throughout the archipelago they were very common, haunting alike the sheltered bays and coves and the open sea. They probably breed on most of the islands, although eggs or downy young have been reported from only three. The Expedition found at Hood Island a fresh egg and a nestling on September 28, a nestling on October 2, fresh and incubated eggs on February 1, fresh eggs on February 6, and nestlings on June 25. Moreover, two birds were seen to enter holes in a cliff on Champion Island in February and one was noted in a hole in a cliff on Indefatigable Island in July. Messrs. Snodgrass and Heller record a single egg taken in December on Wenman Island[3] and Lord Rothschild and Dr. Hartert state that downy young were found on the same island in February[4] and a great many eggs on Culpepper Island in July.[5] It appears, therefore, that relays protract the breeding season, with the laggards causing it to cover most, if not all,

[1] Birds Austr., v. 2, pp. 64-68: compare my remarks under *P. opisthomelas*.
[2] Ibis, 1873, p. 47; Birds Austr., v. 2, p. 64.
[3] Proc. Wash. Acad. Sci., v. 5, p. 241.
[4] Nov. Zool., v. 9, p. 414.
[5] Ibid., v. 6, p. 196.

of the year. Perhaps there are two distinct breeding seasons, some birds laying in winter, others in summer.

At Hood Island, quoting in substance from Mr. Gifford's notes, they nested in small tunnel-like holes in the lava sea cliffs. The lowest holes were near the water and were damp, and the highest were sixty or seventy feet above it. As in some other petrels, the male and female become tenants before the laying of the single egg, which is placed at the farther end of the hole, usually on the bare soil or rock, sometimes within arm's reach of the entrance.

These shearwaters are generally silent. However, on two occasions in January small flocks were flying about the cliffs at Academy Bay, Indefatigable Island, making a twittering sound. One evening near Essex Point, Albemarle Island, a flock of about a hundred was fishing. There was great excitement among them. Rushing madly about, they kept up a continual twittering. Twice at Hood Island, birds in their nesting holes were heard uttering notes somewhat resembling the mew of a kitten. In each instance the hole was tenanted by a pair of birds. These mewing notes, or one or two short shrill notes, were sometimes uttered when the collector's hand was thrust into the hole, which intrusion was always resented, a spirited defense being made with bill and claws. They showed a disposition to bully other birds. One was seen pursuing a Turnstone and several pestered a Brown Pelican until he retreated to a cliff to escape from the annoyance.

Like some others of their tribe, they were sociably inclined, frequently flying about the cliffs and rocks in small compact companies or congregating on the water or winging their way at times over its surface in loose flocks and straggling columns. When fishing, a community of interests was often formed with other species, particularly the Noddy and boobies.

The flight is usually low and somewhat undulatory, ascendant during the rapid wing strokes (which vary from four or five to eight or ten) and descendant during the short sail. In rough weather they rise higher and prolong the sailing flight, but do not attain to the "beautiful evolutions" of the Dark-rumped Petrel. In rising from a calm sea, they extend their wings and paddle rapidly forward for about two feet

when they clear the water and are fairly a-wing. When feeding in windy weather, they often alight for a moment without closing their wings. One proved himself well worthy of the name of petrel while picking up food during a brisk wind. He would poise for a moment, with wings outspread and feet just touching the water, and then dart to the windward for a few feet without flapping his wings, which apparently served the same purpose as "the sails of a vessel when close-hauled on the wind." On another occasion a flock of about thirty while feeding would fly slowly to the windward for a few rods, keeping close to the water, and then turn and fly swiftly back to the starting point and repeat the maneuver. In calm weather they collected in flocks on the water while feeding. On one occasion the birds of a company were continually putting their heads under water and when something edible was discovered they would dive, often remaining beneath the surface for a full minute.

The remains of small crustaceans were found in the stomachs of several birds taken from nesting holes on Hood Island in February. One day a number were flying about a brigantine at Villamil, Albemarle Island, apparently attracted by the droppings from the cattle that were being hoisted aboard.

Galapagos examples of this species exhibit considerable variation, and on the strength of certain features of this variation Mr. Gregory M. Mathews has endeavored to separate the birds of Culpepper and Wenman islands from those of the rest of the archipelago, holding that the former are larger and that their under wing-coverts and axillaries are less dusky.[1] As the Expedition males yielding the maximum measurements are from Hood Island and as certain specimens from that island have white under wing-coverts and axillaries, it is evident that Mr. Mathews has mistaken other variations for geographic variation.

The under wing-coverts and axillaries vary in general aspect from immaculate white to dark gray. The former extreme is typically represented in the Expedition series by No. 837, male, February 6, No. 859, male, May 21, No. 885, female, June 25, and the latter extreme by No. 839, male,

[1] Birds Austr., v. 2, pp. 62, 70.

January 5, No. 820, male, June 28, No. 881, female, May 21. In the white extreme the dark color of the flanks is much restricted. Like most of the birds in definitive feather, two individuals passing out of the natal down are intermediate, having the under wing-coverts gray and white. The amount of white is greater in one than in the other, suggesting that the two color extremes may occur in the juvenal plumage. A series emerging from the down would clear up the whole matter and determine whether these variations are to be credited to age or to dichromatism.

Both eyelids are white, and in some specimens there is an obscure whitish postocular streak. The suborbital region is frequently invaded by white, and the lores are flecked with it in several instances. Examples in high plumage have the greater and middle wing-coverts and scapulars broadly margined with grayish white and the feathers of the upper parts between the rump and bill edged with it, quite distinctly posteriorly and very faintly anteriorly. As in other dark-vented species, the crissum is more or less white. In certain specimens, whitish and brownish filoplumes occur on the crown, occiput, and cervix. No. 815 C. A. S. has albinistic feathers on the pileum and cervix, No. 888 C. A. S. has a tendency to melanism on the jugulum, and No. 854 C. A. S. possesses fourteen fully developed rectrices. The bill of the adult in life is black, becoming bluish on the lower mandible between the gonys and base; the irises are dark brown; the feet are usually flesh-colored, blackish on the outer side (*fide Beck* and *Gifford*).

In the Expedition collection there are five nestlings of this species representing successive stages of plumage development. No. 920, June 25, is in worn double-down with the scapulars just beginning to break from their follicles. Above, the specimen is deep mouse gray; below, it is mouse gray, relieved by a large grayish white patch on the abdomen and by a smaller one on the chest. The same coloration prevails in the natal down of the other specimens. No. 921, June 25, shows a marked decline in the natal down. The throat, chin, lores, orbita, and malar region are partially denuded. Following the lead of the scapulars, the remiges, exterior wing-coverts, and contour-feathers of the breast, sides, and upper

abdomen are making their appearance under the cover of the down. No. 922, June 25, has exposed contour-feathers on the interramal space, malar region, lores, orbita, and suborbital region. Beneath the surface down, the wings and tail have assumed definite form and the body, jugulum, and cervix have become pretty well clothed with contour-feathers. Postnatal down has also appeared. No. 919, October 2, has thrown off most of the natal down on the pileum, scapulars, wings, and upper tail-coverts, and all of it on the tail. Between the chin and crissum the down still persists as an outer covering. The greater and middle wing-coverts and inner secondaries are edged with brown of a more or less grayish tint. The scapulars, too, have paler margins, and under certain lights these feathers present a grayish appearance. No. 918, September 28, is almost entirely free from natal down, except on the abdomen and posterior portions of the breast, where the contour-feathers are hidden. The general color aspect of the upper parts is blackish brown. The wings are without conspicuous margins.

The Expedition series contains one hundred and four specimens in definitive feather, obtained as follows: January, three specimens; February, twenty-six; March, one; April, seven; May, twenty-eight; June, eighteen; July, two; August, seven; September, twelve. The majority of these specimens have more or less feather growth in progress, particularly on the body, neck, and pileum. Twenty-nine are renewing wing and tail feathers as indicated in the following table:

Date	Outer Primaries	Inner Primaries	Secondaries and Tertials	Wing-coverts	Rectrices
Jan. 5	1st, 2nd				Six
Feb. 1	1st				Five
" 5					Two
" 6	1st				One
" "	1st				Four
" "	1st				Six
April 24		9th, 10th			
" "		9th, 10th			Four
May 19	1st				Two
" 21		10th			Three
" "	1st				One
" "					One
" "		6th, 7th, 8th, 9th, 10th	Innermost secondaries and tertials	Greater and lesser	
" "		8th, 9th, 10th			
" "	1st				One
" "		8th, 9th, 10th			
" "		8th, 9th, 10th			
" "					One
June 25	1st				Six
" "	1st				Two
" "	1st				Three
" "					Three
July 30					Five
Sept. 2					One
" 28	1st	10th			Two
" "					One
" "					Two
" "					One
" "					Three

The measurements, taken in millimeters, presented in the table below are from forty-nine males and fifty females—all Galapagos specimens.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	202	74	29.7	7.2	12.3	35.5	44.7
Minimum	♂	181	65	25.6	6	10.4	31.9	37
Mean	♂	191	70	27.6	6.5	11.3	33.8	41.3
Maximum	♀	203	77	29	7	11.9	36.5	43
Minimum	♀	181	63	25	5.5	9.6	31.5	37.8
Mean	♀	191	70	27.4	6.2	10.7	33.3	40.5

Length in flesh: Five males, 285-302 mm. (296); eighteen females, 285-310 mm. (299).

Extent: One male, 625 mm.; one female, 630 mm.

As evidenced by the foregoing dimensions, the males and females are not conspicuously dissimilar in size.

Three eggs from Hood Island measure in millimeters: 47.1x32.9; 48.1x33.9; 48.5x33.8. They are dead white, and in form ovate, inclining to elliptical ovate.

Puffinus carneipes *Gould:* Flesh-footed Shearwater

Coues—*Nectris carneipes,* II, 126, 143, V, 192.
Salvin—*Puffinus carneipes,* 370, 385.
Godman—*Puffinus carneipes,* xlii, 142, pl. 37.

So far as I am aware, this Southern Hemisphere shearwater has been reported for the eastern side of the Pacific only from the vicinity of Point Pinos, California, where Mr. R. H. Beck has secured during his various expeditions ten specimens for the Academy and four for the University of California. His first specimen was taken on November 23, 1903, and his second and third on November 24, 1904. These specimens were the property of the Academy and were destroyed in the Conflagration of April, 1906. The other Academy specimens (seven males) were obtained in 1907. Mr. Beck's notes concerning them are as follows:

During my eleven months' stay in 1907 I saw nine Flesh-footed Shearwaters. They were then perhaps more plentiful than in other seasons; though the close watch I kept on shearwaters that year and the abundance of Sooty Shearwaters partly account for so many being seen.

On February 27, while I was out six miles northwest of the buoy amongst a large flock of fishing birds, I noticed a Flesh-footed Shearwater flying past. A long shot caused him to circle off and drop; but in the choppy sea I would have lost him had not a Cooper's Shearwater circled about and showed the dead bird's position.

On April 29, about six miles northwest of the buoy, I scared up a small bunch of Sooty Shearwaters, and a Flesh-footed swung up and was shot.

June 25 was foggy, with shearwaters abundant from Moss Beach to Seal Rocks. A mile or so off Seal Rocks a Flesh-footed Shearwater, two hundred yards away, was seen flying

along towards Point Pinos. A dead Sooty Shearwater thrown into the air called him over and he was secured. He flew with slower wing beats and was more deliberate in flight than the Sooty Shearwaters.

On July 22, while I was trying to get early southbound Sabine's Gulls that were resting in company with Sooty Shearwaters some distance off Point Cypress, a Flesh-footed Shearwater flew up. A hasty shot, with but one barrel loaded, sent him off wounded, but I could not find him on the rippling water.

August 27 I was out about four miles northeast of Point Pinos amongst thousands of Sooty Shearwaters. As one of the constantly passing throng flew by me, I noticed the light-colored bill and shot the bird, securing thus another Flesh-footed Shearwater.

September 2, while in the same vicinity, one of the shearwaters that flew over my head from behind had a light-colored bill. Hastily dropping the oars and grabbing my gun, I shot the bird, and, as anticipated, it proved to be a Flesh-footed Shearwater.

October 28 I was out about six miles northeast of the buoy and noticed a Flesh-footed flying south with a single Sooty Shearwater. A long shot at seventy-five yards distance failed to stop him.

November 4 I got out about eight miles north of Point Pinos and in a large flock of about twenty thousand Sooty Shearwaters secured two Flesh-footed that flew up to me. No others were seen, though possibly present in other portions of the scattered flock. Two Buller's Shearwaters were taken here and also a Slender-billed Shearwater and several Cooper's Shearwaters.

Inasmuch as the light-colored bill is so characteristic in life, Pale-billed Shearwater would perhaps be a more fitting name for this species than Flesh-footed, or Fleshy-footed, Shearwater.

The four specimens belonging to the University of California were captured in 1910—a male and a female on September 7, a male on September 23, and a female on November 1.

On the labels of the two males of November 4, 1907, Mr. Beck notes that the testes showed functional activity, evidencing that the season of reproduction was beginning, not ending. Furthermore, the male of February 27, 1907, was taken on the same day that the advanced guard of Sooty and Cooper's Shearwaters appeared.

Judging from the manner of their occurrence, it seems evident that the Flesh-footed Shearwaters frequenting the ocean in the vicinity of Point Pinos, California, are regular, but not common visitors from the antipodes and that they follow in their exodus- and return-migrations the American coast route of the Sooty Shearwaters.

In fresh plumage the lower parts are deep mouse gray, in certain specimens more or less varied by obscure pale edgings, especially on the breast and abdomen. With wear the general aspect of the plumage becomes decidedly brownish. New inner primaries in some instances are frosted with gray, and in high feather the tertials and longer scapulars are margined with grayish white, and more rarely the greater wing-coverts are tipped with it.

So far as witnessed by the specimens at hand, the Flesh-footed Shearwater's moult corresponds with that of the Sooty and Cooper's shearwaters. In the specimen obtained on February 27 renewal is progressing on the crown, cervix, back, jugulum, breast, abdomen, and in the lower tail-coverts and tail. The wings are much worn, particularly the greater coverts. In the specimen secured on April 29 the five inner primaries (not counting the remicle) and two rectrices are being replaced. Although somewhat the worse for wear, the specimens taken on June 25, August 27, and September 2 have scarcely any replacement in progress. The male of September 7 is in fine plumage with relatively few worn or growing feathers. The female of the same date, however, is not as forward. In the male of September 23, in the female of November 1, and in the two males of November 4 the distal primary is not fully grown and there are still some old feathers on the back; otherwise the moult appears to be about completed.

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
9519	♂	470	1145	333	113	43.7	12.2	18	52.7	66.1
9520	♂	480	1090	322	113	43	11.7	17.5	52.2	68.4
9521	♂	485	.....	330	111	44.7	12	18.5	50.7	66.5
9522	♂	.....	.....	327	111	42	12	17.7	50.3	63.4
9523	♂	490	1105	325	119	43.4	12	18.1	49.3	66.2
9524	♂	470	1095	321 [2]	108	44.2	12.7	18.5	51.7	64.3
9525	♂	480	1085	321 [2]	113	42.9	11.9	18.5	50.8	69
18688 [1]	♂	470	1092	326	108	40.2	11.3	18	51.1	66.4
18689 [1]	♂	470	1092	325 [2]	112	41.3	12.8	18	50	65
18687 [1]	♀	489	1080	329	111	41.6	11	16.8	52.1	68.6
18690 [1]	♀	483	1118	328 [2]	116	42	12.5	18.4	52.8	67.4

Puffinus griseus (*Gmelin*): SOOTY SHEARWATER

COUES—*Nectris fuliginosus*, II, 123, 143; *Nectris amaurosoma*, II, 124, 143; *Puffinus fuliginosus*, V, 192; *Puffinus amaurisoma*, V, 192.
SALVIN—*Puffinus griseus*, 370, 386.
GODMAN—*Puffinus griseus*, xlii, 145, pl. 38.

After breeding in the South Temperate Zone, the Sooty Shearwaters in their exodus-migration cross the Equator in great numbers. Off Point Pinos, California, they arrive in strength during the latter part of April and in May, and are very abundant at intervals until later autumn. Stragglers occur after the departure of the hosts for their Southern Hemisphere breeding stations, Mr. Beck and myself having obtained individuals in December and January. Seventy-five observed by Mr. Beck on February 27, 1907, thirteen of which were taken, apparently belonged to the vanguard of that year's migration; in common with the Cooper's Shearwaters whose advent was on the same day.

Usually the Sooty Shearwaters avoid the landlocked harbors. At times, however, they follow their prey through the Golden Gate to San Francisco Bay, venturing as far as Alcatraz and Angel islands. The Expedition lost sight of them in the vicinity of the San Benito Islands, Lower California, and did not meet with them again until the home voyage was nearly over, the course of the schooner *Academy* being outside of

[1] Mus. Vertebr. Zool., Univ. Calif.
[2] Distal primary not fully grown.

their fly-line. But two specimens were preserved, and these were shot on November 19, 1906, in latitude 35° 40′ N., longitude 133° 14′ W.

The Academy's two hundred and twenty-three specimens, from the ocean off California, exhibit considerable color variation, particularly on the under surfaces of the body and wings. In extreme light examples, the chin and throat are grayish white; the basal and subterminal portions of the feathers of the jugulum and breast are also grayish white, giving to the lower parts a mottled appearance; the shorter axillaries are varied with grayish white; the under coverts of the wings are white with only slight indications of gray. In extreme dark examples, the chin and throat are deep gray, the basal portions of the feathers of the jugulum and breast are lighter gray, and the general aspect of the under coverts of the wings is gray instead of white.

Whether age, geographic variation, or dichromatism is the bottom fact in this dual coloration, can not be affirmed absolutely from the material at hand—skins of sea-killed birds. Nevertheless, the preponderance of evidence is in favor of dichromatism, for the growing feathers manifest no age transition, being like the worn ones they are succeeding, and on breeding grounds parallel examples of bicoloration occur in other petrels independent of geographic variation.

The superficial color of the lower parts varies in different specimens from mouse gray to deep mouse gray, more or less intensified on the jugulum. New primaries, secondaries, and wing-coverts are often frosted with gray and the dorsal feathers and tertials are sometimes quite distinctly edged with it. With the decline of the plumage, the coloration changes, wearing browner on the upper and lower parts. In a few specimens the supraloral region is varied with grayish white, and in some instances gray filoplumes adorn the occiput, auriculars, cervix, and sides of neck, and even the back anteriorly. No. 9577 C. A. S. has a supernumerary rectrix, the total number of rectrices being thirteen instead of twelve.

Albinism is not uncommon in this species. The Academy's collection contains half a dozen striking examples of it. In one specimen (No. 9705, female, June 17, 1907), the plumage of the head, neck, and anterior portions of the back and breast

is white, relieved by a few gray feathers on the throat. The rest of the body-plumage (except that of the rump) and the tail-coverts are extensively white. Nearly all the greater wing-coverts, the growing inner primaries, and some of the secondaries and scapulars are wholly white. According to Mr. Beck's label, in life the irises were brown and the feet and bill white, the latter tipped with brown. There is such regularity in the abnormal coloration that this specimen might be easily mistaken for a nondescript. In a second specimen (No. 16062, female, September 6, 1909), the plumage of the head and neck is immaculate white. The rest of the body-plumage (except the white-tipped scapulars), the wings, and the tail-coverts are largely white. Two specimens present a general pied appearance above and below. Another is conspicuously varied with white on the posterior portions of the pileum and on the cervix and sides of the head and neck. In the remaining specimen, the white variations are also pronounced, but are restricted to the back and sides of the head, with a partial invasion of the cervix and sides of neck.

The Academy's series is divided according to calendar months as follows: January, five specimens; February, thirteen; March, one; April, fourteen; May, forty-six; June, thirty-two; July, fourteen; August, sixteen; September, thirty-five; October, twenty-nine; November, twelve; December, six. In some cases these specimens represent the extreme results of abrasion and bleaching, Mr. Beck having selected them on that account.

As a whole, the Sooty Shearwaters obtained on February 27, 1907, are much further along in the moult than the Cooper's Shearwaters taken on the same day. The more forward examples are moulting the inner primaries, secondaries, wing-coverts, the rectrices and their coverts, and the plumage of the upper and lower parts. Several of the specimens appear to be in nearly complete attire, which old telltale feathers prove is not the sequence of a postjuvenal moult. One of the specimens is growing the eighth primary on each wing, although all the other primaries have apparently been replaced. In two backward examples, both in worn dress, none of the primaries or rectrices have succumbed to moult.

It is believed that the February birds are early breeders and therefore early in their migration and, with individual exceptions, in their moulting. Outdoor study will throw further light on these matters.

The single March specimen, obtained on the 8th, displays no obvious signs of feather growth in progress.

As in Cooper's Shearwater, April specimens of the Sooty Shearwater are later in their moulting than the February ones. Of eight showing definite feather restoration, only five are replacing their primaries. The usual individuality is manifested. A specimen taken on the 8th is renewing the three inner primaries on the left wing, and the two inner ones on the right, not counting the remicle. A specimen obtained on the 25th has made a slight advance and is renewing the three inner primaries on the left wing and the four inner ones on the right. In three specimens secured on the 29th, one is renewing the three inner primaries on both wings and two, the seven inner primaries. One of the last two specimens is also acquiring a new rectrix, the only instance of tail renewal in the entire April series. In some individuals, the primaries and other plumage are in relatively good condition, but worn and faded feathers are not wanting here and there to mark such birds as old ones, probably late in completing their previous moult.

May specimens show irregular advancement in their moulting. Of twelve captured on the 6th, eight have cast from three to five of the innermost primaries, and four, none of them; in three instances the greater and lesser wing-coverts are involved. Of five specimens taken on the 8th, one is in worn garb with no obvious feather replacement under way, while two are at the other extreme, being well along in the postnuptial moult, the foremost retaining only the first of its old primaries. Three of the 13th and two each of the 15th and 18th are as backward as those of the 6th. One of the 21st is in fine plumage with no dilapidated feathers betraying age, albeit it possesses some feathers still in the sheath, including four rectrices. In contrast, is a worn bird of the 24th with all its old primaries in place. As a whole, the remaining May specimens (four secured on the 21st, two on the 23rd, six on the 24th, and two each on the 27th, 28th, 29th, and 31st) show advance over

those obtained during the first half of the month. Most of them are renewing from five to six innermost primaries and the greater and lesser wing-coverts. A number, also, are beginning to replace their inner secondaries. Two are growing rectrices. The only other instances in the May series are the three forward birds of the 8th and 21st.

A specimen taken on June 1 has outstripped in the moult three specimens taken on June 27. Its plumage is in fine condition with but few worn or growing feathers. The three tardy birds are abraded and bleached with feather renewal active. Of the old primaries, four outermost are left in one specimen, three in another, and three on the right wing and two on the left in the remaining specimen. The rest of the June birds (in dates, scattered along between the 3rd and 25th) further illustrate individual variability in the moult; some have lagged behind and others have pressed forward. Viewed as a whole, the rehabilitation is more advanced than in the May series.

With the exception of one obtained on the 24th and another on the 26th, the birds secured in July were taken between the 1st and 12th of the month. In general, they show progress in the moult, and there is about the same proportion of backward and forward individuals as in the preceding months. One has the plumage of the lower parts of the body much worn, particularly on the anterior portions of the breast, where the feathers are frayed nearly to the shaft and badly faded. The fore-neck, upper parts, inner primaries, and some of the secondaries and wing-coverts are in good condition. None of the specimens appear to be birds-of-the-year.

Of the specimens taken during August, six were obtained on the 17th, eight on the 19th, and one each on the 27th and 30th. In one specimen, an old distal primary and numerous old dorsal feathers still resist the advance of the moult. Eight specimens have lost their worn feathers and are nearly in complete plumage. In each, the sheath persists in two or more rectrices and in the distal primary. Two other specimens are also in new dress, but feather renewal appears to be about over in them. The five remaining specimens show some wear and lesser replacement.

The series of September has its share of specimens that are late in finishing the moult. In eight (one each of the 2nd, 4th, 9th, 10th, 20th, and 22nd and two of the 27th) the distal primary and a varying number of rectrices are in process of growth. There is also more or less minor renewal progressing in these specimens and in most of the others of the series. Three are much the worse for wear on the lower parts, posterior to the jugulum, and on the greater and middle wing-coverts. On portions of the breast, and in spots elsewhere in the worn areas, the feathers are frayed nearly to the shaft and greatly bleached.

October and November specimens show rapid decline or complete cessation in feather growth. In three October specimens (one of them apparently out of health) it has not ceased in the primaries and rectrices, nor in the rectrices of two other October specimens and a November one.

The stragglers of December and January are about at a standstill in their plumage, except one of January 7, which is replacing feathers on the head, neck, and body.

The extensive series, reviewed above, makes it clear that there is a protracted postnuptial moult in this species, but does not make it clear that there is a limited prenuptial or a deferred limited postjuvenal one.

Tabulated below are the extreme and average measurements in millimeters of one hundred and sixty-five specimens (seventy-eight males and eighty-seven females) obtained off the coast of California.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	314	94	47.3	11.9	18	56.9	69.4
Minimum	♂	282	80	40.1	9.1	14.5	50.3	60
Mean	♂	301	88	43	10.2	16.4	53.5	65.2
Maximum	♀	318	97	45	10.8	17.9	55.7	68
Minimum	♀	281	81	38.3	8.8	13.6	50	60
Mean	♀	299	89	41.8	9.8	15.9	53	64.2

Judging by the foregoing table, the majority of the females are somewhat inferior to the males in size.

Puffinus tenuirostris (*Temminck*): Slender-billed Shearwater

Coues—*Nectris tenuirostris*, II, 126, 143; *Nectris brevicauda*, II, 127; *N. brevicaudus*, II, 143.
Salvin—*Puffinus tenuirostris*, 370, 388.
Godman—*Puffinus tenuirostris*, xlii, 149, pl. 39.

As is well known, the Slender-billed Shearwater is a Southern Hemisphere species that penetrates into Arctic regions in its exodus-migration. Offshore in the vicinity of Point Pinos, California, it has been found by Mr. Beck and other collectors to be rather common in November or December in some years, and in others, rare or apparently absent. Individuals have also been met with by Mr. Beck in October and January, his earliest record being a solitary specimen, taken October 13, 1910, and his latest, a straggler taken January 30, 1908.[1] According to Mr. Beck's label, the ova in a female of December 2 were functionally enlarged. It should be added, that this species has not been detected in spring and summer in the hosts of Sooty Shearwaters.

The fact that the Slender-billed Shearwaters are late and irregular in their occurrence off Point Pinos is of peculiar interest, creating the doubt whether they are really returning migrants bound for South American breeding stations, or whether they are strays that have missed their way and, falling in with the rear guard of the Sooty Shearwaters, have come down the wrong coast, the American instead of the Asiatic. It is hoped that Mr. Beck's explorations off the mainland of Chile will clear up the matter.

No specimens of this species were brought back by the Academy's Galapagos Expedition.

Bicoloration in the Sooty Shearwater finds a counterpart in the Slender-billed. In extreme dark examples of the latter species the general aspect of the under coverts of the wings is gray; the feathers of the throat are superficially dark gray, becoming pale gray beneath the surface. In extreme light examples the general aspect of the under coverts of the wings is decidedly grayish white; the chin and anterior portions of the throat are likewise grayish white, sometimes mottled with

[1] The record for "April 10" in Dr. Grinnell's *Distributional List of the Birds of California*, p. 27, is a *lapsus calami*.

gray, and white, more or less tinged with gray, prevails at the base of the feathers of the jugulum and breast. The two extremes are linked together by intermediates. While the significance of this dual coloration has not been fully determined, the collateral evidence, which is of the same character as that presented in the Sooty Shearwater, is in favor of dichromatism —not of age or geographic variation. We must look to future investigations on nesting grounds for a final settlement of the case.

Judging from the original description, the type of *Puffinus intermedius* Hull[1] is apparently intermediate between the light and dark phases of *P. tenuirostris;* its bill is too short for *P. griseus.*

The dark gray of the lower parts varies somewhat in different specimens, and is often of a distinctly brownish shade, becoming still browner by wearing. In some specimens the feathers of the breast and abdomen are conspicuously tipped with pale gray. No. 9731 C. A. S. has numerous obscure brownish and brownish white bars on the throat and brownish ones on the sides of the head posterior to the eyes, and No. 9743 C. A. S. has fourteen fully developed rectrices.

Of the Academy's series of fifty-five specimens from the ocean off Point Pinos, California, three were taken in October, twelve in November, thirty-four in December, and six in January. The general condition of the plumage in this series is similar to that obtaining in the Sooty Shearwater during the same months of the year. Several specimens are belated in moult; two (Dec. 2, 9) have the distal primaries still in the sheath, and one of them, also three rectrices. Two other specimens (Dec. 2, Jan. 2) are growing single rectrices and two others (Dec. 2, Jan. 2) are renewing feathers on the hind neck and back. A couple of Alaskan specimens from the Carnegie Museum, taken June 25, are well along in a complete moult.

The relationship is very close between *Puffinus tenuirostris* and *Puffinus griseus.* As manifested in the accompanying tables, the maximum measurements of the former species overlap the minimum ones of the latter, except in the length of the culmen. The total length, taken from skins, also shows an overlapping, which, however, may disappear in measurements

[1] Emu, v. 11, p. 98.

taken in the flesh. The most tangible characters separating the two species are the form and dimensions of the bill. The bill of *P. tenuirostris* is shorter than that of *P. griseus;* it is also weaker at the tip and relatively, sometimes actually, wider at the base. The culmen in forty-four specimens measures 29.7—35 mm., while in one hundred and sixty-five specimens of *P. griseus* it measures 38.3—47.3 mm. *P. tenuirostris* is further distinguished, in the dark phase, by the uniformity of the gray of the under coverts of the wing, the shaft stripes and other heavy dark markings often present on these coverts in *P. griseus* being altogether wanting. In the extreme light phase of both species the under coverts of the wing are white, and therefore not diagnostic.

Mr. Ridgway's analytical key to *P. tenuirostris*[1] is not always adequate; the exposed culmen in short-footed examples (notably No. 9758 C. A. S.) is sometimes decidedly longer than the combined length of the first two divisions of the outer toe. The keys of Mr. Salvin and Dr. Godman are still more inadequate, the length of the wing[2] and absence of white on the under wing-coverts[3] being given as differential characters of the species.

Appended are the dimensions in millimeters of twenty-two males and twenty-two females—all from the ocean in the vicinity of Point Pinos, California.

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	290	90	35	9.6	16	51	63.5
Minimum	♂	266	81	31.7	8	14	46	58
Mean	♂	282	85	33.3	8.8	14.7	48.2	60.9
Maximum	♀	286	87	35	9.5	15.1	50.3	62.3
Minimum	♀	264	77	29.7	8	13.2	44.3	56.1
Mean	♀	274	84	33	8.7	14.4	48.2	59.5

The above measurements show a slight difference in the size of the sexes in favor of the males.

[1] Man. N. A. Birds, p. 62.
[2] Salvin, monograph, p. 370.
[3] Mon. Petrels, p. xlii.

Puffinus nativitatis *Streets:* Christmas Island Shearwater

Salvin—*Puffinus nativitatis,* 370, 389.
Godman—*Puffinus nativitatis,* xlii, 153, pl. 40.

Lord Rothschild and Dr. Hartert record without date a "♀ ad. at sea, 12° 5′ lat. N., 107° long. W."[1] I know of no other instance of a specimen having been captured within our bounds.

In three Laysan Island specimens (a female of May 17, a male of May 21, and an undated male) feather renewal appears to be at rest. Although apparently fully grown, the distal primary is somewhat shorter than the second in the female and one of the males. A like discrepancy has been observed in other shearwaters.

MEASUREMENTS (in millimeters)

No.	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
18873	♂	247	90	32.5	9	13.5	44	50.1
5650[2]	♂	251	91	31	8.5	12.5	41.3	52
5649[2]	♀	258	88	30	8.7	13	41.9	48

Puffinus chlororhynchus *Lesson:* Wedge-tailed Shearwater

Plate 17

Coues—*Thiellus chlororhynchus,* II, 123, 142; *Thiellus sphenurus,* II, 122, 142.
Salvin—*Puffinus chlororhynchus,* 369, 372; *Puffinus cuneatus,* 369, 371.
Godman—*Puffinus chlororhynchus,* xl, 84, pl. 24; *Puffinus cuneatus,* xl, 76, pl. 22.

To Dr. Godman belongs the credit of having first suggested in print[3] that *Puffinus cuneatus* Salvin is a synonym of *Puffinus chlororhynchus* Lesson, the type specimens representing respectively the light and dark phases of a single species.

The series before me illustrates fairly well the variations shown in specimens from the Revilla Gigedo, Hawaiian, Kermadec, and Seychelle islands. Intergradation is complete throughout this series, there being no constant differences either in color or size.

[1] Nov. Zool., v. 9, p. 414.
[2] Stanford Univ.
[3] Mon. Petrels, pp. 79, 80.

I consider that Lesson's type (preserved in the Natural History Museum at Paris) and original description afford a better basis for determining the specific name of this species than Latham's description of his Pacific Petrel, upon which *Procellaria pacifica* Gmelin was founded.[1] "Length twenty-two inches" is in itself a sufficient discrepancy to disqualify Latham's description.

Although widely dispersed, the individuals of this species do not appear to be migratory, the different colonies apparently frequenting only the seas adjacent to their native islands.

The Galapagos Expedition, as stated in Mr. Gifford's notes, first encountered Wedge-tailed Shearwaters on July 23, 1905, in latitude 20° 59′ N., longitude 111° 57′ W. Only a few were seen then, but two days later they were common in latitude 19° 37′ N., longitude 111° 11′ W. Two that were shot on wing were devoured by sharks before they could be recovered from the water. The rookery on San Benedicto Island was visited on July 26, and was found to be in a flourishing condition. Although the season was advanced, no downy young were discovered; the eggs, however, as a rule were hard-set. In some instances two old birds without an egg occupied a burrow. The burrows were about four feet in length and rarely had more than one turn. As Clipperton Island was neared, these shearwaters became scarce. August 10 seven of the light phase, apparently superannuated birds, were found on the island—three in caves and four on the bank of the lagoon. They were the last individuals observed during the outward voyage. On the return voyage the first were seen on September 28, 1906, in latitude 7° 23′ N., longitude 97° 48′ W. Thereafter they were met with daily for nearly three weeks. They were most numerous on October 8 in latitude 14° 40′ N., longitude 109° 26′ W. The last one was left astern on October 18 in latitude 16° 55′ N., longitude 112° 55′ W.

The diary of Mr. Alexander Sterling Bunnell, who accompanied the Academy's Revilla Gigedo Expedition of 1903, contains the following notes on the San Benedicto colony:

May 15, 1903. Toward sunset the Wedge-tailed Shearwaters came by thousands from the ocean and down from the

[1] Cf. Mathews, Birds Austr., v. 2, pp. 79, 80.

cliffs, filling the air for half a mile, as high as the highest cliff, 900 feet. Their flight was flitting, bat-like, with an occasional sail. The whole concourse, with individual exceptions, moved as if it were a liquid, being stirred in various places. Now and then one uttered a low cat-like call. They were flying so thick and fast that they often bumped into one another. They did not light on the water and appeared to be doing nothing. Especially when we gave their cat-call or killed some, they came close to the boat, so close that we got all the specimens we wanted by batting them with the oar. The white-breasted ones were a very small proportion of the total number. As dusk came on their flight extended to their burrows high on the cliffs, but as night fell they flew near the water and spread out.

May 17. I climbed the main peak of the island, 900 feet in height. It is a cinder cone, composed entirely of powdery pumice caked by water and cut with a hundred steep, deep gorges, radiating from the summit on most sides, and broken by a cliff on the southeast. The whole cone was honeycombed with the burrows of these shearwaters and as I walked over it I heard their growls, which sounded like a combination of the north wind blowing through a knot hole, the wild cat's growl, and the screech owl's call. Every few steps I sank thigh deep into the burrows, raising a choking and blinding dust. A cloud of dust was always about the cone when the wind blew. At the mouths of the burrows the hardened ash was weatherworn into pillars, cupolas, terraces, giving to the rookery an appearance very much like the houses of cliff-dwellers. There were runways leading to each burrow marked with the birds' tracks. The direction of the tracks at the mouth often showed whether the birds were at home or abroad. If a cat-moaning is heard, two birds will be found in the burrow. A strong odor of musk was always apparent. The burrows extended in a horizontal direction, and were sometimes eight by seven inches at the opening and from four to eight feet in length, with a larger nesting cavity at the farther end. They were often four or five feet below the surface and usually had a slight turn. Some had a little grass or twigs in them. Few birds were seen on the cone outside the burrows. Occasionally one came in and sailed around, over and back, keeping close to the surface; then it

suddenly dropped and scurried into its burrow, raising a cloud of dust.

May 23. It is too early yet for eggs.

A series from San Benedicto Island illustrating the transition from the natal down to the definitive feathers would be especially instructive, showing whether or not the light phase is light-colored from birth, and the dark phase, dark-colored. It is apropos to note that Mr. William Alanson Bryan states that a nestling of the light Marcus Island bird is "a smoky lilac-gray over the back and top of the head, and very light pearl gray on the under parts, darkest on the abdomen,"[1] and that Mr. T. Iredale notes that the "down of the young was dark grey"[2] in the dark phase prevailing on the Kermadec Islands.

The Expedition specimens show some points worthy of special mention. A female (No. 748 C. A. S.), taken July 25, 1905, in latitude 19° 40′ N. and longitude 112° W., is immaculate white underneath from bill to crissum; none of the Hawaiian specimens I have handled are whiter (plate 17). Concealed portions of the dorsal feathers of this specimen are more or less washed with gray. In a moulting white-breasted male, obtained on October 4, 1906, the general aspect of the upper parts is quite gray. The throat in extreme examples of the dark phase is not grayer than in four specimens from the Kermadec Islands. As in certain other dark-bodied shearwaters, the dark gray browns with wear. The feathers of the lower parts are white basally in some birds of the dark phase and gray in others, the former condition indicating an approach toward the light phase. No. 116767 U. S. Nat. Mus., dark phase, Kauai Island, Hawaiian Archipelago, also has the feathers of the under surface white at the base, especially on the breast. *Puffinus knudseni* Stejneger[3] was founded on a white-breasted bird from Kauai Island, not on a dark-breasted one, as implied by Dr. Godman[4] in quoting from an article[5] by Mr. A. W. Anthony. Some specimens have gray filoplumes on the occiput, cervix, and sides of the head and neck.

[1] Occ. Papers B. P. B. Mus., v. 2, no. 1, p. 108.
[2] Emu, v. 10, p. 12.
[3] Proc. U. S. Nat. Mus., 1888, v. 11, pp. 93, 94.
[4] Mon. Petrels, p. 77; cf. Biol. Centr.-Amer., Aves, v. 3, p. 433.
[5] Auk, v. 17, pp. 250, 251.

Mr. Gregory M. Mathews remarks that the "all dark birds from San Benedicto Island are separable from any other form of *P. pacificus* [=*chlororhynchus*] by their more powerful bills."[1] Not one of the San Benedicto birds at hand has a bill as large as that of a male from the Kermadec Islands, which has the chord of the exposed culmen 44.1 mm., the depth of the upper mandible 12.2 mm., and the width 18 mm.

The Expedition collection contained fifty-five specimens. When outward-bound in 1905, fifteen were taken at sea on July 25, twenty-one from burrows on San Benedicto Island on July 26, two at sea on August 8, and three on Clipperton Island on August 10; when homeward-bound in 1906, fourteen were secured at sea between the 4th and 12th of October.

The specimens captured at sea on July 25 are in worn plumage with renewal commencing on the pileum, cervix, jugulum, and breast, and in some instances on the abdomen. Specimens taken from burrows on the following day are also in worn dress, but as a whole are more backward in their moulting. The August specimens are in about the same condition as the July ones. Those of October show advance both in wear and restoration; the primaries and rectrices, however, are still unaffected by the moult.

Inasmuch as specimens taken from burrows are often worn and faded, it becomes apparent that breeding stations can not be relied upon implicitly to furnish typical examples of geographic, or other, variations in color.

Seventeen males and thirty females of the Expedition afford the following measurements in millimeters:

	Sex	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
					Depth	Width		
Maximum	♂	309	148	41.2	11.5	17.2	48.2	62
Minimum	♂	289	129	36.6	9.5	13.9	41.4	52.2
Mean	♂	299	138	39.1	10.5	15.7	46.6	57.5
Maximum	♀	311	145	42.1	11.9	17.6	48.1	61
Minimum	♀	287	128	36.6	9.2	14.5	43.8	53
Mean	♀	298	138	38.9	10.3	15.7	46	57.2

Length and extent in flesh: One male, 444 mm., 978 mm.; one female, 430 mm., 980 mm.

[1] Birds Austr., v. 2, p. 84.

From the above, it seems that the average dimensions of the females do not fall short of those of the males.

A dozen eggs from San Benedicto Island are white, and vary in form from ovate to elongate ovate, and measure in millimeters: 58.4x41.5; 58.7x41; 59.4x38.5; 61x43.5; 61.7x40.6; 62x42; 62.5x41.5; 64x40.2; 64x42; 64.2x41.5; 64.5x39.3; 64.5x40.

Puffinus bulleri *Salvin:* BULLER'S SHEARWATER

SALVIN—*Puffinus bulleri*, 369, 371.
GODMAN—*Puffinus bulleri*, xl, 81, pl. 23.

By far, Buller's Shearwater is the rarest shearwater in collections. Dr. Godman reports only six specimens in his monograph—five from New Zealand and one from California waters, the last, a female, shot by myself on the ocean near Point Pinos on November 6, 1896. Mr. R. H. Beck has since obtained fifteen off Point Pinos, more than doubling the number of specimens previously known to science. Unfortunately, his first specimen, secured in September, 1903, was destroyed in the Conflagration of April, 1906, along with the one captured by myself. Of the remaining fourteen, nine were collected for the Academy and five for the University of California. The University specimens are all males, and were taken in 1910—one on September 14, three on September 26, and one on October 13. The Academy specimens are of both sexes and were procured during two autumns, as follows: A female on September 2 and two males on November 4, 1907; a male on the 9th, a male on the 13th, and two males and two females on the 15th of October, 1909.

The breeding places of this Southern Hemisphere species and the route by which it reaches the vicinity of Point Pinos, California, are unknown.

Below are Mr. Beck's notes for 1907 and 1909.

1907. In February I returned to Point Pinos to spend a year endeavoring to replace in some degree the Academy's water bird collection destroyed in the great fire of 1906, giving

especial attention to the Tubinares. Not till September 2 did I see a Buller's Shearwater. On that day I went out on Monterey Bay three or more miles to the northeast of Point Pinos and found a large number of Black-vented and Sooty Shearwaters fishing. The weather was propitious, there being only a light breeze. As I rowed along from one flock to another, a Flesh-footed Shearwater flew over my head from behind, and was shot. A few minutes afterward, as I proceeded leisurely, being then about four miles north of Point Pinos, I saw a lone Buller's Shearwater fishing with a few Spanish mackerel. As the fish went down, the shearwater lit one hundred and fifty yards away from the boat. I rowed with all my might, but the bird arose out of range. As it circled, seventy yards distant, I fired, but merely caused it to settle for a few moments, only a single shot probably hitting it. As the bird shook its wings and rose, I fired both barrels and stopped it again. When I came up within long range, it started off once more, but this time I secured it.

On November 4 I went out seven or eight miles north of Point Pinos and finally reached the gathering of shearwaters I was looking for. There were about twenty thousand Sooty, two hundred or more Black-vented, and about thirty Cooper's Shearwaters. They were scattered about over considerable water, and as I approached one of the larger bunches I saw two Buller's Shearwaters fly around it and enter the bay. Further on I discovered one on the water apart from a flock of Sooty Shearwaters, and secured it. Another was seen sitting in the midst of a flock of Sooty Shearwaters. Another still was sitting close to two of these shearwaters. It decoyed to a dead bird thrown into the air, but unfortunately was missed with my first barrel, and escaped, my other barrel being out of commission. Later in the day I secured a second specimen of Buller's Shearwater from the concourse of shearwaters. I also obtained from it two Flesh-footed and a Slender-billed, the only ones noted.

On November 8, about four miles north of Point Pinos, a single Buller's Shearwater, in worn plumage, was seen flying about in search of food, but too far away to be secured.

1909. I spent the last four months of 1909 in collecting on the bay and ocean adjacent to Point Pinos. On October 9 I got out about four miles northeast of Point Pinos, and found a few Sooty and Cooper's Shearwaters in bunches on the water. The first flock of these shearwaters I neared rose out of gunshot range, and with them a Buller's Shearwater. They all flew north and appeared to settle in the far distance. I rowed in their direction and presently a Cooper's Shearwater flew past me, and shortly after, a Buller's, which I shot. An hour later I approached a flock of shearwaters on the water, but they rose when a hundred yards distant, and flew to the northward. With them were two Buller's Shearwaters. As the weather was not settled and as I was alone as usual in a rowboat I followed no further.

On the 13th of October, when I was out about four miles north of Point Pinos, a Buller's Shearwater came along, going south. It swung up twenty yards astern of the boat, and I shot it.

October 15 there was a low fog all day, and part of the time a drizzle. I went out about five miles northeast of Point Pinos and found a few Cooper's Shearwaters fishing about, and working out to sea. One Buller's Shearwater was seen flying with a couple of Cooper's Shearwaters, a few hundred yards outside the boat. Presently another Buller's came along, and I winged it. Another one appeared, and started after the wounded bird, which was swimming rapidly away. I tossed up a dead Bonaparte's Gull and then a Western Gull, and the flying bird swung back toward me, and I shot it. Later, two other Buller's Shearwaters came my way, and were secured. The flight of all these birds, in the light wind, was similar to the albatross flight, there being no flapping of wings as in Cooper's Shearwater, except when rising over the crest of a wave. Three of the four specimens taken had the generative organs slightly enlarged.

Comparison shows that No. 24302 Carnegie Museum (male, Mokokinou Islands, New Zealand, "1889") is identical in specific characters with the series obtained on the ocean off Point Pinos, California. The following is a blanket description of the fourteen Point Pinos specimens now extant:

Pileum and anterior part of cervix deep, or dark, mouse gray, forming a cap contrasting with the adjacent upper parts; lores and auriculars mouse gray, chiefly dark in tone, interrupted in a varying degree with white; usually a whitish mark just above the eye; posterior portion of cervix and sides of neck, the scapulars, interscapulars, and upper tail-coverts mouse gray or deep mouse gray, more or less varied with darker subterminal borders and grayish white edgings; rump deep mouse gray, relieved in most instances with paler edgings; jugulum, breast and abdomen immaculate white; line of demarcation on sides of neck and breast nebulated gray and white; sides white, in two specimens with indications of gray; flanks mouse gray, the feathers narrowly tipped with grayish white; general aspect of lower tail-coverts white, bordered and tipped with gray, the lateral feathers being varied with mouse gray, particularly on the outer web, and the partially concealed central ones being deep mouse gray, apically at least; primaries outwardly black, the shorter ones frosted with gray, and the inner webs of all extensively white; the secondaries, except innermost, mouse gray, margined with grayish white, and largely white on inner web; the innermost secondaries blackish brown, some of them tipped with grayish white; tertials blackish brown, more or less washed with gray and tipped with grayish white; lesser wing-coverts blackish brown; middle coverts blackish brown, the outermost sometimes mouse gray with paler edgings; greater coverts light mouse gray, margined with grayish white, the innermost blackish brown; alula and primary coverts black; lining of wings and axillaries white; inner edge of wing with a narrow broken border of mouse gray and blackish brown; two lateral rectrices mouse gray (or dark brown frosted with gray), tipped with grayish white; the other rectrices black.

In the majority of specimens gray filoplumes occur on the head and cervix. Two of the University of California males exhibit abnormal tail development, No. 18682 having fourteen rectrices (seven of them still in the sheath) and No. 18685 thirteen rectrices.

The moult of Buller's Shearwater does not appear to differ from that of other Southern Hemisphere shearwaters occurring off Point Pinos during the northern autumn.

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Upper Mandible		Tarsus	Middle Toe and Claw
							Depth	Width		
9293	♂	460	985	296	126	40.4	10.4	13.4	47.6	61
9295	♂	465	980	297	132	40.4	10	13.6	50.1	61
15757	♂	.....	.....	285	123	43.1	10.6	13.5	49	58.9
15758	♂	.....	.....	298	130	42.7	10.7	14.2	49.8	63.2
16233	♂	493	1016	297	125	43.5	11	15.2	51	63.7
16235	♂	.....	.....	291	120	43	11.2	14.6	51	63.1
18682[1]	♂	483	991	298	129	43	11.2	15	48.9	61
18683[1]	♂	483	991	299	129	42.1	11	15.4	49.5	62.8
18684[1]	♂	483	1016	309	127	45	11.1	14.2	50	63.1
18685[1]	♂	483	1016	307	133	42	10.6	15	48.9	62.8
18686[1]	♂	476	991	291	126	41.9	10.8	13.5	48	62.1
24302[2]	♂	.....	.....	297	135	42.5	9.9	13.2	48	61
9294	♀	463	975	.....	119	41.5	10.1	14.5	48.1	61.9
16234	♀	470	991	293	125	40.7	10	13.7	50.3	62.8
16236	♀	.....	.....	303	137	43.1	10.6	14.5	49.5	61.7

Halocyptena microsoma *Coues:* LEAST PETREL

COUES—*Halocyptena microsoma*, I, 79, 90, V, 191.
SALVIN—*Halocyptena microsoma*, 346.
GODMAN—*Halocyptena microsoma*, XXXV, 6, pl. 3.

According to Mr. Gifford's notes, Least Petrels were first noted by the Expedition on July 10, 1905, in latitude 30° 35′ N. and longitude 117° W., and were last seen on July 21, 1905, in latitude 23° 32′ N. and longitude 113° 4′ W., none being observed in the vicinity of the Galapagos Islands or during the homeward passage. On San Benito Islands, Lower California, July 14, 15, 17, pairs were found at home among the rocks and, more rarely, under dead century plants. It was early for eggs; Mr. Beck, alone, was successful in the search, on the 15th obtaining in a rock pile a single fresh one, together with the female parent.

Like other short-legged storm petrels of the Northern Hemisphere, the Least Petrel is migratory, its fly-line apparently paralleling the coast from Lower California to Ecuador.

Feather renewal is dormant and feather disintegration active in the seventeen Expedition specimens. The greater wing-coverts are much darker in some of these specimens than in others, natal brown supplanting the pale grayish brown.

[1] Mus. Vertebr. Zool., Univ. Calif.
[2] Carnegie Museum; New Zealand.

MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
447	♂	.....	.....	122	52	11.3	20.3	18.9
448	♂	.....	.....	125	55	10.7	22	20.7
450	♂	.....	.....	119	51	11.4	21.4	19.3
451	♂	.....	.....	123	52	11.2	21.9	19.1
453	♂	.....	.....	121	53	11.2	21.3	18.5
454	♂	.....	.....	122	54	11.1	20	18.9
456	♂	.....	.....	120	55	11	20.1	18.6
459	♂	.....	.....	121	53	11.5	21	19
449	♀	.....	.....	129	58	11	21.6	19.5
452	♀	.....	.....	123	57	11.1	21.5	20.5
455	♀	.....	.....	125	52	11.2	20.2	20
457	♀	.....	.....	126	53	11.1	20.7	19.3
458	♀	.....	.....	127	54	10.7	20.1	17.8
460	♀	.....	.....	128	56	11.2	20.9	18.9
461	♀	.....	.....	122	55	10.8	21	18.5
462	♀	152	343	120	53	11	20.6	20
463	♀	.....	.....	125	55	11	20.3	19

The single egg, mentioned above, measures 25.4x19.5 mm. It is elliptical oval in shape, inclining to oval, and is dead white, with a very few dark specks, so minute and scattered as to be scarcely discernible.

Oceanodroma tethys (*Bonaparte*): Galapagos Petrel

Coues—*Procellaria tethys*, I, 80, 90, V, 192.
Salvin—*Procellaria tethys*, 343, 346.
Godman—*Procellaria tethys*, xxxv, 4, pl. 2.

Scarcely anything has been written concerning the Galapagos Petrel, and, as might be expected, the results of the Academy's two ocean expeditions add somewhat to the common stock of information. The known northern range of the species was considerably extended by both expeditions. During the one to the Galapagos Islands, individuals first made their appearance on July 21, 1905, in latitude 23° 32′ N., longitude 113° 4′ W., the position where the Black-footed Albatrosses parted company with the schooner *Academy*. On the following day, about a degree further south, a dozen specimens of the Galapagos Petrel were secured, and from this time forward, this petrel is prominent in Mr. Gifford's notes.

When homeward-bound, it was last chronicled by him on October 22, 1906, in latitude 17° 53′ N., longitude 114° 45′ W. During June, 1903, while on the Revilla Gigedo Expedition, Mr. Beck obtained numerous specimens at Banderas Bay, Mexico. In the Galapagos Archipelago, Mr. Gifford records the species for every month of the year except November, December, and March. Messrs. Snodgrass and Heller report[1] it for December, and Mr. Ridgway lists[2] two specimens taken by Mr. C. H. Townsend on March 1 in latitude 4° 22′ N., longitude 82° 3′ W. During the *Academy's* cruise south of the archipelago, in June, 1906, it was met with daily. Individuals were observed on the 11th in latitude 4° 25′ S., longitude 93° 30′ W., the most southerly bird-watching station of the Expedition. Capt. R. Paefsler has logged its occurrence in latitude 17° S., longitude 74° W., June 6, 1910; 18° S., 72° 5′ W., Feb. 15, 1912; 20° 6′ S., 70° 4′ W., Oct. 17, 1913.[3]

From the foregoing facts it would appear that the range of the Galapagos Petrel extends over the intertropical seas contiguous to the American west-coast.

In substance Mr. Gifford's Galapagos notes are as follows:

These storm petrels nest in holes in the cliffs and among the lava blocks on the south side of Tower Island, the rookery extending along the face of the cliffs for three quarters of a mile and inland for about two hundred yards. On September 15 Mr. Beck visited the rookery and found an addled egg and saw one of these petrels enter a nesting hole.[4] The genital organs of the specimens taken were medium-sized. In specimens obtained near Albemarle Island in April these organs were enlarged, indicating the advent of the egg-laying season. These petrels were also observed in the vicinity of Abingdon, Barrington, Bindloe, Brattle, Charles, Chatham, Cowley, Culpepper, Daphne, Hood, Indefatigable, James, Narborough, and Wenman islands, but were not numerous, except between the Equator and Tower Island on the 13th and 14th of September and northwest of Abingdon Island on the 23rd. There

[1] Proc. Wash. Acad. Sci., v. 5, p. 243.
[2] Proc. U. S. Nat. Mus., v. 19, pp. 657, 658.
[3] J. f. O., 1913, v. 61, pp. 42, 49; 1914, v. 62, p. 273.
[4] Cf. Condor, v. 4, 99.

were no flocks, however, not more than two or three being seen together. On all occasions these petrels were silent, even when following the schooner and picking up turtle fat in company with Dark-rumped Petrels. Their flight was butterfly-like, and more erratic than the flight of the Graceful Petrels. Galapagos Short-eared Owls are their great enemies on land, the remains of the petrels being often found in owl pellets. In life the bill, orbital ring, and feet are black and the irises dark brown.

Mr. Beck's label states that the egg, mentioned above, was found in a slight hollow in the soil under a lava block on the south side of Tower Island and that the nesting season had passed, although two or three hundred Galapagos Petrels were seen flying about over the nesting ground. He affirms that the identity of the egg is "sure." Nevertheless, a petrel egg taken without the parent bird is not above suspicion. The egg is ovate in form, inclining to elliptical ovate, and white, with a very few minute dark dots, so small and scattered as to be hardly perceptible. It measures 26.7 x 19.9 mm. So far as I am aware, no description of the egg of this species has appeared in the literature.

The ninety-two Expedition specimens of the Galapagos Petrel have the tail emarginated,[1] very much as in *Oceanodroma castro*. Many of the specimens have the tarsus decidedly longer than the middle toe and claw, which is likewise true in numerous specimens of *Oceanodroma melania*, these relative dimensions being unstable in the Thalassidrominæ—see tables of measurements under the different species. The usual point-of-wing-formula in the Galapagos Petrel and in *O. melania* is: primary 2>3>1>4. Obviously, the Galapagos Petrel is not a square-tailed, but a fork-tailed storm petrel. It is therefore transferred from the genus *Thalassidroma* to the genus *Oceanodroma*, the technical name of the species by this association becoming *Oceanodroma tethys*.

The tone of the brown of the greater wing-coverts varies considerably, being very pale in some specimens, and the lateral

[1] In his description of the species Mr. Salvin states that the tail is "slightly forked" (mon., p. 346), but in his key to the genera he states that the tail is "not distinctly forked" (p. 343).

lower tail-coverts and the base of the tail are more or less white.

Of the Expedition series, twelve specimens were taken on the 4th and 5th of January, four on April 24, sixteen between the 4th and 11th of May, twenty-six between the 7th and 18th of June, fifteen on the 22nd and 25th of July, six between the 1st and 14th of August, eight on the 1st, 2nd, and 15th of September, five on the 4th, 5th, and 12th of October. Although by no means complete, this series affords a fair clue to the moult of the species. In the January specimens feather renewal is practically at a halt. In an April bird the first and second primaries are not fully grown. The first primary is also backward in a bird of May 7, in one of May 10, and in three of June 18. According to some of Mr. Beck's labels, great enlargement of the sexual organs prevails during May and June, indicating the height of the breeding season in Galapagos waters. Most of the specimens obtained in July were undergoing a complete moult. As in the moulting of other petrels, the degree of advancement varies in different individuals. August and September specimens, as a whole, manifest further progress, while October ones, in most instances, show an abrupt decline in feather growth.

The dimensions in millimeters of fifty-four males and seventeen females are summarized in the subjoined table.

	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
Maximum	♂	143	66	13.8	23.7	21
Minimum	♂	130	54	11.4	20	18
Mean	♂	137	59	12.6	22	19.5
Maximum	♀	145	67	14	23.3	21.3
Minimum	♀	132	55	11.8	20.2	18.1
Mean	♀	137	59	12.7	21.8	19.7

No marked difference in the dimensions of the sexes is manifested in the preceding summary.

DETAILED MEASUREMENTS (in millimeters)

No.	Sex	Length	Extent	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
355	♂	170	410	143	65	9	13.7	23.1	20
359	♂	170	.....	134	60	8	12.7	21.3	19.1
361	♂	.....	.....	132	61	7	12.3	23.5	19.5
377	♂	165	400	138	59	9.3	12.2	23.7	20.7
378	♂	160	400	141	60	5	12.5	21.9	19.9
382	♂	165	380	134	59	7.7	12.2	21.1	19.9
383	♂	170	400	137	59	7.5	12.4	22	19.1
386	♂	167	400	138	61	11	13	21.3	19.8
390	♂	.....	.....	130	57	7	13	21	20
396	♂	163	400	142	56	6	13	22.3	19.4
401	♂	155	390	134	55	7	12	22.7	20
405	♂	167	396	137	65	7.5	12.4	21.6	20
406	♂	165	410	139	59	7.5	12.6	21.9	19.2
408	♂	.....	.....	134	55	7	12.4	23	19
410	♂	165	395	133	58	9	13.2	22.4	19.9
418	♂	.....	.....	136	61	9.7	12	21	20.1
430	♂	165	400	142	62	9	12.5	22.2	19.1
440	♂	165	400	138	57	11	12.9	20.4	18.6
441	♂	.....	.....	136	59	8.7	13	22	18
371	♀	.....	.....	138	60	5.5	11.8	20.2	19.5
380	♀	170	400	144	60	5.5	13.2	22.1	20.1
387	♀	165	390	134	55	6.8	12.9	22	20
389	♀	.....	.....	138	60	9.4	12.4	22.5	18.1
403	♀	.....	.....	134	56	5.2	12.4	21.2	20.4
435	♀	165	390	134	58	9	12.5	21.2	18.5
436	♀	166	397	140	58	6	13	22.6	21.3

Oceanodroma macrodactyla *W. Bryant:* GUADALUPE PETREL

SALVIN—*Oceanodroma macrodactyla,* 351.
GODMAN—*Oceanodroma macrodactyla,* xxxvi, 18, pl. 5A.

Our knowledge of the distribution of this species is very deficient. It was not met with on the high sea by either of the Academy expeditions. Whether it performs a migration or whether it breeds anywhere except on Guadalupe Island is wholly in question.

The two types of the species are in the museum of the Academy. They are the only specimens of the Academy's original bird collection that survived the Conflagration of April, 1906. The specimen referred to by Mr. Salvin in his monograph as one of the types was merely a paratype.[1] It was also in the Academy's collection, but was not saved.

[1] Cf. Bull. Calif. Acad. Sci., v. 2, pp. 278, 451.

In the types the dark neutral gray of the crown, occiput, and upper cervix forms a cap, contrasting with the deep neutral gray of the lower cervix and interscapulars.

Three downy young from the Carnegie Museum, taken by Mr. A. W. Anthony May 26, 1892, vary considerably in size and in plumage development. In No. 22239 the secondary natal down has appeared on the body and posterior portions of the neck, but is only partially developed. In No. 22240 the secondary natal down is well developed on these areas, and the primary natal down is worn on the lower parts, especially posteriorly. The chin and throat are nearly naked in each of the three specimens. In No. 22241 definitive feathers, concealed by the natal down, cover the body and contiguous portions of the neck. The white upper tail-coverts have appeared and the wings and tail are assuming definite shape. The head and anterior neck are still clothed with natal down. The color of the natal down in the three specimens is warm deep mouse gray, the distinct brownish cast perhaps due to museum deterioration.

Oceanodroma castro (*Harcourt*): HARCOURT'S PETREL

SALVIN—*Oceanodroma cryptoleucura*, 347, 350.
GODMAN—*Oceanodroma castro*, xxxvi, 15, pl. 5.

The Expedition, Mr. Gifford states, did not find these petrels numerous in the Galapagos Archipelago; never more than three or four were seen at one time. They were noted in the vicinity of Albemarle, Charles, Chatham, Cowley, Hood, James, Seymour, and Wenman islands during the months of January, February, May, June, July, August, and December. A small breeding colony was discovered on August 13, 1906, on Cowley Island, a steep tufaceous islet about two hundred feet in altitude, situate east of Cowley Mountain, Albemarle Island. Two hard-set eggs, with parent birds, were secured, also an egg with a dried embryo. Mr. Beck's labels furnish the following particulars concerning them: One of the eggs with living embryo was deposited in a slight hollow in the soil of a small cave in a hillside amongst "lava boulders;" the other was placed on a little soil under a large "lava boulder" on a hillside. The egg with the dead embryo was found in a slight

hollow in the soil at the end of a small cave in a hillside. Seven young birds in various stages of down were obtained in similar situations.

Immediately south of the archipelago, Mr. Gifford records these petrels daily from the 6th to the 12th of May, 1906. On the 8th twenty were seen. Several were taken about 2 P. M., and the stomachs of some of them contained considerable food. All were in good plumage and had partially enlarged sexual organs. During a cruise south of the archipelago, nearly a month later, these petrels were met with again. When captured, they eject an orange-colored oil. In no instance were they heard to utter a note.

On the home voyage Mr. Beck shot a male (No. 496 C. A. S.) on November 9, 1906, in latitude 30° 30′ N., longitude 130° 55′ W., a position favorable for the occurrence of birds breeding in the Hawaiian Islands.

According to Mr. Gifford, Harcourt's Petrel and the Galapagos Petrel can be distinguished on wing by the difference in size and by the shape of the white patch at the base of the tail, this patch in the Galapagos Petrel forming an isosceles triangle and in Harcourt's Petrel a sort of band.

On the eastern side of the Atlantic, this petrel has been found on more than one occasion north of its breeding range. When its life-history is better known, it may be revealed that it has a migration northward after the breeding season.

The usual point-of-wing-formula is: primary $2>3>1>4$.

In life the bill, feet, and orbital ring are black (slightly brownish in young birds) and the irises dark brown (*Gifford*).

The seven nestlings show the transition from the natal down to the definitive feathers. In No. 520, female, the primary natal down is much worn and definitive feathers are making their appearance on the breast and scapulars, and the upper tail-coverts are emerging. The throat is quite bare in this specimen and in the following one. No. 519, female, is further along. Hidden beneath the natal down, definitive feathers are developing on the lower jugulum, breast, flanks, and upper surface of the body. The white upper tail-coverts are becoming prominent, and the wings and tail are taking form. No. 518, male, is a step in advance. The wings and tail are more developed,

and exposed definitive feathers dominate the pileum. The lower tail-coverts have appeared, definitive feathers have invaded the posterior cervix, and the throat and sides of head are being clothed. No. 517, female, manifests further progress. The wings and tail are beginning to be visible through the natal down, the region below the eyes and the sides of the body are covered with definitive feathers, and the axillaries and under coverts of the wings have broken from their sheaths. In No. 516, female, growing definitive feathers hide the skin on the throat and lores, and the wings and tail have lengthened and are freer from down. No. 515, male, has thrown off most of the natal down. The abdomen, however, is still hidden by it, and conspicuous remnants adhere to the occiput and cervix. No. 514, male, still carries some remains of natal down on the occiput, lower breast, abdomen, and under tail-coverts. The outer webs of the longer tertials are silvered with gray and edged with grayish white. In all the specimens the natal down is mouse gray, darkest in tone on the concealed secondary down.

The twenty-eight adult Expedition specimens were taken as follows: Three on the 4th and 5th of January; fifteen on the 8th, 9th, and 10th of May; four on the 16th and 18th of June; five at the breeding station on the 13th of August; one on the 9th of November. Although very deficient, this series sheds some light on the moult. Four of the fifteen May specimens have slight and irregular feather growth in progress, involving a rectrix in one instance. In two of the June specimens upper tail-coverts are being replaced. Three of the August specimens are renewing upper tail-coverts and a fourth two rectrices and some of the under tail-coverts and a little of the body plumage. The November specimen is replacing a rectrix and feathers on the breast and abdomen and in the lower tail-coverts. In the January specimens renewal is apparently quiescent.

Measurements (in millimeters) of Specimens obtained in Galapagos Waters

No.	Sex	Length	Extent	Wing	Tail	Fork of Tail	Culmen	Depth of Upper Mand.	Tarsus	Middle Toe and Claw
487	♂	190	470	154	69	7.1	16	5.3	21	24
490	♂	.....	.....	148	65	9	15.5	5	20	21.5
491	♂	190	465	155	73	12.7	15.6	5.1	20.5	23.3
494	♂	200	470	158	69	8	15	5.1	21.7	22.8
497	♂	200	475	160	72	6.3	15.5	5	21.6	24.5
499	♂	195	465	151	63	6	15	4.9	20.6	21.8
500	♂	190	468	160	72	9	15.2	5.2	20	22
506	♂	.....	.....	160	69	8.8	15	5	21.2	23.9
507	♂	195	465	160	69	7	14.3	5.1	19	20.1
509	♂	205	470	157	69	9	16	5.4	21.4	24.6
510	♂	190	455	152	66	6.1	14	5	21.3	23.5
512	♂	205	480	160	74	8.7	15	5	21	23
513	♂	.....	.....	154	65	5.5	15.3	5.6	22	23.4
485	♀	195	460	156	70	3	15.6	5.1	21.5	22.8
486	♀	190	455	156	71	4.5	15.5	5	19	21
488	♀	205	485	166	73	9	16	5	21.8	23
492	♀	205	485	162	74	12.5	16	4.5	20.7	23
493	♀	200	465	154	70	5.5	16	5.3	20.7	22.3
495	♀	190	460	156	69	6.3	15.4	4.8	20.8	20.8
498	♀	.....	.....	160	79	11.1	16	5.1	21.5	22
501	♀	198	473	157	72	8.9	14.1	5	21	22.1
502	♀	.....	460	154	69	9.3	15.5	5.2	21.5	23.1
503	♀	195	470	155	70	6	15	4.6	21.8	22.5
504	♀	.....	.....	165	74	11.1	16.3	5	22.4	25
505	♀	.....	.....	156	67	8.7	16	5	22.1	23.7
508	♀	195	465	157	71	4	16	5.3	20.8	22.2
511	♀	195	455	152	65	7.5	15.5	5.1	21	23.5

Inasmuch as Galapagos specimens exhibit considerable individual variation in the dimensions of the bill and in the depth of the fork of the tail, it is evident that long series from the Eastern Atlantic, Galapagos, and Hawaiian islands must be compared before it can be determined whether or not this species is subject to geographic variation in size.[1] Furthermore, the depth of the fork of the tail is an unreliable measurement, unless the rectrices are fully grown and unworn.

No. 496 C. A. S., male: Wing 153 mm.; tail 66.3; fork of tail 6; culmen 14.3; depth of upper mandible 5; tarsus 21.1; middle toe and claw 21.8.

The two eggs of certain identity, referred to above, are white, more or less discolored through incubation. One of them is ovate in form, inclining to elongate ovate, and the other is elliptical ovate. They measure respectively: 32.4 x 23.4 mm.; 33 x 21.4 mm.

[1] Cf. Nichols, Auk, 1914, v. 31, pp. 388-390.

Oceanodroma leucorhoa (*Vieillot*): Leach's Petrel

Coues—*Cymochorea leucorrhoa*, I, 76, 90.
Salvin—*Oceanodroma leucorrhoa*, 347, 348; (?) *Oceanodroma socorroensis*, 352; (?) *Oceanodroma monorhis*, 347, 356, pl. 2.
Godman—*Oceanodroma leucorrhoa*, xxxv, 8, pl. 4; *Oceanodroma beali*, xxxv, 11; *Oceanodroma beldingi*, xxxv, 12; (?) *Oceanodroma kædingi*, xxxv, 13; (?) *Oceanodroma monorhis*, xxxvi, 32, pl. 9.

Enlargement of the synonymy of *Oceanodroma leucorhoa* has been in vogue of late years. Individual variation and geographic variation in size have been given binomial names and treated as species. In order to elucidate these matters I have assembled for comparison a series of one hundred and seventy-one specimens; thirteen from Bird Rock, Gulf of St. Lawrence, one from off Cape Verde, Africa, ten from Sitka Bay, Alaska, including the types of *Oceanodroma beali* Emerson, six from the coast of Oregon, including the type of *Oceanodroma beldingi* Emerson, eight from Humboldt County, California, six from Southeast Farallon Island, one from Pigeon Point, California, the type and twenty-seven paratypes of *Oceanodroma kaedingi* Anthony, seventy-seven *Oceanodroma socorroensis* C. H. Townsend, mainly from Los Coronados and San Benito islands, Lower California, and twenty-one Expedition specimens taken at sea south of the Galapagos Islands and during the return voyage.

In considering color values in fuliginous storm petrels, it should always be kept in mind that the plumage in life soon loses its bloom and browns with wear, and that museum specimens fade with time, becoming valueless so far as nice distinctions of color are concerned.

The tables of measurements, given beyond, prove that the minimum dimensions of the Bird Rock specimens are completely overlapped by the maximum dimensions of the Sitka Bay specimens. In consequence the only character advanced in support of *"O. beali"* fails, the Alaskan bird not being "of uniformly smaller size" than the Atlantic one.

"O. beldingi" is described as similar to *"O. beali,"* "but decidedly grayer, and averaging notably smaller in length of wing and tail." Seven July specimens from Oregon and Humboldt County, California, are not grayer than the types of *"O.*

beali," and the accompanying table of measurements shows no notable superiority in dimensions in favor of the Alaskan birds. *"O. beldingi,"* therefore, has no claim to recognition.

Compared with the northern specimens, the six Farallon specimens exhibit no marked disparity in size. They average decidedly larger, however, than the series of *"O. kaedingi."*

The breeding grounds of *"O. kaedingi"* have not been reported. The specimens, referred to above, were taken at sea off Lower California; twenty-five of them, including the type, in latitude 31° N., longitude 117° W., July 25, 1897, and three in latitude 28° 35′ N., longitude 118° 30′ W., July 18, 1897. The plumage of all has suffered from wear, and the depth of the fork of the tail has thereby been diminished, rendering that dimension unreliable. As shown by the tables of measurements, the various dimensions intergrade with the minimum dimensions of the northern birds, the alleged specific characters proving inconstant. Besides averaging smaller, the *"O. kaedingi"* specimens seemingly average darker than the northern ones. The white of the upper tail-coverts is greatly restricted in several of them. In three it is reduced to two lateral traces. Two others are intermediate, and connect the two phases, which I believe exemplify dichromatism and not individual variation. A tendency to this bicoloration is manifested in some of the specimens from the other regions, the white being conspicuously interrupted by the dark central coverts.

Of the forty-three Expedition specimens of *"O. socorroensis"* obtained on July 14, 15, 17, 1905, on San Benito Islands, not one has any indication of white on the upper tail-coverts. Mr. Adriaan Van Rossem states that on Los Coronados Islands, late in June, 1913, "the majority of birds showed at least a trace of white, while of those taken August 13 of the present year [1914] only about one in four showed the above mentioned character."[1] Specimens with the upper tail-coverts extensively white intergrade with the darkest concolor specimens, and also are apparently indistinguishable from examples of *O. leucorhoa* from the north. As in the *"O. kaedingi"* series, I attribute the dual style of coloration to dichromatism. The absence of a dark phase on the Atlantic indicates a geo-

[1] Condor, v. 17, p. 78.

graphic distribution in the supposed dichromatism. Such distribution is well illustrated in *Puffinus chlororhynchus.* According to the tables of measurements, the dimensions average greater in the Los Coronados than in the San Benito specimens.

Dr. Godman has established the identity of *"O. socorroensis"* with *Oceanodroma monorhis* (Swinhoe).[1] It is significant that *O. leucorhoa* and *"O. monorhis"* are reported for the Asiatic coast.

In short, the material under consideration evidences that *"O. beali"* is based upon geographic variation in size (the dimensions averaging less than in Atlantic specimens), *"O. beldingi"* upon individual variation, *"O. kaedingi"* upon geographic variation in size (the dimensions averaging less than in specimens from Middle California, Oregon, and Alaska), and *"O. socorroensis"* upon dichromatism. However, before a final conclusion is reached concerning *"O. kaedingi"* and *"O. socorroensis"* (=*"monorhis"*), an extensive series of specimens of these supposed species, in new plumage and with nasal tubes undistorted, must be collected and compared with fresh northern specimens. In the meantime I have included the two names, with a question, in the synonymy of *O. leucorhoa,* leaving to the future the attempt to rescue them from limbo.

The usual point-of-wing-formulas, throughout the entire series, are: primary 2>3>1>4 and 2>3>4>1, the former predominating. The extreme base of the lateral rectrices is white in most of the specimens before me having white upper tail-coverts. Certain specimens display as much white on the lower tail-coverts as do some examples of *O. castro.* No. 473 C. A. S., white upper tail-coverts, November 15, has a light patch on the lining of the wings, resembling that in *O. homochroa.* Nos. 468 and 472 C. A. S. (both with white upper tail-coverts) have indications of such a patch. In No. 472 the dark tips of the white upper tail-coverts are as broad as in several *O. castro,* but are dark gray instead of black. The line of demarcation between the gray and white is not oblique in all specimens. The wing-bar generally penetrates further into the lesser coverts than it does in *O. castro.* Furthermore, in that species the dark central upper tail-coverts, usually present in *O. leucorhoa,* ap-

[1] Mon. Petrels, p. 33.

pear to be absent. At the point of nearest approach the two species may be readily distinguished as follows:

O. leucorhoa	*O. castro*
Tips of upper tail-coverts more or less dark gray, becoming white with wear.	Tips of upper tail-coverts black.
Lateral rectrices not definitely white at base for nearly an inch.	Lateral rectrices definitely white at base for nearly an inch, or more.

Eight *"O. monorhis"* specimens from Los Coronados Islands (Nos. 5257-5264, coll. J. Grinnell, Aug. 6, 1902) and one from San Benito Islands (No. 22498 Carnegie Mus., July 14, 1897) are in natal down. Most have reached the stage where the secondary down has emerged on the upper and lower parts of the body and posterior portions of the neck. In color the primary down is hair brown (darkest on the San Benito specimen) and the secondary down chaetura drab. In a specimen from Humboldt County, California (No. 16718 Mus. Vertebr. Zool., Univ. Calif., Sept. 4, 1910), the breast and abdomen are still clothed with the dark secondary down, concealing the definitive feathers. On the upper parts of the body and on the occiput vestiges of the dark secondary down still remain. Another specimen from the same locality (No. 16719 Mus. Vertebr. Zool., Sept. 4, 1910) retains the dark secondary down on the abdomen. In these two specimens the definitive feathers are not as brown as in the adults from the same locality, but are fairly matched by later autumn specimens taken at sea off the California coast.

The material at hand exhibits no exceptional features in the moult. In July specimens from Humboldt County, California, there are no growing feathers, which is also true, with one exception, in July *"O. monorhis"* specimens from the San Benito Islands. Feather growth is likewise in abeyance in the specimen from Pigeon Point, California, May 7, and in five of the six June specimens from Southeast Farallon Island. The other Farallon specimen, June 18, is renewing upper tail-coverts and feathers of the breast. Three belated June specimens taken just below the Galapagos Islands are also moulting, one of them, at least, undergoing a complete rehabilitation of plum-

age. The majority of the specimens obtained at sea between the 5th and 9th of October are in full moult. In three of eight specimens secured on the 15th and 19th of November renewal is still in progress.

During the Expedition's visit to the petrel colonies of the San Benito Islands, on the 14th, 15th, and 17th of July, 1905, five fresh eggs of the "Socorro Petrel" were obtained from deserted burrows of Cassin's Auklets. The burrows were situated in earthy spots, and were about three feet in length and had one or two turns. The egg in each case was deposited on the bare ground at, or near, the end of the burrow. The season was apparently not far advanced, for pairs without an egg were occupying burrows. The duties of incubation were shared by both sexes; in two instances the male was setting and in three the female.

The last captures of the southward voyage (a female and six males) were made on July 22, about latitude 22° 25′ N., longitude 112° 40′ W. In one of the males the upper tail-coverts are white and in the female and the other males they are dark. All exceed the size ascribed to *"O. kaedingi."*

During a cruise below the Galapagos Islands, three specimens, having white upper tail-coverts and dimensions corresponding with the larger northern specimens, were shot on June 11, 1906, in latitude about 4° 20′ S., longitude 93° 30′ W. On both the Atlantic and Pacific this species appears to extend its exodus-migration into the Southern Hemisphere.[1]

On the homeward voyage in 1906 eighteen specimens with white upper tail-coverts were taken as follows: Five, October 5, latitude 14° 28′ N., longitude 107° W.; three, October 8, latitude 14° 40′ N., longitude 109° W.; two, October 9, latitude 14° 11′ N., longitude 109° 20′ W.; three, November 15, latitude 33° 7′ N., longitude 134° W.; five, November 19, latitude 35° 40′ N., longitude 133° 14′ W. With one exception, none exhibits the dimensions of the *"O. kaedingi"* series.

[1] Auk, 1902, v. 19, p. 293; Nicoll, Ibis, 1906, p. 667; Murphy, Auk, 1915, v. 32, p. 170.

MEASUREMENTS (in millimeters)

ATLANTIC SPECIMENS

No.	Locality	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
9687[1]	Bird Rock, Gulf of St. Lawrence...	♂	161	84	22	15.9	23.1	23.1
9688[1]	do.	♂	159	73	17	16	24	23
9690[1]	do.	♂	157	79	18	17	23.8	23.9
9696[1]	do.	♂	163	84	24	16	24.5	24.8
9697[1]	do.	♂	158	78	19	16	23.7	24.5
9698[1]	do.	♂	155	76	18	17	25	24.5
9699[1]	do.	♂	156	82	17	16.3	22.7	24.5
9700[1]	do.	♂	159	80	20	16	24	24.8
9689[1]	do.	♀	165	82	24	17	23.8	23.3
9691[1]	do.	♀	162	82	19	16.8	23.9	25
9692[1]	do.	♀	166	91	24	17	22.9	23.9
9701[1]	do.	♀	155	77	18	16.6	24.8	24.4
111718[2]	do.	♀	160	80	18	16.3	23.8	24.8
24478[1]	Off Cape Verde, Africa.....	♀	153	73	20	17.7	23.4	25
	Average...	....	159	80	19	16.5	23.8	24.2

PACIFIC SPECIMENS

"O. beali" (coll. J. Grinnell)

No.	Locality	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
1138	Sitka Bay, Alaska	♂	148	73	18	15.6	22.8	24
1307	"	♂	150	75	20	16	21.1	23
1309	"	♂	152	76	21	14.4	22.3	22.9
1310	"	♂	152	78	20	16.7	23.4	25
1437	"	♂	160	82	22	16	23.9	25.2
1440[3]	"	♂	156	78	20	16	22.5	24.1
1441	"	♂	160	78	18	16.1	24	24.8
1311	"	♀	150	74	17	15.1	23.4	24
1438[3]	"	♀	152	77	19	16.1	23.8	23
1439	"	♀	162	81	22	16.4	24	25
	Average...	....	154	77	19	15.8	23.1	24.1

[1] Carnegie Museum.
[2] U. S. National Museum.
[3] Types of *"O. beali."*

"O. beldingi"

No.	Locality	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
53 [1]	Netarts, Ore.	♂	154	77	20	14.8	23.1	24
54 [1]	"	♂	149	74	20	16	22	22.9
1261 [2]	Three Arch Rocks, Ore.	♂	152	76	17	14.8	23.1	22.6
1264 [2]	"	♂	156	78	20	15.6	24.4	23.8
1350 [2]	"	♂	154	75	17	15	22.1	22.3
18820	Humboldt Co., Calif.	♂	152	74	16	15	21.2	24
13 [1]	Netarts, Ore.	♀	155	76	18	16	22.4	23.9
21426 [3]	Humboldt Co., Calif.	♀	160	75	16	15	23	24
21427 [3]	"	♀	161	82	21	15.3	23	23
21428 [3]	"	♀	156	74	18	15.4	23	24
21429 [3]	"	♀	159	76	19	15.9	23	24.3
	Average	....	155	76	18	15.3	22.7	23.5

Middle California Specimens

No.	Locality	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
18012	S. E. Farallon I.	♂	153	71	17	16	23.4	23.6
18052	"	♂	144	71	16	15.1	22	22.3
18013	"	♀	154	79	21	16.8	23	25
18014	"	♀	150	74	20	15.5	21.9	24.4
18053	"	♀	149	75	20	14.9	22	24
18103	"	♀	156	71	17	16.4	22.3	25
7090 [3]	Pigeon Point, Calif.	♂	151	76	17	15.4	22.8	23
	Average	....	151	73	18	15.7	22.4	23.9

[1] Coll. H. T. Bohlman; No. 53 type *"O. beldingi."*
[2] Game Department, Oregon.
[3] Mus. Vertebr. Zool., Univ. Calif.

"O. kaedingi" (Carnegie Museum)

No.	Locality	Sex	Wing	Tail	Fork of Tail[1]	Culmen	Tarsus	Middle Toe and Claw
22210	28° 35′ N., 118° 30′ W..	♂	151	63	10.6	15	21.5	21
22212	"	♂	143	66	8.7	14.7	20.9	21.3
22213	31° N., 117° W.....	♂	145	69	14.6	14.4	19.7	20.8
22214	"	♂	145	69	13	13.5	21.5	21
22215	"	♂	145	71	10	15.3	21	21
22216	"	♂	145	61	10	14.5	20.4	21.5
22217	"	♂	146	65	13	14	20.4	20.1
22219[2]	"	♂	151	71	15	14.4	20.8	19.8
22221	"	♂	147	69	14	14	20.3	22
22222	"	♂	149	63	12	13	21	20.9
22223	"	♂	144	63	13	14	20	21.7
22225	"	♂	147	68	15	13.5	21.1	20.9
22226	"	♂	147	70	15	14	20.3	21.1
22228	"	♂	144	66	14	14.9	20	21.2
22230	"	♂	147	70	12	14.9	21.2	22.4
22231	"	♂	149	66	17	15	20.9	21.5
22232	"	♂	147	66	11	14.8	20.5	20.8
22236	"	♂	146	69	16	14.7	21.8	21.4
22237	"	♂	146	68	13	....	20.6	21.7
22238	"	♂	143	66	15	14.2	20.8	21
22211	28° 35′ N., 118° 30′ W..	♀	147	64	13	14.9	20.6	21.7
22218	31° N., 117° W.....	♀	152	73	13	14.8	21.3	21
22224	"	♀	146	65	11	14	21	20.3
22227	"	♀	144	73	12	14	21.5	21.9
22229	"	♀	149	65	12	15	21.7	22.1
22233	"	♀	149	69	14	14	19.3	19.2
22234	"	♀	151	74	16	14	20.3	20.4
22235	"	♀	148	69	12	14.3	21	20.9
	Average.....	....	147	67	13	14.36	20.76	21.09

[1] Rectrices much worn.
[2] Type of *"O. kaedingi."*

"O. socorroensis," Los Coronados Islands

No.	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
22421 [1]	♂	157	80	20	16.7	22	23
22422 [1]	♂	147	75	20	16	22.2	22.5
22426 [1]	♂	155	79	19	15.5	22.8	24
22431 [1]	♂	152	80	22	15.6	21.6	23.4
22436 [1]	♂	162	81	22	16	23.5	24.1
22443 [1]	♂	158	78	21	15.5	22.5	23.3
22447 [1]	♂	154	80	20	17.5	22.1	22.8
5246 [2]	♂	150	70	19	15	23	23.8
5247 [2]	♂	155	74	22	16.9	23	24
5253 [2]	♂	157	78	25	16.7	23	25.5
5254 [2]	♂	149	73	22	15.3	22.4	23.8
22423 [1]	♀	164	81	20	16.9	23.2	25
22428 [1]	♀	156	80	22	16	23	23.3
22442 [1]	♀	162	80	20	16.8	23.5	23.8
5245 [2]	♀	152	73	21	16	21.6	23.1
5248 [2]	♀	157	79	23	16.3	23	24.5
5250 [2]	♀	154	74	23	15.8	21	24
5251 [2]	♀	155	76	19	16	22.2	25.4
5252 [2]	♀	155	79	22	16	22	23.3
5256 [2]	♀	159	82	24	15.8	23	23.8
Average.....		155	77	21	16.1	22.5	23.8

[1] Carnegie Museum.
[2] Coll. J. Grinnell.

"O. socorroensis," San Benito Islands

No.	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
521	♂	153	66	23	17	23.1	23.8
522	♂	155	76	22	16	21.6	22.5
523	♂	149	70	18	15.5	22.5	23.2
527	♂	145	65	17	15	22.7	22.1
530	♂	150	72	21	15.9	22.5	22.8
533	♂	153	72	22	15.3	22.8	23
535	♂	153	75	19	15.9	22.3	22.3
537	♂	150	72	19	15.2	21.6	23
539	♂	152	73	18	15	22	22
542	♂	150	70	18	15.9	23.5	23.3
545	♂	156	77	21	15.9	23	23.3
548	♂	151	78	23	16	22.5	23.7
554	♂	148	79	22	15.7	22	23.2
555	♂	143	72	19	15.4	22	21.5
558	♂	146	75	..	15.5	21	23
559	♂	151	74	25	15	22.2	22.7
560	♂	153	75	18	16	22.6	21.9
563	♂	150	76	21	15.5	23	24
565	♂	151	78	24	15.9	21.1	22.5
566	♂	154	82	26	16	21.2	22
567	♂	151	70	18	16	21.5	24.2
568	♂	155	79	22	15.5	21.7	24
569	♂	147	76	19	16	22.2	23
570	♂	151	69	18	16	21.9	22.4
573	♂	153	74	19	15.5	23.5	25
22462[1]	♂	152	74	20	15.6	22.5	21.8
22497[1]	♂	144	71	17	15.1	21	21
528	♀	152	77	22	16.8	22.4	22
529	♀	159	77	21	15.1	23.5	24
532	♀	155	78	21	15.5	22	23
536	♀	153	76	18	15.8	23	23
538	♀	153	77	19	16.5	24.1	24.5
540	♀	161	80	23	16	23	22.8
544	♀	152	76	19	16.3	22.9	24
546	♀	152	79	22	14.7	22.1	22.7
547	♀	154	79	24	16.5	23	24
549	♀	156	77	18	16.2	21.9	23.1
550	♀	152	72	19	15.1	22	23.2
553	♀	153	73	19	16	23	22.6
556	♀	152	77	19	15.2	21.8	21
561	♀	158	76	20	15.5	21.7	23.8
562	♀	158	78	18	16	23.3	24.4
564	♀	155	78	18	15.3	22	23
571	♀	151	78	21	15.7	22	23.8
572	♀	151	77	20	15.8	21.5	21.5
Average.	.....	152	75	20	15.7	22.3	22.9

[1] Carnegie Museum.

"O. socorroensis," at Sea

No.	Locality	Date	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
526	30° 40′ N., 117° W..	July 10	♂	151	69	18	15.4	23	22
543	"	"	♂	150	74	18	15.7	22.6	24
551	"	"	♂	153	78	19	17	23.3	23.3
557	"	"	♂	155	80	20	15.2	22.9	23.4
524	22° 30′ N., 112° 39′ W.....	July 22	♂	154	73	20	15	21.7	22.9
534	do.	"	♂	155	74	19	14.1	22	24.3
552	do.	"	♀	154	75	19	15	22.7	23
525	22° 25′ N., 112° 40′ W.....	"	♂	152	71	....	14.6	21.1	22.9
531	do.	"	♂	144	74	21	15.3	21.5	23
541	do.	"	♂	152	74	19	16	22	24.1
470[1]	do.	"	♂	152	79	17	15.8	23.1	24.2

Miscellaneous Specimens, at Sea[2]

No.	Locality	Date	Sex	Wing	Tail	Fork of Tail	Culmen	Tarsus	Middle Toe and Claw
484	4° 20′ S., 93° 30′ W.	June 11	♂	150	76	....	17	22.3	25.7
489	"	"	♂	153	73	....	16.5	23.9	24.3
482	"	"	♀	156	77	16	16.5	22.7	24.5
465	14° 28′ N., 107° W.	Oct. 5	♂	145	77	17	15.5	23.3	24.9
469	"	"	♂	145	75	17	16.5	22.9	24
464	"	"	♀	154	86	21	16.2	23.4	24.6
467	"	"	♀	147	78	19	15	22.7	25.3
475	14° 40′ N., 109° W.	Oct. 8	♂	155	70	....	16	23.1	24.5
483	"	"	♂	146	....	....	14.4	20.1	21.6
473	33° 7′ N., 134° W.	Nov. 15	♂	163	84	21	16	23	25.1
480	"	"	♀	160	81	20	16.2	24.4	25
474	35° 40′ N., 133° 14′ W.	Nov. 19	♂	157	82	19	16	23	24.5
478	"	"	♂	158	79	18	16.6	25	27
468	"	"	♀	155	75	17	15.6	23.3	25

The five eggs from the San Benito Islands are of an ovate form, varying to elliptical ovate, and are white, marked with a few scattered reddish specks; two also have an indistinct zone of reddish dots and specks and one has a cap of these markings. The measurements in millimeters are respectively: 29 x 21.5; 30 x 22; 30 x 23.5; 30.2 x 23.8; 31.5 x 24. A later egg from Southeast Farallon Island is similarly, but more distinctly marked, particularly its cap. It is of an ovate form, and measures: 31 x 23.4 mm.

[1] Upper tail-coverts white.
[2] Upper tail-coverts of all the specimens white.

Oceanodroma homochroa (*Coues*): Ashy Petrel

Coues—*Cymochorea homochroa*, I, 77, 90.
Salvin—*Oceanodroma homochroa*, 347, 355.
Godman—*Oceanodroma homochroa*, xxxvi, 29, pl. 8.

No specimens of the Ashy Petrel were secured by the Expedition. How far south the species ranges has not been ascertained. The most southerly occurrence known to me is that of a female (No. 6167 Mus. Vertebr. Zool., Univ. Calif.) in the vicinity of San Clemente Island, California. This bird came aboard the U. S. S. *Albatross* at night on April 8, 1904, and was captured by Mr. Loye Miller. So far as I am aware, there have been no captures north of Point Reyes, the known range of the species extending along the California coast between latitude 33° and 38° N. It has long been a matter of record that this petrel has bred on San Miguel Island. Recently Messrs. Howard Wright and G. K. Snyder have taken four eggs and a nestling with the parent birds on Santa Cruz Island.[1] Off Point Pinos, Mr. Beck has obtained it during its migrations; his latest autumn record is November 4. Southeast Farallon Island, as of old, appears to be the breeding stronghold of this species. Mr. Arthur L. Bolton informs me that he found it more abundant on June 19, 1911, than during early July, 1896, when he accompanied me on a trip to the island, the stoppage of the egg traffic[2] apparently resulting in an increase of population.

Almost without exception, the second primary is somewhat longer than the third, and in most instances the fourth is longer than the first, although the difference is often slight. Independent of wear, some specimens are darker than others; the upper parts vary from deep to dark mouse gray. In unworn plumage the wing-patch and inner secondaries are often very conspicuous, the hoary white edgings being especially prominent. The pale area on the under coverts of the wing varies in extent and in degree of whiteness, but is present throughout a series of one hundred and forty specimens, including one carrying remains of natal down. Albinistic feathers occur in several instances.

Three Academy specimens from Southeast Farallon Island, taken September 15, 1911, well illustrate the passage from the

[1] Condor, 1913, v. 15, p. 88.
[2] Cf. Proc. Calif. Acad. Sci., 2d ser., v. 6, p. 362.

natal down to the definitive feathers. Except on the naked region of the throat, No. 18686, female, is clad in natal down of a mouse gray color. On the body both the primary and secondary down are developed. No. 18685, male, is more advanced, and has definitive feathers, concealed by secondary down, on the breast, abdomen, back, rump, and wings. The rectrices are beginning to sprout. In color, the natal down is mouse gray and the definitive feathers of the upper parts deep mouse gray. No. 18684, male, retains only remnants of the natal down on the upper parts. The breast and abdomen, however, have a dense covering of secondary down, hiding the definitive feathers. Both in the down and definitive feathers the tone of the mouse gray is darker than in the preceding specimen.

While most of the year is poorly represented by specimens, the course of the moult appears to be well outlined in the large series before me. Two early April specimens have no growing feathers and a third taken May 20 has only a few of them. In a Farallon series of one hundred and eleven specimens, captured between May 31 and June 29, there is a little sporadic replacement progressing; otherwise moult is at a standstill. A complete renewal appears to be commencing in a specimen shot at sea on September 20; in one taken October 8 the headway is greater. Of eighteen specimens secured on November 1, ten are apparently birds-of-the-year with no feather growth under way, and eight are adults in full moult. Four of the latter still retain three of the outermost old primaries, one, four of these primaries, and three, five of them. The rectrices have been renewed, save in those retaining five old primaries. A specimen shot November 4 is very backward, and has lost only three of its innermost primaries. Another of the same date, apparently a bird-of-the-year, is not renewing any of its feathers.

Subjoined are the extreme and average measurements in millimeters of seventy-seven males and fifty-eight females.

	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
Maximum.....	♂	148	83	15.2	24	25.4
Minimum.....	♂	134	72	13.4	21.1	21.2
Mean.....	♂	142	77	14.3	22.7	23.7
Maximum.....	♀	152	86	15	25	25.1
Minimum.....	♀	138	74	13.1	21.3	22
Mean.....	♀	144	79	14.3	22.8	23.8

Detailed Measurements (in millimeters) of Specimens taken on Southeast Farallon Island on May 31 and June 1-2, 1911

No.	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
18015	♂	142	78	14	23.8	23.9
18018	♂	142	78	14	22.5	23
18019	♂	138	75	13.5	22.7	24
18020	♂	140	78	14	22.8	24.2
18023	♂	141	81	13.7	21.6	23.5
18024	♂	141	75	14	23	23.4
18027	♂	141	77	14	22.4	24
18029	♂	141	79	14	22.2	23.6
18030	♂	141	77	14	23	24
18031	♂	146	78	14.3	22.5	24
18033	♂	141	76	14.5	23.8	24.1
18034	♂	142	78	14.2	22.6	24.2
18035	♂	143	77	14.2	22	23.1
18037	♂	141	80	14.9	22.1	23
18038	♂	142	80	14.7	23	23.5
18063	♂	139	76	14	22.8	23.5
18065	♂	138	78	14.6	22.3	23.9
18066	♂	145	82	14.4	22.2	24.1
18067	♂	139	73	14	22.5	24.5
18069	♂	141	76	14.5	22	23.6
18071	♂	140	78	14.2	21.8	24
18016	♀	146	81	14.8	23	25
18017	♀	145	83	14	23	23
18021	♀	144	86	14.8	22.5	23
18025	♀	141	74	14.1	24	23.9
18026	♀	143	80	14.6	23.6	24.5
18028	♀	149	83	14.1	22.1	22.3
18032	♀	144	79	14.3	22.1	23.8
18036	♀	143	79	14.5	24	25
18039	♀	144	76	14.5	23.2	24.5
18062	♀	143	77	14	23.2	24
18064	♀	146	79	14.5	23	24
18068	♀	144	84	14	22	23.5
18070	♀	143	80	14.8	24	25

Forty-six eggs of the Ashy Petrel from Southeast Farallon Island are of an ovate, short ovate, elliptical ovate, or nearly elliptical oval shape. They are white, more or less marked with pink, rufous, or dusky specks, dots, and little splashes, which often form a zone or cap at the broader end. Occasionally the dusky and rufous specks are thickly distributed over most of the shell, and sometimes the white ground is nearly immaculate. The series measures in millimeters as follows: 31.8 x 22.5; 31.8 x 21.6; 31.4 x 22.9; 31 x 24; 31 x 22.9; 30.9 x 21.5; 30.6 x 23; 30.6 x 22.7; 30.5 x 23.3; 30.5 x 23; 30.5 x 22.9; 30.5 x 22.5; 30.4 x 22.4; 30.3 x 22.9; 30.2 x 23.1; 30.1 x 22.6; 30 x 23.4; 30 x 23; 30 x 23; 30 x 23; 29.9 x 23; 29.7 x 22.5; 29.6 x 22.3; 29.5 x 23; 29.5 x 22.6; 29.5 x 22; 29.5 x 22; 29.4 x 22.9; 29.4 x 22.4; 29.2 x 23.1; 29.2 x 23; 29.2 x 22.6;

29 x 23.1; 29 x 23; 29 x 23; 29 x 21.9; 28.6 x 22.8; 28.6 x 22.5; 28.6 x 22.5; 28.5 x 22.6; 28.5 x 22.4; 28.5 x 22.4; 28.5 x 21.6; 28 x 23.5; 28 x 22.6; 27.5 x 22.1.

Oceanodroma markhami (*Salvin*): MARKHAM'S PETREL

SALVIN—*Oceanodroma markhami*, 347, 354.
GODMAN—*Oceanodroma markhami*, xxxvi, 27, pl. 7.

A female was shot by Mr. R. H. Beck on August 1, 1905, in latitude 13° 28′ N. and longitude 108° 52′ W., and a male on September 1, 1905, thirty miles south of Cocos Island—about latitude 5° N., longitude 87° W. These captures extend the known range of this species into the Northern Hemisphere. The "types" (two females) came from the coast of Peru and remained unique until Mr. Beck's rediscovery of the species, more than twenty-one years after Mr. Salvin published his original description of it.[1]

Recently, Capt. R. Paefsler has recorded the occurrence of this petrel in December and February off the west coast of South America between latitude 9° and 23° S.[2] North of the Equator its status is probably that of a migrant from the Southern Hemisphere.

Both of the specimens taken by Mr. Beck are apparently having a complete renewal of plumage. Their measurements in millimeters are as follows:

No. 658; ♂; wing (moulting) 176; tail 94; culmen 18; tarsus 23; middle toe and claw 23.1.

No. 592; ♀; wing (moulting) 177; tail 92; culmen 18; tarsus 22.9; middle toe and claw 24.4.

Oceanodroma melania (*Bonaparte*): BLACK PETREL

COUES—*Cymochorea melania*, I, 76, 90.
SALVIN—*Oceanodroma melania*, 347, 353.
GODMAN—*Oceanodroma melania*, xxxvi, 24, pl. 6.

While the little schooner *Mary Sachs* was becalmed on the 10th, 11th, and 12th of August, 1903, fifteen to twenty-five miles west of Point Reyes, California, the ornithologists of the Academy's Revilla Gigedo Expedition saw many Black, Ashy, and Fork-tailed petrels flitting about over the ocean. A series

[1] P. Z. S., 1883, p. 430.
[2] J. f. O., 1913, v. 61, p. 49; 1914, v. 62, p. 277.

of specimens of the Black Petrel was secured, but was subsequently destroyed in the Conflagration of April, 1906.

Offshore in the vicinity of Point Pinos, California, Mr. Beck has taken Black Petrels at the end of May, in June, July, and August and during the first fortnight of September. On certain days late in July and late in August he found them common.

As is well known, this species occurs off Southern California and breeds on Los Coronados and San Benito islands, Lower California.

It is recalled that Prince Bonaparte in 1854 in his original account of this petrel attributed it to the fauna of California. After the lapse of more than sixty years, the extremes of its range and the character of its migrations still remain to be worked out. A female in worn plumage shot on July 25, 1905, in latitude 19° 40′ N. and longitude 112° W. was the last example secured by the Galapagos Expedition. Mr. C. H. Townsend has reported the capture of a single specimen on April 12, 1891, off Acapulco, Mexico.[1] It is not improbable, therefore, that the range of the Black Petrel in the south overlaps that of Markham's Petrel.

The Revilla Gigedo Expedition called at the San Benito Islands May 6, 1903, and Mr. Bunnell records in his diary of that day that he dug fifty of these petrels out of abandoned burrows of Cassin's Auklets; that two petrels usually occupied a burrow, but sometimes only one; that egg-laying had not commenced; that the petrels were very easy to kill, and leaked an orange-colored oil from the mouth and nose; that they were seen abroad only late at night; that their flight was bat-like. The Galapagos Expedition visited the San Benito Islands on the 14th, 15th, and 17th of July, 1905, but apparently failed to find eggs or downy young, although adult birds were found abundantly in old auklet burrows, and less numerously in crevices among rocks.

The usual point-of-wing-formula in the Academy's series of one hundred and fifty-one specimens is: primary 2>3>1>4. In some instances, the interscapulars, scapulars, and tertials of specimens in good plumage are indistinctly margined with brown.

[1] Bull. Mus. Comp. Zool., 1895, v. 27, p. 126.

Two Carnegie Museum specimens (Nos. 22312 and 22316, Sept. 7, 9, 1896, San Benito Is.) are in natal down, with the region of the throat bare. In one the secondary down is well advanced on the body and jugulum; in the other it is backward. The color of the primary down is hair brown and that of the secondary chaetura drab. Fresh specimens would probably be grayer. The wearing off of the primary down, exposing the darker secondary down, was likely the cause of the change of color with age noted by Mr. Adriaan Van Rossem.[1]

Although the Academy's series is a long one, only the interval between May 27 and September 14 is represented in it. The trend of the moult, however, is fairly well indicated. In nineteen July specimens from the San Benito Islands, the renewal of the first primary in one specimen and of a single rectrix in another is the only obvious feather growth in progress. In eighty July specimens taken at sea, one has the second primary of the right wing and eleven have the first primary of both wings still in the sheath stage. One of the eleven specimens is also renewing some feathers on the breast, crown, cervix, and upper back, and another, two rectrices. Five other of the July specimens are restoring each a single rectrix, a sixth is restoring two rectrices, and a seventh, three. As this species is a late breeder, these tardy restorations probably belong to the fag-end of the moult. Five May and five June sea-collected specimens appear to be stationary in their plumage. Of forty taken at sea in August, only six, obtained after the third week, have growing feathers. Two of these specimens, at least, seem to be at the beginning of the moult. A couple shot on the 2nd and 14th of September have apparently not commenced moulting.

The measurements in millimeters of ninety-three males and fifty-seven females are tabulated below.

	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
Maximum	♂	186	92	17.6	33.5	31.1
Minimum	♂	167	78	14.5	29.3	27.3
Mean	♂	176	84	15.8	31.2	29.4
Maximum	♀	186	93	16.6	32.5	30.5
Minimum	♀	170	78	14	28.9	27.4
Mean	♀	178	86	15.6	30.7	29.1

[1] Condor, v. 17, p. 77.

DETAILED MEASUREMENTS (in millimeters)

No.	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
582	♂	173	83	15.9	31.5	27.9
584	♂	179	82	15.8	31.4	28
596	♂	178	85	15.4	30.5	30.5
603	♂	174	81	15.8	32	28.9
617	♂	178	83	17	32.2	29
625	♂	175	87	16	30.7	30.1
637	♂	173	88	15.4	29.8	29
643	♂	172	82	16	31	28
647	♂	180	88	17	32.2	29
652	♂	175	82	15.6	30.6	30.2
9228	♂	173	83	15.2	29.8	27.3
9237	♂	176	82	16	30.4	30
9247	♂	177	88	16	30.5	30
9256	♂	182	92	15.7	31	28
9266	♂	180	87	16.3	33	29.5
9269	♂	179	87	15.6	33.5	30
608	♀	173	84	15.7	30.6	30.5
618	♀	176	78	16	30.6	30
620	♀	182	90	16.2	31	28
624	♀	177	85	15.5	32	29.1
628	♀	181	85	16.3	32	28.7
655	♀	173	84	16.6	30.7	30
9243	♀	177	87	15	32.1	28.8
9262	♀	175	88	16	32.5	30
9263	♀	179	88	16.4	30.4	30
9288	♀	181	88	16.3	31.5	28.9

Oceanodroma furcata (*Gmelin*): FORK-TAILED PETREL

COUES—*Oceanodroma furcata*, I, 74, 89.
SALVIN—*Oceanodroma furcata*, 347, 357.
GODMAN—*Oceanodroma furcata*, xxxvi, 38, pl. 11.

South of California we have no record of the occurrence of this storm petrel. The Revilla Gigedo Expedition found it common and obtained specimens while the schooner *Mary Sachs* was becalmed on the 10th, 11th, and 12th of August, 1903, fifteen to twenty-five miles west of Point Reyes, California. In his Galapagos Expedition notes Mr. Gifford mentions only a solitary individual, seen November 29, 1906, near the Farallon Islands, California. Off Point Pinos, California, Mr. Beck secured sixteen specimens early in November, 1903, and saw several on November 1, 1909. In the same vicinity Mr. L. L. Edner found tardy northbound migrants plentiful on June 13, 1895,[1] and Mr. Edmund Silliman stormbound

[1] Proc. Calif. Acad. Sci., 2d ser., v. 6, p. 28.

migrants on April 30, 1915.[1] Mr. Lorquin's San Pedro specimen,[2] taken in August, still remains the most southerly capture, evidencing how little has been done in the study of migration on the ocean off Southern California.

In twenty-five June and July specimens the second primary is generally the longest, the third nearly equal to it, and the fourth generally decidedly longer than the first, the dominant point-of-wing-formula being: primary 2>3>4>1. In a September and two October specimens, apparently birds-of-the-year, the first primary is decidedly longer than the fourth. In another October specimen, also apparently a bird-of-the-year, the first and fourth primaries are nearly equal.

The specimens at hand, mostly from breeding grounds, show no exceptional features of moult.

Note.—Since part VI was completed, Mr. C. I. Clay has reported the discovery of small breeding colonies in 1916 at Whaler Island, near Crescent City, Del Norte County, and Sugar Loaf Rock, Trinidad, Humboldt County, California,[3] also, Mr. L. E. Wyman has reported finding nine of these petrels "dead on the beach in the vicinity of the village of Sunset Beach, Orange County," California, between May 15 and June 1, 1916.[4]

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[1] O. P. Silliman, Condor, v. 17, p. 204.
[2] Cooper, Proc. Calif. Acad. Sci., v. 4, p. 10; Water Birds N. A., v. 2, p. 414.
[3] Condor, v. 18, p. 205.
[4] Condor, v. 19, p. 141.

MEASUREMENTS (in millimeters)

No.	Locality	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
1398 [1]	Prince William Sound, Alaska	♂	152	79	15	25.7	29
4792 [1]	Russian Mission, Yukon R., Alaska	♂	158	83	15.1	26.9	28.6
4793 [1]	do.	♂	165	89	15.8	28.5	30.3
1130 [2]	Sitka, Alaska	♂	151	89	15	25.5	28
1271 [2]	"	♂	157	91	15	25.4	27
1273 [2]	"	♂	156	87	15	24.8	26
1276 [2]	"	♂	156	89	14.8	25.9	28.9
1278 [2]	"	♂	155	84	15	26.5	28.7
1279 [2]	"	♂	153	89	15	26.1	27.6
1281 [2]	"	♂	160	86	15.3	25	27.8
1282 [2]	"	♂	157	87	14.8	24.8	27.4
1287 [2]	"	♂	156	88	14.2	25	28.4
1288 [2]	"	♂	155	84	15.5	25.9	27.7
1294 [2]	"	♂	156	83	14.7	25.2	28
1295 [2]	"	♂	152	88	15	25.7	27.1
4794 [1]	Russian Mission, Yukon R., Alaska	♀	157	81	15.8	27	27.5
7089 [1]	Sanak Is., Alaska	♀	162	95	15.9	26.5	28.4
1268 [2]	Sitka, Alaska	♀	153	87	14	24	26.9
1272 [2]	"	♀	161	88	15	25.3	28.9
1284 [2]	"	♀	154	91	15.1	24.8	27.6
1285 [2]	"	♀	155	91	14.4	24.4	27
1290 [2]	"	♀	158	88	14.9	24.3	27.8
1292 [2]	"	♀	158	92	14.4	24.4	27.9
1293 [2]	"	♀	161	88	15	25.7	27.9
1298 [2]	"	♀	158	92	16	26	29
1299 [2]	"	♀	160	94	15.5	25	28
1300 [2]	"	♀	155	90	15.8	25	29
1303 [2]	"	♀	158	85	15	26.1	29
14015	"	♀	159	89	15	24.4	26.8

Oceanodroma hornbyi (*Gray*): HORNBY'S PETREL

COUES—*Oceanodroma Hornbyi*, I, 75, 90.
SALVIN—*Oceanodroma hornbyi*, 347, 356, pl. 3.
GODMAN—*Oceanodroma hornbyi*, xxxvi, 36, pl. 10.

Although described over half a century ago, Hornby's Petrel still remains in the list of species known only from a single specimen. The place of capture is broadly stated as "the north-west coast of America."[3] When the details of the exodus-migration of the petrels are better known, Hornby's Petrel may prove to be a common Southern Hemisphere species that visits the North Pacific after its breeding season.

[1] Mus. Vertebr. Zool., Univ. Calif.
[2] Coll. J. Grinnell.
[3] P. Z. S., 1853, p. 62.

Since the above was penned, Capt. R. Paefsler has reported the presence of this species off the western coast of South America between latitude 9° and 30° S.[1]

Oceanites oceanicus (*Kuhl*): Wilson's Petrel

Coues—*Oceanites oceanica*, I, 82, 90.
Salvin—*Oceanites oceanicus*, 358.
Godman—*Oceanites oceanicus*, vi, xxxvii, 41, pl. 12.

Several years ago, in company with Dr. Stone, I looked over the petrels in the research collection of the Academy of Natural Sciences of Philadelphia, but failed to find a specimen of this species that corroborated the statement of Dr. Cooper that "the Museum of the Phila. Acad. Nat. Sc. contains one presented by Dr. Gambel about 1849, as from 'California.' "[2] However, I have before me a specimen (No. 18742 Mus. Vertebr. Zool. Univ. Calif.) which establishes beyond question the occurrence of this species off the Californian coast. The specimen (a male) was taken by Mr. R. H. Beck at Monterey Bay, California, on August 24, 1910.

Professor Giglioli has reported[3] this petrel as numerous in August, 1867, at sea not far to the southward of Callao, Peru, and Capt. R. Paefsler mentions its presence on June 25, 1910, in latitude 6° S., longitude 81° 20′ W.; July 9, 1911, in latitude 10° N., longitude 86° W.; July 26, 1911, in latitude 5° S., longitude 81° 5′ W.[4] It is highly probable, therefore, that this species is of common occurrence during its exodus-migration in the southern part of the ocean area under consideration.

Oceanites gracilis (*Elliot*): Graceful Petrel

Coues—*Oceanites gracilis*, I, 85, 91, V, 192.
Salvin—*Oceanites gracilis*, 358, 361.
Godman—*Oceanites gracilis*, xxxvii, 48, pl. 13.

Graceful Petrels, according to Mr. Gifford's notes, occurred commonly the year round throughout the Galapagos Archi-

[1] J. f. O., 1913, v. 61, p. 49; 1914, v. 62, pp. 273, 274. Orn. Monats., 1915, v. 23, pp. 60, 61, 71.
[2] Proc. Calif. Acad. Sci., v. 4, p. 11.
[3] Fauna Vertebr. Oceano, pp. 38, 92, map.
[4] J. f. O., 1913, v. 61, pp. 42, 43, 44.

pelago. They were never observed far from land, the greatest distance being about fifty nautical miles. They frequented both the bays and open sea, and often as many as a score or more were in sight at a time. One day at Bindloe Island about thirty, in a compact flock, were seen hovering over the water, appearing like gigantic black butterflies. Ordinarily, their flight is bat-like, but not as erratic as the flight of the Galapagos Petrels.

No nesting places were discovered, although these petrels undoubtedly breed in the archipelago. The genital organs were beginning to enlarge in specimens taken April 28, were very large in those taken July 7, and dormant in those obtained November 27.

They often came about the schooner *Academy,* attracted by the refuse thrown overboard, being particularly fond of the turtle fat. They usually pick up their food while fluttering close to the water with their feet dipping. The remains of very small fish were taken from the stomach of one bird, the sea furnishing it other food besides invertebrates.

The color in life of the soft parts of adults were: bill and orbital ring black; irises dark brown; feet black with a light yellow patch in the center of each web.

In the eighty-seven Expedition specimens the usual point-of-wing-formula is: primary 2>3>1>4. The borders of the greater wing-coverts and inner secondaries are decidedly white in certain specimens.

The series at hand is sufficiently comprehensive to indicate the character of the moult, although every month of the year is not represented by specimens. Some renewal is in progress in April, May, June, and July specimens, but only in one (secured June 7) does it affect the primaries. In the single October specimen, taken on the 14th, a complete moult is undoubtedly progressing; seven of the innermost primaries have already been shed. Late November, December, and early January specimens (fifty-nine in number) show the postnuptial moult in various stages of advancement. Some individuals have lagged far behind, in part accounting for the tardy spring and summer moulting.

In the annexed table are exhibited the measurements in millimeters of thirty-four males and fifty-one females.

	Sex	Wing	Tail	Culmen	Tarsus	Middle Toe and Claw
Maximum	♂	143	61	12	31.5	23.8
Minimum	♂	131	51	10	28.1	21.2
Mean	♂	137	56	10.9	30	22.7
Maximum	♀	147	61	13	32.5	25.3
Minimum	♀	133	51	10	27.7	21.4
Mean	♀	139	56	11.1	30.6	23.3

Length in flesh: Two males, 142 mm., 150; seven females, 142—157 mm. (150).

Extent: One male, 340 mm.; six females, 350—370 mm. (359).

Pelagodroma marina (*Latham*): WHITE-FACED PETREL

COUES—*Pelagodroma fregata*, I, 88, 91; *Pelagodroma marina*, V, 192.
SALVIN—*Pelagodroma marina*, 362.
GODMAN—*Pelagodroma marina*, xxxvii, 53, pl. 15.

Only one specimen of this long-legged storm petrel was brought back by the Expedition. It was shot by Mr. R. H. Beck on June 18, 1906, in latitude 2° 40′ S., longitude 91° 20′ W. A complete renewal of plumage appears to be in progress.

No. 746 C. A. S.: Length 200 mm.; extent 400; wing 151; tail 72.6; culmen 17; depth of upper mandible 4.5; width of upper mandible 6.5; tarsus 39.5; middle toe and claw 34.6.

Fregetta grallaria (*Vicillot*): WHITE-BELLIED PETREL

COUES—*Oceanites segethi*, I, 84, 91, V, 192; *Fregetta grallaria*, I, 86, 91; *Fregetta Lawrencii*, I, 87, 91, V, 192.
SALVIN—*Cymodroma grallaria*, 364, 366.
GODMAN—*Cymodroma grallaria*, xxxviii, 65, pl. 18; *Cymodroma melanoleuca*, xxxviii.

During a cruise of the schooner *Academy* south of the Galapagos Archipelago, Mr. R. H. Beck shot a male White-bellied Petrel on June 11, 1906, in latitude 4° 20′ S., longitude 93° 30′ W. It was evidently not astray on the high sea, for Mr.

Gifford reports having seen in the same vicinity two of these petrels on the 10th of June, half a dozen on the 11th, three on the 12th, and one on the 19th. The specimen was undergoing a complete moult. The worn feathers of the dorsal region are black, with vestiges of white tips in some instances, and the new feathers are heavily washed with gray and broadly tipped with white. The throat feathers are more or less white basally. In some specimens these feathers are said to be wholly dark, a dual coloration apparently existing in this species similar to that occurring in *Puffinus griseus* and the dark phase of *Puffinus chlororhynchus*. The tarsus is indistinctly scutellated. In life, according to Mr. Gifford, the bill, feet, and orbital ring were black and the irises dark brown.

When *Fregetta grallaria* is thoroughly studied, I believe that wear of plumage, dichromatism, and geographic and individual variation will be found fully to account for *Fregetta lawrencii* Bonaparte, *Fregetta melanoleuca* Salvadori, and the variations given binomial names by Mr. Gregory M. Mathews.[1]

No. 747 C. A. S.: Length 225 mm.; extent 480; wing 179; tail 84; culmen 15.2; depth of upper mandible 5.1; width of upper mandible 7.6; tarsus 40; middle toe and claw 25.5.

[1] Birds Austr., v. 2, p. 44; Austral Avian Record, v. 2, p. 124.

EXPLANATION OF PLATES

Plate 1—Portrait of Elliott Coues; from a photograph formerly in the possession of the late Dr. D. G. Elliot; reproduced from *Bird-Lore* through the courtesy of Dr. Frank M. Chapman.

Plate 2—Portrait of Osbert Salvin; reproduced from the *Biologia Centrali-Americana.*

Plate 3—Portrait of Frederick Du Cane Godman; reproduced from the *Biologia Centrali-Americana.*

Plate 4—Sketch Chart of the Oceans.

Plate 5—Map of the Galapagos Islands.

Plate 6

Above, *Diomedea irrorata* at rookery on Hood Island.
Below, *Diomedea irrorata* with egg at rookery on Hood Island; in the foreground *Nesomimus macdonaldi,* in the background *Fregata aquila* (old and young).

Plate 7

Above, *Diomedea irrorata* at rookery on Hood Island.
Below, *Diomedea irrorata* "fencing" at rookery on Hood Island.

Plate 8

Above, *Diomedea irrorata* with feathers on sides of head raised in anger, at rookery on Hood Island.
Below, *Diomedea irrorata* with feathers on sides of head in usual position, at rookery on Hood Island.

Plate 9—*Diomedea irrorata;* lower aspect of light and dark phases of nestling.

Plate 10—*Diomedea irrorata;* upper aspect of light and dark phases of nestling.

Plate 11—*Diomedea irrorata;* upper aspect of light phase of nestling.

Plate 12—*Diomedea irrorata;* variation in the form of the bill of breeding birds (reduced).

Plate 13—*Puffinus creatopus;* dual coloration.

Plate 14—*Puffinus opisthomelas;* dual coloration.

Plate 15—*Puffinus opisthomelas;* melanistic specimen and specimen of the light style.

Plate 16—*Uria troille;* melanistic specimen.

Plate 17—*Puffinus chlororhynchus;* light and dark phases.

92° 91° 90° 89°

1°

0°

CULPEPPER I. (860)

WENMAN I. (840)

PACIFIC OCEAN

THE GALAPAGOS ISLANDS

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
Underlined figures in the water in parentheses indicate the height above the plane of high water of the adjacent island or rock

By W H Griffen

ABINGDON I. (1250)

BINDLOE I.

TOWER I. (210)

N
W E

ALBEMARLE PT.

C. BERKELEY

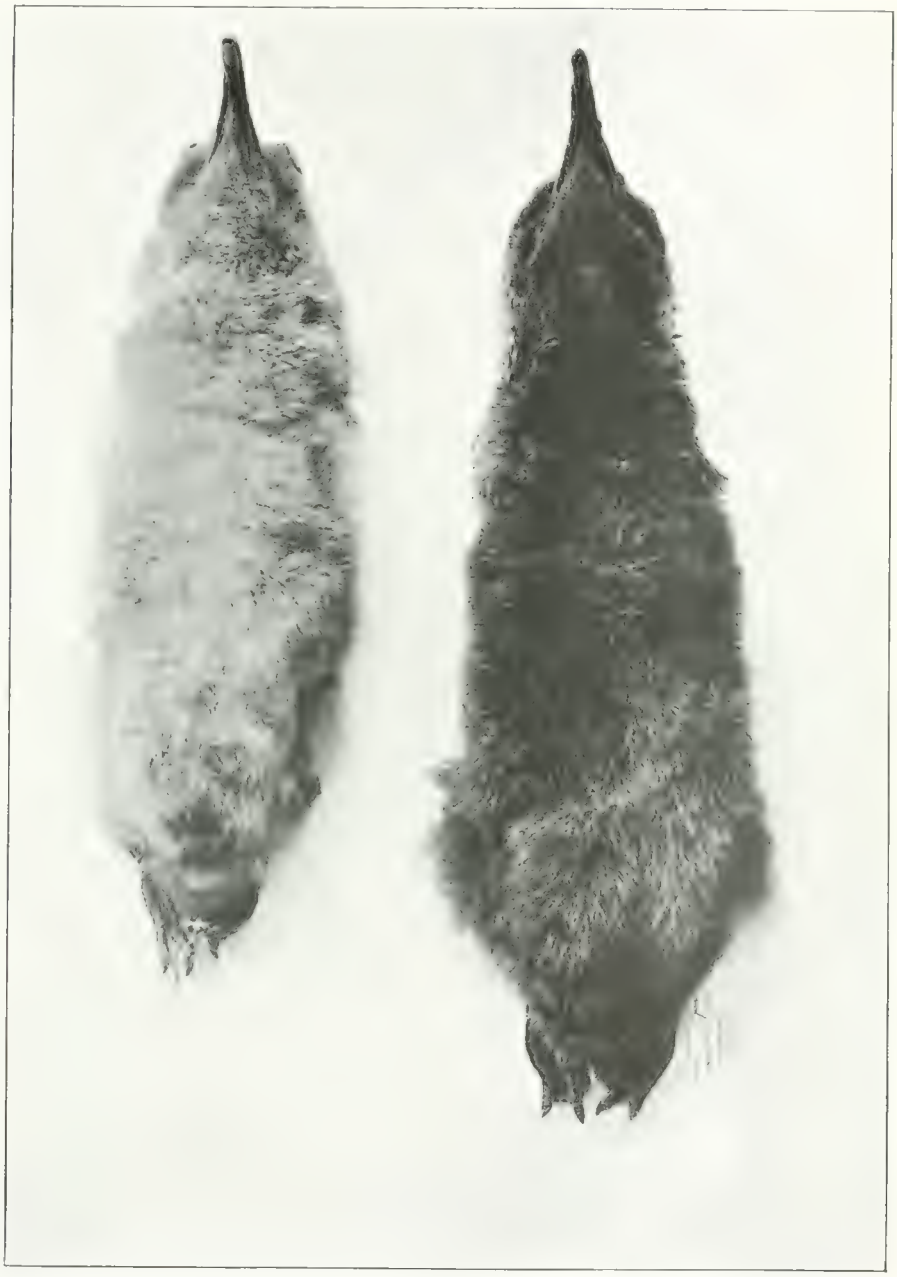
C. NORTHUMBERLAND

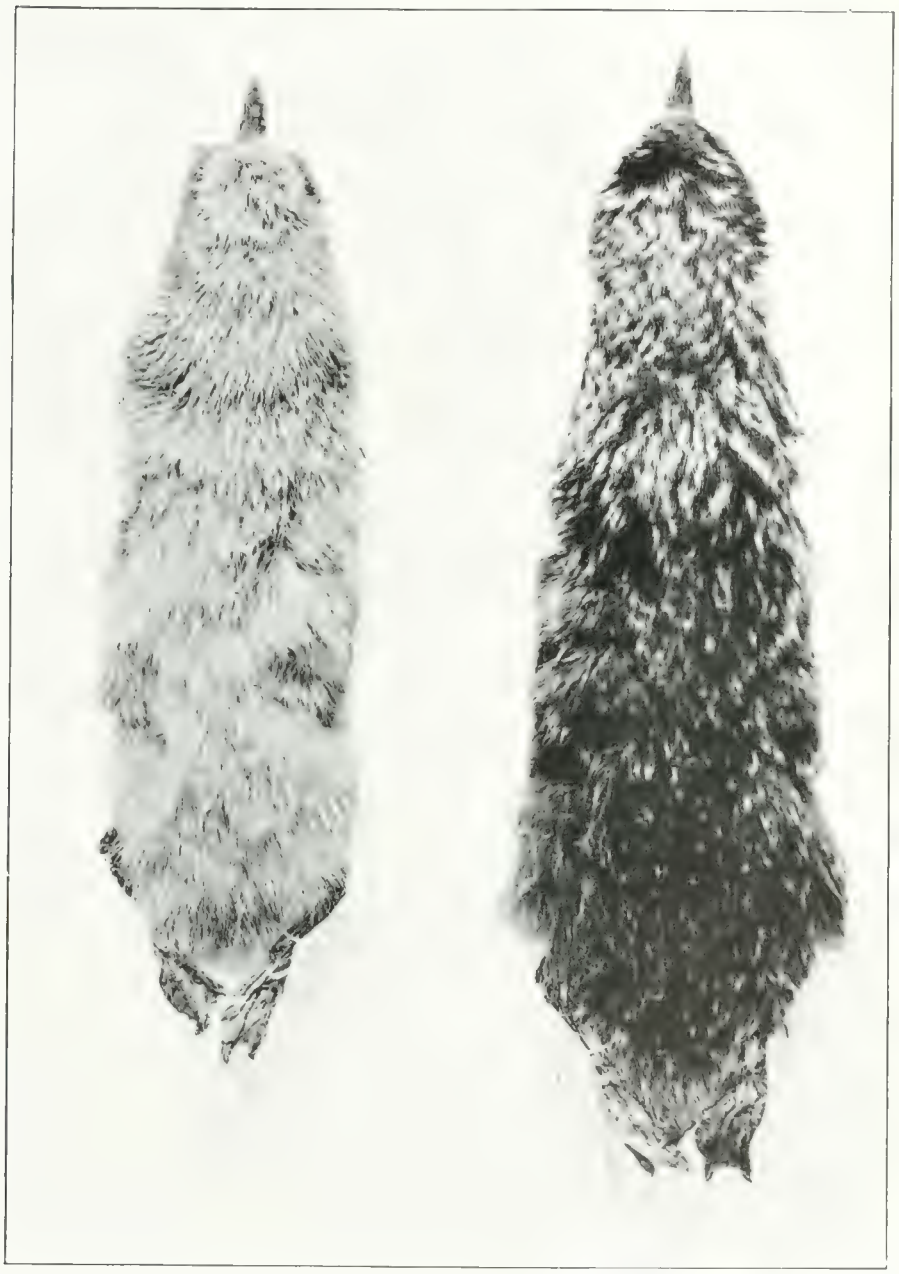
BANKS BAY

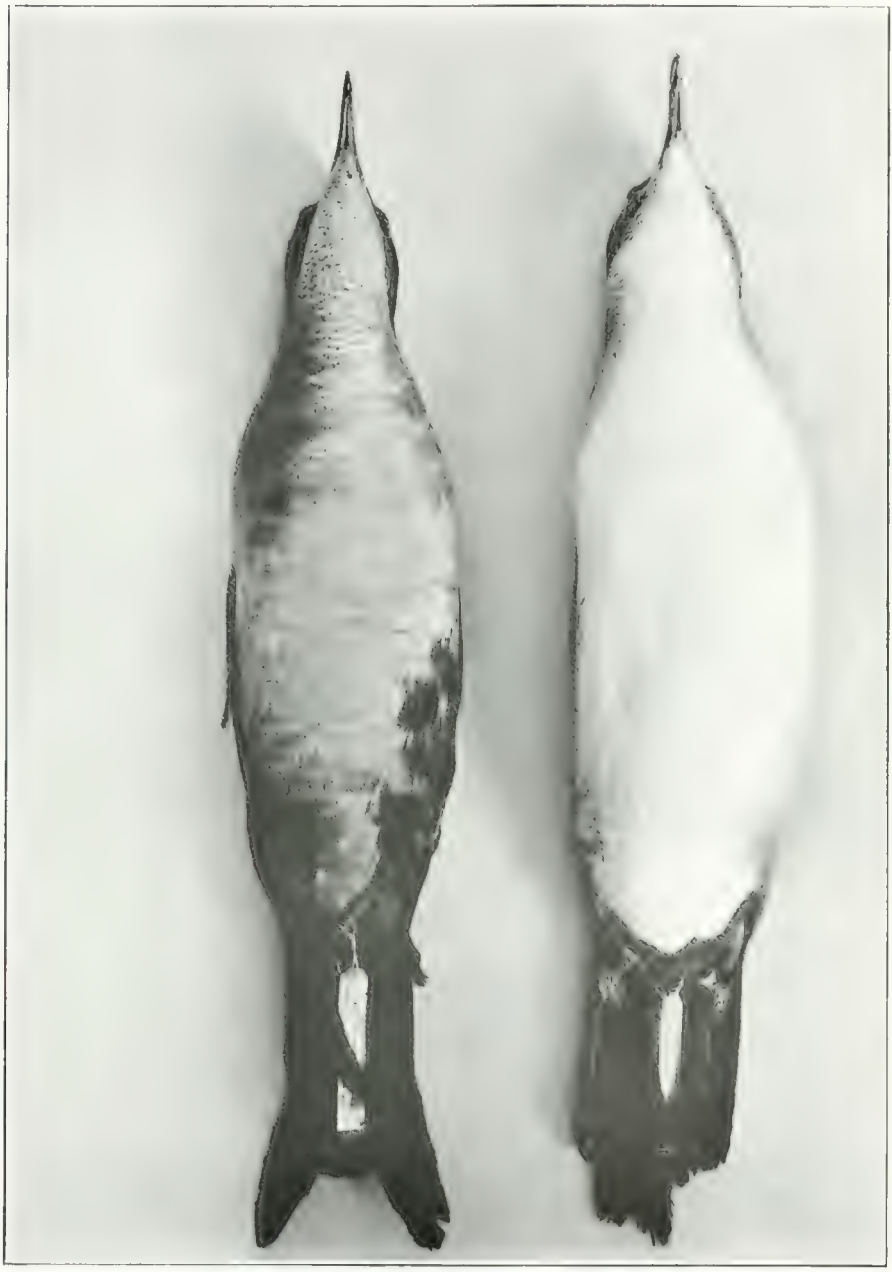
ALBANY I.

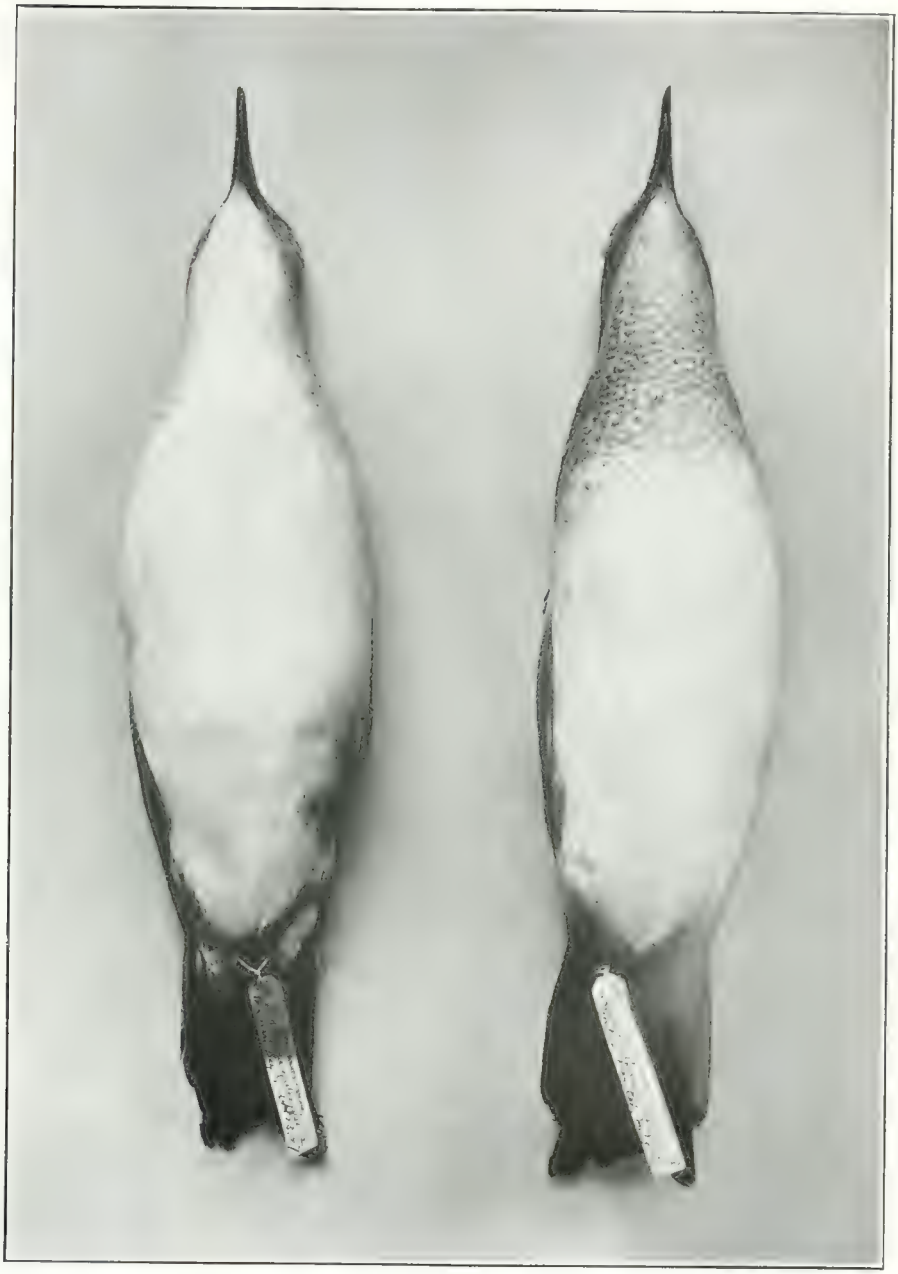
JAMES I.

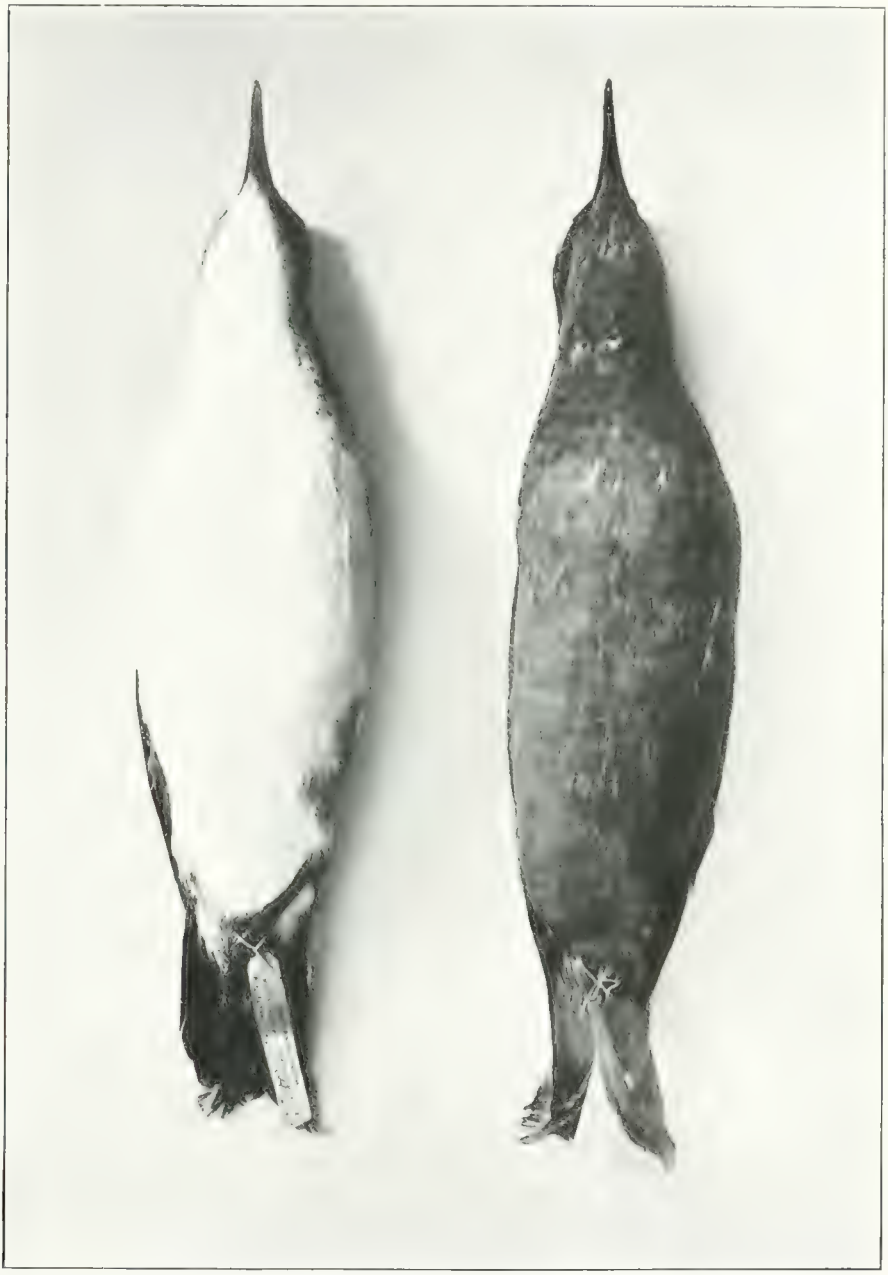
Redonda Rk.
Albemarle Pt.
C. Berkeley
C. Marshall.
Banks Bay
Black Bight
Turtle Pt.
Tagus Cove
C. Douglas
NARBOROUGH I.
C. Hammond
Elizabeth B.
PERRY ISTHMUS
ALBEMARLE I.
Webb Cove
St John Pt.
Christopher Pt.
Iguana Cove
Essex Pt.
C. Rose
Turtle Cove
VILLAMIL
SANTOMAS
Active Volcano
C. Woodford
CROSSMAN Is.
BRATTLE I.
Cowley I.
White Rk.
DUNCAN I.
C. Barrington
NAMELESS I.
JERVIS I.
(1050)
ALBANY I.
James B.
C. Nepean
JAMES I.
Sullivan Bay
Bartholomew I.
DAPHNE Is.
Seymour Is.
Guy Fawkes Is.
Conway B.
Eden I.
Gordon Rks.
INDEFATIGABLE I.
Academy Bay
BARRINGTON I.
Post Office B.
Black Beach Anch.
Black Beach Road
Saddle Pt.
South Pt.
ONSLOW I.
Cormorant Pt.
CHAMPION I.
ENDERBY I. (330)
CHARLES or FLOREANA I.
CALDWELL I.
GARDNER I. (760)
WATSON I.
Macgowen Rf.
HOOD I.
GARDNER I. (160)
Gardner Bay
S. Ripple
Terrapin Road
North C.
Hobbs Rf.
Mt. Pitt (Sugarloaf)
(800)
CHATHAM I.
Finger Pt.
Kicker Rk.
Stephens B.
Bassa Pt.
Sappho
Rosa blanca Bay
Dalrymple Rk.
Lobos I.
Wreck B.
Wreck Pt.
Whale Rk.
East Rk.
Freshwater Bay
0°
1°
92°
91°
90°
89°

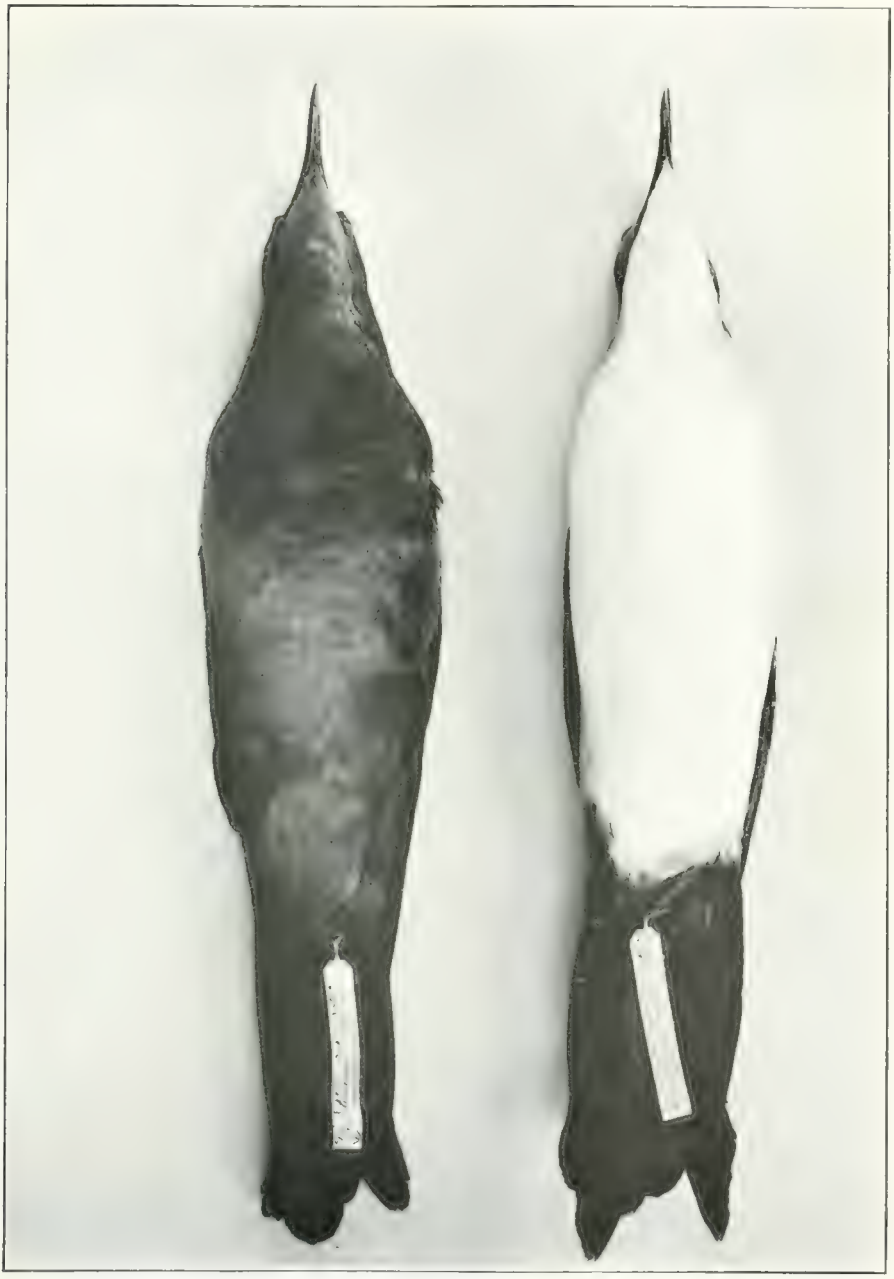












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PROCEEDINGS

OF THE

CALIFORNIA ACADEMY OF SCIENCES

FOURTH SERIES

VOL. II, PT. II, NO. 13, pp. 189–258 JUNE 16, 1919

EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XIII

FIELD NOTES ON THE LAND BIRDS OF THE GALAPAGOS ISLANDS AND OF COCOS ISLAND, COSTA RICA

BY

EDWARD WINSLOW GIFFORD

Associate Curator of the Anthropological Museum, University of California

The present paper is a continuation of "The Birds of the Galapagos Islands, with Observations on the Birds of Clipperton and Cocos Islands (Columbiformes to Pelecaniformes)."[1]

The collection of land bird skins brought back by the Expedition numbers 5,916, exclusive of the Galapagos Dove. The writer lacks the time to study this large number of specimens and therefore deems it advisable to publish his field notes without further delay. In addition to the skins, considerable collections of eggs, nests, and birds and stomachs in alcohol were made. These also await investigation.

[1] Proc. Calif. Acad. Sci., 4th ser., v. 2, pt. 1, pp. 1-132, pls. 1-7.

The land birds of Cocos Island, Costa Rica, and of the Galapagos Islands are treated in the present connection, with the exception of the Galapagos Dove already considered in the earlier paper. The sequence and nomenclature of species in both papers is that of Sharpe's "Hand-list of the Genera and Species of Birds."

As the species of the genera *Geospiza* and *Camarhynchus* demand a thorough revision with all available material at hand, the writer uses provisionally, with a few changes, the specific names as defined by Messrs. Rothschild and Hartert[2] and Messrs. Snodgrass and Heller.[3] Wherever the writer fails to recognize a species admitted by these authors, the rejected name is placed in a selected synonymy.

The localities listed for each species also include those mentioned by Messrs. Salvin,[4] Ridgway,[5] Rothschild and Hartert, and Snodgrass and Heller.

For a full description of the botanical regions or zones (dry or arid, moist or humid, and grassy, in order from seashore to mountain top) mentioned in this paper, the reader should refer to Mr. Alban Stewart's paper "A Botanical Survey of the Galapagos Islands."[6]

1. **Buteo galapagensis**: GALAPAGOS HAWK

Abingdon, Albemarle, Barrington, Bindloe, Chatham, Daphne, Duncan, Gardner-near-Hood, Hood, and Indefatigable islands, islet off northeast James, islets east of Jervis, James, Jervis, Narborough, and Seymour islands.

Indefatigable was the center of abundance of the Galapagos Hawk, which was not observed at all on Charles, Culpepper, Tower, and Wenman. It lived in the arid or dry, and in the humid or moist, regions and along the seashore, being commonest in the dry region. It appeared not to fly far from land, but evidently left the home island at times as attested

[2] A Review of the Ornithology of the Galapagos Islands, Nov. Zool., v. 6, pp. 86-205, pls. 5, 6; Further Notes on the Fauna of the Galapagos Islands, Nov. Zool., v. 9, pp. 373-418, pl. 10.

[3] Papers from the Hopkins-Stanford Galapagos Expedition, 1898-1899. XVI. Birds. Proc. Wash. Acad. Sci., v. 5, pp. 231-372.

[4] On the Avifauna of the Galapagos Archipelago, Trans. Z. S., v. 9, pp. 447-510, pls. 84-89.

[5] Birds of the Galapagos Archipelago, Proc. U. S. N. M., v. 19, pp. 459-670, pls. 56, 57.

[6] Proc. Calif. Acad. Sci., 4th ser., v. 1, p. 206.

by its presence on the islets off James and Jervis. We also saw this species flying back and forth between Hood and the neighboring Gardner. Occasionally birds came out from shore and flew around the schooner when anchored.

This species has a light and a dark phase. Individuals in the two phases were about equal in numbers, although birds in the light phase were not seen in as many localities as birds in the dark phase. Intermediates were not uncommon. Birds in the light phase were commonest at Academy Bay, Indefatigable, which was a great rendezvous for hawks.

The nests were bulky affairs of sticks usually built in a low tree or on a rock in an easily accessible position. On April 8, at Tagus Cove, Albemarle, I photographed a nest belonging to two birds in the dark phase. It was built in a *Bursera* tree, partly fallen over, growing on a steep hillside. The top of the nest was about eight feet from the ground. The nest structure was two feet in height and made of sticks. The depression at the top was shallow and lined with grass pulled from the ground in bunches. It contained two fresh eggs. While Mr. Beck and I were examining and photographing the nest, the birds stayed close by, calling continually. After making several swoops, one of the pair fastened its talons in my hat, while I was in the tree with the camera. It carried the hat a short distance and dropped it.

While anchored at northwestern Indefatigable, July 21 to 23, three nests were examined. One, unoccupied, was built in the usual style about 14 feet above the ground in a *Bursera* tree. Another, unoccupied, was about 10 feet above the ground in a tree growing on a hillside. It was built of sticks and showed signs of use. A hawk made several threatening swoops at me while I was examining it.

The third nest was composed of a mass of sticks resting partly on a heap of lava and partly on a bush growing beside the heap. It was situated on a plain some distance from any rise of ground. The top of the nest was about 12 feet above the ground. The part resting on the lava was about four and one-half feet in height, the part on the bush only one and one-half feet. The owners were much excited, swooping at us frequently and calling constantly. There was a third old bird with them on the two occasions we visited the nest. It was not

as zealous, however, in the defense as were the two owners. They were fearless, allowing us to come very close to them. The nest contained two young with downy heads and fairly well-feathered bodies. They were in the nest and were not observed to sit up.

An adult, taken on Hood on July 2, had large sexual organs.

Like most of the native birds, the hawks lacked the fear of man. They were very inquisitive, alighting close to and even following a person. At times, however, dusky-plumaged birds appeared a bit wary. When we were encamped three or four hawks, sometimes more, frequently stayed around camp all day. On northwestern Indefatigable, while collecting along the coast, several followed me, alighting around me, often within four or five feet, every time I stopped.

Twice we saw Galapagos Hawks in company with Man-o'-war Birds, circling high in the air. They were usually seen, though, only with birds of their own kind. Frequently at sundown there would be three or four roosting in the trees about our camp. They also roosted in cactuses, on the rocks along the sea coast, and on telephone poles.

The hawks killed were in good health and were frequently very fat. They put up a game fight when wounded, getting on the back if hard pressed and bringing the talons into play.

In food habits, Galapagos Hawks fill the offices of birds of prey and of scavengers, and seem to draw the line at no animal matter dead or alive. Any of their own species, killed or seriously wounded, they fell on with avidity, disposing of them in short order. On one occasion we killed two and left them on a beach; in a short time 17 of their fellows congregated and devoured them. A list of the animal remains which we found in specimens of this hawk, or which we saw them eating, gives some idea of the variety of their diet: Crabs, centipedes, grasshoppers, finches, lizards, fat torn from seal and pig skins staked out to dry, tortoise, iguana, and goat remains, young Swallow-tailed Gulls, and the putrid remains of an adult Blue-footed Booby. We found the carcass of the booby in the nest of a pair of hawks on South Seymour. Their craws were crammed with its rotten flesh.

While sitting under a tree one day on southern Indefatigable, I noted a seven-inch centipede close by on the ground. A hawk, standing a few feet above me in the tree, also saw it, hopped down to the ground beside it, and promptly seized it in his talons. He then stood still for a moment, shifted the centipede from one foot to the other, pulled at it two or three times with his bill, and finally flew away with it in his talons.

2. **Pandion haliaëtus:** Osprey

Albemarle and Chatham islands.

The first Osprey seen was circling high in the air with a number of Man-o'-war Birds near Villamil, Albemarle, on November 1. The next day a male was taken. On August 25 another was seen at Villamil. At Sappho Cove, Chatham, on February 14, I saw one soaring high above the sea.

When a few miles off Cocos Island, Costa Rica, on September 3, an Osprey was seen. On each of the two following days one was observed on the island, and on the 7th Mr. Beck shot a male.

3. **Asio galapagensis:** Galapagos Short-eared Owl

Abingdon, Albemarle, Barrington, Bindloe, Champion, Charles, Chatham, Culpepper, Duncan, Gardner-near-Charles, Hood, Indefatigable, James, Seymour, and Tower islands.

We saw short-eared owls on the above islands, except Bindloe, Culpepper, and James. They were most numerous on Tower, where ten were seen during one day. Usually they were noted singly.

In most cases they were observed in the dry region and near the beaches. At Iguana Cove, Albemarle, where the moist region extends practically to the sea coast, a number were seen at night in the trees. On southern Indefatigable, the center of abundance of the barn owl, only one was taken, while on northern Indefatigable three were taken, although they were hunted more in the former locality.

Often they frequented rock piles and sides of craters, and on Tower some were observed in trees in broad daylight.

In daytime they could be approached closely enough to be shot with an auxiliary cartridge, while twice birds were killed with stones. At night they came to our camp fires, and one evening at Villamil, Albemarle, one alighted on the vessel.

The stomach of a specimen, taken on Hood on June 26, contained the remains of a centipede, a Sooty Ground Finch, and grasshoppers.

Certain individuals, taken on Hood in September and October, had long parasitic worms between the skull and the skin covering it.

4. **Strix punctatissima**: GALAPAGOS BARN OWL

Abingdon, Albemarle, Indefatigable, James, Narborough, and Seymour islands.

Although its chief stronghold was southern Indefatigable, where five were taken in one night, this barn owl was also observed and taken by us on Albemarle and Narborough.

Mr. Beck reported them in the elevated, humid, fertile portions of southern Narborough in early April. A female, with slightly enlarged ovaries, was killed with a stick on the night of April 6 at 1500 feet elevation on Tagus Cove Mountain, Albemarle. At Santo Tomas (elevation 1000 feet), in the moist region of southeastern Albemarle, one flew into the house of the major-domo of the ranch on a foggy night in August.

In the moist region of southern Indefatigable on November 13, one was taken about midnight at 700 feet elevation. It alighted on a branch close above us, although we had no camp fire. A few nights before Mr. Beck obtained two in the dry region. On the night of January 17, two were seen at our camp at 350 feet elevation. While spending the night of July 11 in the region just mentioned, I took three females at camp. Each one alighted on branches six or seven feet above the fire. There they sat until shot, turning their heads from side to side, and staring down with large wondering eyes at me and the fire.

The only vocal sound I heard from this species was a hiss emitted by a wounded bird. Grasshoppers were found in their stomachs.

5. **Coccyzus ferrugineus:** Cocos Island Cuckoo

The extremely shy cuckoo of Cocos Island, Costa Rica, proved to be the rarest of the indigenous birds of that island. We saw it only at Wafer Bay, where six individuals were observed during the first half of September, 1905. The Academy's collection contains four of these. They were observed in the clumps of banana trees as well as in the virgin forests. Twice they were heard calling. An examination of the stomach of one showed the remains of what appeared to be crickets.

6. **Coccyzus melanocoryphus:** Azara's Cuckoo

Albemarle, Barrington, Charles, Chatham, Duncan, and Indefatigable islands.

This cuckoo was common on Charles and Chatham, and less so on Albemarle. On Indefatigable it was heard frequently and twice seen, but not captured. On Duncan, also, it was observed and heard twice during December. Mr. Nelson shot one on Barrington on July 10.

Cuckoos occurred in the dry as well as the damper portions of the islands and were occasionally seen in the mangroves on the coast. On Chatham they were noted in the hedges of sisal hemp bordering the sugar fields in the moist region. They were also common in the native Galapagos vegetation from there down to the coast. At Black Beach Roads, Charles, the species was noticed most commonly on the westerly slope of the island, only one or two individuals being observed in the interior, which is overrun by lemon and orange trees introduced by former settlers. On Indefatigable, in the vicinity of Academy Bay, it was heard in the dry region up to 350 feet elevation, and two were seen near the beach. On Duncan and Barrington it occurred in the dry region. On Albemarle the species was seen in both the moist and dry regions and also in the mangroves of the coast, being observed on all of the mountains except Cape Berkeley, which we did not visit. It was noted above 1500 feet elevation on the west side of Tagus Cove Mountain.

This species was not gregarious, seldom more than one individual being seen at a time. Once in a while they were

observed flying, usually only from bush to bush. They were very shy and could not be approached closely, the majority of specimens being shot with 12-gauge shells or with a shot pistol, and not with an auxiliary barrel. When approached a cuckoo usually flew a short distance into the brush and then stopped to see if it was being followed; if so, it would go on a little further and then stop again. Sometimes, however, if the collector remained motionless, the bird became inquisitive and approached close enough to be shot.

On the ground cuckoos were swift runners. Their chief food seemed to be grasshoppers varied with occasional katydids.

The call of this cuckoo was similar to that of the Cocos Island Cuckoo, and was heard oftener than the birds themselves were seen. In late May and early June on Charles and in early June on Chatham, they were not heard to call.

Nests were not infrequent, although those found were usually old or deserted. They were almost invariably built several feet above the ground in bushes or small trees, often in hard wood bushes (*Psidium galapagcium*). They were commonest on Chatham in the native vegetation.

On January 27 at Wreck Bay, Chatham, Mr. Beck obtained three eggs with incubation just begun. The nest from which they were taken was about six inches across and composed of little twigs and orchilla moss. It was placed in the fork of a small tree 12 feet above the ground. The parent stayed on the nest until approached closely, and then remained in the tree until shot. In the same locality and on the same day, Mr. Hunter found a nest with one fresh egg. When the nest was examined two days later, the egg was broken and the bird nowhere to be seen. The nest was eight feet above the ground in a bush of *Psidium galapagcium*. It was very shallow and built of twigs loosely put together, and lined with moss.

At 1000 feet elevation on the west side of Tagus Cove Mountain, a nest containing three eggs was found by Mr. Beck on March 28 in a bush growing on a steep canyon side. It was composed of dry twigs with a few grass stems for lining.

On January 27 a female was shot near Wreck Bay and an egg ready to be laid was taken from her oviduct. A specimen taken at Banks Bay, Albemarle, on April 15, had

small sexual organs. Specimens taken on Charles on May 14 and 15, also had their reproductive organs much reduced in size.

On August 10 and 11, high up on the east side of Cowley Mountain, Albemarle, the remains of cuckoos were found in two places. They had perhaps met violent deaths owing to the presence of cats. At Wreck Bay on July 7, I shot a cuckoo which did not have a vestige of a tail—perhaps also the work of a cat.

The bill of the bird in life is black and the feet pale blue.

7. **Pyrocephalus nanus**: Gould's Vermilion Flycatcher

Abingdon, Albemarle, Barrington, Bindloe, Charles, Duncan, Indefatigable, James, Jervis, Narborough, Seymour, and Wenman islands.

The Gould's Vermilion Flycatcher was found along the seashore, in the dry region, in the moist region, and in the grassy region of the higher mountains. Native and introduced vegetation was frequented alike.

It was common on Albemarle, Charles, Indefatigable, and James. Mr. Hunter shot a lone individual on Wenman on September 24, demonstrating that this species also leaves its home island. None were seen on Barrington or Narborough, although reported by other expeditions.

Their methods of hunting are like those of the Galapagos Flycatcher. They haunt the bushes and trees in search of insects. On Tagus Cove Mountain I saw a young one in striped plumage catch an insect on the wing. Another time I saw an immature male devouring a small butterfly while sitting on a branch. In one case one took insects from Mr. Williams' hand, and as a rule they were very tame, approaching within a foot or two of one, and often being killed with a short stick. One was noted eating a small scorpion during our stay on Cowley Mountain. On southeast Albemarle they were common in a large slaughter field above Santo Tomas. There they were seen catching insects on the putrid remains of numerous cattle which had been slaughtered from time to time for their hides. At Academy Bay, Indefatigable, these flycatchers were seen at various times standing

on the muddy bed of a saline lagoon making rushes at passing insects.

Several times I have noted males flying high in the air in a wavy style, often dropping several feet and then going up again. This was noticed on southern Indefatigable in November and in January, and on Abingdon in September. Whether these were mating antics, or whether the birds were hawking for insects, I do not know. At Black Beach Roads, Charles, in October, they were seen chasing each other through the woods.

The condition of the reproductive organs was noted as follows:

November 3; Villamil, Albemarle; one in intermediate plumage had large testes.
December 5; Duncan; two with enlarged testes.
December 11; Duncan; enlarged testes.
May 14, 15; Charles; small reproductive organs.

On February 28, in the interior of Charles, I took two nests each containing three unfeathered young, another containing two, and another containing one. On March 2, in the same locality, one nest was found containing three well-grown young and several containing two each. On the same day, Mr. Beck found a nest 12 feet above the ground in a bush of *Zanthoxylum pterota*. The nest was a small, neat, compact cup of moss placed at the forking of a limb, and contained one fresh egg. The nest of this species, to all appearances, is the same as that of the Pygmy Vermilion Flycatcher of Chatham.

8. **Pyrocephalus dubius**: Pygmy Vermilion Flycatcher

Chatham Island.

The habits of this species are like those of the Gould's Vermilion Flycatcher. It was not common near the beach at Wreck Bay, but about a mile up the road it became quite common, and was found in all of the wooded region below El Progreso. On February 22, one or two individuals were seen in the lemon trees planted in the upper grassy pasture land above El Progreso. Mr. Beck took a number in the elevated moist region, high on the mountain above Basso Point, on

the north coast of the island. Mr. Hunter and I saw none that day below in the dry region.

The food habits of this species were identical with those of the Gould's Vermilion Flycatcher. Occasionally an insect too large to swallow was taken. Then the bird would hold it firmly in its bill and proceed to break it against a branch.

These flycatchers were very tame, despite the fact that Chatham had been occupied by man for many years. Their extreme inquisitiveness and unwariness allowed us to kill many of them with sticks.

In the latter part of January, I noted occasional individuals flying up and down in the air in a wavy style just as the Gould's Vermilion Flycatcher was observed to do. It was a common thing to see them chasing one another through the forest. Two couples were seen copulating in January. Birds taken as early as October 17, however, had enlarged sexual organs.

Like other Galapagos land birds this species nests in the wet season when the vegetation of the arid region is green. The following is a list of the nests we found. They were indistinguishable from those of the Gould's Vermilion Flycatcher.

January 26; Wreck Bay region. An empty nest was found 14 feet above the ground in a tree of *Zanthoxylum pterota*. It was small, open, and built of moss. The owners were very much disturbed, keeping quite close to me while I was in the tree, jumping from limb to limb, and uttering occasional cries.

January 27; Wreck Bay region. Mr. Beck took a nest similar to the above, but containing two incubated eggs.

January 29; Wreck Bay region. I found a female sitting on a nest containing two fresh eggs. The nest was about 20 feet above the ground in a *Bursera* tree, being built at the forking of a branch. It was quite shallow and made of grass, moss, and cotton, and lined with moss. The bird allowed me to climb within a few feet of her without leaving the nest. The nest investigated on the 26th was again examined and was found to be apparently deserted.

The next nest was taken by Mr. Beck on February 8, in the moist region on the mountain above Basso Point. It was

likewise at the forking of the limb of a tree, about 20 feet from the ground, and was composed principally of moss taken from the tree, two or three species being used to form the delicate cup. The female remained on the nest until frightened by the shaking of the limb.

Close beside the wagon road connecting the wharf at Wreck Bay with the village of El Progreso, another nest was found on February 21. It was about nine feet from the ground in a bare bush. The female stayed on the nest, guarding zealously her one fresh egg, until I was very close. An egg, incubated about six days, was taken on February 23 from a nest in the Wreck Bay region. As usual, the nest was open, small, compact, shallow and like that of the Gould's Vermilion Flycatcher. It was built of moss, small twigs, and wild cotton. It was nine feet above the ground in a tree close beside the wagon road. On the same day, in the same locality, another nest containing two fresh eggs was found. It was built of small twigs and moss, and placed in the fork of a limb of a tree 30 feet from the ground. The female remained on the nest while the limb was being cut off and hauled in, so that the nest could be reached.

Birds in plumage intermediate between red and buff were rare.

9. **Nesotriccus ridgwayi:** Ridgway's Flycatcher

This sombre-colored little bird haunts the dense rain forests of Cocos Island, Costa Rica. It is met with singly and in pairs as one proceeds along the overgrown trails or works his way up one of the numerous streams of that island. Bating the Cocos Island Cuckoo, this species is the least numerous of the four species of land birds known from that island. During our stay at Cocos in September, 1905, we usually saw several whenever we journeyed into the forests.

10. **Eribates magnirostris:** Galapagos Flycatcher

Abingdon, Albermarle, Barrington, Bindloe, Brattle, Charles, Chatham, Daphne, Duncan, Hood, Indefatigable islands, islet off northeast James, James, Jervis, Narborough, Tower, and Wenman islands.

This inquisitive and unsophisticated little flycatcher has been observed on all of the islands just named, and was seen by us on all except Jervis and Narborough. It was quite a common species, seldom more than a couple of individuals being seen together, however. Only one was seen on Daphne, one on the islet off northeast James, and one on Tower. Mr. Beck saw three on Wenman on September 24. At the same time other species also known previously only from islands to the southward were seen and taken.

Galapagos Flycatchers were observed from the ocean beach, where they were seen among the rocks below the high tide line, to the tops of the mountains, living under quite a variety of conditions. Everywhere they were observed in the arid belt, the usual vegetation of which is spiny bushes, cactus, *Bursera* trees, and thorn trees *(Prosopis dulcis)*. They were occasionally seen about the saline coastal lagoons. In the transition region between the arid and humid belts, in which the cacti disappear and the ferns appear, they were also present.

In the central part of Charles, which is overrun with lemon and orange trees and is blessed with two or three springs, quite a number were seen. Only a few were noted in the very humid belt on the south side of Indefatigable, where the vegetation is so thick and rank that the ground is hidden from view and one has to cut his way with a machete. In the upper grassy region of southeastern Albemarle at an altitude of about 3200 feet, where bushes and trees are scarce, some were seen. In the crater of the same mountain several were noted; the vegetation there was that of the arid region of the coast, and not that of the outer slopes of the mountain at the same altitude (about 2800 feet). At Iguana Cove, Albemarle, they were common only above 300 feet elevation. At a large tree at 1500 feet elevation on the west side of Tagus Cove Mountain, Albemarle, quite a number were observed. On Abingdon two were noted in the humid belt about 500 feet below the dense and almost impenetrable growth of ferns, which crowns its summit. On James they were observed on the main peak (altitude 2850 feet), which is covered with tall grass *(Paspalum conjugatum)* and stunted trees and bushes, as well as on the scantily clothed black lava lying be-

tween the principal mountains and the Sugar Loaf hill on the southwestern portion of the island.

They frequented the bushes and trees and were seldom seen on the ground. Their movements were quite rapid, although often not quick enough to escape the stick in the hand of the collector. The bird often sat on a limb until approached within a foot or two, when it would dart off to an adjacent branch. At each resting place it would look about carefully for insects, turning its head in all directions. Occasionally they were seen in company with vermilion flycatchers, and once on James they were observed with four or five species of ground and tree finches feeding in a large tree with red flowers *(Erythrina velutina)*. On southeastern Albemarle I observed a pair catching moths for their young. One held a moth in its bill for five minutes while examining me, and then finally took it to the young, which were only partially fledged. At Villamil, Albemarle, one was noticed hunting insects in a wood pile near the chief house of the village.

During the mating season they were heard to sing a little. In early January, on James, I saw two chasing each other, and heard one singing. A few days later, on southern Indefatigable, I again heard the song. At Iguana Cove, Albemarle, on March 19 and 20, two, three, and four were often seen pursuing each other, and singing constantly. At Academy Bay, Indefatigable, on July 11 and 12, two couples were observed pursuing each other and calling at the same time. In the same locality one was heard calling on the 15th and another on the 16th.

The condition of the reproductive organs was noted as follows:

December 11; Duncan; considerable enlargement.
January 13; Academy Bay, Indefatigable; large.
February 8; Basso Pt., Chatham; large.
May 23; Black Beach Roads, Charles; small.

In latter May most of the adult land birds on Charles were moulting. Two bob-tailed Galapagos Flycatchers with new tail feathers just appearing were seen.

The following is an account of the nests, eggs, and young that were found:

On January 26, in the vicinity of Wreck Bay, Chatham, Mr. Hunter found a nest with eggs in a rotten stump. In the interior of Charles, on March 2, Mr. King found a nest in the trunk of a very old, cleft orange tree, the nest being about four feet above the ground. It was six inches in length, and of loose construction. It was built of twigs, roots, primaries of small land birds, and the hair of large animals such as pigs and donkeys. The lining consisted of hair. The depth of the nest was about an inch. The three young birds contained in this nest were just beginning to get feathers. The parents made practically no disturbance while the nest was being examined, but merely sat above us on a limb and watched our movements. Mr. King found two other empty nests of this species in positions similar to the above in a tropical plum tree on the same day.

The next nest I found while on a horseback trip on southeast Albemarle on March 7 and 8. The nest was in the lower part of the moist region. It was placed in a thorny tree *(Zanthoxylum pterota)* 15 feet above the ground, and was round and domed just like the nest of a ground finch, which it perhaps may have been at one time. It differed totally in its construction from the flycatcher nest described above, being quite spherical and compactly built. It was made of grass and green and brown moss, with a lining of hair. The nest was discovered by observing the old bird go to it. It contained three recently hatched young and one egg about ready to hatch. This egg had two half shells of other eggs adhering to one end of it. The egg is of cream color with brown streaks all over it, particularly at the large end. The parents made no disturbance save a little clicking noise when I tore the nest down.

On March 12, at a mangrove swamp in an inlet about 10 miles west of Villamil, Albemarle, another nest was found. This time it was placed in a cleft in a large straight tree *(Avicennia officinalis)* growing on the seaward side of the swamp, which contained some fresh water ponds. The nest was about 20 feet from the ground, and the entrance, which was nearly horizontal, was too small for me to insert my hand. The nest contained partially fledged youngsters, which were about six inches from the mouth of the hole. One of

the parents had its tail worn half off, apparently from passing in and out of the hole. They were both greatly disturbed, flying about me all the time.

While on a trip above 2000 feet elevation on the west side of Tagus Cove Mountain, Albemarle, on March 26 and 27, still another nest was found. It was placed between two broad cactus *(Opuntia)* leaves about seven feet from the ground, and for all the world looked to be the old nest of a ground finch, resembling it in most ways, being domed and made of grass and lichen, and lined with grass. The lichen was on the top of the nest. To the old lining of grass were added a few primaries and tail feathers of the Galapagos Flycatcher. It seems to be a fairly regular practice of this species to put wing and tail feathers of small birds in its nests. The egg, which was addled, was of the usual coloration. The actions of two adult flycatchers led me to believe, in the first place, that it was their nest. They made some objection when I tore the nest down, fluttering close to my hand in mute protest.

These little birds are remarkably tame and inquisitive, and, even on the islands occupied by man, they do not seem to have learned to be cautious. They were easily dispatched with a stick or even the barrel of one's shot-pistol. Once or twice on Chatham I have had them attempt to alight on the barrel of my gun while I was carrying it. They will often sit on a branch within a foot or two of a person, until some quick movement of the hand will cause them to fly swiftly to a limb close by with crest erected in alarm. One day I saw one pursued by a Sturdy Ground Finch, whose nest it approached too closely.

At Villamil, Albemarle, in March, a specimen was obtained with two featherless swellings or tumors at the base of the rami of the lower mandible. Another individual with similar swellings was seen at Iguana Cove, Albemarle, a little later in the month. This disease also affects the feet of many of the species of land birds. It is probably similar to the disease described by Mr. Henshaw as afflicting Hawaiian birds.[7]

[7] Birds of the Hawaiian Islands, pp. 20, 21.

11. **Hirundo erythrogaster**: American Barn Swallow

Charles, Chatham, and Hood islands.

We met with this swallow only at Black Beach Roads, Charles, where several were noted flying about the shore on October 11 and 12.

At Cocos Island, Costa Rica, it proved to be more numerous, for on the 5th of September I saw some 20 of them flying about the top of a hill above Chatham Bay. On September 2 Mr. Beck captured one at sea about 40 miles south of the island during a calm.

12. **Progne concolor**: Galapagos Martin

Albemarle, Barrington, Charles, Chatham, Daphne, Duncan, Eden, Indefatigable, James, and Seymour islands.

We did not meet with this species on either Duncan or Barrington, although it has been reported by other observers. It seemed to be commonest on Albemarle, but was not particularly abundant anywhere.

They were observed in every region: the arid, the forested humid, the bare mountain tops, and also about the seashore and saline coastal lagoons.

On Charles several were met with on October 7, on the main peak above 1500 feet in the bald, shrubless and treeless region. Two days later Mr. Hunter took three in the interior. On our visit to Black Beach Roads, Charles, in latter May and early June, individuals were observed several times low down in the arid region, in the forested humid interior, and on the bald mountain top. One, which was noted flying over the tree tops in the interior basin of the island and which was taken May 24, had slightly enlarged reproductive organs.

The first specimen from Chatham was taken in the Wreck Bay region by Mr. Beck, October 17. On February 12 I noted several around the topmost pinnacle of Finger Point, a high and very precipitous promontory on the north central coast of the island. On February 22, a few were seen in the upper pasture country above the village of El Progreso.

Several were seen in the humid forested country on the south slope of Indefatigable, above Academy Bay, about the middle of November. While on a four days' trip inland from

Academy Bay, January 15 to 18, one was seen at about 900 feet elevation.

Mr. Beck obtained two on the south end of South Seymour on November 23.

On December 22, a few were seen near the beach at James Bay, James. One was seen August 9, in the same vicinity.

The Galapagos Martin was fairly common about Villamil, on the southeast coast of Albemarle. On November 1, 2, and 3, they were quite a noticeable feature of the village, skimming low over the ground and houses. On March 7 and 8, three or four were observed about the village of Santo Tomas, 12 miles inland from Villamil. On August 22 and 23, they were abundant over the salt lagoons in the vicinity of Villamil; all were on the wing and twittering a good deal. The following day I saw several on a dead tree on the shore of the largest lagoon. One or two were noted at the village on September 3. August 27 to 30, they were noted from the seashore to the top of the mountain, which is 3200 feet high, occurring in the arid, forested humid, and grassy humid belts. A short way above the town of Santo Tomas was a large slaughter field, which was a great resort for martins. There were a good many martins noted catching insects every time we went by on the road.

On Iguana Cove Mountain, Albemarle, they were quite common on March 19 and 20, above 400 feet, where insects abounded. I saw one with a butterfly in its mouth being pursued by two others. They were twittering considerably.

On August 10 and 11 several were seen flying at about 2000 feet elevation on the east side of Cowley Mountain, Albemarle.

Tagus Cove, Albemarle, however, was the true center of abundance of this bird. There it was observed commonly at a fresh water hole at the seashore, at 2500 feet elevation and below on the mountain, and also in the arid country a short distance inland from the ocean. On March 24, they were found nesting in holes in the cliffs over the ocean a short distance south of Tagus Cove. Mr. Beck took two nests with eggs, one with two, the other with three. The eggs were white. The nest containing the three eggs, which were fresh, was a shallow, though neat, affair of grass stems lined with

a few feathers of the Blue-footed Booby. It was placed in a small hole in the tufa cliff some 20 feet above the ocean. Mr. Beck stated that he took an egg from the same hole five years before, March 31, 1901. The two eggs contained in the second nest were incubated five days. The female was on the nest, which was of grass stems and small twigs, lined with feathers. It was in a small crack in the face of the tufa cliff, also about 20 feet above the ocean.

On the morning of March 24, at Tagus Cove, several martins were noted on a dead tree at the top of a bluff over the ocean. They were seen quite frequently sitting on ledges and at the openings of their nests in the cliffs, both singly and in pairs. I saw one enter its nest with a medium-sized yellow butterfly in its mouth. The sexual organs of birds taken in March and April were large. On April 5, they were common as usual along the cliffs. I saw one make a dozen or so unsuccessful attempts to catch a yellow butterfly which was crossing the cove. On April 9, I noted one chasing a sphinx moth over Tagus Cove; the moth finally dropped into the water and the bird left it.

On May 18, one was seen 20 miles south of Indefatigable. This was the only time the species was noted at sea.

13. **Nesomimus trifasciatus**: Three-banded Mockingbird

Champion, Charles (extinct), and Gardner-near-Charles islands.

A number were taken on Gardner-near-Charles, October 3. On the same day we visited Champion, which lies close to Charles, and there a few were found around the tree cacti *(Opuntia)*.

On February 26, I visited Champion again, but saw, however, only 10 or 12 birds, in somewhat worn plumage. One or two were in song, the music being different from that of the other species of *Nesomimus*. One young bird in spotted plumage was taken.

Nests were common, many being built like the one described below, others with an abundance of twigs. Most of them were old, but a few were fresh. A nest or two was found in nearly every good-sized cactus tree.

I took a nest with two fresh eggs. It was resting on the top of a broad cactus limb about nine feet above the ground. The nest was of the usual shallow construction which characterizes the nests of all of the species of this genus. It was built chiefly of grass and cactus fibre, with a few twigs on the outside. The bird did not leave the nest until I pulled a cactus limb away right beside her. She then left without a sound, and when I returned to the ground, she went back and looked into the nest without making any noise.

I think that two more days of hunting on Champion would have made the species extinct there.

14. **Nesomimus macdonaldi**: Hood Island Mockingbird

Gardner-near-Hood and Hood islands.

This mockingbird is the largest species of the genus and is found commonly on the two above-mentioned islands. As the islands are low, this species is confined to the arid region.

Like the other mockingbirds, these were at home either on the ground or in the trees and bushes. They were good flyers as mockers go, and were excellent runners, often following a person along the sea beaches.

Their food is very diversified; in fact they seem willing to eat almost anything. They feed among the rocks at low tide, on the beaches, and inland. One day several were noted at different times digging vigorously with their beaks into the wet sand at low tide. Seventeen were caught one day in June under an ordinary box propped up with a stick. It was baited with dead crabs, bread, and a breakfast food called "Grape Nuts." Many birds were wary and would not go under, despite the tempting morsals. On one occasion I saw a mocker picking the eyelid of a pelican which had just been killed. On July 2, mockers devoured a young albatross in an egg which had been picked and from which we had driven the parent. Morsels of bread and meat from our lunches were always appreciated. No doubt insects form a considerable portion of their diet.

They were common about the water bird colonies on the south and east sides of Hood. On June 25 I noted them as common among the nesting albatrosses, who paid no atten-

tion to them, even though the mockers undoubtedly break eggs when the opportunity offers. It was a rainy day and the mockers presented a most bedraggled appearance.

On Hood on September 24, they were noted as very quarrelsome, and as uttering a harsh note at that time. A short song was also noted. On September 29 some were heard singing on Gardner-near-Hood. On February 3 they were again heard singing on the same island, and on Hood two days later some were singing. On June 24, after the breeding season, three or four calls were heard. Two or three birds we had alive in a basket could, by uttering a single, rich, full note, send all the mockers in sight into the brush as fast as they could travel; this was apparently a cry of warning. The young birds which were about seemed to employ only one call, a shrill cry, used also in begging parents for food. Whenever a Man-o'-war Bird or Galapagos Hawk passed over, although high up, most of the birds would look up apprehensively.

The nesting season appears to be in February. A male taken January 31 had large testes. On the same day I noticed two or three pairs chasing each other on the ground through the brush, an occurrence noted a number of times in the following days. On February 3 and 5 fresh nests were seen. On the latter date I found a nest occupied by a female and four fresh eggs of a greenish blue ground color, covered thickly with pale brown spots. The nest was built at the junction of two bushes, about four feet above the ground. The foundation was of twigs, and was loose and bulky. The inner part consisted of grass, goat's hair, and cotton, and was about two inches deep—shallow compared to two or three other mocker nests seen. The bird did not leave until I was quite close, and then went only a few feet away

About half of the birds seen during our visit in June were immature. All, however, were as audacious as usual. On June 24 the young birds noted seemed to feed themselves satisfactorily until the parents appeared, when they would become very helpless and solicitous. When a youngster wished to be fed, it fluttered its wings, elevated its tail, lowered its head, and called imploringly to the parent. I did not see any fed, however. Young were noted chasing each other. Adults were in fresh plumage.

On June 30 Mr. Beck took two showing albinistic tendencies. One had a white tail feather, the other had white feathers in the upper side of the wings.

This species is very tame, coming up close to inspect one and often following a person about. One day one alighted on a short walking stick I carried.

15. **Nesomimus adamsi**: Chatham Island Mockingbird

Chatham Island.

This species was common and was found in the littoral, the arid, the humid forested, and the humid grassy zones. During the breeding season it kept more under cover than at other times, and fewer were seen. Few were seen during September in the Wreck Bay region. They were observed on the isthmus to the eastward of the mountainous part of the island and were also common in the crater of Finger Point, a high promontory on the north coast. In the humid grassy country about Mount San Gioacchimo they were found in the lemon groves, which have been introduced.

Like the other species of the genus, they are active birds, being at home either on the ground, in the trees, or in the air.

In my notes I have mention of birds singing on the following dates:

January 25; Wreck Bay.
February 8; Basso Point.
February 10; Sappho Cove.
February 23; Wreck Bay.
July 5; Wreck Bay.
July 7; Wreck Bay.
September 7; Wreck Bay.

Birds taken on February 23, at Wreck Bay, had large reproductive organs.

Eggs and nests were found as follows:

On January 26 Mr. Hunter obtained three well-incubated eggs from a nest taken in the vicinity of Wreck Bay. On January 29 I saw a bird building a nest high in a tree. The nest appeared to be made of loose twigs.

On February 8, on the mountain above Basso Point, Mr. Beck obtained a nest and one fresh egg. The nest was made of twigs and moss of two or three species and lined with fine grass stems. It was placed in a small bush and was nine feet

above the ground. The parents made no sound while in the vicinity of the nest, as was frequently the case when the nest was taken.

On February 10 a nest containing one fresh egg was taken at Sappho Cove. The nest was built in the usual style and was placed 12 feet above the ground in the fork of a tree. It was composed of twigs, grass stems and leaves. The parent remained on the nest until closely approached.

On February 13 Mr. Beck obtained two fresh eggs from a nest found near the center of the isthmus connecting the northeastern and southwestern portions of the island. The nest was composed of twigs, dry grass, and a few cotton balls; it was lined with fine grass and rootlets.

On February 14 one or two old nests were seen in the bushes along the beach near Sappho Cove. Mr. Beck obtained three fresh eggs from a nest found near the center of the above-mentioned isthmus. The nest was in a tree 18 feet above the ground. It was made of dry twigs, many cotton balls, dry grass, and orchilla moss. It was lined with fine grass, rootlets, and bunches of very soft spines from the leaves of the *Opuntia*.

On February 21, at Wreck Bay, I saw two or three new nests. A nest containing five eggs incubated about six days was found. The nest was bulky, and was built of twigs and moss, the inner part being made of grass. It was 13 feet above the ground in a bush beside the wagon road. The owner sat bravely on the nest while I was scarcely two feet away. After I had removed the nest, it sat for a minute where the nest had been.

On February 22 I saw two or three nests in bushes of *Zanthoxylum pterota* overhanging a good-sized stream in the forested country on the south slope of the mountains. On the same day Mr. King obtained a nest in the Wreck Bay region. It contained three fresh eggs, and was placed, with the usual foundation of twigs, in a tree 18 or 20 feet above the ground.

Nestlings and young just out of the nest were noted as follows. On January 25 Mr. Beck took two partially fledged young from a nest in the vicinity of Wreck Bay. The following day Mr. Hunter obtained three nearly naked young from a nest. On February 21, at Wreck Bay, I found a nest

with three newly-hatched young. While I was in the tree examining the nest the parents kept very close to me. They made very little noise, but one picked my hand when I placed it near the nest. On February 23, in the same region, two or three young just from nests were seen. The species seemed commoner than it had been in the previous month.

On the whole this species was fairly tame, but not nearly so tame as the Hood Island species. The Chatham birds were particularly tame and inquisitive in September; probably many of them were immature and inexperienced birds at that time of the year.

Birds with diseased feet were not uncommon and were observed at Basso Point as well as at Wreck Bay. Many species of land birds were noted in this condition at every visit we made to Chatham. Mockers were noted in October, January, and February. This disease appears to begin very early in life, as a young one with diseased wings, bill, feet, and neck, and but a short time from the nest, was taken on February 23.

Cats, which are quite common, must decimate the numbers of this species to a considerable extent. During our stop at Wreck Bay in latter January, Mr. King heard two or three mockingbirds making considerable noise, and upon creeping toward them, saw a large black cat on the ground beneath their tree, and against whom their angry outcries were directed.

16. **Nesomimus melanotis:** Black-eared Mockingbird *

Abingdon, Albemarle, Barrington, Bindloe, Culpepper, Daphne, Duncan, Indefatigable, James, Jervis, Narborough, Seymour, Tower, and Wenman islands.

Generally distributed and exhibiting considerable variation on different islands, this species was seen more or less commonly on all of the above islands, except Culpepper, Daphne, and Duncan. On the last-named island I saw one in the south crater on August 14, my attention being attracted by its continual chirping. On Daphne I saw one, July 25. None were seen on Culpepper.

Black-eared Mockingbirds were found in all the life zones from the seashore to the mountain top, with one exception,

viz., the thick, almost impenetrable fern belt crowning the summit of Abingdon. On the south side of Indefatigable they were found in the moist zone, although not to such an extent as in the dry. On a rainy day in the higher part of the moist zone they were certainly wet and bedraggled creatures. On James they were observed from the seashore to the top of the island. On southeast Albemarle they were seen in the arid, the forested humid, and the grassy humid belts, and also in the great crater, the vegetation of which is rather that of the arid belt. They were noted sparingly on the lower slopes of Iguana Cove Mountain, Albemarle. On the east side of Cowley Mountain, Albemarle, they were seen as high as 2500 feet, which is in the arid belt. On Tagus Cove Mountain, Albemarle, they were not noticed commonly above 1500 feet elevation. On Banks Bay Mountain, Albemarle, they were seen as high as we went, 2100 feet. On Abingdon they were noted in both the arid and humid belts on the south side of the island. On Narborough they were observed in the arid region to the north of the great mountain, and they doubtless also occur at high elevations in the humid belt. Occasionally they were noticed in mangrove swamps, and they commonly frequented the sea beaches and the neighboring brush. On James they were noted among the rocks at low tide, while on Bindloe they were as common along the seashore as inland.

Their walk and flight is the same as that of the other species of the genus.

The food of this species proved to be varied. Among exceptional things they ate might be mentioned tortoise fat and lizards. One which stayed about our camp on the west side of Tagus Cove Mountain took a dead lizard I threw to it. The bird carried the lizard away a few yards, and then proceeded to devour it, first puncturing it with repeated stabs of its beak. Some, which we kept alive on board the vessel on the homeward voyage until off the coast of Baja California, enjoyed live cockroaches and dermestes very much, taking them from our fingers.

The song of the mockingbirds of this species on Barrington was noticeably different from that of the Chatham Island Mockingbird. The Black-eared Mockingbird was heard in song during every month except February, May, and June,

when we were out of the range of the species, and on all of the islands of its range, except Jervis, Narborough, Abingdon, and Wenman. It was in song the least during the nesting time, when it was rather inconspicuous. Besides the song, this species also has a sort of chirp of several notes used as a signal of alarm and as a call note. Birds were heard in song on Barrington in July, while they were not heard on Indefatigable. I one day heard one singing while it was sitting on a dead tree in the middle of a large salt lagoon on southeast Albemarle.

The following notes were made on the condition of the reproductive organs:

October 21; Barrington; somewhat enlarged.
October 31; Villamil, Albemarle; testes enlarged.
November 6; south Indefatigable; considerable sexual enlargement.
March 13; ten miles west of Villamil, Albemarle; large.
March 26, 27; Tagus Cove, Albemarle; large.
April 17-19; north Narborough; large.
September 22; south Abingdon; small.
September 24; Wenman; medium-sized.

On Bindloe, on September 17, I saw a pair in the act of coition in a tree.

Owing to our absence from the greater part of the range of this species during the breeding season, we found it nesting only on Albemarle. Two occupied nests were found in bushes of *Zanthoxylum pterota* beside the wagon road in the humid forested zone on the mountain of southeast Albemarle on March 8. Both were about 12 feet from the ground. One contained three eggs with incubation begun; the nest in this case was of twigs, lined with grass, hair, etc. The second nest contained three newly-hatched young and two eggs ready to hatch. The parent of these was on the nest when it was pulled down; she uttered a cry and flew off a few feet, but made no other disturbance.

On March 12 a nest with a bird sitting on four fresh eggs was found near the coast about 10 miles west of Villamil. The nest was in a bush some nine feet above the ground, and was made of twigs and lichens lined with roots, grass, and hair. The bird made two or three outcries when I reached for the eggs.

Young and immature birds were noted as follows:

March 5; Villamil, Albemarle; I took three young, which were flying about.
March 7, 8; southeast Albemarle; in the moist region I saw four or five birds of the year.
March 13; ten miles west of Villamil, Albemarle; I took one bird of the year.
March 15; Cape Rose, Albemarle; two or three young birds.
March 26, 27; Tagus Cove, Albemarle; about two-thirds of the birds observed were young.
March 30, 31; Tagus Cove, Albemarle; many young.
April 2; Tagus Cove, Albemarle; young about as common as adults; two or three young above fifteen hundred feet elevation.
April 12; Banks Bay, Albemarle; mostly young.
April 13, 14; Banks Bay, Albemarle; young and old in equal numbers.
April 25; ten miles west of Villamil, Albemarle; young birds noted.
July 9; Barrington; one young one in spotted plumage.
September 19; south Abingdon; one young one with spotted breast.

Black-eared Mockingbirds usually occurred singly or in pairs and did not associate with other birds to any extent. An exception was noted when we landed on Wenman, where a pair of these mockers along with a dozen Northern Cactus Finches were peering over a ledge at us within a couple of feet of our heads.

We did not meet with these birds at sea, as we did certain other Galapagos land birds. The finding of one on Duncan and of one on Daphne was the only proof we had that they moved about somewhat from island to island.

As these birds ate most anything, they had little or no sharp competition with other species. On south Indefatigable I saw one drive a Parrot Tree Finch from some heliotrope blossoms on which it was feeding; this was done by making a swoop at the finch. A little later I saw another similar occurrence, the victim being a Sturdy Ground Finch.

Four, which we kept in captivity with a number of Galapagos Doves, proved quite warlike, killing two doves, apparently by striking them on the head with both bill and wings. One mocker in particular seemed to take a mischievous enjoyment in chasing doves.

All were tame and inquisitive; least so, however, in the breeding season. Their tameness and inquisitiveness varied on the different islands, being at the maximum on Bindloe.

The mockers of Barrington were not as inquisitive as their congeners on Chatham, which is inhabited. They were very amusing in their actions. I remember one in particular, an Indefatigable bird, which was prying into things around our camp and inadvertently jumped into a bed of live coals. It jumped out with great alacrity, much amazed and alarmed.

Their tenacity of life was not great, being decidedly less than that of sandpipers and snipes, birds of about the same size.

On Albemarle these birds have cats to contend with, in addition to the owls and rats common to so many of the islands.

17. **Dendrœca petechia**: Jamaican Yellow Warbler

Abingdon, Albemarle, Barrington, Bindloe, Brattle, Champion, Charles, Chatham, Culpepper, Daphne, Duncan, Enderby, Gardner-near-Hood, Hood, Indefatigable islands, islet off northeast James, James, Jervis, Narborough, Seymour, Tower, and Wenman islands.

Abundant on none of the islands, yet generally distributed over all of them, both large and small, these birds were usually seen singly. They were found from the rocks below the high tide line to the tops of the mountains. They were essentially birds of the arid and littoral regions, as can be seen by the number of islands in the list which have no moist region. In September, on Cocos Island, Costa Rica, where the climate is exceedingly humid, they were fairly common and a good many were noted feeding among the rocks along the beaches at low tide.

On Charles they were as common in the humid region as in the arid. On Chatham they were seen in both the arid and the humid belts. On southeast Albemarle, in March and August, they were noted in the humid forested region as high as Santo Tomas. I did not note any in the humid region of James. On Iguana Cove Mountain, Albemarle, they were seen chiefly below the 300-foot elevation at the time of our visit in March. One old nest, and also one new one, was seen at about 700 feet elevation. On the west side of Tagus Cove Mountain, Albemarle, they were pretty generally distributed, the arid belt extending practically to the top of the

mountain. On the south side of Indefatigable they were not seen in the damp region. On the east side of Cowley Mountain, Albemarle, they were seen as high as 2500 feet, the highest altitude we reached; there was practically no moist region, however.

This species might be said to be more of a ground bird than any of the *Camarhynchi*. Often they were seen catching insects on the beaches, making dashes after them. At Academy Bay, Indefatigable, on November 16, I saw a few feeding on the bed of a salt lagoon from which the water had nearly evaporated. On Jervis they were also noted on the lagoon beaches. In March and April they were found in the mangroves on the east coast of Narborough. They were observed commonly in similar locations on the shore of Banks Bay, Albemarle, in the same month. On April 15 and 16 some were observed feeding on caterpillars. On Hood they were observed feeding among the rocks at low tide in company with the Sooty Ground Finch and the Gray Certhidea. On Abingdon they were observed in like locations in company with the former species. At Villamil, Albemarle, one was noted in the wood pile next to a house. In the interior they proved to be birds of the trees and bushes.

The first singing was heard on Duncan on December 13. On Chatham in January they were singing commonly in the Wreck Bay region. In February they were heard singing in the country about Sappho Cove, Chatham, and a few were heard in the Wreck Bay country. On February 28 birds on Charles were in song. In March I heard birds singing in the coastal region 10 miles west of Villamil, Albemarle. On Tagus Cove Mountain, Albemarle, they were heard as late as March 26 and 27. At Banks Bay, Albemarle, April 10, one or two were singing in the mangroves. April 25, ten miles west of Villamil, Albemarle, they were singing, while in latter May none were in song on Charles.

The condition of the reproductive organs was noted as follows:

January 25; Wreck Bay, Chatham; sexual organs large.
February 23; Wreck Bay, Chatham; large sexual organs.
May 13; ten miles west of Villamil, Albemarle; large sexual organs.
May 14, 15; Black Beach Roads, Charles; sexual organs reduced in size.

The first signs of nesting were seen on Chatham, in the Wreck Bay region, on January 25; when two or three were seen gathering nesting material. Two days later Mr. Hunter found a pair building a nest, while on the 29th Mr. Beck took a nest containing one fresh egg. This nest was nicely and symmetrically made of fine dry grass stems and fibres, a few cotton balls, and leaves of two or three different kinds. It was placed in a thick bunch of green limbs nine feet from the ground.

The greatest number of eggs taken from any nest was three. On February 8 Mr. Beck obtained a nest high up on the mountain above Basso Point, on the northwest coast of Chatham. On February 9, near Sappho Cove, Chatham, I saw two or three fresh nests in the crotches of small slender bushes about seven feet above the ground. They were made of grass plastered on the outside with cotton and leaves. One female I found on an empty nest. When I intruded she stayed within two or three feet, constantly uttering short, quick notes; she seemed quite disturbed.

On February 13, at Sappho Cove, Chatham, a nest with one fresh egg was taken. The nest was of the usual style, and placed seven feet from the ground in the branches of a small tree. It was composed largely of cotton balls, lined with fine rootlets and grass. On February 23, only old nests were found in the vicinity of Wreck Bay, Chatham.

On Charles on February 28, I took a nest with two fresh eggs. The nest was small, compact, made of grass, and lined with cow or pig hair; it was 11 feet above the ground in a bush. Another nest taken March 2, contained one fresh egg; it was five feet above the ground in a small lemon tree, and was composed of grass and cotton balls. The owner tried to decoy the collector from her nest by feigning a wound. On March 5, this species was nesting at Villamil, Albemarle. On March 10, a very vertically-elongated nest composed chiefly of cotton balls was secured. On April 7, three fresh eggs were taken near Tagus Cove, Albemarle, the nest being in the top of a small tree in the flat country near the sea. It was composed about the same as usual, dry grass stems, cotton balls, and a lining of fine rootlets. April 13 and 14, only old nests were noted in the Banks Bay country, Albemarle.

Immature birds were noticed on Champion, October 3, and at Black Beach Roads, Charles, October 11. On February 23, at Wreck Bay, Chatham, a young one just from the nest was taken. On the 28th in the same locality a nest containing two slightly-fledged young was found. On March 6, a young bird with almost white underparts was observed at Villamil, Albemarle. Then miles west of Villamil, Albemarle, two partially-fledged young were found in a nest placed 10 feet from the ground in a bush in a mangrove swamp. I also saw an adult bird feeding a youngster on a limb. At Cape Rose, Albemarle, on March 15, I saw a young bird fresh from the nest. On April 4, Tagus Cove, Albemarle, I saw two or three in an immature cream-colored plumage. On April 8, a nest found in the Tagus Cove region, Albemarle, contained two young about able to fly, one, in fact, sitting on the outside of the nest. April 10, one in pale cream-colored plumage was observed at Banks Bay, Albemarle. In the Black Beach Roads region, Charles, on May 26, birds were seen in all stages from white-breasted immature birds to adult males. Hood, June 23, several immature birds were noted; the following day nearly all were immature, only a couple of adults being seen.

On Hood in January and February, they seem to retire to the higher parts of the island which are green whilst the lower parts are still dry. Neither Mr. Hunter nor I observed any about Gardner Bay, where on our other visits they were fairly common; they were found only in the interior.

Of all the Galapagos land birds, this warbler is met with most frequently away from the land. On January 12, one was seen flying over the water at Academy Bay, Indefatigable. On May 4, when 10 miles west of Charles, one alighted in the rigging about 8 A. M. When 20 miles south of Indefatigable on May 18, a calm day, one came aboard in the morning. On May 23, when off west Charles, two investigated the vessel on the wing and then kept on their journey towards Albemarle. On the morning of June 6, when 20 miles south of Brattle, two flew about the vessel. On June 23, two or three miles south of Hood one passed the vessel.

On July 15, while lying at anchor in Academy Bay, Indefatigable, one of these little warblers came aboard, remaining all day. It spent its time catching flies and cockroaches, and was very tame, even alighting on our heads. On July 17, the same bird was still aboard. It had become exceedingly tame, and one could occasionally stroke it with a finger. One or two others had also come aboard.

Some of the individuals taken on Chatham had diseased feet.

18. **Certhidea olivacea**: Darwin's Certhidea

Abingdon, Albemarle, Bindloe, Charles, Chatham, Culpepper, Duncan, Indefatigable, James, Jervis, Narborough, Seymour, Tower, and Wenman islands.

This bird was found more or less commonly on all of the above islands, although it was not gregarious as were the finches. It was usually encountered singly. It was found in every life zone, the arid, the humid, and the grassy treeless zone of the high mountains.

On Charles it was rather uncommon. Examples were taken, however, on all three visits, October, February-March, and May-June; most commonly during the last two. They were found all over the wooded interior and on the southern slope of the island, chiefly in lemon and orange groves.

On Chatham they were quite common in the Wreck Bay region in the wooded humid belt and in the region intermediate between the humid and the arid. Mr. Beck took the nest and eggs of this species from near the center of the low isthmus northeast of the high mountainous part of the island. On February 22, I noted a few along the banks of a moderate-sized stream in the forest on the south slope of the mountains just below the grassy pasture country.

A few were seen in the southeast coast region of Indefatigable opposite Barrington, one being noted in a mangrove swamp. Two were seen in a like location on south Indefatigable, November 6. On south Indefatigable, inland from Academy Bay, they were found commonly in the humid forested belt up to 1100 feet, as high as we went. On our visit to this zone in November, they were found to be the commonest land bird from 525 feet to 700 feet elevation.

On November 12, one was seen feeding in a bush near the beach. A few were noted in November, on the barren north and northeast coasts of the island. In January, they were common at Academy Bay from the beach up to 1000 feet elevation in the moist region, where they were most numerous. During July, at Academy Bay, a few were noted in the arid belt. On northwest Indefatigable in the same month several were seen in the arid region near the coast, one or two actually being seen on the rocks of the seashore.

At Villamil, Albemarle, three or four were seen in October and November, and on March 6 another was seen. On March 7 and 8, while on a trip inland on the southeastern mountain of Albemarle, a few were seen in the moist zone. Eight examples taken by Mr. Hunter proved to be males. On March 12, one was noted in the brush near the coast 10 miles west of Villamil. One or two were seen near Villamil on August 22. On August 27 to 30, it was noted in the open treeless country above Santo Tomas, Albemarle. None were seen on Tagus Cove Mountain, Albemarle, but Mr. Beck writes me that on previous expeditions he has found them commonly high up on the mountain during the breeding season. On April 12, one was seen at the western base of Banks Bay Mountain, Albemarle. On the two following days a few were noted from the base of the mountain up to about 2000 feet. On August 10 and 11, three or four were noted high up on the east side of Cowley Mountain, Albemarle. Two were observed on South Seymour on November 21; on July 26, I took a bright-plumaged male. On Duncan in December, occasional birds were seen; half a dozen were seen on August 14. Three or four were taken on Jervis in December.

While on a visit to an island of vegetation in a sea of recent lava in the dry region on the south side of James on December 19, one or two were noted. At James Bay, James, they were common in the humid zone during the same month. At Adams Cove, an exceedingly dry and sterile locality north of James Bay, one or two were seen. January 2 to 4, they were remarked as common on the mountain back of James Bay. On northeast James, northwest of Sullivan Bay, it was feeding chiefly in the bushes

along the shore, although it was occasionally seen inland. On July 28, twenty were seen in the former locality, and only one or two inland. At James Bay, in the following month, August, I noted two about the lagoons at the beach.

On Tower in September a few were seen, this species and the Black-eared Mockingbird being the commonest land birds on the island, which is low and in the arid belt. A few were also seen on Bindloe a day or two later; this island is also low and rises little if any above the arid belt. On September 19, on the south side of Abingdon, for three or four hundred feet below the fern belt at the summit, I saw this species commonly. They seemed to keep dry, as on Indefatigable, despite the continual rain. The following day in the arid belt three or four were noted. One male was in full song as he hopped about the dry bushes. On Wenman six or eight were taken in all. Four or five were taken on a landslide on the north side of Culpepper.

These birds fed in the trees and bushes and were not ground feeders. They were very active and constantly on the move, although they examined each twig carefully, often hanging head downwards as did the Black-headed Tree Finch. They seldom made any flights, but kept entirely in the trees and shrubs. They were insect feeders. On December 22, however, at James Bay, James, I saw one eating a green leaf.

Birds were heard singing on southwest Chatham on February 23, and at Iguana Cove, Albemarle, on March 19 and 20. The condition of the reproductive organs was noted as follows:

October 17; Wreck Bay, Chatham; testes enlarged.
February 23; Wreck Bay, Chatham; large sexual organs.
September 20; south Abingdon; one male with very large testes.
September 25; Culpepper; sexual organs large.

The first nest and eggs of this species were found by Mr. Beck on February 13, near the center of the isthmus joining the northeast and southwest portions of the island of Chatham. The nest contained three eggs incubated about six days. A parent was at the nest, which was similar to that of a ground finch and was made of orchilla moss, fine grass, and cotton balls, lined with shredded grass. It was in a bush about two feet above the ground.

On February 23, Mr. King found a nest with two fresh eggs. It was 12 feet from the ground in a bush of *Zanthoxylum pterota* beside the wagon road on southwest Chatham. The nest was small and domed and built of moss and grass with a few small twigs interwoven. The outside was covered with cotton balls. The lining was of fine grass. One of the parents was on the nest. Both of the old birds were quite excited, making a clicking noise similar to that made by the ground and tree finches when their nests were disturbed. One of the birds sat on the nest site after the nest had been removed.

The first young bird was taken in the interior of Charles on February 28. It was the only immature bird out of about a dozen individuals taken that day. On March 19 and 20, many young were met with above 300 feet on Iguana Cove Mountain, Albemarle. On May 25, two young in striped plumage were taken in the interior of Charles. Like most of the Galapagos land birds this species was quite tame. Many of the individuals taken on Chatham had swollen diseased feet.

19. **Certhidea cinerascens**: Gray Certhidea

Barrington, Gardner-near-Hood, and Hood islands.

This species was quite common on Hood and the neighboring Gardner, while on Barrington it was not common. Unlike its congener, Darwin's Certhidea, it was found on the rocks of the seashore below the high tide line, as well as in the brush. In fact one was seen bathing in a pool of sea water.

In the bushes these birds were insect feeders, inspecting each branch carefully. On the rocks of the coast they probably fed on small marine worms as did the Sooty Ground Finches. They were seen feeding on the seashore on Hood and Gardner in September and October, and in June, in company with Sooty Ground Finches, Jamaican Yellow Warblers, and Hood Island Mocking birds. On Barrington they were seen only in the brush, where they were very hard to detect as they matched it almost exactly in color. On June 27, on Gardner-near-Hood, I saw two or three feeding on the ground in the open, which was unusual.

We heard them singing on Hood and Gardner-near-Hood in early February. Birds taken about that time had large reproductive organs.

On January 31, in bushes close to the beach at Gardner Bay, Hood, I found two or three nests, shaped like *Geospiza* nests, but much smaller. They were built of roots, and I suspect belonged to the Gray Certhidea.

20. **Geospiza magnirostris**: Great-billed Ground Finch

Geospiza strenua, Rothschild & Hartert, Nov. Zool., v. 6, p. 155; v. 9, p. 388; Snodgrass & Heller, Proc. Wash. Acad. Sci., v. 5, p. 330.

Abingdon, Albemarle, Barrington, Bindloe, Charles, Chatham, Culpepper, Duncan, Indefatigable, James, Jervis, Narborough, Seymour, Tower, and Wenman islands.

Although widely distributed, this species is by no means abundant. At no time did we find it in flocks, although in some localities quite a few were seen. It seemed to inhabit the arid region chiefly, although on Abingdon and James it was found in the humid belt. We first met with it on South Seymour on November 21, when two were noted.

Two were seen on north Indefatigable, November 25. On the south side of that island in January, two or three were taken at the water hole near the beach at Academy Bay. Mr. Beck saw several inland in the dry region. In the middle of July in the same locality, I shot two very large-billed ones and a third one was seen. On northwest Indefatigable, south of Conway Bay, on July 21 and 23 two were taken.

On Jervis quite a few were seen during our visit in the latter half of December. They were noted from the beach to the summit of the island. One or two specimens had white feathers in the abdominal region.

James was also a stronghold of this species. They were observed mostly in the moist region, although on December 26, at Adams Cove, on the arid northwestern corner of the island, two or three were taken, one being a male with large testes. A black male taken December 28, had a white feather on its neck. In the humid region on the west side

of the main peak in early January we found quite a few. On August 7, Mr. Beck took specimens inland in the James Bay region. The following day I took one in the brush on the east side of the lagoon at the beach. None were noted in the rugged, sterile, northeastern part of the island.

Near Cape Rose on the south coast of Albemarle, a young bird fresh from the nest was taken on March 15. An adult with large reproductive organs was taken at about 450 feet elevation on Banks Bay Mountain, Albemarle, in April. It was feeding on a green leaf on a bush. In the middle of August of the same year, on Cowley Mountain, Albemarle, a half dozen were seen in the dry region a little above 2500 feet elevation.

On Charles the largest-billed birds of all were taken, the first being captured on June 1. I took a young female which was feeding in the gravel beside the road about half way up the western slope of the island. Mr. Beck took two or three immature ones at the spring in the interior. On June 4 Mr. Beck took three or four more near the spring, and Mr. Hunter took one half way up the road.

On Tower on September 14 and 15 three or four were seen each day. They were a bit shy as were most of the land birds. On the second day they were heard singing. Two were noted on Bindloe on September 17. On the south side of Abingdon quite a number were seen in the lower part of the moist zone and in the arid region below. Occasional individuals were noted feeding on the ground. Eight or 10 were taken on Wenman on September 24. The following day three were taken on a landslide on the north side of Culpepper. This was the only accessible part of the island. A male from that island had large testes.

21. **Geospiza conirostris**: Conical-billed Ground Finch

Culpepper, Gardner-near-Hood, Hood, and Tower islands.

The Conical-billed Ground Finch was common on Hood and the neighboring Gardner. On Tower and Culpepper it was much less so. All of these islands are so low that their summits do not project above the dry zone, hence this species may rightly be said to be confined to that zone.

On Tower, September 14, I saw three or four, and on the following day one or two. One was taken on a landslide on the north side of Culpepper on September 25. On Hood and Gardner-near-Hood they were quite common on all three of our visits: September-October, January-February, and June-July.

This species feeds chiefly on the ground, and in the wet season (February) in the green bushes as well. On September 24, Hood, numbers of this species and the Sooty Ground Finch were sitting in the brush and cactus when not feeding. The following day some were noted on the rocks on the shore of Gardner Bay. On September 28, they were noted both in the brush and on the beach. When on the ground they feed on small seeds. On February 5, Hood, they were feeding chiefly on thorn bushes. I saw one eat a green leaf.

In the early part of February, on Hood and Gardner, many were singing, and all had large reproductive organs, as this was the mating season. On February 3 I noted a pair pursuing each other about the bushes. One female had a large shell-less egg in her ovary. On the 5th of February, some were noted nest-building. One couple which I watched had a nest in a thickly-leaved *Maytenus* bush at the beach; it was about seven feet above the ground and built of grass. The male was doing the building, while the female was feeding. He would fly to the ground and pick up three or four pieces of grass, holding them crosswise in his bill at the base of the mandibles. He would then fly up to the nest and enter, returning in a minute for more. He sang nearly all the time—not one continuous song, but a short one oft-repeated. The female was silent and seemed to pay no attention to his operations. The eggs of this species were not taken.

On June 27, the majority of the few birds seen on Gardner-near-Hood were black. Their chief associates, and doubtless competitors, are the Sooty Ground Finches and the Galapagos Doves. Finches were seen flying between Hood and Gardner quite often and doubtless some belonged to this species. Aside from this none were observed at sea. Like the remainder of the birds of Hood, this species was tame.

22. **Geospiza fortis**: Sturdy Ground Finch

Abingdon, Albemarle, Barrington, Bindloe, Champion, Charles, Chatham, Cowley, Daphne, Duncan, Gardner-near-Charles, Hood, Indefatigable, James, Jervis, Narborough, Seymour, and Wenman islands.

Next to the Sooty Ground Finch, this species and the Cactus Finch were the two most abundant and widely distributed finches of the archipelago. It was common on Champion during my first visit, on Abingdon, Albemarle, Chatham, Daphne, Duncan, Indefatigable, and South Seymour. It was very common on Charles. On the other islands it was not scarce, except on such small ones as Wenman and Cowley. Individuals of this species do not seem to be as numerous anywhere as are the Sooty Ground Finches, nor have they such a wide altitudinal distribution as the latter.

They were found in the dry zone of the islands listed above. Several birds, apparently of this species, were taken on Hood in February and June. They did not frequent the seashore at low tide as did the Sooty Ground Finches. One or two were found in the humid region on south Indefatigable at about 425 feet elevation in November. On Duncan they frequented the south crater which is within the dry region. On James in December a few were noted below the moist region. Again on south Indefatigable in January, several were noted in the moist region. They were also frequently seen at the water hole at Academy Bay. On Charles they were common from the seashore to the top of the highest peak. On Iguana Cove Mountain, Albemarle, in March, they were common above 250 feet elevation, but one being seen below. On Tagus Cove Mountain, Albemarle, in April, they were seen in the arid region above 1500 feet as well as at the base of the mountain. Twice at our camp on the shores of Banks Bay, Albemarle, in April, I observed one of these birds in the mangroves. In this locality they were seen in the gently sloping country at the base of the steep and lofty northern peak of Albemarle. On the north side of Narborough during the same month several were taken on the lower slopes of the mountain. On southeast Albemarle a few

were seen in the moist region in March. None were seen in the elevated grassy belts on the high peaks of Chatham and southeast Albemarle.

Feeding for the most part on seeds on the ground, these birds were often found in company with the Sooty Ground Finch, the Cactus Finch, and the Galapagos Dove. On Charles in October, flocks of 20 or 30 were seen feeding near the coast with the two finches just mentioned. In May large flocks of this species and the Sooty Ground Finch, with an occasional Cactus Finch, were seen just below the divide on the western side of the island. On Champion in the same month they were found commonly in the little crater of the island. On Barrington one was noted feeding on an old cactus blossom. On Duncan they fed on seeds, for the most part in the south crater with large flocks of Sooty Ground Finches and Galapagos Doves. On Chatham this species and the Sooty Ground Finch were the only species which consorted about the buildings at the shore. There they acted like the House Sparrow (*Passer domesticus*) in California. At Iguana Cove, Albemarle, in March, they were feeding on bushes and trees and not on the ground. On Charles in May, some were feeding on green tropical plums on the trees in company with other finches. Single birds were also seen feeding in cactuses (*Cereus*) and occasionally one or two were noted in orange trees. At Villamil, Albemarle, in August, one or two were seen feeding in the village. At the springs in the interior of Charles they were observed drinking with the other finches, hanging on the dripping moss on the almost perpendicular wall of the spring. It would seem upon comparison with the food habits of the Sooty Ground Finch, that the food of this species is not as varied.

They were noted as singing at Basso Point, Chatham, and Sappho Cove, Chatham, in February; on south Albemarle in March; at Tagus Cove and Banks Bay, Albemarle, in April. On Charles in May no singing was heard, but some twittering. The young birds chirp, especially when wishing to be fed.

Birds with enlarged reproductive organs were noted on Chatham in February and on Abingdon in September. As

early as November 3 one was seen carrying straw for a nest at Villamil, Albemarle. Another was seen at Wreck Bay, Chatham, carrying cotton, January 29. Their nests were built in the same manner as those of other species of the genus. On Daphne in November there were a few old nests in cactus trees. The nests were usually of dried grass, although in the damper regions moss, lichen, creepers, and small twigs were used. Fine grass, moss, and cotton balls served as lining. As with the Sooty Ground Finch old nests were occasionally repaired and used. In one case a new entrance and a new top were added. Some nests were more domed than others. The openings of most of the nests of Chatham finches are on the northwest side in localities where the nests were exposed to the rains from the southeast. On Charles a nest was taken which had hair and the tops of weeds with seeds for a lining. One nest collected at Tagus Cove, Albemarle, March 24, was of dry grass with fresh green grass inside, and lined with shredded bark from nearby trees. Another nest taken on Narborough, April 18, was wholly of fresh grass, leaves, and stems.

The nests were found in thorn bushes, cacti, lemon trees, trees and bushes generally, vines growing on bushes, and mistletoe. They were often placed in crotches, and on an average about nine feet from the ground, the extremes being 20 feet and three feet.

The following is a list of the clutches of eggs obtained, the state of incubation, etc.:

January 25; Wreck Bay, Chatham; three, fresh.
January 25; Wreck Bay, Chatham; two, fresh.
January 27; Wreck Bay, Chatham; three, fresh.
January 27; Wreck Bay, Chatham; four, incubation begun.
January 29; Wreck Bay, Chatham; three, fresh.
February 9; Sappho Cove, Chatham; two, fresh.
February 12; Sappho Cove, Chatham; two, fresh.
February 13; Sappho Cove, Chatham; three, fresh.
February 13; Sappho Cove, Chatham; four, well-incubated.
February 14; Sappho Cove, Chatham; four, incubated two days.
February 21; Sappho Cove, Chatham; four, fresh.
February 28; Charles; two, fresh.
February 28; Charles; three, fresh.
February 28; Charles; three, fresh.
February 28; Charles; three, fresh.

February 28; Charles; four, fresh.
March 1; Charles; four, fresh.
March 2; Charles; two, fresh.
March 2; Charles; four, fresh.
March 2; Charles; three, fresh.
March 2; Charles; three, fresh.
March 2; Charles; two, fresh.
March 24; Tagus Cove, Albemarle; five, fresh.
April 18; Narborough; four, incubation begun.

When a nest was disturbed one of the parents or both usually stayed about making a clicking noise. This habit was observed in other species as well.

Young and immature birds were observed as follows:

February 23; Wreck Bay, Chatham. Mr. Beck took one or two well-fledged young ones.
March 8; Southeast Albemarle. One bird of the year was taken.
March 13; ten miles west of Villamil, Albemarle. I took a young bird of the year.
March 15; Cape Rose, Albemarle. I saw two or three immature birds. One was being fed by an adult male. They kept up a continual chirping.
March 19, 20; Iguana Cove, Albemarle. I saw several young birds and noted a black male feed two well-feathered youngsters. I found a nest on the 19th containing four unfledged young four or five days old.
March 30, 31; Tagus Cove, Albemarle. I observed one or two birds of the year at the base of the mountain.
April 2; Tagus Cove, Albemarle. One young one seen.
April 12; Banks Bay, Albemarle. Young plentiful.
April 13, 14; Banks Bay, Albemarle. Many young.
May 31; Black Beach Roads, Charles. Rather common, few adults.
September 19; South Abingdon. Mr. King found a nest with young.
September 21; South Abingdon. One or two very young birds seen.

This species travels from island to island to a certain extent. One was taken on September 24 at Wenman, an island from which it has not been reported. On May 23, when three or four miles west of Charles a bird-of-the-year alighted on board the schooner. It apparently came from Charles and seemed to be headed towards Albemarle or Indefatigable. Two Jamaican Yellow Warblers were also seen travelling in the same direction. This was during the calm season of the year, as were also the next two instances. An immature one alighted on the vessel on June 6, when about 20 miles south of Brattle. I caught it in my hand.

After letting it go it flew off toward Albemarle. On the following day in latitude 1° 43′ S. longitude 91° 24′ W. two came aboard at different times; they were either immature birds or females.

When at Iguana Cove, Albemarle, I saw a black male bathing in a pool of water in a rock at about 250 feet elevation; the water was at least of a temperature of 100 degrees Fahrenheit. This species proved as tame as the average of Galapagos finches. Quite a number of the birds on Chatham, both at Wreck Bay and Sappho Cove, had swollen diseased feet, as have most of the other passerine birds. Occasionally birds with diseased bills were taken. West of Villamil, Albemarle, in April, I saw a young Sooty Ground Finch trying to induce a large-billed adult Sturdy Ground Finch to feed it.

23. **Geospiza fuliginosa**: Sooty Ground Finch

Abingdon, Albemarle, Barrington, Bindloe, Brattle, Champion, Charles, Chatham, Daphne, Duncan, Enderby, Gardner-near-Charles, Gardner-near-Hood, Hood, Indefatigable islands, islet off northeast James, James, Jervis, Narborough, Seymour, Tower, and Wenman islands.

This species was the commonest of all the Galapagos birds, being found on every island and islet visited, except Culpepper. It was common or abundant on all of the larger islands, except perhaps Narborough, into which we did not penetrate far. It was scarce on the smaller islands of Champion, Daphne, Enderby, islet off northeast James, and Wenman.

It seemed well adapted to every condition of the islands, except the heavy rainfall and dense jungle of parts of the humid region. However, as to life zones, this bird seemed to be confined to none, although on south Indefatigable it was found commonly in the arid region and but very scantily in the densely vegetated humid belt. It was seen commonly at low tide along the beaches below the high water mark. Its greatest stronghold was in the arid belt, however, where it was found as commonly about the settlements as are the House Sparrows *(Passer domesticus)* in parts of California, and in

still greater numbers in the uninhabited regions. It was common in the humid belt, except on Indefatigable. On Abingdon the small-billed form of this species occurs both in the arid and the humid belts, while the large and slender-billed form seemed to be confined almost entirely to the humid belt of the island. In the elevated treeless, grassy country of Charles, Chatham, and southeast Albemarle they were common. On Charles they were seen feeding commonly with the Sturdy Ground Finch on the top of the main peak, which was devoid of trees. On Chatham a few were seen along a medium-sized stream on the south slope of the island. In the great crater of southeast Albemarle, the vegetation of which is that of the arid region, they were common, as well as on the beautiful grassy pasture lands on the southern slope of the mountain. On Tagus Cove Mountain, Albemarle, they were common up to an altitude of 1500 feet; above that they were rather scarce, although the arid region extends to the top of the mountain (altitude 4000 feet) on the west side. Occasionally one was noted in a mangrove swamp.

They fed singly and in large and small flocks on the ground. At certain seasons numbers were seen, usually singly, feeding in bushes like tree finches. This occurred mostly in the wet season when the foliage was green and there were fewer seeds on the ground than later. When not feeding, the birds usually retired to the bushes, cacti, and trees, and often during the hot part of the day kept well under cover, as did other species. The following is an account of their feeding habits and food as observed in the field.

When feeding below the high tide mark they seemed to be in search of small marine worms which occurred quite commonly on the rocks. Birds were taken with their gullets full of these. They were seen feeding thus in September, October, November, December, June, and July. A few were noted feeding at times on the white coral sand beaches.

Above the littoral region they fed in the open spaces on the ground, small seeds forming the bulk of the food. At Post Office Bay, Charles, in October, they were seen feeding close to the shore in flocks of 20 to 30. This same habit was noted on other islands: Duncan, Indefatigable, southeast Albemarle, etc. During October, on Barrington, I noted several

feeding on the pulp of a fallen cactus tree *(Opuntia)*. On southeast Indefatigable, in October, several were observed feeding on bushes, two on a bush with a Black-headed Tree Finch. On Duncan they were commonest in the south crater, where they fed in large numbers on the ground with the doves and Sturdy Ground Finches. There also a few were observed feeding on the blossoms of thorn bushes in December. On James, in December, some were noted feeding in trees. On Gardner-near-Hood, in February, they fed principally in the bushes on the northeast side of the island, and on Hood, in the Gardner Bay region, they were seen eating the blossoms of thorn bushes.

Above Santo Tomas, Albemarle, in March, flocks of them were feeding beside the road in the open grassy country. On Banks Bay Mountain, Albemarle, in April, they were observed feeding in the trees on leaves. On Charles, in May, some were seen eating tropical plums; they were also feeding in cacti *(Cereus)* and in orange trees. Large and small flocks were seen during that month with the Sturdy Ground Finch and an occasional Cactus Finch chiefly below the divide on the western side of the island. On northeast James, in August, I noted several drinking the juice of a cactus leaf *(Opuntia)*. At Villamil, Albemarle, in the same month, I saw one in company with a Cactus Finch feeding on an old bull skull. At that time and place a good many were seen feeding on the mud of the salt lagoons. At Santo Tomas during that month they proved themselves to be carrion feeders. During our stay there two or three remained about our room during the day, picking up bits of corn and refuse. On Tower and Bindloe, in September, they fed on the bushes largely. On Abingdon a few days later they were seen feeding both on the ground and in bushes.

The freshwater hole on the coast just south of Tagus Cove, Albemarle, was a great rendezvous for this species. There they bathed and drank to their hearts' content. The springs in the interior of Charles were visited by great numbers of the birds as well as by the animals of the island. The finches might be seen hanging to the wet and dripping moss on the overhanging wall of one from which the water drips. A few of this species and the Sturdy Ground Finch were seen drink-

ing and bathing in a temporary water hole on Iguana Cove Mountain, Albemarle, in March.

Adults were noted as being in song as follows: On Hood, Chatham, and Charles in February; on south Albemarle in March; at Banks Bay, Albemarle, in April; and on Abingdon in September. In this last locality only one was heard, however.

The young birds fresh from the nests seemed to do nothing more than chirp, particularly when their parents were about and the youngsters wished to be fed. In fact, one young one was even seen coaxing a large-billed Sturdy Ground Finch to feed it.

The condition of the sexual organs was noted as follows:

October 30; Brattle; testes very much enlarged.
October 31; Villamil, Albemarle; testes enlarged.
December 11; Duncan; considerable sexual enlargement.
January 31; Hood; fairly large sexual organs.
February 23; Chatham; large sexual organs.
March 18; Iguana Cove, Albemarle; one male with large sexual organs.
April 18; north Narborough; sexual organs large.
May 15; Charles; sexual organs reduced in size.
September 20; Abingdon; sexual organs of two were large.

Eggs were found as follows:

January 25; Wreck Bay, Chatham; five, fresh.
January 26; Wreck Bay, Chatham; four; incubation begun.
January 29; Wreck Bay, Chatham; three, fresh.
January 29; Wreck Bay, Chatham; three, incubation begun.
January 29; Wreck Bay, Chatham; four, incubation begun.
February 9; Sappho Cove, Chatham; three.
February 9; Sappho Cove, Chatham; two.
February 10; Sappho Cove, Chatham; three, fresh.
February 10; Sappho Cove, Chatham; one, fresh.
February 12; Sappho Cove, Chatham; three, fresh.
February 13; Sappho Cove, Chatham; three, badly incubated.
February 13; Sappho Cove, Chatham; three, fresh.
February 13; Sappho Cove, Chatham; two, fresh.
February 21; Wreck Bay, Chatham; three, fresh.
February 22; Wreck Bay, Chatham; five, incubated four days.
February 23; Wreck Bay, Chatham; five, nearly ready to hatch.
February 23; Wreck Bay, Chatham; three, incubation begun.
February 23; Wreck Bay, Chatham; four, incubation begun.
February 23; Wreck Bay, Chatham; four, incubated six days.
February 23; Wreck Bay, Chatham; three, fresh.

February 23; Wreck Bay, Chatham; three, fresh.
February 28; Charles; three, fresh.
February 28; Charles; three, fresh.
February 28; Charles; three, incubated two days.
March 1; Charles; three, fresh.
March 1; Charles; two, fresh.
March 2; Charles; four, fresh.
March 2; Charles; three, fresh.
March 2; Charles; two, fresh.
March 2; Charles; three, fresh.
March 5; Villamil, Albemarle; three, well incubated.
March 5; Villamil, Albemarle; four, fresh.
March 7; southeast Albemarle; four, begun.
March 7; southeast Albemarle; four, begun.
March 12; southeast Albemarle; four, fresh.
March 13; southeast Albemarle; three, fresh.
March 15; south Albemarle; three, incubated.
March 17; Iguana Cove, Albemarle; two, fresh.
March 17; Iguana Cove, Albemarle; three, fresh.
March 19; Iguana Cove, Albemarle; four, fresh.
March 28; Tagus Cove, Albemarle; four, fresh.
April 5; Tagus Cove, Albemarle; three, fresh.

As can be seen from these dates, these finches nest for the most part in the wet season. In fact, when they were nesting on Chatham in latter January, the wagon road was turned into a river, and small ponds and puddles stood by the roadside for many days. The vegetation was green from the shore up. Such also was the case at Iguana Cove, Albemarle, and on Charles.

On Chatham, Charles, and southeast Albemarle the nests were often placed close to the roads, which on Chatham were travelled daily by many teams and people on horseback and on foot. The nests were always placed in trees, bushes, vines, and occasionally in cacti. Once or twice nests were found in dead trees. The height above the ground averaged about seven and a half feet, the extremes being 15 feet and three feet. Usually, when in a tree or bush, they were placed in a crotch. A few old nests were seen on Brattle on October 30. That island is in the form of a semi-circle, which is part of the wall of an old crater. It is only a few feet wide at the top and supports a scanty growth of bushes in which nests were found.

On Tagus Cove Mountain, Albemarle, in April, I found a nest, apparently belonging to this species, low down in a

thorn bush. It contained four eggs which had been broken when fresh; perhaps the work of rats or mice. A small spider was found in one.

Like the nests of all of the Galapagos finches, the nest of this species is domed and has a side entrance. An exception to this rule was once seen in a nest built in a curled cactus leaf, which had entrances on two opposite sides. The nests were usually built of coarse grass and cotton balls lined with fine grass and cotton. Sometimes they were lined with the bushy tops of grass. I saw an old nest utilized, the owners making a new entrance of fresher dried grass for it. Often the nests were composed largely of orchilla moss or lichens, instead of grass, when built in a region where the grass was very scarce. Sometimes both were used. Leaf fibre was also used to some extent, often along with orchilla moss. Creepers and small vines were limited in their use to the regions where they occurred. Once in a while feathers were used in the lining of a nest, although very rarely. In several cases green grass was used along with the dry material. The hair of cows, pigs, and donkeys was used to a small extent in lining the nests. Mr. Beck found a nest with a large entrance and of peculiar construction, being made with the heads of a small weed, all the stalks facing the same way. Once or twice long narrow nests were found.

When a nest was disturbed the owners usually stayed close by, making a clicking noise.

Apparently the first young bird was noted on Chatham, February 23. It was a well-fledged one, which flew from a nest containing five eggs nearly ready to hatch. On March 13, about 10 miles west of Villamil, Albemarle, I saw one following its parent about and being fed. Two days later, near Cape Rose, Albemarle, I saw a young bird fresh from the nest. At Iguana Cove, Albemarle, March 18, one or two young birds were noted. At about 1500 feet on the west side of Tagus Cove Mountain, Albemarle, on April 2, I saw several in the brush during the afternoon. On April 4, on the same mountain, a nest of five young was found; they had their eyes open, but were unfledged. On April 12, 13, and 14 young birds were found quite commonly on Banks Bay Mountain, Albemarle. On Charles, in latter May and early

June, the majority of individuals of this species, and there were many of them, appeared to be immature, and but few black adults were seen. On south Abingdon, on September 20, two youngsters just from the nests were seen, while Mr. Beck also took one. The following day three or four more were noted.

Their presence on the small islet off northeast James, where one was observed on two visits, and on Wenman, where six were taken, would perhaps indicate that they move about somewhat from island to island. They were often seen flying between Hood and the adjacent Gardner. Occasionally, when we were sailing about the bays in small boats, for example Wreck Bay, Chatham, and the harbor at Villamil, Albemarle, individuals would alight on the boat, being quite fearless. When anchored at Villamil, Albemarle, a short distance offshore, in August, several were often aboard the vessel at one time.

Although they were quite tame, they were not as tame as the flycatchers. Birds with abnormally colored feathers seemed to be quite wary. A total albino was taken at Black Beach Roads, Charles, on October 10, by Mr. Beck. An adult male with a white feather in the abdominal region was taken on Duncan in December. Few black individuals were seen on Charles in May and June. On June 4 I took, at a spring on Charles, a bird which had several white feathers in its head, breast, abdomen, back, and rump, and also a pale primary.

Many individuals on Chatham had diseased feet.

A Galapagos Short-eared Owl was taken on Hood in June, with the remains of a Sooty Ground Finch in its stomach. It was captured about 10:30 A. M.

24. **Geospiza debilirostris**: Weak-billed Ground Finch

Indefatigable, James, and Narborough islands.

This species was common on Indefatigable and James, and was seen by Mr. Beck on Narborough, although not taken. The birds on Indefatigable are smaller than those of James, but, like them, were found almost entirely in the humid zone.

They were first found on Indefatigable, inland from Academy Bay on the south coast, in the first half of November. There they were found commonly in the thickly vegetated region of the lower humid belt, usually feeding on the ground under bushes, often in flocks. More than once we shot at one, mistaking it for a rail, so skulking were its habits.

When visiting Academy Bay again in January, they were noted as fairly common from the junction of the arid and humid zones up. They seemed to be lower down on this visit than on the last. I saw one near the beach.

At the time of our third visit in the middle of July they were found in the arid region below 75 feet elevation. I did not visit the humid belt during our stay, so cannot say if they were there also. They did not seem to be common in the arid region. They were found, as formerly in the humid belt, under bushes, digging vigorously in the grass and dry leaves.

On northwest Indefatigable, about 10 or 12 days later, I saw three in the tufaceous arid region near the coast, while Mr. Beck took three or four some miles inland.

Mr. Beck stated that he found this species in the high, humid, thickly vegetated country on the south slope of Narborough. On April 4 he took a nest containing three fresh eggs on the top of the mountain. The parents were seen but not taken. The nest was of dry and green grass with some moss, and was placed in a small cactus at an elevation of five feet from the ground.

The James Island birds are larger than those of Indefatigable, but, like them, are ground finches in the strictest sense of the word. They were found commonly in the green zone at 1500 feet elevation in the James Bay region. A few were noted at an altitude of 2100 feet. This was in December and January. The specimens taken showed no particular enlargement of the reproductive organs. They were found singly and in flocks feeding on the ground under the brush, and doing considerable scratching. The largest flock (say of 20 or 30 birds) we came across was on a rather steep hillside. During our visit to James Bay in August Mr. Beck took several in the lower part of the humid zone. None were found in the rough arid northeastern portion of the island, visited early in

August, nor in the island of vegetation on the south side, to which we made a trip in December from Jervis.

From what little was seen of this bird, it is strictly terrestrial and does not feed in the trees as do the other species. Of course, our experience with it was very limited compared to that with the Sooty and Sturdy Ground Finches and the Cactus Finch.

25. **Geospiza scandens**: Cactus Finch

Abingdon, Albemarle, Barrington, Bindloe, Champion, Charles, Chatham, Daphne, Duncan, Gardner-near-Charles, Indefatigable, James, Jervis, Onslow, and Seymour islands.

The Cactus Finch occurred more or less commonly on all of the above islands, excepting Daphne and Onslow. One was taken on the former island on November 23, another on July 25. The latter locality is a mere rock off the coast of Charles, on which one was seen February 25. On Duncan they were not common; however, one or two were noted almost every time we went inland. On the west end of Chatham they were also scarce, two being taken by Mr. Beck on February 23 and two more on July 7. Two were seen on the road near the beach at Wreck Bay on September 8 and 10 respectively. Only two were seen on Cowley Mountain, Albemarle, in August, and they were at an altitude of 2500 feet.

They were perhaps most common on Charles, where they were found both in the arid region and the humid; in the latter chiefly when the oranges were ripe. As a rule these birds were at home in the arid region, particularly where there was a good growth of cactus. The interior of Charles was the one exception. There their occurrence seemed to be governed by the abundance of ripe oranges. In early March, when very few ripe oranges were found, only two or three were noted in the interior. In May they were found commonly in a grove of trees bearing ripe fruit, while elsewhere in the interior they were scarce. This habit of coming into the humid belt to feed is evidently recently acquired and brought about by the introduction of oranges. On islands where oranges do not occur they were not found in the humid belt. On such islands their frequency of occurrence seemed nor-

mally to be in direct ratio with the supply of cactus. Quite often they were observed feeding on the ground.

As already indicated, the three main sources of food are the ground, the cacti, and the orange trees. Flocks of 20 to 30 birds of this species, often mixed with the Sturdy Ground Finch and the Sooty Ground Finch and sometimes accompanied by the Galapagos Dove, were seen feeding on the ground at various seasons. They also fed singly and in small numbers on the ground, both alone and with other species. On Duncan, in August, they were observed feeding on the ground, but in the preceding December they were seen only in cacti.

A cactus tree was the characteristic setting of this species, which feeds upon the soft moist pulp. On one occasion I noted several of this species and the Sooty Ground Finch feeding upon the pulp from the trunk of a fallen cactus tree. At Villamil, Albemarle, a few were remarked as feeding on low bushes as well as on cacti, and some were seen on banana trees. Cactus blossoms were much relished, and birds were commonly observed feeding on the flowers. Several were seen with pollen-covered beaks. A bird, taken on the south side of James on December 19, had its gullet filled with a yellow fluid, apparently extracted from cactus blossoms.

Oranges seemed to be much relished, the birds eating the ripe and overripe fruit on the trees. They dig a hole in the top and then pick the pulp out, often leaving nothing but the bare rind. They also eat figs and tropical plums, both fruits having been introduced on Charles. It would seem that the coming of man has been a benefit to this species, owing to its fondness for fruit.

At Villamil, Albemarle, in August, I saw one in company with a Sooty Ground Finch feeding on the skull of a bull recently killed. None of this species was observed at springs. They do not seem to frequent them as do some of the other finches. Probably they obtain sufficient moisture from cacti and oranges.

On March 1, at Black Beach Roads, Charles, I saw the black males of this species and the Sturdy Ground Finch singing with wings partially spread and drooping as our English Sparrows do. No nests and eggs of this species were satis-

factorily identified. The breeding season on Charles seemed to be in March, birds being noticeably scarcer then.

The condition of the reproductive organs was noted as follows:

November 6; south Indefatigable; not much enlargement.
November 21; South Seymour; showed some enlargement.
December 19; south James; the few taken showed no enlargement of the organs of reproduction, while two males taken on Jervis the day before had very large testes.
May 14, 15; Charles; organs reduced in size.

On January 12 two young, about a week from the nest, were taken near Academy Bay, Indefatigable. The following day two more of about the same age were taken. On January 18 I obtained two in the same locality; they were but shortly from the nest. One of the young-of-the-year was taken on March 12 in the brush near the coast about 10 miles west of Villamil, Albemarle. Three days later, in the vicinity of Cape Rose, on the same island, several were seen close to the sea. In latter May, at Black Beach Roads, Charles, considerable numbers of this species were seen, but few were adult.

That individuals of this species also leave the land at times is testified by the fact that on the morning of May 18, when about 20 miles south of Indefatigable, an immature one came aboard. A *Dendræca petechia* also visited us.

This species was never noted bathing. It seems to have little or no competition as regards food. It is about as tame as the other finches. None was noted with diseased feet. Mr. Beck took a partial albino at Black Beach Roads, Charles, on June 4. It had several white primaries and rectrices and a number of white patches on its body. During our sojourn on Jervis on December 18 most of the birds seen were black males.

26. **Geospiza septentrionalis:** Northern Cactus Finch

Culpepper and Wenman islands.

These birds were abundant and very bold on both islands. On the former they were taken on the landslide on the north side, this being the only accessible portion of the island, which is practically an elevated table land with precipices on all sides.

Wenman is also very rugged and steep, but can be pretty well explored. The following observations were made entirely on that island, which was visited on September 24. Culpepper was visited the following day.

When we landed, a dozen of these interesting little birds and a pair of mockingbirds were peering over a ledge at us within a couple of feet of our heads, exhibiting great curiosity.

A number of nests of the usual *Geospiza* type were seen in the bushes, but no eggs or nestlings were found. Several birds were heard singing and one was observed carrying a bit of grass in its bill. Three males I skinned had very large testes. I shot four young which had been out of the nest but a few days. Black individuals were not common.

Whenever I shot a bird several others would gather about it and pick at the blood. I saw some feeding on cactus, some on leaves, like the Sooty Ground Finches, but the great majority were feeding on the ground, where they scratch and dig quite vigorously.

This species was the most fearless and least suspicious of all of the finches of the archipelago, for, instead of leaving when one of their number was shot, they came about all the thicker to see what the trouble was.

So far as known there are no introduced or indigenous mammalia to bother them on either Wenman or Culpepper; nor are hawks known. The Galapagos Short-eared Owl, however, is reported from Culpepper.

27. **Pinaroloxias inornata**: COCOS ISLAND FINCH

This species combines the habits of a ground-feeding finch with those of a tree-feeding warbler. It was found commonly in September, 1905, everywhere we went on Cocos Island, Costa Rica, being equally adapted to both cultivated ground and virgin forest. It made itself at home in and about the houses of the settlement at Wafer Bay.

Much of its food was obtained by hanging head downward from twigs and leaves. Some individuals which we caged on board the schooner lived on bird seed and bread. I saw one bathe in the drinking cup.

The only call heard was a sort of chirp, in spite of the fact that the nuptial season was on, as attested by the testes of all the adult males skinned. One day I saw an adult male fall to the ground from the branch of a bush. Upon approaching him he jumped up to a branch, where he hopped about with his wings spread and fluttering and his head and neck stretched forward, apparently indulging in a form of courtship, although I could not see the object of his affections.

House cats run wild seem to be the chief enemies that beset this and other species of Cocos birds.

Mr. Beck saw on two or three occasions nests which he thinks belonged to the Cocos Island Finch. These were well out on slender limbs 20 or 30 feet above the ground. They were similar to *Geospiza* nests in shape and construction, though of finer material. In one there were three broken eggs, red-spotted and about the size of the eggs of the smallest form of *Geospiza fuliginosa.*

28. **Platyspiza crassirostris:** Darwin's Tree Finch

Abingdon, Albemarle, Bindloe, Charles, Chatham, Duncan, Indefatigable, James, Jervis, and Narborough islands.

Darwin's Tree Finch was fairly common on the 10 islands named above, being found chiefly in the moist and upper dry regions, and in sandy coastal localities, where the "poison-fruit trees" *(Hippomane mancinella)* grow. It was not found in flocks as were the ground finches. In November, on south Indefatigable, it was found in the humid belt up to an elevation of 700 feet. In January one was seen at 1000 feet. In the region back of Black Beach Roads, Charles, in February and March, it was seen only above 1000 feet elevation. On southeast Albemarle it was encountered in August in the grassy treeless region above the village of Santo Tomas. None was seen in the dense thicket of brake ferns that crowns the summit of Abingdon, but below, in the humid belt, they were not uncommon. They were found in the vegetation about most springs and water holes, both in the interior and on the coast. However, none was observed at the water hole south of Tagus Cove, Albemarle, which was in the bare rock at the edge of the ocean.

Like the other tree finches, they live in the trees and bushes most of the time. There their strong legs and toes stand them in good stead in making long reaches for berries and in hanging head downwards. The only flights they make are from tree to tree. None of the tree finches were met with at sea as were occasional ground finches.

Their food, judging from observations in life, seems to consist of vegetable matter, while the other tree finches often eat insects. An examination of the stomachs of this species may prove that it is also an insect feeder. It feeds in the trees and bushes as do the other species, but usually eats berries, blossoms, green leaves, etc. On James, in December, several were seen feeding in a tree with red flowers *(Erythrina velutina)* in company with Pallid and Black-headed Tree Finches and some small black ground finches. Early in January, in the same region, I saw a dozen or more in one tree at about the same altitude, 1500 feet. In March they were seen feeding on the blossoms of bushes, occasionally hanging head downwards. In the coastal region west of Villamil, Albemarle, in April, a good many were seen in the "poison-fruit trees" growing about the fresh water holes and salt lagoons. On May 29 several were noted feeding on green tropical plums on the trees on Charles, in company with the Black-headed and Small-billed Tree Finches and the Sooty and Sturdy Ground Finches. In July a few were observed feeding on the blossoms of the sisal hemp on Chatham. On Abingdon, in September, they were feeding chiefly on green leaves, biting off small pieces here and there, although one was noted picking some very small berries from a shrub.

On one or two days when these birds were not seen their presence was made known by their song, which is like that of the Red-winged Blackbird *(Agelaius phœniceus)*. This song was heard on Indefatigable in January; on Chatham in January, February, and September; on Charles in February; on south Albemarle in March; and on Banks Bay Mountain, Albemarle, in April. On south Albemarle in April none were heard. In most cases where the songsters were seen they were black-headed males. On south Abingdon, in September, birds (many not black-headed) were singing a short song

while feeding. It could not be heard at any distance, being a *tweet* and then a prolonged *twür*.

Birds with large sexual organs were noted on November 3 at Villamil, Albemarle; on February 8 at Basso Point, Chatham; and on March 13, ten miles west of Villamil, Albemarle. Specimens taken on Charles on May 14 and 15 had sexual organs much reduced in size.

Nests and eggs were found as follows:

Mr. Beck took a nest, containing four eggs incubated four days, on February 23, in the Wreck Bay region, Chatham. The female was flushed from the nest which was of the domed form common to all Galapagos finches. It had a large entrance and was composed of dry grass, weed stems, and orchilla moss. The depression in which the eggs were laid was only slight.

Mr. Beck took a second nest of this species on the same day and in the same locality. It contained four eggs incubated three days. The nest was 18 feet from the ground in a tree, and was composed of small twigs, grass, and weed stems, and a large amount of orchilla moss.

Above 1900 feet elevation on Banks Bay Mountain, Albemarle, April 14, this species was the only finch seen. At 1900 feet I took a nest from the crotch of a croton bush. It was about 10 feet from the ground and contained three fresh eggs. It was large and made of grass, lined with fine grass. The parents stayed very close, making a clicking noise.

A young bird fresh from the nest was taken on March 15, on the edge of a mangrose swamp near Cape Rose, Albemarle. Many of the birds seen on Banks Bay Mountain on April 14 were young birds.

This species did not associate regularly with other species. The cases observed appeared to be accidental. As it seemed to live on vegetable matter, it did not appear as though it had much competition with other species, the food supply being unlimited.

These tree finches were quite tame, although not as tame as were the flycatchers. In one case one was very inquisitive, flying to within a couple of feet of my face, and acting somewhat like a Galapagos Flycatcher. At another time one alighted in a tree above me, then flew down within two feet of me to make a critical examination, singing all the time.

This species, along with other passerine birds on Chatham, had diseased feet, the disease manifesting itself by large rounded swellings on toes, tarsi, and at the junction of the tarsi and the tibiæ. Birds in the vicinity of Basso Point, as well as those at Wreck Bay, were affected.

Black-headed males were not uncommon, except on Chatham, where only one was taken, and that in January. This case is nearly parallel to that of the Black-headed Tree Finch on that island.

29. Camarhynchus psittaculus: Parrot Tree Finch

Barrington, Charles, Chatham, Duncan, Indefatigable, James, and Jervis islands.

The Parrot Tree Finch was apparently one of the rarest of the finches of the Galapagos Islands, being found very sparingly on the above islands, chiefly on Indefatigable and James.

They were found in the arid regions of all the islands mentioned except Chatham, and also in the humid regions of Charles, Indefatigable, and James. One was taken in the north crater of Duncan at an elevation of 450 feet. On the same day, August 15, 1906, three others were taken on a ridge at about 1000 feet altitude on the south side of the island. One was seen in the arid region of northeast James, as well as in that back of James Bay.

Like the other finches of the genus they lived up to their name of tree finch, being observed with one exception to feed in the trees and bushes, often hanging head downwards in the search of some dainty morsel. Never more than one or two were seen at a time, nor were they ever seen in company with other species. One was seen at about 375 feet elevation on south Indefatigable, feeding on heliotrope blossoms, when suddenly a mockingbird swooped at it and drove it away. The exception to the rule of feeding in trees and bushes was noted in the upper part of the arid region inland from Academy Bay, Indefatigable. There a bird was seen beside a fallen, rotten log, scratching the dirt away very vigorously.

Four or five were seen in July, about the freshwater hole at the beach at Academy Bay. Although rare, these birds were always very tame like the other finches.

Three black-headed males were taken in the humid zone of James on December 22 and one on Jervis on the preceding day. With the Jervis male was also taken a female. Birds taken on James in early January showed enlargement of the sexual organs. Mr. Beck took a large-billed, black-headed male at Academy Bay, Indefatigable, on July 17.

30. **Camarhynchus habeli:** Habel's Tree Finch

Abingdon and Bindloe islands.

This species was found equally as common on Bindloe as on Abingdon. We visited both of these islands in September.

Nineteen were taken on northwest Bindloe on the seventeenth. The following morning Mr. Beck spent an hour ashore and secured six. They were all taken in the arid region, as there is really no humid belt on this island.

On the south side of Abingdon they were found in both the arid and humid regions. One was taken just below the dense growth of ferns capping the summit of the island, which was enveloped in fog during the five days of our stay.

Like the other tree finches, this species feeds in the trees and bushes, being seen in the dry brush in the arid region.

On September 21 Mr. Hunter took a female with an egg almost ready to be laid. On the same day I took about 10 young birds. Of the 25 specimens taken on Bindloe, six were black-headed. I noticed but one black-headed one on Abingdon.

This species proved as tame as the majority of finches of the islands.

It fed singly and not in flocks as did the majority of the ground finches.

31. **Camarhynchus affinis:** Allied Tree Finch

Geospiza incerta, Rothschild & Hartert, Nov. Zool., v. 6, p. 168; v. 9, p. 401; Snodgrass & Heller, Proc. Wash. Acad. Sci., v. 5, p. 289.

Albemarle, Duncan, James, and Narborough islands.

The Allied Tree Finch was not found commonly on any of the above islands except at Iguana Cove, Albemarle, where 27 were taken in the humid region on March 19 and 20. We

did not meet with it on Narborough. On James two were taken and on Duncan one.

The one shot on Duncan on August 15, was found on the floor of the north crater, the elevation of which is about 450 feet. The floor is paved with reddish earth, which supports a rather scanty growth of bushes and shrubs, and is strictly in the arid belt.

The two taken on James, December 28, were found in the humid or semi-humid region.

Albemarle was the stronghold of this species, it being found on all of the five great mountains. On southeast Albemarle the first specimen was taken in the humid region below Santo Tomas in March. Later in the year, August 27-30, one or two were seen in the once-cleared fields just below the village. On the 15th of March, in the arid region three or four miles west of Cape Rose, Mr. Beck saw one and on April 26, in the dry coastal region a few miles west of Villamil, an example was secured.

Only one was seen on Tagus Cove Mountain, Albemarle, and that was in latter March, the bird being observed in a large thick-foliaged tree at 1500 feet elevation on the west side of the mountain.

Three or four were taken on the east side of Cowley Mountain, Albemarle, above 1200 and below 2500 feet elevation in the middle of August.

Several immature ones were shot at the western base of Banks Bay Mountain, Albemarle, in the middle of April, and one adult was also taken at about 1500 feet elevation.

They move about in the same manner that the Black-headed Tree Finch does, flying from tree to tree and bush to bush in search of food, which they hunt singly, a trait apparently constant with but few exceptions to all the tree finches. One bird seen feeding on a tree on Cowley Mountain had several chrysalides of a small species of moth in its gullet.

A few birds were in song at Iguana Cove on March 19 and 20.

Only one black-headed bird was taken and that was on Cowley Mountain on August 10 and 11. A bird having a slight tendency toward a black head was taken at Iguana Cove in March. One-third of the birds taken there on March 19 and

20 were young ones, some in striped plumage. The adults had only medium-sized reproductive organs at that time.

32. **Camarhynchus pauper**: Small-billed Tree Finch

Charles Island.

With the exception of three birds taken in the arid region in the vicinity of Cormorant Bay, two in October, one in May, and two taken near the beach at Black Beach Roads, on May 26, all of the specimens were seen above 1000 feet elevation in the country tapped by the old wagon road back of Black Beach Roads. It was not a common bird compared to the Sooty Ground Finch or the Sturdy Ground Finch. About 100 specimens were taken, nearly all from the interior basin of the island, only one or two being taken below the divide on the western slope. The interior region of Charles is in the humid belt, possessing two perpetual springs, the great rendezvous of the small land birds. The greater part of this region is overrun by lemon and orange trees, although here and there are patches of strictly native vegetation, in which are seen small *Scalesia*.

Like all of the Tree Finches, this species is very agile in getting about trees and bushes after food, and like others of the genus, often hangs head downwards. We found that they feed almost entirely in the orange trees, which are introduced, eating the pulp of the fruit. They were shot with their gullets full of it. One or two I took in *Scalesia* trees. Near the shore at Black Beach Roads, two were seen feeding in thorn bushes and hanging head downwards at times. One was seen in a tropical plum tree. On June 1, on the west slope of the island, one was seen eating the red berries of a *Bursera* tree, and at still another time one was noted feeding in some mistletoe growing on a *Scalesia*. One individual was seen feeding in a small shrub by the roadside and another on an orange on the ground.

Their song is very distinctive, being readily distinguished from that of the Black-headed Tree Finch, as well as from those of the other finches. In early March they were heard singing, while in latter May all song had ceased. They usually fed singly and in company with no other species. Cats and rats are probably their only introduced natural enemies.

33. **Camarhynchus prosthemelas**: Black-headed Tree Finch

Abingdon, Albemarle, Barrington, Champion, Charles, Chatham, Cowley, Duncan, Gardner-near-Charles, Indefatigable, James, Jervis, Narborough, Seymour, and Wenman islands.

This, the smallest of the tree finches, has its strongholds on Albemarle, Charles, Chatham, Indefatigable, and James. On the other islands it was not found to be common. It was not seen in flocks as were the ground finches. Abingdon and Wenman are islands from which it has not been previously reported. Whether the birds found there were rare residents or accidental visitants is an open question. No tree finch was encountered at sea. On south Abingdon on September 19, one was taken and two others were seen; on the following day another was taken. Four were taken on Wenman on September 24. Three or four other species, which were known only from islands to the southward, were also secured. On the west side of Tagus Cove Mountain, Albemarle, this species and the Sooty Ground Finch seemed to be the commonest finches.

They were found from the seashore to the mountain tops, in the arid region, in the region intermediate between the arid and the humid, in the forested humid region, and in the grassy region of the higher mountains. They were found in the arid regions of all the islands except Abingdon and Narborough. On the latter we saw none. They were found in the zone intermediate between the arid and the humid, and in the forested humid regions of all the islands named above that are of sufficient height to have such a region. On southeast Albemarle they were found about the scattered heliotrope bushes growing in the grassy, treeless country above Santo Tomas. They were found about the lagoons and shores of some of the larger islands. They were common about the spring in the interior of Charles in October. This spring was the great rendezvous of finches and doves in the dry season. On south Indefatigable in January, they were seen up to about 700 feet elevation.

Their numbers, of course, varied from day to day, but they were found in most cases to be commonest in the transition and humid regions, rather than in the arid. Two were taken in the mangroves on south Indefatigable and one was also seen feeding on the ocean beach proper. They were even seen on the

extremely barren and sterile coast of northeast Indefatigable, where vegetation is very sparse and the mountains are miles away. On the east side of Cowley Mountain, Albemarle, they were found only above 1200 feet in the arid region; only three or four were seen.

Like all of the other species of tree finches this little bird haunts the trees and bushes, feeding on seeds, leaves, buds, etc., often hanging head downwards in the quest. In December, in a canyon in the arid region just back of the lagoons at James Bay, James, I saw two eating the green leaves of a thorny tree. Occasionally on other islands they were seen eating leaves of trees and bushes. On the mountain above Iguana Cove, Albemarle, in March, they were observed tearing bits of bark from trees, mostly Compositæ, with their bills, apparently searching for food. One was seen feeding on a cactus on Charles. On Chatham, in July, individuals were seen twisting little pieces of bark off of trees. A bird would take hold of a piece with its bill and then twist and pull. On Charles they were noted eating green tropical plums on the trees, as well as feeding in the *Scalesia* and lemon trees.

They were heard singing on Chatham in January and February, on southwest Albemarle and at Tagus Cove, Albemarle, in March, and at Banks Bay, Albemarle, in April. In May, on Charles none were heard singing.

The condition of the sexual organs were noted as follows:

November 3; Villamil, Albemarle; large.
January 25; Wreck Bay, Chatham; very large.
January 26; Wreck Bay, Chatham; one in worn plumage with large sexual organs.
January 29; Wreck Bay, Chatham; large.
February 8; Basso Point, Chatham; large.
February 23; Wreck Bay, Chatham; large.
March 13; south Albemarle; large.
March 15; south Albemarle; large.
March 19 and 20; Iguana Cove, Albemarle; medium-sized.
May 14 and 15; Black Beach Roads, Charles; small.

The nests were about the size of those of the Sooty Ground Finch, and like those of all Galapagos finches, were domed, with entrances on the sides. This species also nested in the wet season as may be seen by the dates given below. About the middle of January, at Academy Bay, Indefatigable, I saw

a male building a nest of moss about 20 feet above the ground in the crotch of a *Scalesia* tree in the humid region. On Chatham in latter January, I saw one carrying cotton for a nest. At this time it rained a great deal, the wagon road being like a river on the slopes of the hills, and ponds being abundant. In early February, at Basso Point, on the same island, I saw one carrying straw crosswise in its beak. About a quarter of a mile inland from Black Beach Roads, Charles, at an elevation of 150 feet, two pair were found nesting, both in *Bursera* trees. One nest, which was just being built, was composed chiefly of lichen; the other was of dried grass and contained one fresh egg. The males in these two cases were not black-headed. On south Albemarle on March 12, a bird was seen gathering cotton in its beak.

The nests were usually well-made and composed of grass blades and grass stems, orchilla moss or lichen, and cotton balls. Cotton balls and soft dry grass were usually used as a lining. The nests were found in trees and bushes (*Bursera, Scalesia,* lemon, thorn bushes) all the way from five feet to 20 feet from the ground, the majority being found at about 12 feet, sometimes in a crotch and at other times out towards the end of a limb.

Eggs were found as follows:

January 27; Wreck Bay, Chatham; three fresh.
January 29; Wreck Bay, Chatham; three fresh.
February 8; Basso Point, Chatham; one fresh.
February 8; Basso Point, Chatham; one fresh.
February 13; Isthmus of Chatham; three incubated five days.
March 1; Black Beach Roads, Charles; one fresh.
March 2; Black Beach Roads, Charles; two fresh.
March 2; Black Beach Roads, Charles; three, incubated six days.
March 2; Black Beach Roads, Charles, four fresh.

Three partly fledged young were taken from a nest at an altitude of about 750 feet in the Wreck Bay region, Chatham, on February 23. The nest was about 15 feet from the ground in the top of a small *Scalesia* tree; it was domed, about five inches in diameter, and made of grass. The parents flew excitedly back and forth in front of me, while I was examining the nest. On the 28th of February, another nest containing three slightly-fledged young was found about 20 feet above the ground in the top of a *Scalesia* tree.

On May 16, about a quarter of a mile inland from Black Beach Roads, Charles, I saw a black-headed male feeding a young one. On the 24th another black-headed male was seen feeding a young one sitting on a stick about a foot from the ground.

All of the other tree finches and some of the ground finches, also the warblers, might be considered as competitors, but the food supply is apparently abundant. As a rule the Black-headed Tree Finches fed alone. Once in the arid region of southeast Indefatigable I saw a Black-headed Tree Finch feeding on a bush in company with two Sooty Ground Finches. At another time on Charles they were seen feeding in tropical plum trees with Darwin's Tree Finch, Small-billed Tree Finch, Sooty Ground Finch, and Sturdy Ground Finch. None of these finches are very tenacious of life.

On Chatham, this species, like the majority of the passerine species with the exception of the flycatchers, was afflicted with diseased feet, these often having large rough swellings on them. Specimens from Basso Point were diseased as well as those from Wreck Bay. On Chatham, Charles, and Albemarle, the natural enemies of this species, aside from those indigenous to the islands, are cats, and to a much less degree, rats.

34. **Camarhynchus pallidus**: Pallid Tree Finch

Geospiza heliobates, Snodgrass & Heller, Proc. Wash. Acad. Sci., v. 5, pp. 279-284; Rothschild & Hartert, Nov. Zool., v. 9, p. 400.

Albemarle, Charles, Chatham, Duncan, Indefatigable, James, Jervis, Narborough, and Seymour islands.

This tree finch occurs fairly commonly on all parts of Albemarle, Indefatigable, and James, and sparingly on the other islands. One was taken inland from Black Beach Roads, Charles, on October 11, 1905. One was taken on Duncan in December, 1905, and several in August, 1906. Those taken in August were found as follows: one on northeast side of island, one on ridge on south side at 1000 feet elevation, and five on the floor of the north crater, which is about 450 feet above sea level and consists of reddish earth scantily clothed with vegetation and surrounded by rocky walls 300 or 400 feet in height.

Two or three were taken on Jervis in December, 1905. On Chatham, in the Wreck Bay region, five were taken in latter January, 1906, a young one just from the nest on February 23, 1906, and two on September 10, 1906. In April, 1906, Mr. Beck reported seeing them in the humid region high up on the south side of Narborough. On July 26, 1906, one was taken in a small tree near the beach at the anchorage on the western side of South Seymour Island.

This species was found from the ocean shore through the various life zones to the grassy humid belt of the higher mountains. On Albemarle, Duncan, Indefatigable, James, Jervis, and Seymour they were seen in the arid region. On Charles the only specimen taken was shot in the interior humid region. On Chatham they were taken in the humid zone just below the sugar plantations and in the region intermediate between the humid and the arid.

During our stay on the southeast side of Indefatigable, opposite Barrington, in October, two were taken, one about three miles inland in the arid region, the other in some green shrubbery growing along the beach. While at Academy Bay in November, a few were seen up to 525 feet elevation, one being observed in the brush in the arid region at about 100 feet elevation, a few in the region where the arid and humid zones meet, and a few in the humid zone. During our stay there in the middle of January, two or three were seen on the 12th in the moist region, while on the 17th one was noted at about 1000 feet elevation, high in the moist region. On the 20th one was observed at a water hole near the beach. On July 11 and 12, two were taken close to the same water hole, while on the 17th Mr. Beck took one a short distance inland in the arid region. On northwest Indefatigable, opposite Duncan, one was shot in a tree near the beach on July 21.

On southeast Albemarle in March, August, and November, they were found in the "poison-fruit trees" (*Hippomane mancinella*) and mangroves bordering the lagoons near the ocean shore. They were also observed in the forested humid region below the plantation of Santo Tomas in the mountains. They were fairly common in the open, treeless country above Santo Tomas, occurring mostly in the scattered shrubs and bushes. Mr. Hunter shot more than 30 in one forenoon in

the latter part of August. On the 19th of March, 23 were taken on the mountain above Iguana Cove, Albemarle, where the humid zone comes down to the seashore. Most of the birds were taken at 200 or 300 feet elevation, however. On the 20th I saw only five or six. On March 26 a male was taken at 3000 feet elevation on the west side of Tagus Cove Mountain, Albemarle, where there is no true moist region. Cactus and other arid-region plants occur to within 100 feet of the summit (about 4000 feet), which, at the place we climbed, was crowned with tall, coarse grass, higher than our heads. On the 31st an individual was observed feeding in a large tree at 1500 feet elevation. None were seen in the mangrove swamps on the shores of Banks Bay, Albemarle. On the Banks Bay Mountain, however, an adult was taken at an altitude of 1900 feet on April 14, while one or two immature ones were seen at the base of the mountain. One or two individuals were also seen in a small flat valley between the main mountain and a small recent volcano near its base. On the east side of Cowley Mountain, Albemarle, a region of scanty vegetation and of pumice-stone soil, a dozen were taken on August 10 and 11, above 1200 feet elevation, which is well within the arid region.

In the arid region of James, on an island of vegetation cut off from the nearest plant life by several miles of fresh lava and cinders and bordered by the ocean on the south, one was taken on December 19. In the humid region behind James Bay, James, several were taken in latter December and early January. One was feeding on an *Erythrina* tree with red flowers, in company with Darwin's Tree Finch, Black-headed Tree Finch, and some small black ground finches, probably the Sooty Ground Finch. Two were taken on August 8, at the lower edge of the moist zone. On August 6 a striped individual was taken in the green bushes bordering the lagoon behind the beach at James Bay. On August 1, an individual was taken in the rough, arid region of northeast James, lying northwest of Sullivan Bay and Bartholomew Island.

These birds, in common with all of the tree finches, were never observed to take any extended flights, but were seen flying from bush to bush and tree to tree, where they seem to

find their food almost entirely. They were quite lively birds, jumping from limb to limb, and often hanging head downwards while searching for food.

In the humid region on south Indefatigable they were found to feed as a rule high up in the branches of the large *Scalesia* trees, which there grew to a height of 30 to 40 feet. One was seen in the humid region examining thoroughly a rotten tree trunk lying on the ground. On Chatham and southeast Albemarle they were also seen feeding head downwards in the trees in the moist zone. On southeast Albemarle they were frequently seen feeding in the mangroves, and chiefly in the "poison-fruit trees", in the coastal region. At 1900 feet altitude on Banks Bay Mountain, Albemarle, I saw an adult feeding in a tree of the family Compositæ. On Cowley Mountain, Albemarle, *Scalesia* trees appeared to be their favorite feeding places.

In the arid region 10 miles west of Villamil, Albemarle, I one day watched a bird feeding in a leafless, dead tree. It was apparently searching for insects, for it inspected every hole carefully. Finally it found one too deep for its bill. It then flew to a neighboring tree and broke off a small twig, about half an inch in length. Returning to the hole, the bird inserted the little stick as a probe, holding it lengthwise in its bill. It proceeded to examine other holes by the same method. Mr. Beck and Mr. King said they had noted similar instances elsewhere.

At Academy Bay, Indefatigable, one was taken while it was working over a rotten cactus limb. About Iguana Cove, Albemarle, they were feeding in the trees and bushes. On July 26, on South Seymour, one was noted picking the bark off a small tree, which grew near the beach, and eating small red eggs, probably spiders', which abounded beneath it.

They were heard singing in the "poison-fruit trees" near Villamil, Albemarle, on November 1. On March 12, in the mangroves about 10 miles to the westward of Villamil, several birds which had nests were singing. On March 19 and 20 some of the birds above Iguana Cove, Albemarle, were singing.

The condition of the reproductive organs was noted as follows:

November 1; Villamil, Albemarle; testes enlarged.
January 2-4; James Bay, James; two with enlarged sexual organs.
March 13; ten miles west of Villamil, Albemarle; large reproductive organs.
March 19 and 20; Iguana Cove, Albemarle; medium-sized reproductive organs.

A female, whose feathers showed signs of nesting, was taken on Chatham on January 29, but no nests were found. Nests were found as follows:

On March 10, in a clump of "poison-fruit trees" close to the lagoon and to the road leading inland from Villamil, Albemarle, two nests were found, one being new and unusued, the other containing two partly-fledged young. Both nests were about 10 feet from the ground, quite spherical, and made of coarse grass, with the opening on the side, as is the case with all the known nests of Galapagos finches. The parents made no disturbance when their nests were examined. On March 12, ten miles to the westward of Villamil, two nests were found in a mangrove swamp. One was about 20 feet from the ground and was unoccupied, being built in the same manner as the one seen on the 10th at Villamil. The second one was near the top of a tree about 40 feet high, and was inaccessible. A bird was seen going in and out of it.

During our stay at Iguana Cove, Albemarle, in March one was noted carrying nesting material in its bill.

Young and immature birds were seen as follows:

March 12; south Albemarle; one immature male taken.
March 19; Iguana Cove, Albemarle; of the 23 specimens taken the majority were immature birds.
April 25; south Albemarle; mostly young birds in striped plumage; three adults.

Like all of the finches occurring in these islands this species proved quite tame. None of the finches, however, were as tame and fearless as the flycatchers and mockingbirds.

35. **Dolichonyx oryzivorus**: Bobolink

Charles, Chatham, and James islands.

On September 28, 1906, in latitude 7° 23′ North, longitude 97° 48′ West, a female came aboard during the forenoon. A

squally southwest wind prevailed at the time. The bird was shot, and on examination, the stomach was found to contain a small amount of brownish fluid.

The second bird, in yellow plumage, came aboard on October 3 in latitude 14° 24′ North, longitude 106° 42′ West, during a strong squally southwest blow accompanied by rain. This bird was not captured. It took flight from the stern of the vessel, and in doing so was caught in the downward draught from the mainsail and blown into the water, but recovered itself immediately and flew away.

August 2, 1905, in latitude 12° 2′ North, longitude 109° 11′ West, a female American Redstart (*Setophaga ruticilla*) alighted on the schooner in the evening and was taken. The weather was squally and rainy that day.

The three above positions range from about 300 to 500 miles from the nearest point on the Mexican or Central American mainland.

While sailing slowly southward about 75 miles west of northern Baja California on July 9, 1905, two Mourning Doves (*Zenaidura carolinensis*) alighted on the vessel in the morning and remained aboard all day. The sky was overcast and a gentle wind was blowing from the land.

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XIV

THE ANTS OF THE GALAPAGOS ISLANDS[1]

BY

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Since the memorable voyage of the "Beagle" in 1835, more than a dozen biological expeditions have explored the Galapagos Islands, but none of the collectors, with a single exception, has bestowed more than the most casual attention on the ants, so that our knowledge of these insects and their distribution has been too fragmentary to have any weight in the famous controversy concerning the origin of the archipelago and its fauna. In 1877 Frederick Smith[2] described three species of *Camponotus* from Charles Island, two (*C. planus* and *macilentus*) taken by Darwin on the voyage of the "Beagle" and one (*C. senex*) taken by Cookson on the voyage

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 137.

[2] *Smith, Frederick.* Hymenoptera and Diptera in "Account of the Zoological Collection made during the visit of H. M. S. 'Peterel' to the Galapagos Islands." Proc. Zool. Soc. 1877, pp. 82-84.

of the "Peterel" in 1875. Concerning the ants taken by the "Albatross" expedition of 1888, Howard[3] in 1890, makes only the following statement: "dark-colored species of the genus *Camponotus* was collected, one male from Albemarle Island, numerous males and two females from Charles Island. Of a light-colored species of the same genus seven males were taken on Charles Island and one on Albemarle Island." These were, without doubt, the sexual forms of Smith's *C. planus* and *macilentus*. In 1893 Emery[4] recorded the following species which he had received from Dr. George Baur, who made an expedition to the islands in 1891 in a sloop chartered in Guyaquil: *Solenopsis geminata* Fabr., *Tetramorium guineënse* Fabr., *Tapinoma melanocephalum* Fabr., *Odontomachus bauri* Emery, and *Camponotus peregrinus* Emery. All these forms were taken at Chatham Island, and all, except the first, were found on the ship, so that two of them, *Tetramorium guineënse* and *Tapinoma melanocephalum*, may have had their nests in the woodwork and may have come from Guyaquil. The *Camponotus peregrinus* can hardly be more than a variety of Smith's *planus*. Emery also mentions the receipt of five males of the genus *Camponotus* taken on one of the "Albatross" voyages: "One of them is black and comes from Albemarle and Charles islands, the other, of a testaceous color, with very pale legs, is represented by two specimens from Charles." These seem to be part of the two series mentioned by Howard, i. e., specimens of C. *planus* and *macilentus*. Since the publication of Emery's paper no additions have been made to the seven or eight forms recorded from the archipelago. I was much interested, therefore, to learn from Dr. F. X. Williams, that he had collected a number of ants while he was a member of the California Academy of Sciences Expedition (Voyage of the "Academy") in 1905 to 1906. Through the kindness of Dr. E. C. Van Dyke the specimens were loaned me for study. Dr. Williams also informed me that some ants had been taken by the Hopkins-Stanford Expedition to the Galapagos (Voyage of the "Julia E. Whalen") in 1898 to 1899,

[3] *Howard, L. O.* Scientific Results of Explorations by the U. S. Fish Commission Steamer Albatross. V. Annotated Catalogue of the Insects Collected in 1887–1888. Proc. U. S. Nat. Mus. 12, 1889, pp. 185-207.

[4] *Emery, Carlo.* Notices sur Quelques Fourmis des Iles Galapagos. Ann. Soc. Ent. France, 63, 1893, pp. 89-92.

but correspondence with Prof. Vernon Kellogg revealed the fact that the specimens were no longer in the collections of Stanford University and that their whereabouts could not be ascertained. More recently the curators of the National Museum have generously loaned me the ants taken on some of the voyages of the "Albatross". Though in part poorly preserved, this material has been very useful in supplementing Dr. Williams's collection, which was made with great care and considerably increases our knowledge of the ant fauna of the archipelago.

As shown in the accompanying table, the Galapagos ants which I have studied, comprise 36 different forms, representing 18 species, 10 genera and four of the five subfamilies of *Formicidæ*. Significantly the subfamily *Dorylinæ* is not represented. None of the genera is peculiar to the islands. Six

Names of Species, Subspecies and Varieties	Narborough	Albemarle	Duncan	Charles	Hood	Chatham	Barrington	Indefatigable	James	Tower	Bindloe	Abingdon
Cylindromyrmex striatus Mayr								X				
Odontomachus bauri Emery				X		X						
Pheidole williamsi Wheeler								X				
Pheidole sp		X										
Monomorium pharaonis L.								X				X
Solenopsis sævissima F. Smith								X				
Solenopsis geminata Fabr						X						
Solenopsis galapageia Wheeler				X								
Solenopsis pacifica Wheeler		X								X		
Solenopsis rubida Wheeler					X							
Tetramorium guineense Fabr		X				X						
Tetramorium simillimum F. Smith				X								
Dorymyrmex albemarlensis Wheeler		X										
Tapinoma melanocephalum Fabr					X	X		X				
Prenolepis longicornis Latreille				X		X		X				
Prenolepis itinerans Forel									X			
Prenolepis nesiotis Wheeler				X								
Camponotus senex F. Smith				X								
Camponotus macilentus F. Smith									X			
Camponotus jacobensis Wheeler		X										
Camponotus albemarlensis Wheeler		X										
Camponotus vulcanalis Wheeler			X									
Camponotus duncanensis Wheeler	X				X							
Camponotus narboroensis Wheeler							X					
Camponotus hoodensis Wheeler											X	
Camponotus barringtonensis Wheeler										X		
Camponotus bindloensis Wheeler				X		X		X				
Camponotus macilentus var												
Camponotus planus F. Smith		X						X				
Camponotus peregrinus Emery							X					
Camponotus isabelensis Wheeler								X				
Camponotus indefessus Wheeler												
Camponotus santacruzensis Wheeler							X					
Camponotus fidelis Wheeler	X		X									
Camponotus fernandinensis Wheeler												
Camponotus pinzonensis Wheeler												
Number of forms on each island	2	7	2	7	3	6	2	8	2	2	1	1

of the species, *Monomorium pharaonis, Tetramorium guinēnse* and *simillimum, Tapinoma melanocephalum, Prenolepis longicornis* and *P. vividula itinerans,* are well-known tropical "tramps", evidently introduced by commerce within recent times. Not improbably three others, *Solenopsis geminata, S. sævissima* and *Camponotus senex,* have been similarly introduced. Only nine species, therefore, would seem to be clearly indigenous to the islands. All of these are distinctly neotropical in their affinities and all but three, or possible four of them, namely *Pheidole williamsi, Pheidole* species, *Camponotus macilentus* and *C. planus,* are either well-known species, widely distributed in tropical and subtropical portions of America, or merely subspecies or varieties of such forms. Nevertheless, if we consider the distinct forms, no fewer than 26, or 72.2%, of the 36 are endemic, and these forms would undoubtedly rank as true species if the same estimate were applied to the subspecies and varieties of ants as is applied by the ornithologists and mammalogists to their taxonomic categories. This high percentage of endemicity agrees with what has been observed in other groups of organisms. Stewart[5] cites 615 species of plants from the archipelago, with 252, or 40.9%, endemic. Among the birds, according to Ridgway[6], 13.04% of the 46 genera are endemic; among the Arachnida, according to Banks[7], 31, or 57.4% of the 54 species are endemic; among the Orthoptera, according to McNeill[8] and Snodgrass[9], and among the Coleoptera cited by Linell[10], the percentage of endemicity is also very high, although the authors do not give precise percentages.

Many writers have noticed closer affinities between the Galapagos and Central American or West Indian species than between those of the Galapagos and the western coast

[5] *Stewart, Alban.* A Botanical Survey of the Galapagos Islands. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906. II. Proc. Calif. Acad. Sci. (4) 1, 1911, pp. 7-288, 18 pls.

[6] *Ridgway, Robert.* Birds of the Galapagos Archipelago. Proc. U. S. Nat. Mus. 19, 1896, pp. 459-670, 2 pls.

[7] *Banks, Nathan.* Arachnida. Papers from the Hopkins-Stanford Galapagos Expedition 1898-1899, VII. Entomological Results (6). Proc. Wash. Acad. Sci. 4, 1902, pp. 49-86, 3 pls.

[8] *McNeill, Jerome.* Orthoptera. Papers from the Hopkins-Stanford Galapagos Expedition 1898-1899, IV. Entomological Results (4). Proc. Wash. Acad. Sci. 3, 1901, pp. 487-506, 10 figs.

[9] *Snodgrass, R. E.* Schistocerca, Sphingonotus and Halmenus. Papers from the Hopkins Stanford Galapagos Expedition. 1898-1899, VIII, Entomological Results (7). Proc. Wash. Acad. Sci. 4, 1902, pp. 411-455, 2 pls.

[10] *Linell, M. L.* On the Coleopterous Insects of the Galapagos Islands. Proc. U. S. Nat. Mus. 21, 1898, pp. 249-268.

of South America, but no such difference in affinities can be detected among the ants, because most of the neotropical species to which the Galapagos forms are most closely allied, are very widely distributed and because our knowledge of the ants of Ecuador, Peru and Chili is less complete than that of the ants of the West Indies, Central America and Brazil. I suspect that a similar dearth of knowledge of the western South American species of other groups may account for the high percentage of West Indian and Central American elements recorded by several authors as obtaining among the Galapagos organisms, as e. g., by Banks, who mentions only five of the 54 Galapagos spiders as being known from Western South America as compared with 14 from Central America, Colombia and the West Indies.

Special interest attaches to the two species of *Camponotus, macilentus* and *planus,* as each of them is represented by distinct varieties on each of several of the larger islands. In fact, Albemarle Island possesses two varieties of *macilentus* and Indefatigable Island two of *planus.* The distribution of the various forms is shown in the following table:

	Islands.	
macilentus, typical....	Charles.....	*planus,* typical
	Chatham.....	var. *peregrinus*
var. *narboroënsis*.....	Narborough...	var. *fernandinensis*
var. *albemarlensis*.....	Albemarle.....	var. *isabelensis*
var. *vulcanalis*.....		
var. *duncanensis*.....	Duncan.....	var. *pinzonensis*
	Indefatigable..	var. *indefessus*
		var. *santacruzensis*
var. *hoodensis*.....	Hood.....	
var. *barringtonensis*...	Barrington....	var. *fidelis*
var. *jacobensis*.....	James.....	
var. *bindloënsis*.....	Bindloe.....	
var.....	Tower.....	

Although a similar "harmonic" distribution has been observed in birds, reptiles and plants, the only group of invertebrates in which it has been recorded, is, to my knowledge, the Acridians. Snodgrass cites three species of

Schistocerca and two of *Sphingonotus,* each of which is represented by a recognizable subspecies or variety on each of several islands. The resemblance to the two species of *Camponotus* is further shown by the fact that *Schistocerca melanocera* is represented by two subspecies on Albemarle and that two forms of *Sphingonotus tetrancsiotis* occur on Barrington and two on Indefatigable.

On the whole, the ant-fauna of the Galapagos is decidedly poor for islands lying on the equator and possessed of an abundant and varied flora. Dr. Williams informs me that even the colonies of the species which do occur on the larger islands are far from numerous and are found only after diligent search. Only one or two forms have been taken on most of the islands. Chatham has six, Charles and Albemarle each seven, and Indefatigable eight, but even these numbers indicate a very limited fauna. At first sight this might be regarded as evidence that the ant-fauna was accidentally introduced and had lingered on, undergoing slow varietal and subspecific modification in response to the different physical conditions on the various islands. In my opinion, however, no such conclusion can be legitimately advanced. The poverty of the fauna is more probably due to adverse conditions, as ants are not fond of volcanic soil, probably because it gives off deleterious gases in the process of decomposition, or does not afford proper nesting sites, as would be the case with the great stretches of hard lava said to occur on some of the Galapagos islands. The climatic conditions, moreover, are decidedly unfavorable, as the littoral zone of the islands up to 800 feet is very arid, while the more densely wooded portions, at higher levels, are cool and damp. I have pointed out in other publications that moisture coupled with a low temperature is very unfavorable to ant-life and have called attention to the meagre faunas of such regions as New Zealand, Great Britain and the Selkirk Mountains of British America in support of this contention.

The bearing of my study of the Galapagos ants on the two great rival hypotheses that have been advanced to account for the origin of the islands and of their biota, is indecisive. A study of the literature shows that the problem is still far from solution and that probably as much evidence

can be adduced in support of the subsidence or "continental" as for the emergence or "oceanic" origin of the archipelago. So evenly divided are the authorities that 19, namely, Darwin, Wallace, Hooker, A. Agassiz, Salvin, Griesebach, Engler, Moritz Wagner, Peschel, Wolf, Dall, Stewart, Stearns, Snodgrass, Heller, Robinson, Williams, McNeill and Matthew, have expressed themselves in favor of the "oceanic" hypothesis, while an equal number, namely, H. Milnes Edwards, Murray, Baur, Hemsley, Ridgway, Robinson and Greenman, Boetger, von Ihering, Handlirsch, Scharff, Ortmann, Ratzel, Günther, Sarasin, Gadow, Arldt, Barbour, and Van Denburgh, have expressed themselves as favoring a "continental" origin of the archipelago. Eleven other workers who have studied material from the islands, namely Banks, Coquillet, Currie, Heidemann, Kellogg, Gifford, Linell, Howard, Garman, Rothschild and Hartert, have not committed themselves to either hypothesis. Some of the authors who take sides in the controversy are evidently influenced by the fancied facilities afforded by their special groups of organisms for transportation by winds or currents from the western coast of South or Central America. The botanists find it easy to suppose that seeds and the spores of ferns have thus found their way to the islands, while herpetologists balk at postulating such means of transportation for the huge land tortoises which have been so carefully studied by Baur and by Van Denburgh. At least one of the authors, Robinson, has changed his views in the course of his studies. In his first paper on the flora, written in collaboration with Greenman[11], he favored the Murray-Baur hypothesis of a continental origin of the islands, but in a more voluminous work[12], based on additional collections, he returns to the older Darwin-Wallace hypothesis. Some authors, like Stearns[13], Dall[14] and Stewart, make much of the "flotsam and jetsom" origin of the Galapagos fauna and flora, whereas

[11] *Robinson, B. L., and Greenman, J. M.* On the Flora of the Galapagos Islands as shown by the collections of Dr. G. Baur. Amer. Journ. Sci., 50, 1895, pp. 135-176.

[12] *Robinson, B. L.* Flora of the Galapagos Islands. Papers from the Hopkins Stanford Expedition to the Galapagos Islands. Proc. Amer. Acad. Arts and Sci. 38, 1902, pp. 77-269, 3 pls.

[13] *Stearns, R. E. C.* Report on the Mollusk Fauna of the Galapagos Islands, with Descriptions of New Species. Proc. U. S. Nat. Mus. 16, 1893, pp. 353-450.

[14] *Dall, W. H.* Insular Landshell Faunas, Especially as Illustrated by the Data Obtained by Dr. G. Baur in the Galapagos Islands. Proc. Acad. Nat. Sci., Phila., 1896, pp. 395-459, 3 pls.

others like Scharff, very properly point to the lack of positive observations on any such method of transportation. The unbiassed worker can only conclude from what has been written on the subject, and, notwithstanding the many excellent monographs that have been produced on various portions of the fauna and flora, that we need a still more intensive and exhaustive exploration of the islands and above all a much better acquaintance with their geology than we now possess, before he can definitely accept either of the hypotheses.

Family FORMICIDÆ.

Subfamily PONERINÆ.

1. Cylindromyrmex striatus Mayr.

Cylindromyrmex striatus Mayr, Verh. zool. bot. Ges. Wien 20, 1870, p. 697 ♀ ; *ibid.*, 37, 1887, p. 546 ♀ (*nec* ☿, *nec* ♂) ; Emery, Ann. Soc. Ent. Belg. 45, 1901, p. 53; Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 15.

Holcoponera whymperi Cameron, in Whymper, Travels Andes Equator, Suppl. Append. 1891, p. 92, fig. ☿.

Cylindromyrmex whymperi Forel, Ann. Soc. Ent. Belg. 36, 1892, p. (2).

A large ocellate and a small nonocellate worker taken by F. X. Williams at Academy Bay, Indefatigable Island, agree perfectly with Cameron's figure of *Holcoponera whymperi* from Guyaquil, Ecuador. His specimen was taken indoors, which indicates that the species may occur about houses, unlike other Ponerinæ, and suggests that it may have been recently introduced into the Galapagos by vessels from the Ecuadorian or Peruvian Coast.

2. Odontomachus hæmatoda bauri Emery.

Odontomachus bauri Emery, Ann. Soc. Ent. France, 60, 1891, p. 591 ☿ ; *ibid.*, 63, 1893, p. 476, fig.

Odontomachus hæmatoda bauri Emery, Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 115.

Worker. Length 9—11 mm.

Differing from the worker of the typical form in having the head proportionally narrower behind, slightly narrower

mandibles, with longer preapical tooth, the smooth, shining portion of the occiput extending somewhat further forward and that of the sides of the head further dorsally. The longitudinal striæ of the pronotum and transverse striæ of the epinotum are somewhat coarser and the anterior surface of the petiole is rather coarsely, transversely striate. The pilosity, pubescence and color are much as in the typical *hæmatoda,* but the body has a somewhat bronzy lustre and the antennæ and legs are darker.

Female. Length 10—11 mm.

Very similar to the worker and differing from the female of the typical *hæmatoda* in the same characters. The wings measure only 7 mm. or somewhat less, however, whereas those of the typical *hæmatoda* measure at least 8 mm.

Male. Length 6 mm.

Closely resembling the male of the typical *hæmatoda,* except in color. The head, thorax, legs and antennæ are whitish yellow, with the epinotum, petiole and dorsal surface of the gaster dark brown, the venter brownish yellow. The mesonotum has a dark brown longitudinal spot on each side and a slightly paler median spot of the same color just behind its anterior border. Wings whitish, with pale brown stigma.

This form, which is extremely close to the typical *hæmatoda,* so widely distributed in the tropics of both hemispheres, was described by Emery from a single worker taken by Dr. G. Baur on Chatham Island. I have redescribed it from a number of workers and females and a single male taken by Dr. F. X. Williams on the same island and at Cormorant Bay, Charles Island. The specimens were nesting under stones from sea-level to an altitude of 1100 feet.

Subfamily MYRMICINÆ.

3. **Pheidole williamsi,** new species.

Soldier. Length 2.3—2.6 mm.

Head small, subrectangular, scarcely longer than broad and scarcely broader behind than in front, with rounded posterior and anterior corners, feebly excised posterior bor-

der, nearly straight sides and the eyes of moderate size and situated in front of the middle. Mandibles rather convex, with two large apical and several minute and rather irregular basal teeth. Clypeus short, flat, with the anterior border deeply notched in the middle. Frontal area triangular, not impressed; frontal carinæ short, subparallel in front, slightly diverging behind; median dorsal groove shallow, running only from the occipital excision to the middle of the head. Antennæ slender, scapes curved but not flattened at the base, only slightly thickened at their tips, which nearly reach the posterior corners of the head; all the funicular joints distinctly longer than broad; club slender, shorter than the remainder of the funiculus. Thorax rather small; pronotum very convex, broadest through the humeri, which are rounded; mesonotum in profile sloping, with a strong, short, transverse convexity in the middle; epinotum long, its base straight in profile, fully 1½ times as long as the declivity, which is concave; spines short, slender, longer than broad at their bases, shorter than their distance apart at the base, directed backward and upward and very slightly outward. Petiole narrower in front than behind through the node, which in profile has a long, concave anterior and short, feebly concave posterior slope and rather acute summit; seen from behind the superior border of the node is deeply notched in the middle. Postpetiole scarcely a fourth again as broad as the petiole, broader than long, transversely elliptical, with rounded sides and dorsal surface. Gaster as large as the head, of the usual shape. Legs rather slender, femora only feebly incrassated in the middle.

Shining; mandibles coarsely punctate; sides of clypeus and anterior half of the head longitudinally rugulose; remainder of head smooth and shining, with minute, scattered, piligerous punctures. Pronotum transversely rugulose; mesonotum, epinotum, petiole and postpetiole subopaque, finely and densely punctate; gaster and legs shining, with sparse piligerous punctures.

Whole body, including the legs and antennæ, covered with moderately abundant and rather coarse yellow hairs, varying in length but longer and more erect on the body, more reclinate on the scapes and legs.

Brownish yellow; legs paler; posterior two-thirds of head somewhat darker and more reddish, borders of mandibles blackish, anterior clypeal border deep red.

Worker. Length 1.5 mm.

Head elliptical, longer than broad, rounded and entire behind, with the eyes just in front of the middle of the sides. Mandibles rather narrow, with about six teeth. Clypeus convex in the middle, its anterior border feebly but distinctly notched in the middle. Frontal carinæ very short. Antennæ much as in the soldier, scapes reaching nearly one-third their length beyond the posterior border of the head. Thorax like that of the soldier, but the pronotum much less convex and narrower, the mesonotum much less convex in profile and the spines of the epinotum reduced to minute, slender teeth. Petiole slender, its node low, with entire superior border; postpetiole small, subglobular.

Smooth and shining; mandibles sparsely punctate; cheeks longitudinally rugulose; meso- and epinotum, petiole and postpetiole subopaque, finely and indistinctly punctate.

Pilosity shorter and much less conspicuous than in the soldier, appressed on the scapes and legs.

Yellow; dorsal surface of head and gaster brownish; mandibular teeth blackish.

Female. Length 5—5.5 mm.

Head resembling that of the soldier, but a little narrower in front than behind, with nearly straight posterior border. Thorax large, as broad as the head, mesonotum nearly circular, flattened, as is also the scutellum. Epinotum with the declivity sloping, distinctly longer than the base, the spines stout, scarcely longer than broad at their insertions. Petiolar node less deeply excised above and postpetiole more transverse than in the soldier. Gaster large, of the usual shape. Wings measuring about 6 mm.

Mandibles and clypeus rather shining, the former striato-punctate, the latter longitudinally rugose. Head subopaque, longitudinally rugose, the rugæ extending to the occiput where they are mingled with coarse longitudinal punctures. Pronotum, pleuræ, epinotum, petiole and postpetiole opaque and densely punctate. Epinotum coarsely transverely rugose between the spines, the postpetiole longitudinally rugose.

Mesonotum, paraptera and scutellum smooth and shining, with coarse, sparse, piligerous punctures. Gaster shining, finely shagreened and very sparsely and finely punctuate.

Pilosity much as in the soldier.

Brownish yellow: pleuræ, epinotum, nodes, posterior portion of each gastric segment, scutellum, a large spot on the middle of the mesonotum and the mandibular teeth, brown. Wings yellowish hyaline, with pale yellow veins and scarcely darker stigma.

Male. Length 4—4.5 mm.

Head through the eyes slightly broader than long, flattened above, produced behind in the ocellar region, with very short cheeks and large eyes. Mandibles minute, bidentate. Clypeus carinate, convex behind. Antennal scapes as long as the two basal funicular joints together. Thorax broad and short, flattened above; epinotum sloping, rounded, unarmed, without distinct base and declivity. Petiole and postpetiole like those of the soldier, the node of the former being lower, more rounded and entire.

Mandibles and clypeus shining. Head above more opaque, especially on the sides, rugulose. Thorax, postpetiole and gaster shining and sparsely punctate; pleuræ and epinotum subopaque, the latter longitudinally rugulose.

Pilosity as in the female, but shorter and less abundant.

Mandibles, clypeus, antennæ and legs pale yellow; remainder of body brown, the head darker behind, the sutures of the thorax broadly pale yellow. Wings colored as in the female.

Described from several specimens of each of the phases taken on Indefatigable Island by Dr. F. X. Williams.

Cotypes, 12 specimens, No. 444, Museum California Academy of Sciences.

The soldier of this species resembles that of *Ph. arhuaca* Forel of Colombia in size and coloration, but is very distinct in the longer antennæ, notched clypeus, different shape of the mesonotum and in the sculpture of the dorsal surface of the head. It is even more closely related to *Ph. alfaroi* Emery of Costa Rica, but the soldier of this species is larger (4.5 mm.) and differs considerably from *williamsi* in the structure of the thorax, petiole, epinotal spines, etc.

4. **Pheidole,** species.

Among the "Albatross" material of the National Museum there are several poorly preserved or defective females and males belonging to a small *Pheidole* of the *flavens* group from Albemarle Island. One of these, a female, of which only the head and thorax remain, is labelled *"Pheidole galapagensis* Ashmead, type, No. 5515". Nothing can be done with this material at the present time, since soldiers are lacking and since our knowledge of the females and males of the known species of the large and exasperating group of *Pheidole* to which it belongs is very fragmentary.

5. **Monomorium pharaonis** (L.)

Formica pharaonis Linné, Syst. Nat. Ed. 10, 1, 1758, p. 580 ☿.

Formica antiguensis Fabricius, Ent. Syst. 2, 1793, p. 357.

Myrmica domestica Shuckard, Mag. Nat. Hist. (2), 1838, p. 626 ☿ ♀.

Myrmica unifasciata Bostock, Trans. Ent. Soc. London, 2, 1839. Proc. LI-LII.

Atta minuta Jerdon, Madras Journ. Litt. and Sci. 17, 1851, p. 105.

Myrmica (*Monomorium*) *fragilis* F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 124 ☿.

Myrmica (*Monomorium*) *contigua* F. Smith, *Ibid.,* p. 125 ♀.

Myrmica (*Monomorium*) *molesta* F. Smith (*nec* Say), *Ibid.*, p. 122 ☿ ♀ ♂.

Monomorium pharaonis Mayr, Verh. zool. bot. Ges. Wien. 12, 1862, p. 752.

Myrmica pharaonis Roger, Berl. Ent. Zeitschr. 6, 1862, p. 294 ♀ ♂.

Diplorhoptrum domesticum Gaskell, Ent. Month. Mag. 13, 1877, p. 254.

Two workers from Indefatigable Island and four workers and three deälated females from Abingdon Island (F. X. Williams). This common house and ship ant has evidently been imported into the islands by commerce.

6. **Solenopsis sævissima** F. Smith.

Myrmica sævissima F. Smith, Trans. Ent. Soc. London (2) 3, 1855, p. 166 ☿. Pl. 13, Fig. 18; Bates, Natural. Riv. Amazon, 1863; Trans. Ent. Soc. London (3) 1, 1864, Proc. 214.

Solenopsis geminata Fabricius race *pylades* Forel, Ann. Soc. Ent. Belg. 48, 1904, p. 172 ♀.

Solenopsis pylades Forel, Deutsch. Ent. Zeitschr. 1909, p. 268 ☿ ♀.

Solenopsis sævissima Wheeler, Bull. Amer. Mus. Nat. Hist., 34, 1915, p. 395; Psyche, 23, 1916, p. 142.

A single worker from Indefatigable Island (F. X. Williams), unmistakably belongs to this species, though it is somewhat damaged. The hairs on the body, however, are more abundant, more flexuous and paler than in my specimens from Argentina, Brazil and British Guiana, but in this respect the Galapagos specimen agrees with a series taken by Silvestri at Talca, Chili. *S. sævissima,* as the foregoing localities show, is very widely distributed in tropical America. It was originally described from Brazil.

7. **Solenopsis geminata** (Fabricius).

Emery records this species as having been taken by Baur on Chatham Island. Perhaps the specimens belong to the following variety. I have omitted the long and tangled synonymy of *S. geminata,* much of which can be found in Dalla Torre's Catalogus Hymenopterorum 7, 1893, p. 76.

8. **Solenopsis geminata galapageia,** new variety.

Several workers and females taken by Dr. Williams on Charles Island "under stones near top of crater" average smaller than the corresponding phases of the typical *geminata.* The females are only 6—6.5 mm., the largest workers only 4—4.5 mm., whereas the females of the typical *geminata* measure 7—8 mm., the largest workers 6—6.5 mm. In color the Galapagos specimens are much like the typical Central

and South American specimens, being somewhat paler than the var. *nigra* Forel and darker than the var. *diabola* Wheeler.

Cotypes, 6 specimens, No. 445, Museum California Academy of Sciences, and 8 specimens in author's collection.

9. **Solenopsis globularia pacifica,** new subspecies.

Worker. Eyes slightly smaller, pilosity longer and coarser, postpetiole and gaster distinctly more voluminous as compared with the petiole than in the typical form, represented in my collection by specimens taken by W. M. Mann in Natal, Brazil.

Male. Eyes more convex and perhaps a little larger, head narrower behind, mandibles smaller, epinotum more sloping, more rounded and less angular than in the typical *globularia.* The color is also different, the body being dark brown, the antennæ and legs whitish or pale yellow, whereas in the typical form the body is black and the appendages brown.

Thirteen workers and four males from Albemarle and Tower Islands ("Albatross 1899", U. S. Nat. Mus.). Albemarle should be regarded as the type locality.

Cotypes, 2 specimens, No. 446, from Albemarle Island, Museum California Academy of Sciences, and 6 specimens from Albemarle in author's collection.

10. **Solenopsis globularia pacifica rubida,** new variety.

Worker. Length 1.8 mm.

Differing from the other forms of the species in color, the body being red, with the mandibles, antennæ and legs yellow and the first gastric segment, except its anterior and posterior borders, black. The postpetiole is globular, but little broader than long.

Described from a single specimen taken by Dr. Williams on Hood Island "under a stone".

Holotype, No. 447, Museum California Academy of Sciences.

11. Tetramorium guineënse (Fabricius)

Formica guineënsis Fabricius, Ent. Syst., 2, 1793, p. 357 ☿.

Myrmica bicarinata Nylander, Acta. Soc. Sc. Fennic. 2, 1846, p. 1061 ☿ ♀.

Myrmica carinicceps Guérin, Rev. Mag. Zool. (2) 4, 1852, p. 79 ☿.

Myrmica kollari Mayr. Verh. zool. bot. Ver. Wien, 5, 1855, p. 425 ☿ ♀ ♂.

Tetramorium carinicceps Roger, Berlin, Ent. Zeitschr. 5, 1861, p. 171.

Myrmica reticulata F. Smith, Trans. Ent. Soc. London (3) 1, 1862, p. 33 ☿.

Tetramorium kollari White, Ants and Their Ways, 1883, p. 262 ☿.

Tetramorium guineënse Mayr, Verh. Zool. bot. Ges. Wien, 20, 1870, p. 972 ☿.

A single worker of this undoubtedly introduced tropicopolitan ant from South Albemarle (F. X. Williams) and 14 workers taken by the "Albatross" (U. S. Nat. Mus.) but bearing only the label "Galapagos Islands, 1899." Emery records the species as taken also on the boat at Chatham Island by Dr. G. Baur.

12. Tetramorium (Tetrogmus) simillimum (F. Smith)

Myrmica simillima F. Smith, List Brit. Anim. Brit. Mus. 6, 1851, p. 118 ☿.

Tetrogmus caldarius Roger, Berl. Ent. Zeitschr. 1, 1857, p. 12 ☿ ♀.

Myrmica (Leptothorax) simillima F. Smith, Cat. Brit. Fossor. Hymen., 1858, p. 31 ☿.

Myrmica caldaria Meinert, Naturv. Aft. Dansk. Vid. Selsk. (5) 5, 1860, p. 334 ☿ ♀ ♂.

Tetramorium simillimum Mayr, Europ. Formicid. 1861, p. 61 ☿.

A single worker taken by Dr. Williams on Charles Island, "under stones near top of crater." This species, like *T. guineënse,* is a tropicopolitan "tramp" of Old World origin. It is not infrequently found in hot-houses in temperate regions.

Subfamily DOLICHODERINÆ.

13. **Dorymyrmex pyramicus albemarlensis,** new variety

Worker. Length 2.3—2.5 mm.

Resembling the var. *bicolor* Wheeler, but smaller and the head somewhat narrower and longer, with nearly straight sides and the epinotal cone smaller. The eyes are small, just in front of the middle of the head. Sculpture, pilosity and color as in *bicolor,* the head, thorax and antennal scapes a little more sordid red, the funiculi, petiole, gaster and legs dark brown or blackish.

Five workers from South Albemarle (F. X. Williams) and 19 workers from the same island taken by the "Albatross" in 1899 (U. S. Nat. Mus.). This form is very closely related to one of which several specimens were sent me by Mr. C. H. Tyler Townsend from Piura, Peru. The Peru form may be designated as **peruvianus,** new variety. It measures 2.5–3 mm. and is therefore as large as var. *bicolor.* The head is shaped like that of *albemarlensis* but the epinotal cone is as large as in *bicolor* and rather blunt. The color, however, is different, the head, thorax, petiole, legs, scapes, bases of funiculi and extreme base of the first gastric segment being clear, bright yellow, the remainder of the gaster black. The head is very smooth and shining, the remainder of the body a little more opaque, the pubescence is finer and less conspicuous.

Cotypes, 2 specimens, No. 448, Museum California Academy of Sciences; also 2 paratypes from Albatross collection of 1899.

14. **Tapinoma melanocephalum** Fabricius

Formica melanocephala Fabricius, Ent. Syst. 2, 1793, p. 353 ☿.

Lasius melanocephalus Fabricius, Syst, Piez. 1804, p. 417.

Myrmica melanocephala Lepeletier, Hist. Nat. Insect. Hymen. 1, 1836, p. 185.

Formica nana Jerdon, Madras Journ. Litt. and Sci. 17, 1851, p. 215 ☿.

Myrmica pellucida F. Smith, Journ. Proc. Linn. Soc. Zool. 2, 1857, p. 71 ☿.

Myrmica (Monomorium) pellucida F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 124 ☿.

Formica familiaris F. Smith, Journ. Proc. Linn. Soc. Zool. 4, 1860, Suppl. p. 96 ☿.

Tapinoma melanocephalum Mayr, Verh. zool. bot. Ges. Wien. 12, 1862, p. 651.

Two worker specimens, one from the east side of Indefatigable Island, the other from Hood Island (F. X. Williams). This species is also recorded by Emery as having been taken on the boat at Chatham Island by Dr. G. Baur. Like the two species of *Tetramorium, Tapinoma melanocephalum* has been disseminated throughout the neotropical region from its original home in the Indomalayan region and has become a pest about houses and shops.

Subfamily CAMPONOTINÆ.

15. Prenolepis (Nylanderia) longicornis (Latreille)

Formica longicornis Latreille, Hist. Nat. Fourmis. 1802, p. 113 ☿.

Formica vagans Jerdon, Madras Journ. Litt. Sc. 17, 1851, p. 124 ☿ ♀.

Formica (Tapinoma) gracilescens Nylander, Ann. Sc. Nat. Zool. (4) 5, 1856, p. 73 ☿.

Tapinoma gracilescens F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 56.

Prenolepis gracilescens Mayr, Verh. zool. bot. Ges. Wien, 12, 1862, p. 698.

Prenolepis longicornis Roger, Verz. d. Formicid. 1863, p. 10.

Five workers from Cormorant Bay, Charles Island (F. X. Williams). This species is of Indomalayan origin like *Tapinoma melanocephalum* and has also become a household pest throughout the tropics and even in some cities in temperate regions. It is known to nest on ships and has brought its Old World myrmecophiles, a beetle, *Coluocera maderæ,* and a cricket, *Myrmecophila prenolepidis,* to America. Both of these insects were recently taken by Dr. W. M. Mann on the island of Haiti in nests of *P. longicornis.*

16. **Prenolepis (Nylanderia) vividula guatemalensis itinerans** Forel.

Prenolepis guatemalensis Forel var. *itinerans* Forel, Mitth. Naturh. Mus. Hamburg 18, 2. Beih. 1901, p. 81 ☿.

A single worker from Indefatigable Island and two deälated females from Cormorant Bay, Charles Island, taken in October, 1905, by F. X. Williams. Two workers, a male and four females, taken by the "Albatross" in 1899 (U. S. Nat. Mus.), but labelled only "Galapagos Islands," also belong to this variety, which was originally described from specimens introduced into Hamburg with plants from Brazil. I have compared the Galapagos specimen with cotypes given me by Prof. Forel.

17. **Prenolepis (Nylanderia) fulva nesiotis, new subspecies.**

Worker. Length 1.6—2 mm.

Differing from all the known forms of *fulva* in its small size and in the shape of the thorax, the mesonotum being somewhat more convex and descending more abruptly behind to the constriction. On the other hand, the epinotum is distinctly less convex, its base about half as long as the declivity, which is straight in profile. Scapes extending two-fifths their length beyond the posterior border of the head. Sculpture and pubescence much as in the typical *fulva,* but the pilosity is less abundant and somewhat finer, especially on the legs and scapes. Dark brown, mandibles, clypeus, front of head, scapes, first funicular joint, legs and mesonotum paler and more reddish.

Female (deälated). Length 4 mm.

Differing from the worker in pilosity, the stiff erect hairs being absent on the scapes and legs, though conspicuous on the upper surface of the head, thorax and gaster. The pubescence is longer and denser and the whole body therefore slightly less shining. The thorax seen from above and excluding the epinotum is circular and broader than the head, which is small, subrectangular, fully as broad as long and a little broader behind than in front. The scapes extend about half their length beyond the posterior corners of the head.

Male. Length 1.5—1.75 mm.

Somewhat paler and more uniformly reddish brown than the worker and female. Wings gray, with brown veins and stigma. Pilosity much as in the female, but the pubescence sparser and shorter than in the worker so that the body appears shining. Antennal scapes reaching about half their length beyond the posterior corners of the head. Genitalia much as in the typical *fulva*.

Described from several workers and males taken by Dr. Williams on James Island (2000 ft., under stones) and two females from Chatham Island (low altitude, under stones).

Cotypes, 8 specimens, No. 449, Museum California Academy of Sciences.

At first sight I took these ants to represent a form of *P. vividula* or a small form of *P. bourbonica*, like the var. *hawaiiensis* Forel, but the genital appendages proved on dissection to conform to the *fulva* type. The new subspecies is, however, smaller than any of the recorded forms (subspecies *pubens* Forel, subspecies *biolleyi* Forel, var. *longiscapa* Forel). The mesonotum in profile is much like that of *biolleyi*, but the epinotum is distinctly less convex.

In the colony taken on James Island, Dr. Williams found six specimens of a myrmecophilous Bethylid, which proved to be a new species of *Sclerodcrma*. This is described by Prof. C. T. Brues in an accompanying paper.

18. **Camponotus (Myrmobrachys) senex** (F. Smith).

Formica senex F. Smith, Catalog. Hymen. Brit. Mus. 6, 1858, p. 47 ☿ ♀.

Camponotus senex Mayr, Verh. zool. bot. Ges. Wien. 12, 1862, p. 676; *ibid.*, 27, 1877, p. 867, ☿ ♀ ♂; F. Smith, Proc. Zool. Soc. London 1877, p. 83.

Camponotus (*Myrmobrachys*) *senex* Forel, Rev. Suisse Zool. 22, 1914, p. 271.

Frederick Smith cites this well known neotropical species as having been taken on Charles Island by W. E. Cookson, commander of the "Peterel" on her voyage to the Galapagos in 1875. As no specimens of it are among the collections of the California Academy or the "Albatross" Expeditions, and

as Smith was notoriously careless in making identifications even of his own species, its inclusion among the Galapagos ant fauna must be regarded as doubtful.

19. Camponotus (Myrmamblys) macilentus F. Smith.

Camponotus macilentus F. Smith, Proc. Zool. Soc. London, 1877, p. 83 ☿.

Smith described this species very briefly from worker specimens taken by Charles Darwin on Charles Island as follows:

"*Worker.* Length, 2¼ lines. Pale ferruginous, with the legs pale testaceous, smooth and shining, and having a few scattered pale hairs. The head wider than the thorax, oblong, with the eyes large, ovate and black; the vertex slightly emarginate behind. Thorax compressed and much narrowed behind, convex above. Abdomen wider than the head, and oblong ovate. The scale of the petiole wedge-shaped and rounded above."

I have not seen specimens of this ant from Charles Island, but I have before me a number of specimens from many of the other islands and these specimens differ varietally according to their localities. Hence I am compelled to describe in detail the form from James Island, which is represented by the most complete series, as if it were the specific type and to compare with it the several other varieties. I assume that when the type from Charles Island is again collected, it will prove to differ at least as much from the other forms as these differ from each other. From the fact that Smith says nothing about the color of the abdomen of his specimen, I infer that it was probably without dark markings like the variety which I call *hoodensis.*

The following varieties show that *C. macilentus,* which has remained unknown to myrmecologists since it was described by Smith and has been placed by Forel among the *Camponoti incertæ sedis,* is a true *Myrmamblys,* rather closely related to *C. claviscapus* Forel, a species widely distributed in Central America, Brazil and the West Indies. *C. claviscapus,* however, is smaller and the worker major has a much more sharply rectangular head, with flattened and strongly and abruptly incrassated tips to the antennal scapes. This species

nests in hollow twigs, but Dr. Williams on the label to the specimens of *macilentus* var. *hoodensis* mentions their occurrence "under stones".

20. Camponotus (Myrmamblys) macilentus jacobensis, new variety.

Worker major. Length 7.5—8 mm.

Head about one-quarter longer than broad, subrectangular, a little narrower in front than behind, with nearly straight sides posteriorly and occipital border and the cheeks rather convex though feebly impressed near the insertions of the mandibles. Upper surface of head convex; eyes large, flat, elliptical, their anterior orbits distinctly behind the middle of the head, two small ocellus-like pits on the vertex and a sharply defined frontal groove extending half the distance from the clypeus to the posterior margin. Clypeus suboblong, one-quarter longer than broad, nearly as broad behind as in front, carinate on its posterior half, with a deep pit at the suture on each side in front; its anterior border feebly rounded, not produced, distinctly crenulate. Frontal area minute and indistinct, transverse, rather deeply impressed. Frontal carinæ more than half as long as the head behind the clypeus, strongly diverging, more than twice as far apart at their posterior as at their anterior ends. Mandibles rather small, very convex, 5-toothed. Antennæ slender, scapes curved, slightly flattened at the base, their tips gradually thickened, surpassing by a distance equal to their greatest diameter the posterior corners of the head. Thorax rather short, narrower than the head, laterally compressed behind, arcuate above in profile with sharply impressed promesonotal and mesoëpinotal sutures; pro- and mesonotum slightly flattened above, epinotum high, in profile with subequal base and declivity, the former convex, the latter abrupt, forming a rounded right angle with it, straight above and very feebly concave below. Petiole small, nearly as broad as the posterior end of the epinotum, but only about half as high as the epinotal convexity, its node broadest above, evenly rounded and entire, with moderately acute margin; in profile it is inclined forward somewhat and has a convex anterior and flat posterior surface. Gaster rather long and narrow, with subparallel sides

and the four segments of subequal length. Legs moderately long, the fore femora somewhat enlarged.

Smooth and shining, very finely and delicately shagreened; mandibles, clypeus and head slightly subopaque, covered with minute, shallow punctures, which are densest on the mandibles. Pro- and mesonotum with a few elongate, shallow foveolæ above.

Hairs pale yellow, erect, very sparse and rather short, confined to the dorsal surface, the venter and the tips of the scapes and femora. Pubescence pale, short and dilute, distinct only on the legs and antennæ.

Brownish yellow, legs pale yellow; mandibles, scapes and tarsi reddish, the mandibles with narrow blackish borders. Front, vertex and sides of meso- and epinotum clouded with brown and each gastric segment with a broad dark brown band across its posterior surface. This band expands in the middle to form a rather broad streak which reaches to the anterior border of the segment.

Worker minor. Length 4.5—5.5 mm.

Resembling the worker major, but the posterior corners of the head are much more rounded, the clypeus is trapezoidal and scarcely longer than broad and the antennal scapes extend about one-quarter their length beyond the posterior corners of the head. The puncturation of the head is less distinct than in the worker major so that this region is more shining. In other respects the sculpture, pilosity and color are very similar.

Female. Length 8—8.5 mm.

Closely resembling the worker major but the head is smaller and more narrowed in front, with the antennal scapes extending about one-sixth their length beyond its posterior corners, the petiolar node is thicker and much blunter, with its upper margin more transverse and very feebly impressed in the middle. The thorax is rather long and narrow, though as broad as the head, the mesonotum as long as broad. Wings long (nearly 9 mm.).

Sculpture, pilosity and coloration very much as in the major worker. Wings distinctly yellowish, with pale brown veins and pterostigma.

Male. Length 6 mm.

Head through the very large and convex eyes as broad as long, rounded behind, with straight, parallel cheeks. Clypeus subrectangular, as broad as long, carinate, with rounded anterior border. Mandibles indistinctly tridentate. Antennæ very slender, the scapes reaching about one-half their length beyond the posterior border of the head. Mesonotum nearly circular, as broad as the head through the eyes. Epinotum convex and rounded, without distinct base and declivity. Node very thick, blunt and low, its border transverse and very feebly impressed in the middle. Gaster and legs slender.

Sculpture and pilosity much as in the minor worker.

Brownish yellow, legs scarcely paler; ocellar region dark brown, gastric segments pale brown, except at their anterior and posterior edges. Wings colored as in the female.

Described from 10 major workers, seven minor workers, seven females and a single male taken by Dr. F. X. Williams from a single colony on James Island during August, 1906.

Cotypes, 12 specimens, No. 450, Museum California Academy of Sciences, and 12 specimens in author's collection.

21. Camponotus (Myrmamblys) macilentus barringtonensis, new variety.

Worker minor. Length 4—5.5 mm.

Differing from the var. *jacobensis* in its distinctly paler and more ivory-yellow color, the brown clouds on the vertex and thorax being paler and less sharply defined or more diffuse, so that in some specimens the whole meso- and epinotum is pale brownish. The bands on the gaster are narrower, their mid-dorsal expansion shorter and the color of these markings, though paler than in *jacobensis,* is nevertheless darker than those on the head and thorax. The knees are distinctly brownish.

Female. Length 8—8.5 mm.

Colored very much like the minor worker, but the bands on the gaster are broad and sharply defined and their mid-dorsal expansions are broken into spots.

Twenty-one minor workers and eight females from a single colony taken by Dr. Williams on Barrington Island during October, 1905.

Cotypes, 17 specimens, No. 451, Museum California Academy of Sciences, and 12 specimens in author's collection.

22. Camponotus (Myrmamblys) macilentus duncanensis, new variety.

Worker major. Length 5—5.5 mm.

Distinctly smaller than the two preceding forms. Head proportionally shorter, with less convex cheeks and broader clypeus, the antennal scapes extending nearly one-quarter their length beyond the posterior corners of the head. The punctures on the mandibles, clypeus and head and the foveolæ on the pro- and mesonotum are more feebly developed, so that the head is much more shining. The color is much like that of *barringtonensis,* pale ivory yellow, but there are no dark markings on the head and thorax and the bands on the gaster are narrow and rather sharply defined, reddish brown, the mid-dorsal marking either absent or present only as a narrow, more or less interrupted line.

Worker minor. Length 4—4.5 mm.

Colored like the worker major, but some specimens have the meso- and epinotum and a cloud on the vertex pale brownish. The bands on the gaster are usually reduced to brown transverse lines and the mid-dorsal markings are frequently absent.

Female (deälated). Length 7 mm.

Colored like the worker major, i. e. without any dark markings on the head and thorax. The gastric bands are well-developed, but there are mid-dorsal markings only on the third and fourth segment, where they appear as small spots. The head is shining, owing to the very feeble development of the punctures.

Male. Length 4.5—5 mm.

Differing from the male of *jacobensis* in color, the body and legs being rather dark brown, with paler brown thorax and antennæ. The wings are rather opaque.

Described from a single female, six major workers, 17 minor workers and four males taken August 13-14, 1906, by Dr. Williams on Duncan Island.

Cotypes, 14 specimens, No. 452, Museum California Academy of Sciences, and 12 specimens in author's collection.

The six specimens regarded as major workers may possibly be mediæ, but the whole appearance of the series, and especially of the female, suggests a distinct variety characterized by the small stature of all the castes and a very incomplete polymorphism of the worker caste in particular. The coloration of the male is peculiar.

23. Camponotus (Myrmamblys) macilentus albemarlensis, new variety.

Worker major. Length 7—7.5 mm.

Closely resembling the vars. *jacobensis* and *barringtonensis*, but the head is slightly broader in front and more nearly rectangular, and the clypeus is distinctly broader in proportion to its length, being only a little longer than broad and much less distinctly carinate behind. The antennal scapes do not reach beyond the posterior corners of the head. On the mandibles, clypeus and head the punctures are much finer than in *jacobensis* so that the surfaces are more shining. The color is similar to that of *barringtonensis* and *duncanensis*, being pale, ivory yellow, the gaster, coxæ and legs a little paler than the head and thorax, which are immaculate. The brown bands on the gaster are well-developed, darker than in *duncanensis*, but paler than in *jacobensis*, and there are distinct though interrupted portions of the mid-dorsal streaks. The knees are brownish, the antennæ and tarsi reddish.

Described from two specimens taken by Dr. Williams during May, 1906, on Mt. Cowley, South Albemarle.

Cotypes, 2 specimens, No. 453, Museum California Academy of Sciences.

24. Camponotus (Myrmamblys) macilentus vulcanalis, new variety.

Worker major. Length 5—6 mm.

Head and clypeus broad as in the preceding variety, but the head with somewhat more convex sides. Antennal scapes extending a distance equal to their greatest width beyond the posterior corners of the head. Clypeal carina obsolete. Thoracic dorsum in profile nearly straight, much less convex than in the other forms. Color brownish yellow, thorax immacu-

late, vertex sometimes faintly clouded with brown. The bands on the gaster are broad and rather dark brown but ill-defined anteriorly, their mid-dorsal expansions faint or lacking. The puncturation of the head is nearly as well developed as in the var. *jacobensis*.

Worker minor. Length 3.5—4 mm.

Resembling the worker major, but paler in color, with the gastric bands narrower and their mid-dorsal expansions obsolete.

Female. Length nearly 9 mm.

Very similar to the worker major in the form of the head and in color. The antennal scapes extend nearly one-quarter their length beyond the posterior corners of the head. There is a well-defined brown patch on the ocellar region and the gastric bands are broad and dark brown, covering the greater part of each segment, except the first. The wings are almost colorless, the veins and stigma brownish yellow.

Male. Length 6.5 mm.

Very similar to the male of the var. *jacobensis*, but the head and gaster are of a distinctly darker brown tint.

Described from three major workers, three minor workers, four females and five males taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Albemarle Island. Some of these specimens are very imperfect and part of them are greasy. The absence of color in the wings may be due to fading with age. The markings on the gaster of the major workers and females are deeper and more vivid, however, than in the fresher specimens of the var. *albemarlensis* taken by Dr. Williams, so that I do not hesitate to regard the two varieties as distinct. Two of the specimens, a worker minor and a damaged female, are labelled as taken at Tagus Cove. The dates on the other specimens indicate that they were taken at different times and possibly in other parts of Albemarle.

25. Camponotus (Myrmamblys) macilentus hoodensis, new variety.

Worker major. Length 7.5—8 mm.

Resembling the two preceding varieties in the structure of the head and clypeus and in puncturation. The antennal scapes extend a distance equal to their greatest width beyond

the posterior corners of the head. The color is pale ivory yellow, the gaster, coxæ and legs whitish, the head and thorax are immaculate and the bands and their mid-dorsal expansion on the gastric segments are narrow and so very faint as to be scarcely discernible. The knees, mandibles and tarsi are brownish yellow.

Worker minor. Length 5—6 mm.

Resembling the worker major but even slightly paler in color, almost white. The clypeus is as broad as long and distinctly carinate. The antennal scapes extend about one-third their length beyond the posterior corners of the head. The mandibles are scarcely darker than the head, with reddish teeth.

Described from five major and five minor workers taken by Dr. Williams in November, 1905, on Hood Island "under stones". This variety is readily distinguished by its very pale color.

Cotypes, 6 specimens, No. 454, Museum California Academy of Sciences, and four specimens in author's collection.

26. Camponotus (Myrmamblys) macilentus narboroënsis, new variety.

Female. Length of head and thorax 4 mm.

Head but little longer than broad and nearly as broad in front as behind. Clypeus a little broader in front than behind. The color is reddish yellow, the pleuræ, coxæ and femora pale yellow, the tibiæ, tarsi and antennæ more reddish, the mandibles scarcely darker than the head. Wings with a distinct yellowish tinge. The gaster and petiole are missing.

A single, greasy and defective specimen taken by the "Albatross" in 1899 (U. S. Nat. Mus.). More and better material will be required to establish the status of this form, which seems to represent a distinct color variety.

27. Camponotus (Myrmamblys) macilentus bindloënsis, new variety.

Worker major. Length about 8 mm.

Head large and rather broad, with distinctly rounded sides, slightly narrowed in front; cheeks without transverse impres-

sions. Clypeus subrectangular, distinctly longer than broad, scarcely broader in front than behind, with distinct carina. Antennal scapes extending a distance equal to their greatest width beyond the posterior corners of the head. Epinotum in profile convex, without distinct base and declivity. Petiole with the upper border rather blunt and feebly emarginate in the middle. Brownish yellow, with the pronotum, coxæ, femora and tibiæ pale yellow. Vertex faintly clouded with brown; gaster with broad, dark brown bands on the segments, but without mid-dorsal streaks. Mandibles red, with black teeth. Puncturation of head well developed, as in the var. *jacobensis*.

Worker minor. Length 3.5 mm.

Resembling the worker major but the posterior half of the head, the whole thorax and petiole pale brown as are also the paler portions of the gaster so that the bands of the latter are not sharply contrasted with the other portions of the segments.

Described from a single worker major and two minor workers (one very immature) taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Bindloe Island.

28. **Camponotus (Myrmamblys) macilentus,** variety.

A single major worker and two minor workers taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Tower Island probably represent a distinct variety, but all have lost the gaster and of the worker major only the thorax and legs remain. The specimens are small and all are very pale, like the var. *hoodensis*, the head and thorax being immaculate brownish yellow, the coxæ and legs white. The mandibles, except their teeth, are scarcely darker than the remainder of the head. The specimens are so imperfect that I refrain from introducing a new name.

29. **Camponotus (Myrmorhachis) planus** F. Smith.

Camponotus planus F. Smith, Zool. Coll. made by H. M. S. "Peterel", Proc. Zool. Soc. London 1877, p. 83 ☿.

Worker major. Length 5—6 mm.

Head rather large, trapezoidal, decidedly broader behind than in front, excluding the mandibles a little longer than broad, very convex above, flat beneath, with feebly convex sides, feebly and broadly excised occipital border and a distinct transverse impression on the cheeks. Eyes moderately large, flat, situated well behind the middle of the head. Mandibles short, convex, 5-toothed. Clypeus subrectangular, as broad as long, a little broader in front than behind, convex but not carinate in the middle, transversely impressed just behind the anterior margin, which is feebly but distinctly excised in the middle and rather deeply emarginate on each side. Frontal area very small, distinct, triangular. Frontal carinæ rapidly diverging in front, but parallel behind. Antennal scapes stout, funiculi slender, the former flattened, curved and very narrow at their insertions, extending about one-quarter their length beyond the posterior corners of the head. Thorax a little longer than the latter, including the mandibles, laterally compressed behind, with flat pleuræ; promesonotal and mesoëpinotal sutures very sharp and distinctly impressed; pronotum flat above, including the neck nearly as long as broad; mesonotum much narrower, flat, almost circular when seen from above, bluntly marginate on the sides; epinotum nearly as broad as the mesonotum, a little longer than broad, subcuboidal; in profile with the base a little longer than the declivity, both distinctly concave, the former horizontal, the latter sloping and separated by a sharp transverse ridge, which is slightly emarginate in the middle so that the apex of the epinotum viewed obliquely or from above is feebly bidentate. Petiole nearly as high as the epinotum, its superior margin blunt, broadly rounded and entire, its posterior surface flat, its anterior surface formed of two subequal planes meeting at an obtuse angle, the more ventral plane vertical and parallel with the posterior surface. Gaster rather large, elliptical; legs rather long and stout.

Opaque; mandibles, gula and sides of head, occipital corners, declivity of epinotum and sutures of thorax shining. Whole body very densely and finely punctate, the mandibles, cheeks, sides of head, antennal scapes, legs and gaster also with somewhat larger, sparser, shallow punctures which bear

the hairs and pubescence; the punctures on the sides of the thorax somewhat coarser than those on the dorsum.

Hairs short, erect, glistening, pale yellow, rather obtuse, sparse on the head, thorax and border of the petiole, more abundant on the gaster, absent on the cheeks. Pubescence short, appressed and sparse, but easily visible on the sides of the head, dorsum of pronotum and on the legs, especially on the tibiæ, on the gaster much denser and longer, so that it hides the sculpture and produces a silky or bronzy gray reflection.

Black; mandibles, except the teeth, front of clypeus, cheeks and sometimes the sides of the head, including the posterior corners, anterior portions of frontal carinæ, antennæ, legs, including the coxæ, rich ferruginous red; venter dark brown.

Worker minor. Length 3.5—4.5 mm.

Resembling the worker major, but the head smaller and proportionally longer, with more rounded posterior corners, the clypeus feebly carinate behind, the eyes situated a distance about equal to their length from the posterior corners. Antennal scapes much more slender, reaching about one-half their length beyond the occipital border of the head. Thoracic sutures less deeply impressed, the base of the epinotum more concave and the ridge separating the base from the declivity more pronounced and somewhat more distinctly bidentate.

Sculpture, pilosity and color practically the same as in the worker major.

Female. Length 8.5—9 mm.

Head smaller and narrower than in the worker major, the sides and posterior border straight, the antennal scapes less flattened. Thorax rather long, elliptical from above, a little broader than the head; epinotum with convex, rounded base passing gradually into the longer, sloping declivity. Superior border of the petiole distinctly emarginate in the middle.

Sculpture of the head resembling that of the worker major but the remainder of the body is more shining owing to its much finer and more superficial puncturation.

Pilosity like that of the worker, but the shining appressed pubescence on the gaster is distinctly shorter and sparser so that the black surface is more apparent and much more shining.

Color as in the worker major, but the anterior border of the pronotum and the mesonotum about the wing insertions more or less ferruginous red. Wings long (nearly 10 mm.), faintly brownish and rather opaque, with pale brown veins; pterostigma with a long hyaline area in the middle.

Male. Length 5 mm.

Head, including the eyes and mandibles, a little longer than broad, broadly and semicircularly rounded behind. Cheeks straight and subparallel. Eyes large and convex. Clypeus rather convex, broader than long, with straight, entire anterior border. Mandibles small and rather broad, with only the acute apical tooth developed. Antennæ very slender, the scapes terete, reaching only two-fifths their length beyond the posterior border of the head. Thorax broader than the head, mosonotum as broad as long, subhexagonal. Epinotum resembling that of the female. Petiole thick and low, subcuboidal, with flattened dorsal surface, seen from above transversely oblong, twice as broad as long. Gaster somewhat flattened dorsoventrally, with very slender genital appendages. Legs very slender.

Sculpture like that of the female; head, including the mandibles, subopaque; thorax and gaster more shining, densely and very finely shagreened, except the mesonotum and scutellum, which are more sharply shagreened and subopaque.

Hairs grayish, much less abundant than in the worker, absent on the thorax and almost absent on the head. Pubescence very feebly developed, even sparser on the gaster than in the female.

Black or dark brown; mandibles dull yellowish, anterior portion of head and clypeus, antennæ, epinotum, thoracic sutures, petiole, legs and tip of gaster more piceous. Wings colored as in the female.

Described from 10 major workers, five minor workers, three females and a single male taken during October 1905 by Dr. F. X. Williams from a single colony at Cormorant Bay, Charles Island. The label bears a note that the species is "common in old logs". I have also before me 18 well-preserved males taken by the "Albatross" on the same island (acc. 21,699, U. S. Nat. Mus.).

The specimen from which Smith drew his description was evidently a worker minor.

C. planus belongs to a group of small *Camponoti* which Forel has recently segregated as the subgenus *Myrmorhachis*. It comprises several neotropical forms rather closely related to *planus*, notably *quadrilaterus* Mayr, *rectangularis* Emery, *bidens* Mayr, *mucronatus* Emery. So far as known the American species all nest in hollow twigs or in dead wood.

30. **Camponotus (Myrmorhachis) planus peregrinus** Emery.

Camponotus peregrinus Emery, Ann. Soc. Ent. France, 63, 1893, p. 91 ☿.

Camponotus (*Myrmorhachis*) *peregrinus* Forel, Rev. Suisse Zool. 22, 1914, p. 274 ☿.

As I have seen no specimens of *planus* from Chatham Island, I regard the form described by Emery as possibly of varietal rank, although it is by no means certain that his specimen, which was taken by Dr. George Baur on the vessel, came originally from the island. I translate Emery's description in its entirety, although it contains very little that does not agree with specimens of the typical *planus*.

"*Worker minor.* Black, opaque, with the mouth, antennæ and legs, excepting the coxæ, ferruginous; pilose, with the head and thorax very sparsely pubescent, the gaster with dense griseoæneous, shining, silky pubescence. Head subrectangular, clypeus in front broadly rounded, obtusely carinate, mandibles short, 4-toothed, eyes at the posterior part of the head. Thorax with distinct sutures, dorsally depressed, sides obtusely marginate, epinotum behind abruptly truncate and obsoletely bituberculate, its declivity concave, somewhat shining. Petiole truncate behind. Head and thorax very densely, petiole more sparsely punctate; gastric segments transversely rugulose-punctate; mandibles, scapes and legs delicately punctate; legs without erect hairs. Length 4.3 mm.

"This species belongs to an exclusively American group, and among the species known to me in nature, it approaches most closely *C. quadrilaterus* Mayr, from which, however, it differs considerably. The head is a little longer than broad if it be regarded as truncated in front at a level with the

insertions of the mandibles. The eyes are very close to the occipital border, from which they are separated by a space less than half the length of an eye. This character is found also in the minor worker of *C. quadrilaterus*. The clypeus is broadly rounded in front, with a very blunt, median carina. The antennæ are long, the scapes surpass the occipital border by more than one-third their length. The thorax is rather slender (total length 1.9 mm., width of pronotum 0.9 mm.), with the sutures well-marked but not impressed, the dorsum depressed, bordered by obtuse ridges. The epinotum is narrowed posteriorly, where it is sharply truncated, the base rising a little at its posterior end and nearly in the form of a right angle with the declivity, which is concave longitudinally; the ridge separating the two surfaces is very feebly notched, so that if the insect is viewed obliquely from the side, the epinotal base seems to terminate on each side in a pointed projection. The petiolar scale is truncated behind, i. e. its posterior surface is flat and vertical when viewed in profile; it forms a very sharp and feebly rounded angle with the anterodorsal surface; the anterior and dorsal surfaces form a very obtuse angle.

"The head and thorax are opaque and covered above with very fine and dense thimble-punctures; the inferior surface of the head is shining; the sides of the thorax are a little less opaque than the dorsum and covered with coarser punctures; the epinotal declivity is rather shining and irregularly and transversely rugose. The mandibles and appendages are opaque and covered with exceedingly fine and dense punctures. The anterodorsal surface of the petiole has a sculpture very much like that of the thorax, but the punctures tend to flow together to form transverse striæ. This transverse confluence is even more pronounced on the gaster, the sculpture of which is almost completely concealed by the ashen, slightly bronzy pubescence which forms a pelt. The pubescence of the head and thorax is composed of short, scattered hairs. The coxæ are finely and densely pubescent. There are rather numerous, erect, yellowish hairs on the thorax and gaster, shorter and sparser on the front.

"Perhaps this ant is not specifically different from *C. planus* F. Smith, to which it seems to be very closely related. The

English author says nothing about the bronzy pubescence of the gaster and describes the petiole as having a different form."

The omission to which Emery refers was probably due to the age of the specimen described by Smith, since it was taken by Darwin on the voyage of the "Beagle" and not described till 42 years later. Smith's description of the petiolar node as "incrassate, narrow, the sides nearly parallel, rounded above", is not so very inapplicable to specimens which undoubtedly belong to the true *planus*.

31. **Camponotus (Myrmorhachis) planus isabelensis,** new variety.

Worker major. Length 6.5—7 mm.

Somewhat larger than the typical *planus,* with the sides of the head decidedly more opaque and with larger, scattered punctures. The cheeks bear short, erect, blunt hairs. The hairs on the front, vertex and thoracic dorsum are more abundant, and those on the gaster are somewhat shorter, the pubescence on the legs, especially on the tibiæ, is distinctly longer and less appressed.

Worker minor. Length 4—5.5 mm.

Very similar to the worker major in sculpture, pilosity and pubescence. The base of the epinotum is more concave in profile and much more distinctly bidentate posteriorly than in the worker minor of the typical form, and the border of the petiole is distinctly more acute.

Female. Length about 8 mm.

Resembling the worker major and differing from the female of the typical *planus* in pilosity. The pubescence on the gaster is noticeably longer and denser and more as in the worker. The petiolar border is entire.

Male. Length 5—5.5 mm.

Indistinguishable from the male of the typical form.

Described from eight major and three minor workers taken by Dr. Williams in 1905 on Cowley Mt., South Albemarle, and 16 major workers, 13 minor workers, five females and 27 males taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on the same island.

Cotypes, 5 specimens, No. 455, Museum California Academy of Sciences, and 6 specimens in author's collection.

This variety is readily distinguished from all the other forms of *planus* by the erect, stubby hairs on the cheeks, the more abundant pilosity of the head and thorax and the longer pubescence on the legs of the worker and female.

32. **Camponotus (Myrmorhachis) planus indefessus, new variety.**

Worker major. Length 5—6 mm.

Body shorter and stouter than in the typical *planus* and var. *isabelensis,* the head larger and broader. Sculpture, pile and pubescence as in *isabelensis,* but the cheeks without erect hairs. The ferruginous red color extends back further on the head, covering the clypeus, cheeks and front and is suffused with the black on the sides and posterior corners. The antennæ and legs, excluding the coxæ, are somewhat more yellowish. The ridge between the base and declivity of the epinotum is scarcely impressed in the middle.

Worker minor. Length 4—4.5 mm.

Very similar to the worker major, even in the color of the head. Epinotum very feebly bidentate.

Described from six major and three minor workers taken from a single colony by Dr. Williams, Oct. 25-28, 1905, on Indefatigable Island.

Cotypes, 3 specimens, No. 456, Museum California Academy of Sciences, and 6 specimens in author's collection.

33. **Camponotus (Myrmorhachis) planus santacruzensis, new variety.**

Worker major. Length 5.5—6 mm.

Like the typical *planus* in stature, in the size of the head, sculpture, pilosity and color, but the hairs are even sparser on the dorsal surface of the head and thorax and the pubescence on the scapes, legs and gaster is distinctly shorter and finer, so that the gaster has a less silky lustre. The base of the epinotum is straight and horizontal in profile, not concave,

and the ridge between the base and declivity is semicircular and entire, without indications of teeth.

Worker minor. Length 4.5—5 mm.

Like the worker major, but the epinotum is slightly concave in profile just in front of the ridge between the base and declivity. This ridge is very narrow and indistinctly bidentate.

Female. Length 10 mm., wings nearly 11 mm.

Larger than the female of the typical *planus* and var. *isabelensis* and of a deeper black color, the thorax being without red markings. The pubescence on the gaster as in the type.

Male. Length 5—6 mm.

Like the male of the typical *planus,* except that the body and appendages are somewhat darker and more blackish.

Described from five major workers, 11 minor workers, seven females and five males taken during November, 1905. by Dr. Williams from a single colony on Indefatigable Island. Although this form occurs on the same island as the preceding it is nevertheless so different that I am compelled to regard it as a distinct variety.

Cotypes, 15 specimens, No. 457, Museum California Academy of Sciences, and 15 in author's collection and 8 in the Museum of Comparative Zoology.

34. Camponotus (Myrmorhachis) planus fidelis, new variety.

Worker major. Length 5.5—6 mm.

Resembling the var. *indefessus* in stature, in the size of the head, pilosity and sculpture, but the pubescence of the head and thorax is much shorter and less conspicuous. On the gaster it is dense and rather long and has a pronounced silvery lustre. The epinotum differs, however, from that of all the preceding varieties, the base being scarcely longer than the declivity and perfectly straight and horizontal in profile. The ridge separating it from the declivity is straight, transverse, rather blunt and entire, without any indications of teeth. The reddish color of the anterior part of the head is suffused with the black even on the vertex and occiput and

the pronotum and basal gastric segment are also distinctly reddish.

Worker minor. Length 3.5—4 mm.

Very similar to the worker major even in the structure of the epinotum. The red parts of the body, however, are distinctly more yellowish.

Female (deälated). Length 9 mm.

Colored like the worker major but with the anterior and lateral portions of the mesonotum, the mesopleuræ above and the sutures of the thorax and gaster ferruginous red. The pubescence on the gaster as in the female of the typical *planus*. The border of the petiole is blunt, transverse and entire.

Described from two major and six minor workers and a single female taken by Dr. Williams, Oct. 19-24, 1905, on Barrington Island. I do not regard the more reddish color of the head and thorax of all these specimens as due to immaturity.

Cotypes, 5 specimens, No. 458, Museum California Academy of Sciences, and 4 specimens in author's collection.

35. Camponotus (Myrmorhachis) planus fernandinensis, new variety.

Worker major. Length 6.5—7 mm.

With the stature and size of the head of the typical *planus* and very similar pilosity and color. The pubescence on the gaster, however, is shorter and dull grayish, without the silky lustre of many of the other varieties. The pubescence on the legs and scapes is very short and inconspicuous. The sculpture is most like that of the var. *isabelensis,* although the sides of the head are somewhat more shining and more feebly punctate as in the typical *planus*. The base of the epinotum is concave in profile and the ridge between the base and declivity is rather sharp and feebly emarginate in the middle.

Described from 10 specimens taken by the "Albatross" in 1899 (U. S. Nat. Mus.) on Narborough Island.

Cotypes, 1 specimen, No. 459, Museum California Academy of Sciences, and 4 specimens in author's collection.

This variety is most distinctly characterized by the short, dull grayish pubescence of the gaster.

36. Camponotus (Myrmorhachis) planus pinzonensis, new variety.

Worker major. Length 6.5—7 mm.

Very similar to the preceding variety and with the same kind of pubescence on the gaster, but the pubescence on the head, thorax, scapes and legs is more abundant though not longer. The base and declivity of the epinotum are subequal in profile and the former is perfectly straight and horizontal, the latter straight above; the ridge separating them is transverse and entire, without any indications of teeth.

Worker minor. Length 3.5—4.5 mm.

Very similar to the worker major, but the epinotum has the base feebly concave and bidentate behind.

Female. Length 7.5—8 mm., wings 8.5 mm.

Smaller than the female of the typical *planus*, with the pubescence of the gaster precisely the same as in the worker. The superior border of the petiole is distinctly emarginate in the middle. The pronotum and paraptera are tinged with ferruginous red and the legs and antennæ are more yellowish than in the worker. The head and body are more distinctly shagreened and much less shining than in the typical *planus*.

Described from five major workers, three minor workers and six females taken by Dr. Williams, August 13-14, 1906, on Duncan Island.

Cotypes, 6 specimens, No. 460, Museum California Academy of Sciences, and 8 specimens in author's collection.

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XV

THE ANTS OF COCOS ISLAND[1]

BY

WILLIAM MORTON WHEELER

Cocos Island, owing to its isolated position some 300 miles off the west coast of Costa Rica, is of unusual interest in connection with the origin of the fauna and flora of the Galapagos Archipelago, a problem which, in turn, according to Scharff[2], "presents the key to the solution of the most complex and intricate questions concerning the American fauna with which we are confronted." While in charge of the Hopkins-Stanford Galapagos Expedition, Snodgrass and Heller[3] explored the island June 30 to July 3, 1899, and gave such an interesting and succinct account of its topography and biota that it seems

[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 138.

[2] *Scharff, R. F.* Distribution and Origin of Life in America. New York, Macmillan Co., 1912.

[3] *Snodgrass, R. E., and Heller, E.* The Birds of Clipperton and Cocos Islands. Papers from the Hopkins-Stanford Galapagos Expedition. 1898-1899, XI. Proc. Wash. Acad. Sci. 4, 1902, pp. 501-520.

appropriate to quote most of their remarks by way of introduction to the present paper:

"Cocos Island lies in latitude 5° 33′ north and longitude 87° 2′ west. It is about four miles long in its longest diameter, which is east and west, and has a circumference of about thirteen miles. Its highest part, on its western side, is visible from a distance of sixty miles. The island is mountainous, presenting on all sides perpendicular cliffs, and above these steep slopes and canyons. The northern side, however, has several indentations. * * * Streams of fresh water flow down on all sides of the island, in most places pouring over the cliffs into the ocean. * * *

"The rock composing Cocos Island is volcanic, but is not made up of layers of lava as is the case with the Galapagos, Rivillagigido and Guadalupe Islands, but, at least about Chatham Bay, forms one solid mass as does the volcanic rock on Clipperton Island. The surface is greatly eroded, there being everywhere, as before stated, numerous deep canyons, and the rock is almost everywhere covered by a rich shallow soil.

"The climate resembles that of Clipperton, being extremely humid. The island lies in the warm counter equatorial current which flows past Cocos in an easterly direction towards Panama Bay, where its waters are deflected to the north and south. With the currents flowing as they now do, it is apparently impossible for plants or animals to be carried by them from the mainland to Cocos Island.

"The vegetation is extremely rich, though the number of plant species is few. Everywhere a dense covering of tall trees and smaller undergrowth clothes the irregular mountain slopes and ridges. In this respect Cocos strongly contrasts with any other island of the eastern tropical Pacific. Guadalupe Island, the Rivillagigido and Galapagos archipelagos are for the most part dry and barren, even the wettest parts of the Galapagos being far less humid and less thickly covered with vegetation than is Cocos.

"Animal life on Cocos Island is very scarce. Besides the birds there is present a rat, *Mus norwegicus,* brought hither by vessels that have touched here for wood and water. A lizard, *Anolis townsendi,* is rather numerous. With the exception of a

snake reported by Townsend this lizard and the birds are the only native land vertebrates known. Hogs have been introduced and now run wild on the island. Insects are very scarce. One *Cicada* occurs but is rare. We obtained one nymph of it in July but saw no adults. A fly, *Leucomelina pica,* is somewhat plentiful. There is one ant, *Tetramorium auropunctatum,* that is extremely numerous, occurring in great numbers on the leaves of all the vegetation. It is minute but its bite is excessively annoying, causing an almost unendurable irritation of the skin. Its presence makes traveling on the island exceedingly disagreeable."

Forel in 1892[4] published the first and up to the present time the only account of the ants of Cocos Island. Among the specimens collected for him by Mr. P. Biolley he recognized only four forms: *Tetramorium guineënse* Fabr., *Wasmannia auropunctata* Roger., *Prenolepis guatemalensis* var. *cocoënsis* Forel and *Camponotus biolleyi* Forel; the latter two being peculiar to the island.

Several months ago Dr. E. C. Van Dyke, at the request of Dr. F. X. Williams, sent me for study the Cocos Island ants which he collected during November, 1905, while a member of the California Academy Expedition to the Galapagos. The specimens comprise seven forms, four of which are identical with those recorded by Forel, but the three others, *Euponera (Trachymesopus) stigma* Fabr., *Odontomachus hæmatoda* L. subsp. *insularis* and a new *Camponotus (C. cocosensis)* constitute a significant addition to the ant-fauna of the island. With the exception of the tropicopolitan "tramp", *Tetramorium guineënse,* of Old World origin, none of the forms is known to occur in the Galapagos Islands and all are neotropical or have strongly neotropical affinities. *Camponotus biolleyi* and *cocosensis* are related to *C. lindigi* Mayr and *C. novogrenadensis* Mayr respectively of Central and South America. The *Wasmannia, Euponera* and *Odontomachus* are well known species abundant and widely distributed through the neotropical region, and the var. *cocoënsis* is merely a form of *Prenolepis vividula* Nyl., which is also widely distributed in the American tropics and occurs even in the hot-houses of North America and

[4] *Forel, A.* Quatre Notices Myrmécologiques. II Fourmis de l'île de Coco, etc. Ann. Soc. Ent. Belg. 46, 1902, pp. 176-178.

Europe. Hence the only forms really endemic and characteristic of Cocos Island are the two species of *Camponotus*.

The ants, therefore show the same relation as the diurnal Lepidoptera to the Galapagos fauna of which Williams says[5]: "Only two species of butterflies were taken on Cocos Island, and neither of them occurs in the Galapagos." It is evident that the Cocos ants are decidedly tropical whereas those of the Galapagos are mainly such as belong to subtropical or temperate regions or at any rate to the cooler or subalpine regions in the New World tropics. Williams calls attention to this difference in the climates of the two island regions. It comes out strongly also in the Cocos plants which have been recently studied by Stewart.[6] This author records 77 species of vascular plants from Cocos Island, 20 of which are ferns. There are only eight endemic species, one of which is a *Cecropia (C. pittieri)*. Thus only 8.69 percent of the plants are endemic, whereas the percentage of endemicity in the Galapagos is 40.9. There are, however, 27 species common to the two regions, although 11 of them are ferns. Botanists have repeatedly called attention to the great difference between the Cocos and Galapagos plants, but this would be expected as a result of the pronounced climatic differences. The data derived from a study of the ants are too meager to enable me either to accept or to reject Stewart's view that Cocos is a true oceanic island of more recent origin than the Galapagos and that it has received its biota as "flotsam and jetsam" from the Central American mainland.

Family FORMICIDÆ

Subfamily PONERINÆ

1. Euponera (Trachymesopus) stigma (Fabricius)

Formica stigma Fabricius, System. Piez. 1804, p. 400 ☿.

Ponera quadridentata Roger, Berl. Ent. Zeitschr. 4, 1860, p. 285 ☿.

[5] *Williams, F. X.* The Butterflies and Hawk-Moths of the Galapagos Islands. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906, III. Proc. Cala. Acad. Sci. (4) 1, 1911, pp. 289-322, 2 pls.

[6] *Stewart, A.* Notes on the Botany of Cocos Island. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905-1906, V. Proc. Calif. Acad. Sci. (4) 1, 1912, pp. 375-383.

Ponera americana Mayr, Verh. zool. bot. Ges. Wien, 13, 1862, p. 722 ☿ ; *ibid* 28, 1878, p. 663, ☿ ♀.

Ponera stigma Roger. Verzeich. Formicid. 1863, p. 16; Emery, Ann. Mus. Civ. Genoa, 25, 1887, p. 434 ☿ ; Dalla Torre, Catalog. Hymen. 7, 1893, p. 42.

Pachycondyla (Pseudoponera) stigma Emery. Ann. Soc. Ent. Belg. 45, 1901, p. 46.

Euponera (Trachymesopus) stigma Emery, Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 85.

Dr. Williams took a dozen workers which are indistinguishable from specimens from various parts of the American tropics (Southern Florida, West Indies, Mexico, Central and South America) in my collection. A variety of the species, *quadridentata* F. Smith, occurs in the East Indies.

2. Odontomachus hæmatoda insularis Guérin

Odontomachus insularis Guérin, Icon. Règne Anim. 7. 1845, p. 423 ☿ ; Lucas, in Ramon, Hist. Fis. Cuba, 7, 1857, p. 757, pl. 18, Fig. 7 ☿ ♀ ♂.

Odontomachus hæmatodes subsp. *insularis* Emery, Bull. Soc. Ent. Ital. 22, 1890, p. 44, *nota.*

? *Atta brunnea* Patton, Amer. Natural. 1894, p. 618.

Odontomachus hæmatoda subsp., *insularis* Emery, Gen. Insect. Ponerinæ, Fasc. 118, 1911, p. 115.

Fifteen workers agreeing in all respects with specimens from Georgia, Florida, West Indies and Central America in my collection.

Subfamily MYRMICINÆ

3. Tetramorium guineënse (Fabricius)

Seven workers and three deälated females. This is a very common tropicopolitan species, which occurs also in the Galapagos Islands and even in hot-houses of temperate regions as it is frequently introduced with plants from the West Indies and the adjacent mainland. A portion of the rather extensive synonymy of this ant is given in my "Ants of the Galapagos Islands," p. 274.

4. Wasmannia auropunctata (Roger)

Tetramorium? auropunctatum Roger, Berl. Ent. Zeitschr. 7, 1863, p. 182 ☿ ♀ ♂.

Tetramorium auropunctatum Forel, Bull. Soc. Vaud. Sc. Nat. (2) 20, 1884, p. 375 ☿; Mayr, Verh. zool. bot. Ges. Wien, 37, 1887, p. 623; Dalla Torre, Catalog. Hymen. 7, 1893, p. 130.

Ochetomyrmex auropunctatus Forel, Ann. Soc. Ent. Belg. 30, 1886, C. R. p. XLIX.

Tetramorium (Xiphomyrmex) auropunctatum Forel, Mitth. Schweiz. Ent. Ges. 7, 1887, p. 385.

Wasmannia auropunctata Forel, Trans. Ent. Soc. London, 1893, p. 383 ☿ ♀ ♂.

Seven deälated females and numerous workers taken by Dr. Williams in November, 1905, and seven workers taken by the "Albatross" in 1899 (U. S. Nat. Mus.). The females are considerably darker than West Indian specimens but of about the same color as Brazilian and Colombian specimens in my collection. This is the ant to which Snodgrass and Heller refer (*supra* p. 301) under the old name *Tetramorium auropunctatum* as occurring in great numbers on the leaves on Cocos Island and as making "traveling on the island exceedingly disagreeable." It is not the bite, however, but the sting which is so irritating. There is also a note on Dr. Williams' label to the effect that his specimens were found on rocks and vines and had a "fiery sting." This ant is well known in Porto Rico under the name of "albayarde". Mr. R. H. Van Zwalenberg wrote me from Mayaguez: "In regard to *Wasmannia auropunctata* Roger I would say that as a rule this species is not pugnacious even when handled under ordinary collecting circumstances. It has a burning sting, however, though not so severe as that of *Solenopsis geminata*. The ferocity of the "albayarde" is proverbial among the natives; when present during the coffee picking it gets under the workers' clothes and then gives a good account of itself." This difference in behavior is easily explained. When one opens the populous nests under stones or logs the minute workers are unable to penetrate the thick skin of one's hands with their stings, but can easily thrust them into the thinner skin of the covered parts of the body.

Subfamily CAMPONOTINÆ

5. **Prenolepis vividula guatemalensis cocoënsis** Forel.

Prenolepis guatemalensis Forel var. *cocoënsis* Forel, Ann. Soc. Ent. Belg. 46, 1902, p. 178 ☿.

This variety is very close to the var. *itinerans* Forel, the worker being "of the same form and stature, but the color is a little duller, the legs, especially the tibiæ are brownish, the surface is more opaque, and the hairs are a little longer and more abundant than in *itinerans* or the typical *guatemalensis*. The epinotum is also a little more elevated and more gibbous than in the type of *itinerans*, with deeper mesoëpinotal suture. The legs and hairs are dark-colored, strikingly contrasting with the yellowish body."

Thirteen workers taken by Dr. Williams agree with Forel's description, except that the legs are concolorous with the body. Three females from the same colony are of the same color as the workers but distinctly paler than females of *itinerans* from the Galapagos Islands and have the head smaller, with much more rounded occipital corners and the hairs on the thorax shorter and less abundant. The specimens of *cocoënsis* were taken by Dr. Williams in rotten logs. Forel's name '*cocoënsis*' should probably be amended to read "*cocosensis*".

6. **Camponotus (Myrmobrachys) biolleyi** Forel

Camponotus biolleyi Forel, Ann. Soc. Ent. Belg. 46, 1902, p. 177 ☿ ♂.

Camponotus (Myrmobrachys) biolleyi Forel, Rev. Suisse Zool. 22, 1914, p. 270.

Forel's description and four worker cotypes in my collection show that this species is very closely related to *C. lindigi* Mayr of Central and South America. Two minor workers taken by Dr. Williams agree perfectly with the cotypes. Biolley found the species nesting in dead branches and abundant on the ferns which form the undergrowth on Cocos Island.

7. **Camponotus (Myrmamblys) cocosensis,** new species

Worker major. Length 6.5–7 mm.

Head large, subrectangular, about 1.2 times as long as broad, a little narrower in front than behind, with straight sides

and broadly excised occipital border, and rather convex dorsal surface, not truncated anteriorly. Eyes moderately large, flat, their anterior orbits at the median transverse diameter of the head. Mandibles rather small, convex, 4-toothed. Clypeus trapezoidal, longer than broad and distinctly broader in front than behind, rather flat, sharply carinate behind, with entire, feebly rounded anterior border. Frontal area very distinct, transverse, triangular. Frontal carinæ rapidly diverging in front, subparallel behind. Frontal groove distinct but not very deeply impressed. Antennæ slender, scapes not flattened, curved at the base, extending a little beyond the posterior corners of the head. Thorax decidedly narrower than the head, laterally compressed behind, evenly arcuate above in profile, with distinct promesonotal and feeble mesoëpinotal sutures. Pronotum somewhat broader than long, slightly convex, indistinctly marginate in the humeral region; epinotum with distinct base and declivity meeting at a very obtuse angle, the former sloping and straight, the latter more abrupt, marginate on the sides and longitudinally concave in the middle. Petiole rather low and thick, not as high as the epinotum, narrower than the posterior end of the epinotum, flat behind, rather strongly and evenly convex in front, with blunt, rounded and entire superior border. Gaster somewhat larger than the head, elliptical, slightly flattened dorsoventrally. Legs moderately long, anterior femora somewhat enlarged.

Subopaque; mandibles, posterior corners of the head and legs more shining. Surface of body distinctly shagreened and with piligerous punctures, which are small and shallow on the head, coarser, deeper and sparser on the thorax and gaster, finer, sharper and more numerous on the mandibles.

Hairs pale yellow, rather glistening, abundant, erect and rather long on the dorsal surface of the head, thorax, petiole and gaster, absent on the legs and antennæ. Pubescence yellowish, short, very dilute, distinct and appressed on the sides of the head, slightly longer and subappressed on the legs, extremely short and inconspicuous on the antennal scapes.

Dull yellowish ferruginous, mandibles, petiole and gaster and in some specimens the epinotum or whole thorax, brown; tips of mandibles and their teeth blackish, legs paler and more yel-

lowish than the thorax, knees slightly infuscated, posterior borders of the gastric segments very narrowly yellowish.

Worker minor. Length 4.5–5 mm.

Differing from the worker major mainly in the structure of the head and in coloration. The head is somewhat longer than broad but the posterior corners are more rounded and the occipital border is straight, the clypeus is broader than long, the antennal scapes extend half their length beyond the occipital border, the eyes are large and distinctly convex. Thorax much like that of the worker major but higher and somewhat more gibbous in the mesonotal region and with the epinotal angle less distinct and more rounded and the declivity more sloping.

Sculpture and pilosity much as in the worker major but the surface of thorax, petiole and gaster and of the head behind the clypeus decidedly more shining and the puncturation of all these parts finer, denser and more indistinct.

The erect hairs are glistening white, somewhat more abundant and conspicuous than in the worker major and the pubescence longer and distinct on the whole dorsal surface of the head.

Head between and behind the eyes, thorax, petiole and gaster dark brown, the antennal funiculi byond the first joint and the knees distinctly infuscated, anterior portion of the head, including the mandibles yellowish, tips and teeth of the mandibles brown.

Worker media. Length 5.5–6 mm.

Intermediate in structure between the major and minor worker but with the coloration, sculpture and pilosity of the former.,

Described from six major workers, three mediæ and six minor workers taken in November, 1905, by Dr. Williams. The worker major resembles the corresponding phase of *C. novogrenadensis* Mayr in size and in the structure of the head and body, but the sculpture, pilosity and color are very different, the eyes are much larger, the antennal scapes somewhat longer, the thorax longer and less convex in the mesoëpinotal region, etc. The worker minor bears a strange resemblance to the worker minor of *C. biolleyi* but can be distinguished by its

greater size, somewhat paler color, longer and lower epinotum, the more extensive infuscation of the antennal funiculi, the fuscous knees and the longer and somewhat less abundant erect hairs on the dorsal surface of the body.

Cotypes, 8 specimens, No. 461, Museum California Academy of Sciences, and 9 specimens in author's collection.

PROCEEDINGS

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XVI

A NEW SPECIES OF THE HYMENOPTEROUS GENUS SCLERODERMA FROM THE GALAPAGOS ISLANDS

BY

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Scleroderma galapagense, new species

♀. Length 2.5–3 mm. Head and thorax pale brown to castaneous, abdomen fuscous or piceous, lighter toward apex and at the incisures; legs and antennæ pale yellowish brown; wings entirely absent. Head shining, faintly shagreened, with a few isolated punctures; one-half longer than wide; eyes one-fifth as long as the head, bare; ocelli absent; head widest at the middle, slightly narrowed behind with the angles rounded; malar space extremely short. Head below with sparse long pale backwardly curved hairs. Antennæ 13-jointed, reaching to the vertex, pedicel half as long as the scape and twice as long as thick; first flagellar joint minute, quadrate; second and third

transverse, no longer than the first; fifth and following quadrate except the last which is twice as long as thick. Thorax of nearly even width, four times as long as broad except where the mesopleuræ project at the sides, propleuræ not visible from above; pronotum shagreened, twice as long as wide and slightly narrowed from its posterior angles to the neck. Mesonotum shagreened, rounded behind, two-thirds as wide as pronotum; axillæ (metanotum) triangular on the sides, meeting medially as a narrow band; propodeum with the sides nearly parallel, very slightly constricted near the base, declivous on its posterior third, its surface more coarsely shagreened than the mesonotum. Pleuræ shagreened, the propleura nearly smooth; mesopleura strongly protuberant. Abdomen smooth and shining, over twice as long as the thorax; with a few scattered whitish hairs laterally toward apex; first segment semicircularly rounded at apex; following ones with the margins straight; second and third subequal, each half wider than long; following growing shorter, apex acute. Legs stout, the middle tibiæ faintly denticulate, but not spinulose; claws slender, simple.

Described from six specimens, taken under a stone in a colony of *Prenolepis (Nylanderia) fulva* Mayr, subsp. *nesiotis* Wheeler on James Island, Galapagos at an altitude of 2000 ft.

This species is very similar to the other members of this cosmopolitan genus which is already known from many oceanic islands as well as from the continental areas. In the form of the head, eyes and thorax it seems to be most closely related to *S. sidneyanum* Westwood.

Holotype, No. 462, female, and one paratype, female, Museum California Academy of Sciences, and 4 paratypes in author's collection.

PROCEEDINGS

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EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

XVII

DERMAPTERA AND ORTHOPTERA

BY

MORGAN HEBARD

During the years 1905 and 1906, an expedition under the auspices of the California Academy of Sciences visited the Galapagos Islands. One of the members, Mr. F. X. Williams, concentrated his efforts on collecting insects and a considerable series of Orthoptera was secured. This material has been placed in our hands for study, and the results are incorporated in the present paper. Over five hundred specimens have been examined, representing eighteen genera and twenty-eight species and races, of which one is here described as new.

We take the present opportunity to thank most heartily Dr. Barton Warren Evermann, Director of the Museum of the California Academy of Sciences, for enabling us to undertake this task, and Mr. E. P. Van Duzee, Curator of Entomology of that institution, who has not only prepared and shipped the material to us with the greatest care, but has also aided in supplying such field notes as were made.

Dr. R. W. Doane of Leland Stanford Jr. University has also rendered invaluable assistance by sending for examination the most important of the material collected by the Hopkins-Stanford Expedition to the Galapagos. From this material we have been able to select single types for the species described by McNeill, determine their validity, and ascertain their proper generic position.

As this was the tenth scientific expedition to visit these islands, we believe that the Dermaptera and Orthoptera there found are now very well understood. As is usual in insular environment, the number of native species known to occur in the Galapagos is very small in comparison with any continental locality situated on the Equator. One roach, one mantid, eight grasshoppers, four katydids and four crickets comprise the native species. These are, however, of decided interest, as all but one grasshopper, one katydid, and one cricket, are peculiar to this archipelago. Additional interest is found in the fact that the grasshoppers, *Schistocerca literosa* (Walker) and *Halmenus robustus* Scudder, each divides into three distinct geographic races, while the color forms of *Schistocerca melanocera* (Stål) are remarkably intricate, and *Schistocerca intermedia* Snodgrass, is found to be a striking type, evidently annectent between the two other very different appearing species of the genus. One earwig and eight roaches are adventive.

It has long been known that many forms of life found on the Galapagos exhibit a complexity seldom found under natural conditions. Thus in the birds, the genus *Melanospiza* has proved a most difficult and intricate problem. In the Orthoptera we find that we are confronted with racial differentiation only in the two species of grasshoppers noted above.

It is evident that the complexities known to occur in the biota of the Galapagos have led several authors into assuming that far more racial differentiation existed in the Orthoptera than is really the case. We can find no justification for Snodgrass's division of *Sphingonotus* into two species and many races, or of *Schistocerca melanocera* into numerous races. McNeill is similarly at fault in endeavoring to divide his material of the genus *Liparoscelis* into three species.

The present known distribution of Orthoptera in the Galapagos Archipelago is shown by the following table.

		Wenman	Abingdon	Bindloe	Tower	Narborough	Albemarle	James	Jervis	Duncan	Seymour	Indefatigable	Barrington	Chatham	Charles	Gardner	Hood
A	*Euborellia annulipes*						*							*			
A	*Anisolabis maritima*																*
A	*Blattella germanica*																
1	*Symploce lita*																
A	*Leucophaea surinamensis*																
A	*Periplaneta americana*																
A	*Periplaneta brunnea*																
A	*Periplaneta australasiæ*																
A	*Nauphoeta cinerea*																
A	*Pycnoscelus surinamensis*						*										
2	*Galapagia solitaria*						*					*					
3	*Clesteridea baeri*						*										
4	*Sphingonotus fuscoirroratus*		*			*	*	*			*	*	*	*	*	*	*
5	*Schistocerca melanocera*		*	*		*	*	*	*	*	*	*	*	*	*	*	
6	*Schistocerca intermedia*									*							
7	*Schistocerca literosa literosa*													*			
7a	*Schistocerca literosa punctata*															*	*
7b	*Schistocerca literosa hyalina*				*												
8	*Halmenus robustus robustus*							*				*					
8a	*Halmenus robustus cuspidatus*						*										
8b	*Halmenus robustus choristopterus*														*		
9	*Halmenus eschatus*	*															
10	*Desmopleura convexa*							*									
11	*Anaulocomera darwinii*							*				*		*			
12	*Liparoscelis cockerelli*						*	*				*	*		*		*
13	*Neoconocephalus triops*													*			
14	*Conocephalus exitiosus*							*				*					
15	*Gryllus assimilis*			*	*	*		*				*		*	*		*
16	*Hygronemobius speculi*							*									
17	*Cryptoptilum erraticum*		*			*		*							*		*
18	*Cryptoptilum laevissimum*							*									

The adventive species are marked "A", instead of being numbered.

The material here studied belongs to the California Academy of Sciences, with the exception of a duplicate series which the Academy has kindly permitted the author to retain.

For a description of the islands and for excellent photographs showing the various types of vegetation, we would refer to the account published by Alexander Agassiz[1].

DERMAPTERA

A single species of Dermaptera, *Euborellia annulipes* (Lucas), has been found adventive in the Galapagos Islands. It is widely distributed through the tropics of America and has been introduced as far north as Philadelphia, Pennsylvania, in the United States, and as Paris, France. The species is not represented in the present collections.

[1] Bull. Mus. Comp. Zool., XXIII, pp. 1 to 89, pls. I to XXII, (1892).

BLATTIDÆ

Nine valid species of Blattidæ are now known from the Galapagos Islands. All but one are adventive forms, domiciliary or adapted to thrive about the habitations of man.

PSEUDOMOPINÆ

Anisopygia Saussure

1893. *Anisopygia* Saussure, Soc. Ent. Zurich, VIII, p. 57.

From a consideration of the description and figures of *jocosiclunis* Saussure, genotype of *Anisopygia,* described from Guatemala, we believe that *Temnopteryx snodgrassii* McNeill, the only known native species of the Blattidæ found in the Galapagos, should be assigned to the same genus.

The following features are shown by *snodgrassii* and are shared by *jocosiclunis* so far as we are able to determine from the literature. We believe that all will be found to be diagnostic for *Anisopygia.*

Interocular space very wide. Tegmina greatly reduced but with sutural margins overlapping, anal sulcus obsolete. Wings greatly reduced. Dorsal surface of male abdomen with caudal margin of penultimate tergite very deeply concave, supra-anal plate very strongly and deeply fissate. Ventro-cephalic margin of cephalic femora with a row of spines which decrease suddenly in size mesad, those distad being piliform, terminating in three heavy distal spines. Pulvilli and arolia present, the former on all four proximal tarsal joints. Tarsal claws symmetrical and unspecialized.

From the above it will be noted that the position of this genus is near *Chromatonotus* Hebard.

To this genus the Mexican species *limbata* and *sumichrasti,* described by Saussure[2] as members of the genus *Temnopteryx,* show close affinity. The character of the dorsal portion of the male abdomen, at least as described for *limbata,* would appear to indicate that they belong, however, to a distinct though closely related genus. Females of *limbata* are in the Hebard Collection, but without males we are not able to make a definite generic assignment.

[2] 1868. Rev. et Mag. Zool., (2), XX, pp. 97 and 98.

1. **Anisopygia snodgrassii** (McNeill)

1901. *Temnopteryx snodgrassii* McNeill, Proc. Wash. Acad. Sci., III, p. 493, figs. 35 to 37. [♂, ♀, juv.; Albemarle Island, Galapagos Islands.]

The present insect is readily distinguished from *jocosiclunis,* as well as from the Mexican species we have discussed above, by its solid coloration, nearly rectangulate tegmina with angles rounded and distinctive specialization of the male supra-anal plate.

It appears that McNeill had five specimens before him at the time of original description, though at the end of his diagnosis the adult male was not recorded. The series now before us includes one adult male, so recently emerged that it had not become chitinized, one adult female and three immature females, all taken on Albemarle Island, June 9, 1899. We here select the adult female as single type, the adult male as allotype; both the property of the Leland Stanford Junior University.

McNeill's figure 37 is extremely sketchy and inaccurate. We have consequently given an outline of the distal portion of the abdomen in this male, figure 1.

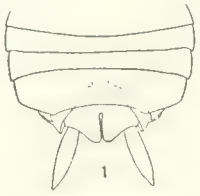

Fig. 1.—*Anisopygia snodgrassii* (McNeill). Dorsal outline of distal portion of male abdomen. *Allotype.* Albemarle Island, Galapagos Islands. (X 6)

2. **Blattella germanica** (Linnæus)

1767. [*Blatta*] *germanica* Linnæus, Syst. Nat., ed. XII, I, p. 668. [Denmark.]

Hood Island, June 1, 1906, 1 ♀.

This cosmopolitan domiciliary species has become widely established through North and South America.

3. **Symploce lita** Hebard

1916. *Symploce lita* Hebard, Trans. Am. Ent. Soc., XLII, p. 357, pl. XVII, fig. 8, pl. XVIII, figs. 1 to 4. [♂, ♀; Key West, Florida; Vera Cruz and San Jose del Cabo, Mexico.]

Chatham Island, October, 1905, 1 ♂.

We have stated that this domiciliary species is probably widely distributed through the North American tropics. The specimen here recorded is the first to be found south of Mexico.

EPILAMPRINÆ

4. **Leurolestes pallidus** (Brunner)

1865. *Nauphoeta pallida* Brunner, Nouv. Syst. Blatt., p. 286. [Cuba.]

Chatham Island, January, 1906, 1 ♀.

The present domiciliary species has been widely distributed through the American tropics. It is also known from Teneriffe, Canary Islands.

BLATTINÆ

5. **Periplaneta brunnea** Burmeister

1838. *P[eriplaneta] brunnea* Burmeister, Handb. Ent., II, Abth. II, pt. I, p. 503. [♂, ♀; Chile; Demerara [=British Guiana].]

Chatham Island, January, 1906, 1 ♀.

This is a circumtropical domiciliary insect, the most abundant of the species of *Periplaneta* in tropical America.

6. **Periplaneta australasiæ** (Fabricius)

1775. [*Blatta*] *australasiæ* Fabricius, Syst. Ent., p. 271. ["In nave e mare pacifico et regionibus incognitis revertente".]

Chatham Island, October, 1905, January, 1906, 1 ♀; and Charles Island, October, 1905, 3 ♂, 6 ♀.

This domiciliary species is likewise circumtropical in distribution. When encountered, *australasiæ* is usually found in very large numbers.

Panchlorinæ

7. **Pycnoscelus surinamensis** (Linnæus)

1767. [*Blatta*] *surinamensis* Linnæus, Syst. Nat., Ed. XII, p. 687. [Surinam.]

Villamil, Albemarle Island, 1 ♀; Chatham Island, October, 1905, 3 ♂, 3 juv. ♀; and Charles Island, October, 1905, 1 juv. ♀.

This circumtropical species, which thrives in the vicinity of human habitations, appears to be parthenogenetic in the Americas. The smallest immatures here recorded have the subgenital plate bearing styles; the brief cleft meso-distad, however, determines the sex with certainty.

8. **Nauphoeta cinerea** (Olivier)

1789. *Blatta cinerea* Olivier, Encycl. Method., Ins., IV, p. 314. [Adults and juv.; L'ile de France [=Mauritius].]

Chatham Island, October, 1905, 3 ♂, 4 ♀, 3 juv.; and Charles Island, October, 1905, 6 ♂, 8 ♀, 3 juv.

This is a circumtropical domiciliary species. Immatures are very differently colored than the adults, particularly the head which is dark and unicolorous, with pale mouthparts. Adults from the Galapagos have been recorded by Bruner as the synonymous *bivittata* and by Scudder correctly. Immatures were, however, recorded from these islands as *Nauphoeta lævigata* by Bruner and as *Nauphoeta circumvagans* by Scudder, as material before us from the United States National Museum shows.

Mantidæ

A single species of Mantid is known from the Galapagos and is peculiar to these islands.

9. **Galapagia solitaria** Scudder

1893. *Galapagia solitaria* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 8, pl. 1, figs. 2 and 3. [♂, ♀; South Albemarle Island, Galapagos Islands.]

San Tomas, Albemarle Island, 1200 feet, September, 1906, 1 ♂, and Cormorant Bay, Charles Island, October, 1905, 1 juv. ♂.

This genus and species is of particular interest, due to the fact that though a member of Giglio-Tos' eighth subfamily, the Parathespinæ, it is aberrant in certain features showing some divergence toward the eleventh subfamily, Oligonicinæ, of Giglio-Tos. The reduction in the number of cephalic tibial spines and decided production of the juxta-ocular portions of the vertex are the features of particular interest. Though the cephalic tibiæ bear no dorsal spines, as characteristic of the Oligonicinæ, *Galapagia* bears to *Oligonyx* a decidedly close general superficial resemblance, as well as showing the features mentioned above.

We figure the cephalic tibia and head, as these portions are poorly represented in the figures given by Scudder. We would note that the limb armament is as follows in the present material. Cephalic femur with four discoidal and four not very elongate spines on the ventro-external margin, ventro-internal margin armed with eight spines, IIIIIIII, of which the first two large spines are obliquely placed. A minute genicular spine is found on but one of the internal genicular lobes of the cephalic femora in the adult male, but an indication of such spination is shown on all of these portions in the immature example. The cephalic tibia has the ventro-external margin armed with two large spines, placed distad; the ventro-internal margin with two minute spinulæ proximad and three large spines distad. The unguicular sulcus of the cephalic femora is suffused and very dark.

2

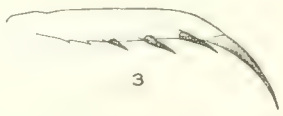

Fig. 2.—*Galapagia solitaria* Scudder. Cephalic aspect of head. Male. San Tomas, Albemarle Island, Galapagos Islands. (X 6)

Fig. 3.—*Galapagia solitaria* Scudder. Internal aspect of cephalic tibia. Male. San Tomas, Albemarle Island, Galapagos Islands. (X 13)

Phasmidæ

No walking-sticks have been found in the Galapagos Islands.

Acrididæ

Eight native species of grasshoppers occur on the Galapagos. Two of these each divide into three geographic races. Of these species, but one is known from the mainland. That species is *Sphingonotus fuscoirroratus* (Stål.), recorded also from the island of Puna, in the harbor of Guayaquil, Ecuador.

Acridinæ (Truxalinæ of authors)

10. **Closteridea bauri** Scudder

1893. *Closteridea bauri* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 9, pl. I, figs. 4 and 5. [♀; Wreck Bay, Chatham Island, Galapagos Islands.]

Cowley Mountain, Albemarle Island, August 9 to 13, 1906, 1 ♂.

The male sex of this remarkable species differs from the female[3] in its smaller size, slightly more rugose surface, more convex occiput and very slightly less produced but more declivent vertex. The cerci are short, moderately stout, blunt. The subgenital plate is very small, conical, with apex blunt and somewhat transverse when seen from above. The preceding ventral abdominal segment is broadly obtuse-angulate produced, with apex broadly rounded and fitting into base of the subgenital plate.

Coloration. The specimen before us is evidently intensively colored. Occiput clay-color, weakly washed with cinnamon-brown mesad and more heavily so laterad near the eyes; vertex clay-color; other portions of head clay-color, heavily and irregularly overlaid with mummy-brown, with a broad post-ocular bar almost solidly mummy-brown. Eyes dresden-brown. Antennæ clay-color, overlaid with mummy-brown, this very irregularly greater on the alternating joints, giving the antennæ an irregularly annulate appearance. Pronotum dorsad,

[3] Comparison with Scudder's apparently excellent figures is made.

in very narrow area between lateral carinæ of prozona and mesozona, and in very broadly expanding area of metazona clay-color, this portion of the metazona showing a pair of triangular spots of mummy-brown and caudal margin flecked rather closely and heavily with the same. Remaining lateral portions of pronotum mummy-brown, the raised portions over a large area ventro-caudad and feebly dorso-cephalad, marbled with clay-color. Abdomen with dorsal surface light cinnamon-brown, the mesonotum, metanotum, and first abdominal segment broadly dark laterad, warm sepia, so that the pale dorsal portion reaches the caudal margin of the pronotum in a bluntly V-shaped area; third and fourth, and succeeding segments to a lesser degree, with paired depressed areas of warm sepia: ventral surface argus-brown, flecked in scattered, irregular, minute depressions with blackish brown. Cephalic and median limbs clay-color, heavily and irregularly overlaid with mummy-brown. Caudal femora cinnamon-buff, suffused proximad and distad, and with two broad, irregularly margined, transverse bands of warm sepia. Caudal tibiæ olive-buff, genicular area suffused with mummy-brown, particularly on the internal face, a broad meso-proximal bar and distal fourth of tibiæ similarly suffused with mummy-brown, distal half of spines chestnut-brown.

Length of body 20.; greatest width of body (across caudal margin of pronotum) 5.8; length of pronotum 4.3; length of tegmen .3[4]; length of caudal femur 11.; width of caudal femur 3.4 mm.

Œdipodinæ

11. Sphingonotus fuscoirroratus (Stål)

1860. *Œdipoda fuscoirrorata* Stål, Kongl. Svenska Freg. Eugenies Resa, II, Zool., I, Ins., p. 345. [♀: [probably Charles Island], Galapagos Islands; [Island of] Puna, Ecuador.]

1902. *Sphingonotus trinesiotis* Snodgrass, Proc. Wash. Acad. Sci., IV, p. 439. [♂, ♀; Chatham, Indefatigable, Seymour and Albemarle islands, Galapagos Islands.]

[4] The dextral tegmen is concealed; the length given is for the exposed portion of the sinistral tegmen.

1902. *Sphingonotus tetranesiotis* Snodgrass, Proc. Wash. Acad. Sci., IV, p. 444. [♂, ♀; Charles, Barrington, Hood, Indefatigable and Seymour islands, Galapagos Islands.]

We here select the type locality of *fuscoirroratus* as the Galapagos Islands.

The two synonyms erected by Snodgrass were based partly on probably genetic color factors, partly on features of coloration showing only as much individual variation as is well known to occur in many species which are members of the group to which *Sphingonotus* belongs.

Ignorance of these facts might explain such action, but the erection of seven additional subspecies, based on Galapagos material, is inexcusable. Less striking features of the same character were used by Snodgrass as foundation for such action.

In the large series now at hand, every combination and transition between these features is found. We do not feel that it is necessary to give further space for the discussion of these, as such characters in this group have long been known to have no importance from a specific diagnostic point of view. We would note, however, that generally in the genera related to *Trimerotropis,* a number of clearly defined, probably genetic, patterns run through many species, while the immediate environment has a strong effect on the color and degree of intensification and recession of the color-pattern of individuals.

In the present species a strong response to local environmental conditions is clearly developed in the coloration and intensification and recession of the color-pattern, and, as a result, some series before us show a certain amount of uniformity in these respects. From the viewpoint of an elaborate study of the individual variations in this species, with the immediate environmental conditions and probably genetic factors taken into consideration, Snodgrass might have secured some data of interest; but from the standpoint of nomenclatorial stability and systematic research the work under consideration is one of synonyms are: for *trinesiotis—chathamensis, indefatigabilensis* the most unfortunate found in recent literature. The subspecific and *albemarlensis;* for *tetranesiotis—charlesensis, barringtonensis, hoodensis* and (again!) *indefatigabilensis.*

In the present series we would note that the material from Hood Island and the adjacent Gardner Island averages darker in general coloration, with tegminal bars more weakly indicated, than in material from the other islands. In addition, a very conspicuous, probably genetic, factor is developed in four males and one female from Hood Island, in which the pronotal disk and dorsal fields of the tegmina are margined laterally, narrowly and very conspicuously, with light buff.

The series containing the majority of the most contrastingly colored individuals, with tegminal bands very decided, is from Barrington Island. The most contrastingly colored individual, however, comes from Abingdon Island.

The caudal femora are, in the present series, pale, have the distal third suffused, have this suffusion and an additional broad meso-proximal annulus, or have all but the proximal portion suffused. These types all intergrade and are clearly due to recession or intensification of the color pattern.

Distinct difference in the width of the vertex is found, particularly in the male sex. No geographic correlation appears to exist and we believe the difference found, though much more decided than is usual within a species, to be best considered another feature of the striking individual variation exhibited by *fuscoirroratus*.

Specimens examined: 132; 52 males, 75 females and 5 immature individuals.

Abingdon Island, September, 1906, (small immatures seen here and there; adults rare and going pretty well up the mountain), 2 ♂, 2 ♀; Narborough Island, April, 15, 1906, 3 ♂, 1 ♀; Banks Bay, Albemarle Island, April, 1906, (common), 2 ♀; Villamil, Albemarle Island, (common), 2 ♂; Cowley Mountain, Albemarle Island, August 9 to 13, 1906, (very common from shore up to 1100 feet, and perhaps higher), 11 ♂, 30 ♀, 4 immature ♀; James Island, December 21, 1905 to January 5, 1906, 2 ♂; South Seymour Island, March, 1 ♂; Academy Bay, Seymour Island, July, 1906, (fairly common in more sandy spots), 2 ♂, 1 ♀; Barrington Island, October, 1905, (rare), 8 ♂, 7 ♀; Chatham Island, January, April, July and October, 1905 and 1906, (at Wreck Bay taken at light at night on beach), 6 ♀; Charles Island, February, May, June and October, 1905 and 1906, (at Cormorant Bay, common up to 800 feet),

5 ♂, 12 ♀, 1 juv.; Gardner Island, June, 1906, 1 ♂, 2 ♀; and Hood Island, June, 1906, 15 ♂, 12 ♀.

Locustinæ (Acridiinæ of authors)

12. Schistocerca melanocera (Stål)

(Plate 18, figures 1 to 5)

1861. *Acridium melanocerum* Stål, Kongl. Svenska Freg. Eugenies Resa, II, Zool., I, Ins., p. 326. [♀; [probably Charles Island], Galapagos Islands.]

We find the systematic treatment by Snodgrass[5] of this brilliant and beautiful species to be nearly as bad as for *Sphingonotus fuscoirroratus* (Stål). That author divided the species into five races, naming four as follows: *m. minor, m. pallida, m. lineata* and *m. immaculata.* These are based on features of size and color variation, wholly unworthy of nominal recognition and are here unreservedly assigned to synonymy.

In size, material from certain islands shows a different average from material from other islands. This is of interest in studying differences in environmental conditions and in studying the lines followed by the species in becoming distributed through the islands. It is of no specific or racial diagnostic value, as similar size variation is found in many other species of the genus, in none being worthy of nominal designation, hence *m. minor* falls. Color recession explains and disposes of the type named *m. pallida.* A distinct pale line bordering the ventral margins of the dorsal abdominal segments, an interesting feature of color development, but of no taxonomic value, was used as the main reason for proposing *m. lineata.* The series at hand shows this condition as follows: Tagus Cove, Albemarle Island 1 ♂; Villamil, Albemarle Island, 1 ♂. A solidly dark colored prozonal and metazonal portion of the pronotal lateral lobes was used as a basis for *m. immaculata.* This is a color-phase (see plate 18, figure 2), similarly of no taxonomic value and probably genetic in character. The normal condition, showing a spot in this area, is probably the primitive type. The solidly dark phase is represented by the following material; Villamil, Albemarle Island, 1 ♀; James Island, 2 ♂,

[5] Proc. Wash. Acad. Sci., IV, pp. 413 to 425, pl. XXVII, figs. 1, 5 and 6, (1902).

6 ♀ ; South Seymour Island, 2 ♂ , 5 ♀ ; Indefatigable Island, 2 ♀ ; Gardener Island, 1 ♀ .

Specimens examined: 140; 73 males, 66 females, and 1 immature individual.

Tagus Cove, Albemarle Island, March 22 to April 9, 1906, 2 ♂ , 1 ♀ ; Cowley Mountain, Albemarle Island, August, 1906, (common in places, lower levels to sea, especially seen clinging to brush to escape the strong breeze; not thick in green zone up to 1400 feet; very common in grassy districts at about 1800 feet), 10 ♂ , 7 ♀ ; Villamil, Albemarle Island, May, 1906, (rather common on roadside; specimens also found at 1400 feet), 3 ♂ , 7 ♀ ; James Island, July, 1906, and December, 1905, (near coast), 4 ♂ , 10 ♀ ; Jervis Island, December, 1905, (rare and hard to capture), 2 ♂ , 2 ♀ ; Duncan Island, August 14, 1906, 2 ♂ , 1 ♀[6]; South Seymour Island, November, 1905 (quite common, especially on big lava piles), 2 ♂ , 5 ♀ ; Indefatigable Island, November, 1905, 1 ♀ ; Academy Bay, Indefatigable Island, July, 1906, (common on plains near coast), 1 ♀ ; Barrington Island, October, 1905, (not common, found on bare lava streams), 12 ♂ , 13 ♀ ; Chatham Island, January and February, 1906, (rather scarce), 5 ♂ , 1 juv. ♂ ; Charles Island, October, 1905, (common up to highest point of Island), 31 ♂ , 17 ♀ ; and Gardner Island, October 3, 1905, 1 ♀ .

13. **Schistocerca intermedia** Snodgrass

(Plate 18, figure 6)

1902. *Schistocerca intermedia* Snodgrass, Proc. Wash. Acad. Sci., IV, p. 431, pl. XXVII, fig. 3. [♀ ; Duncan Island, Galapagos Islands.]

The race described as *i. borealis* by Snodgrass[7], shows no difference of importance from material of this variable species from Duncan Island and is consequently placed in synonymy here.

This insect is one of the most difficult forms of Orthoptera we have ever studied. A single individual blends so remarkably the features of *S. melanocera* (Stål) and of *S.*

[6] These specimens are clearly typical of the present species, though on this island *Schistocerca intermedia* Snodgrass is the dominant type.
[7] Proc. Wash. Acad. Sci., IV, p. 435, pl. XXVII, fig. 2. (1902).

literosa (Walker), that the student might easily imagine he had a hybrid before him. The present large series from Abingdon and Duncan islands shows, however, that this is the dominant type on those islands, typical *melanocera,* however, occurring also on Duncan Island. Snodgrass also reports *intermedia* as the only form found on Bindloe Island, while a specimen from Jervis Island is now before us.

We do not agree with Snodgrass in considering this species absolutely intermediate between *melanocera* and *literosa,* for the larger series now at hand show a distinctly closer affinity to the former species. Individual variability is, however, considerable, and is largely due to the varying degrees of weak infusion of the striking colors and color-pattern developed in *melanocera.*

As the insect here considered represents a type distributed over several islands, and represents a condition combining the features of two distinct types of the same genus found on the same or adjacent islands, the problem as to the proper name designation is most difficult.

Three theories are advanced. 1. The ancestral stock is *intermedia,* and from it have developed two species, *melanocera* and *literosa.* 2. That *melanocera* and *literosa,* having at some time become isolated on one of the islands, interbred and the hybrids, through generations, developed into the species *intermedia.* 3. That *melanocera, intermedia* and *literosa* are descendants from a common ancestor, which became isolated on the various islands of the Galapagos Archipelago and divided into the three species now extant, the ancestral type having disappeared.

We prefer the third hypothesis, though we must admit that the problem is far from being solved[8]. Very similarly puzzling differences are found in some of the birds of the Galapagos.

The species is fully discussed by Snodgrass, the present material showing nothing of additional importance. We do not find *literosa* sufficiently close to *intermedia* to warrant considering the Hood Island race of that species (*l. punctata*), intermediate between the Chatham Island race of that species (*l. literosa*) and the present species, as stated by that author.

[8] Snodgrass offers another hypothesis, i. e., that *intermedia* is a form of *melanocera* varying toward *literosa,* or the opposite. That author prefers the hybridization theory and did not consider the third theory offered here as the probable solution of the problem.

Specimens examined: 39; 19 males and 20 females.

Abingdon Island, September 18 to 23, 1906, (not plentiful, more numerous in barren places, taken at 900 feet), 3 ♂, 1 ♀; James Island, 1 ♂, 1 ♀; and Duncan Island, August 14, 1906, and December 1 to 17, 1905, (common, especially higher up in valley and on summit, found in copulo and flying singly against the wind), 15 ♂, 18 ♀.

14. Schistocerca literosa literosa (Walker)

(Plate 18, figure 7)

1870. *Acridium literosum* Walker, Cat. Dermapt. Saltat. Br. Mus., IV, p. 620. [♂, Galapagos Islands.]

1893. *S[chistocerca] l[iterosa] discoidalis* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 16. [♂, ♀; Chatham Island, Galapagos Islands.]

Scudder considered Chatham Island material as a distinct race from typical *literosa*, which race he supposed was peculiar to Charles Island, following Butler, who recorded the species from Charles Island, and whose study was probably based on Walker's type. We follow Snodgrass in placing the race discussed in the synonymy here. Sufficient work has now been done to show that the Darwinian material recorded by Butler was probably incorrectly labelled "Charles Island," as *literosa* is now definitely known to be absent from that island.

Chatham Island, January and February, 1906, and October, 1905, (rather rare), 9 ♂, 5 ♀.

Scudder has given a thorough tabular comparison of the races of this species and Snodgrass has added much valuable information[9]. We would note in addition only that the caudal femora, in the present series, range from dark bluish glaucous to light ochraceous-buff faintly tinged with bluish glaucous. The majority of the series more closely approach dark bluish glaucous.

[9] Proc. Wash. Acad. Sci., IV, pp. 425 to 431, pl. XXVII, fig. 4, (1902).

15. **Schistocerca literosa punctata** Scudder

(Plate 18, figure 8)

1893. *S[chistocerca] l[iterosa] punctata* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 16. [♀ ; Hood Island, Galapagos Islands.]

Hood Island, June and September, 1906, 6♂, 18♀ ; and Gardner Island, January and February, 1906, (common up to summit), 2♂, 1♀.

Though very close to *l. literosa* (Walker), the present race is readily distinguished by the features given by Scudder. It is the largest of the races of this species. The character of the distal fissure of the male subgenital plate, given by Scudder, is shown by the series before us to be variable, exhibiting in all the races the types described by that author. In the present race the caudal tibiæ are colored as described here for *l. literosa*.

16. **Schistocerca literosa hyalina** Scudder

(Plate 18, figure 9)

1893. *S[chistocerca] l[iterosa] hyalina* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 16. [♂, ♀ ; Tower Island, Galapagos Islands.]

Tower Island, IX, 1906, (fairly common), 12♂, 1♀.

This race is also easily separated by Scudder's diagnosis. In size it approximates closely the Chatham Island race, *l. literosa* (Walker). The difference in tegminal coloration is not decided and is principally indicated in the present series by the spots being not quite as much congregated. The caudal femora in the present series are, however, distinctive in being uniform ochraceous-buff, without trace of glaucous.

17. **Halmenus robustus robustus** Scudder

1893. *Halmenus robustus* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 18, pl. I, figs. 6 and 7. [♂, ♀ ; Conway Bay, Indefatigable Island; Indefatigable Island; James Island, all Galapagos Islands.]

Indefatigable Island, July, 1906, (southern part of island, lower edge of green zone at 500 feet), 1♂, 1♀, in coitu.

This pair is more brilliantly colored than any of the other specimens of the races of *robustus* before us. The pale dorsum,

including the tegmina, and dark sides give the female a particularly striking appearance.

This race appears to be best characterized by the vertex, which averages slightly sharper than in the other races and by the tegmina which slightly overlap in both sexes and have their apices rather sharply rounded.

18. **Halmenus robustus choristopterus** Snodgrass

1902. *Halmenus choristopterus* Snodgrass, Proc. Wash. Acad. Sci., IV, p. 450. [♀ ; Charles Island, Galapagos Islands.]

Charles Island, May 30 to June 4, 1906, 1 ♀.

This race is now known from two females. It is apparently very close to *H. robustus cuspidatus* Snodgrass. The female before us, however, has the apical portions of the ovipositor valves strongly curved, much more so than in any of the other females of *Halmenus* at hand, in which these portions are only weakly curved.

The present specimen, though dried alcoholic, was in life clearly very pale in coloration, with tegmina showing a narrow whitish border along their ventral margins and caudal femora having dark areas dorsad in place of bands. The pronotum has a medio-longitudinal carina, weak but distinct, which feature is shown to a like degree in but one female of *r. cuspidatus.*

The lateral angulation of the pronotal disk is distinct though not decided, the caudal margin of the pronotum weakly and bluntly angulate, the tegmina elongate, separated by a brief interval (1. mm.), with apices broadly rounded. In these latter features complete agreement with specimens of *r. cuspidatus* is found.

19. **Halmenus robustus cuspidatus** Snodgrass

1902. *Halmenus cuspidatus* Snodgrass, Proc. Wash. Acad. Sci., IV, p. 450. [♂, ♀ ; Iguana Cove and Tagus Cove, Albemarle Island, Galapagos Islands.]

Tagus Cove, Albemarle Island, 3000 feet, 1 ♂, 1 ♀, in coitu; Cowley Mountain, Albemarle Island, August 9 to 13, 1906, 3 ♂, 5 ♀, 1 juv. ♀ ; Villamil, Albemarle Island, 1200 feet, August 20 to September 5, 1906, 5 ♂, 4 ♀.

This race is decidedly variable. The angle of the vertex is more acute in some individuals than in others. The pronotum has the medio-longitudinal carina usually very weak, particularly in the prozonal and mesozonal portion, which portion is then somewhat swollen, in other individuals it is subobsolete and in one example it is moderately strong. The dorsum of the pronotum rounds into the lateral lobes with scant trace of angulation in some, in others angulation is marked, particularly in the median section. The caudal margin of the pronotum usually shows a blunt angulation, but it is evenly convex in a few examples. The tegmina vary much in length (♂ 3.9–5.2; ♀ 4.7–6.7 mm.), have the apices ranging from broadly rounded to acute and are overlapping (in three males only), or separated by a brief interval in both sexes (♂ attingent to .3; ♀ .5 to 1. mm.)

The color-pattern is weakly to strongly developed in the series, and two striking features, a very pale line on the costal margins of the tegmina and transverse caudal femoral bands, are present or absent in different individuals. In the present series the pale line on the costal margins of the tegmina is very conspicuous in five males and one female, conspicuous in three males and two females, weak in one male and two females, and absent in five females. The majority have the caudal femora immaculate, but variation is shown in all degrees up to one female in which the three dark bars are very heavy.

20. **Halmenus eschatus,**[10] new species

(Plate 18, figures 10 and 11)

1902. *Halmenus* sp. Snodgrass, Proc. Wash. Acad. Sci., IV, p. 451. [From stomach of a mockingbird on Wenman Island, Galapagos Islands.]

The present insect is clearly a derivative from the same stock as *H. robustus* Scudder, the differentiation having reached a much greater degree than in the races of that species here treated, and, in our opinion, warranting its recognition as a full species.

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[10] From ἔσχατος=the most remote, in allusion to the fact that this species occurs only on Wenman Island, the most isolated of the Galapagos Archipelago.

When compared with *robustus,* this species is found to be particularly distinguishable by its larger size, much broader interocular space and vertex, tegmina with greatest width meso-distad and separated by a space nearly equalling the tegminal width, and strikingly shorter and heavier caudal femora, which about reach the abdominal apex in males and fail to reach that point in females.

Type: female, No. 717, Mus. Cal. Acad. Sci., Wenman Island, Galapagos Islands; collected late September, 1906, by F. X. Williams.

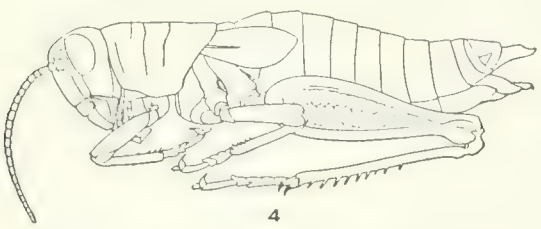
Size large and form moderately robust for the genus. Vertex broad, interocular space broad (1. mm. in width). Fastigio-facial angle blunt, forming an angle of approximately 90°. Pronotum with dorsal portion of prozona and mesozona swollen, transverse sulcus weak but distinct, medio-longitudinal carina weakly indicated on prozona and mesozona, well developed on metazona, caudal margin or disk broadly convex with a very small median angulate emargination. Disk of pronotum scarcely pitted, almost smooth, in prozonal and mesozonal portion, rugose on metazona, this surface less rough than in *robustus.* Tegmina decidedly shorter than pronotum, elongate-ovate, slightly wider meso-distad than proximad, with apices broadly rounded. Tegmina separated by a distance nearly equalling the width of one of the tegmina. Prosternal spine proportionately small, conical. Ovipositor valves with apices moderately curved, intermediate in degree between the types shown by *H. robustus robustus* Scudder and *H. robustus choristopterus* Snodgrass, their internal surfaces similarly plentifully supplied, with rather short, silky hairs. Caudal femora heavy, much heavier and proportionately shorter than in *robustus,* not reaching the apex of the abdomen.

Allotype: Male, No. 718. Mus. Cal. Acad. Sci., Wenman Island, Galapagos Archipelago; collected late in September, 1906, by F. X. Williams.

Size larger and form more robust, as compared with males of *robustus.* Vertex broader and blunter. Pronotum heavier, with dorsal portion of prozona and mesozona moderately swollen, transverse sulcus weak but distinct, medio-longitudinal carina percurrent, well developed, low but heavy and comparatively broadly rounded in transverse section, caudal margin of disk broadly convex with a minute median angulate emargination. Disk of pronotum, tegmina[11] and prosternal spine as described for the female sex. Furcula represented by very briefly produced, transverse projections, with distal margins rounded but indicating some angulation. Supra-anal plate with lateral margins rather strongly convex-convergent proximad for a brief distance to above cerci and in this portion sharply but narrowly reflexed, thence straight and weakly convergent to distal portion, where they are very strongly convergent and weakly concave to the bluntly rounded apex, so that the distal portion of the plate is almost subtruncate. Surface of supra-anal plate showing a short medio-longitudinal sulcus in proximal portion, bounded by carinæ. Cerci heavy, hardly twice as long as proximal width, tapering very weakly to distal

[11] The tegmina, though varying greatly in proportionate length to width, are seen in the series to be always much shorter than the pronotum and separated by a decided interval.

portion, where the margins, particularly the ventral margin, are more decidedly convex-convergent to the rather blunt apex. Subgenital plate small, sharply concave, emarginate at apex, the two apices thus forming two very small, rounded projections. Caudal femora heavy as in female, and, similarly, much heavier and proportionately shorter than in *robustus*, but in this sex only reaching the apex of the abdomen.



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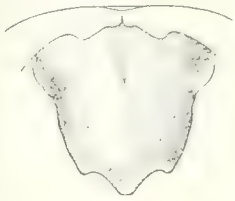

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Fig. 4.—*Halmenus eschatus*, new species. Lateral outline of female. *Type*. Wenman Island, Galapagos Islands. (X 2)

Fig. 5.—*Halmenus eschatus*, new species. Dorsal view of male supra-anal plate. *Allotype*. Wenman Island, Galapagos Islands. (Much enlarged.)

Measurements (in millimeters)

♂	Length of body	Length of pronotum	Exposed length of tegmen	Width of tegmen	Least width between tegmina	Length of caudal femur
Allotype	23.	5.8	4.	2.	1.8	11.3
Paratype	23.3	5.2	3.9	1.6	1.7	10.4
Paratype	22.	5.7	3.7	1.8	2.2	11.2
Paratype	20.8	5.9	3.6	1.9	2.	10.9
♀						
Type	32.8	7.9	6.2	3.	2.6	14.5
Paratype	29.	7.1	5.8	2.3	2.6	13.2
Paratype	27.	7.1	5.	2.4	2.4	13.4

The width of the caudal femur in the type is 3.9 millimeters[12]. In the present series this width varies in the males from 3. to 3.2 millimeters, in the females from 3.8 to 4. millimeters.

Coloration of type: Dorsal surface cinnamon-brown. Head with eyes buckthorn-brown, with a moderately broad postocular bar of mummy-brown, margined dorsad narrowly with tawny, occiput and vertex cinnamon-brown, remaining portions of head ochraceous-tawny, flecked with chestnut-brown. Pronotum with dorsum and lateral lobes to impressed area cinnamon-brown, small impressed area smooth, shining, blackish chestnut-brown, bordered ventrad and particularly ventro-caudad with patches of ochraceous-buff, below this the lateral lobes are ochraceous-tawny, flecked with chestnut-brown. Tegmina cinnamon-brown, marbled with mummy-brown. Abdomen cinnamon-brown. Limbs cinnamon-brown, flecked with mummy-brown. Caudal femora with traces of three darker bars on external face, internal portion of dorsal face and internal face ochraceous-tawny, with three distinct dark bands and genicular area mummy-brown. Caudal tibiæ sayal-brown, tinged with drab internally, spines black in distal half.

In general coloration the series before us agrees closely with the type, except that the males have the lateral post-ocular bar

[12] In an average female of *H. robustus cuspidatus* Snodgrass, the caudal femur is 16.6 millimeters in length and 3.4 millimeters in width.

(on the pronotum an extension of the dark marking in the impressed area as described for the type) more apparent, with portions below, and particularly caudad, paler; in one individual broadly buff.

In addition to the type and allotype, a paratypic series of three males and two females, bearing the same data, is before us as well as a female taken from the stomach of a mockingbird on Wenman Island, December 14, 1899.

TETTIGONIIDÆ (Locustidæ of authors)

Four species of katydids are found native on the Galapagos Islands. Of these three are peculiar to the islands, and one is widely distributed over the American continent as well.

PHANEROPTERINÆ

21. Anaulocomera darwinii Scudder

1893. *Anaulocomera darwinii* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 19, pl. III, figs. 1, 4, and 5. [♂, ♀; Chatham Island; Wreck Bay, Chatham Island; Indefatigable Island.]

At 1100 feet, February 22, 1906, (on grass), 1 ♂.

This specimen agrees fully with the type. We would note that the male supra-anal plate is triangular, distinctly longer than its basal width, and has the dorsal surface moderately convex. Meso-ventrad, an elongate, slender shaft (the titillator?) projects from the anal chamber. This shaft reaches half the distance to the furcation of the elongate cerci and shows a weak and even upward curvature to its aciculate chitinous apex.

PSEUDOPHYLLINÆ

22. Liparoscelis cooksonii (Butler)

1877. *Agræcia cooksonii* Butler, Proc. Zool. Soc. London, 1877, p. 87. [♀; Charles Island; Albemarle Island, both Galapagos Islands.]

1901. *Liparoscelis cooksoni ensifer* McNeill, Proc. Wash. Acad. Sci., III, p. 498, text fig. 39. [♂, ♀; Hood Island, Galapagos Islands.]

1901. *Liparoscelis paludicola* McNeill, Proc. Wash. Acad. Sci., III, p. 499, text fig. 40. [♂, ♀; Albemarle Island, Galapagos Islands.]

1901. *Liparoscelis pallidus* McNeill, Proc. Wash. Acad. Sci., III, p. 500, text fig. 41. [♀; Barrington Island, Galapagos Islands.]

In 1893, Scudder erected the genus *Nesœcia*[13], placing in it the single species here under consideration. In 1895, Brunner, without comment, placed *Nesœcia* as a synonym of *Liparoscelis* Stål[14]. This assignment was followed by McNeill, and is in our opinion correct. Kirby, however, in 1906, has resurrected Scudder's *Nesœcia,* evidently assigning to it the species having smooth faces and limiting *Liparoscelis* to the species having rough faces[15]. This action we believe, from study of the literature and material of three of the four species involved, before us, to be untenable and we consequently place *Nesœcia* Scudder under *Liparoscelis* Stål.

McNeill, in 1901, described two additional species and one race from the Galapagos Islands. Careful consideration of his paper, a pair from the original series of his synonymous *paludicola,* and a large series at hand convinces us that but one species occurs in the Galapagos. It is evident that McNeill was ignorant of the variation which occurs in many species of the Pseudophyllinæ, and the differences described by that author are clearly of no specific diagnostic value.

The species apparently reaches its largest size and develops a conspicuously colored phase in the mangrove (*Aviccnnia* sp.) swamps. Upon this condition McNeill's *paludicola* was based.

In the present material, the length and degree of curvature of the ovipositor is decidedly variable. In length the tegmina usually slightly exceed the pronotum, frequently are somewhat longer than this and very rarely slightly shorter than the pronotum. The pronotum is distinctly tuberculate, occasional individuals having this slightly less pronounced than is usual.

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[13] Bull. Mus. Comp. Zool., XXV, p. 20.
[14] Monogr. der Pseudophylliden, p. 174.
[15] Syn. Cat. Orth., II, p. 329.

When compared with material of *L. nigrispina* Stål[16] and Brunner's figure of *L. pallidispina* Stål, the present species is seen to be much less heavily built, with limbs proportionately by no means as robust as in those species and of what may be termed a much more normal type. In all features which we would consider of generic diagnostic importance, however, very close agreement is shown.

The very decided size variation is shown by the following table for the extremes of the present series.

Measurements (in millimeters)

♂	Length of body	Length of pronotum	Greatest width of pronotum[17]	Length of tegmen[18]	Length of caudal femur
Cowley Mountain, Albemarle Island	23. –27.8	5. –5.9	4.5–5.9	6.2–8.8	10.2–14.6
San Tomas, Albemarle Island	31.7–32.	6. –6.4	5.9–6.3	7.3–7.8	15. –15.7
Iguana Cove, Albemarle Island	29.	5.5	6.	8.3	12.2
Indefatigable Island	25. –28.	4.8–6.	5.2–5.8	8.5–9.7	12. –14.7
Charles Island	27.	6.3	6.9	8.5	13.8

♀	Length of body[19]	Length of pronotum	Length of tegmen	Length of caudal femur	Length of ovipositor[20]
Cowley Mountain, Albemarle Island	26.2–30.5	6. –6.3	7.6–6.8	12.2–17.7	10.7–14.
San Tomas, Albemarle Island	33. –34.	6.8–7.	6.1–7.	17.9–17.7	14. –14.1
Villamil, Albemarle Island	28. –36.	5.9–7.	5.9–7.4	14.1–18.	11.3–14.7
Indefatigable Island	28. –30.5	5.7–6.2	7.9–8.8	13.4–18.4	10.7–12.9
Charles Island	31. –38.	7. –7.3	7.6–7.3	17.1–18.2	12.7–15.
Hood Island	34.	7.1	10.6	19.7	16.

Variation in coloration is decided, some individuals being almost immaculate, many moderately maculate, and a few heavily and conspicuously mottled. The color differences are evidently wholly or in large part attributable to individual response to local environmental influences. The majority of flightless katydids show such signal individual color adaptation to their immediate environment.

Specimens examined: 42; 12 males, 27 females and 3 immature individuals.

Tagus Cove, Albemarle Island, I, 30, 1899, 1 ♂, cotype of *L. paludicola,* [Leland Stanford Jr. Univ.]; Elizabeth Bay, Albemarle Island, II, 25, 1899, 1 ♀, cotype of *L. paludicola,* [Leland Stanford Jr. Univ.]; Cowley Mountain, Albemarle

[16] Four males, taken by Gaumer at Merida, Yucatan, are in the Hebard Collection.
[17] Including the lateral lobes.
[18] Measuring the exposed portion only.
[19] In females of this species the length taken is from the vertex to the abdominal apex, the apex of the subgenital plate falling considerably short of the apex of the abdomen.
[20] We take this measurement as a straight line from the point of emergence of the line of juncture of the valves to the apex. McNeill's method of measuring the arc is difficult, more liable to inaccuracy, and unnecessarily heterodox.

Island, August 7 to 13, 1906, 4 ♂, 9 ♀; San Tomas, 1200 feet, south Albemarle Island, October 30, 1905, 2 ♂, 4 ♀, 1 juv.; Iguana Cove, Albemarle Island, 1 ♂, 1 ♀; Villamil, Albemarle Island, August 20 to September 5, 1906, 2 ♀; Indefatigable Island, October 25 to 28, 1905, November 11 to 20, 1905, 2 ♂, 5 ♀; Academy Bay, Indefatigable Island, November 5 to 16, 1905, 1 ♂, 2 ♀; Charles Island, May 30 to June 6, 1906, 1 ♂, 1 ♀, 1 small juv.; October, 1905, 1 ♀; and Hood Island, June, 1906, 1 ♀, 1 large juv. ♂.

Conocephalinæ

23. **Conocephalus exitiosus** (McNeill)

1901. *Xiphidium exitiosum* McNeill, Proc. Wash. Acad. Sci., III, p. 501, fig. 42. [2 ♂, 3 ♀, 3 juv.; Indefatigable and James islands, Galapagos Islands.)

1915. [*Xiphidium*] *exitiosum* Rehn and Hebard, Trans. Am. Ent. Soc., XLI, p. 235. (No additional material.)

In 1915, at the time the American species of *Conocephalus* were revised, no material of the present species was available for study.

The type series, belonging to the collection of the Leland Stanford Jr. University, is now before us. The specimens from James Island were taken on April 22, 1899, those from Indefatigable Island on May 1, 1899. We here select a male from James Island as type, a female, bearing the same data, as allotype, of this interesting species.

The species is found to belong to the subgenus *Xiphidion* Serville and shows close agreement with *C. nemoralis* (Scudder), a species peculiar to the central-eastern interior of the United States.

The males in general appearance agree rather closely with males of *nemoralis*[21], showing in the cerci, however, a condition in some respects intermediate between the types developed in *nemoralis* and *C. occidentalis* (Morse), the latter a species

[21] The coloration of the present specimens can not be determined, except that the vertex and dorsum of the pronotum are marked with a very broad band of dark brown. McNeill gives green as the general coloration of the species.

of the Pacific coastal portion of the United States. The females are, in general appearance, nearest *occidentalis.*

Fig. 6.—*Conocephalus exitiosus* (McNeill). Dorsal view of male cercus. *Type.* James Island, Galapagos Islands. (X 11)

It is of interest to note that, of the many tropical American species of *Conocephalus,* none shows close affinity to *exitiosus.*

The following features are noted in the male type. Caudal tibiæ armed distad with three pairs of spurs. Subgenital plate not produced disto-laterad in sharp spikes, disto-lateral styles small and filiform, the sockets of which are produced beyond the transverse distal margin of the plate. Cerci with mesal portion not contrastingly swollen and with a heavy mesal (in vertical sense) tooth, so that its base is entirely visible from above; distal portion elongate conical, with blunt apex hardly at all depressed[22]. Form moderately robust. Vertex scarcely ascending, fastigium very slightly wider than proximal antennal joint. Eyes normal. Pronotum with lateral lobes considerably longer than deep, ventro-cephalic angle distinct though rounded. Convex callosity vary broad, humeral sinus subobsolete. Abdomen immaculate. Caudal femora rather short, with proximal swollen portion heavy, ventral margins unarmed, genicular lobes not spined[23]. Tegmina much as in *nemoralis,* reduced, covering slightly more than half the dorsal surface of the abdomen, veins heavy, stridulating area large, apex of tegmen rather broadly rounded.

The female allotype shows, in addition, the following diagnostic features. Tegmina slightly more elongate than in male, with apices slightly less broadly rounded. Ovipositor heavy, tapering distad to the acute apex, the shaft showing a very weak upward curvature, its ventral margin being straight in the proximal two-thirds.

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[22] In form of the cerci, *exitiosus* is seen to be almost intermediate between *nemoralis* and *occidentalis.*

[23] This is the only American species of the genus known to us in which the genicular lobes of the caudal femora are unarmed.

McNeill's figure of a female of this species is sketchy throughout. In particular, the lateral lobes of the pronotum are not sufficiently deep, the angles are too sharp, the curvature of the margins overlooked, particularly the very slight but apparent concavity at the humeral sinus.

Length of body ♂ 13.5, ♀ 14.5; length of pronotum ♂ 3.9, ♀ 4.9; length of tegmen ♂ 6.8, ♀ 7.7; length of caudal femur ♂ 12.4, ♀ 15.8; greatest width of caudal femur ♂ 2.4, ♀ 2.9; length of ovipositor 10.2 mm.

24. **Neoconocephalus triops** (Linnæus)

1758. [*Gryllus (Tettigonia)*] *triops* Linnæus, Syst. Nat. Ed. X, i, p. 430. ["Indies", probably the West Indies.]

1893. *Conocephalus insulanus* Scudder, (not *Conocephalus insulanus* Redtenbacher, 1891), Bull. Mus. Comp. Zoöl., XXV, p. 21, pl. III, figs. 2 and 3.]

1907. *Conocephalus insularum* Karny, Revisio Conocephalidarum, p. 38. (New name for Scudder's preoccupied name.)

This variable species appears to be the cause of a large portion of the confusion and synonymy evident in the literature covering the American species of the genus. The synonyms *obtusus* Burmeister and *dissimilis* Serville have long been established. We have also added *mexicanus* Saussure, *fusco-striatus* Redtenbacher and variety *tibialis* Karny to the present synonymy[24].

In determining the Galapagos species, we have gone over the literature and extensive series of the genus from Colombia, Panama, Central America, the West Indies, and North America. We have found that the Galapagos species is *triops* beyond question, as recognized by us, and we consequently add *insulanus* Scudder and *insularum* Karny to the present synonymy.

Moreover, it is clear from the several hundred specimens of *triops* now before us, that this species develops several distinctive color phases, is very widely distributed through North

[24] Rehn and Hebard. Trans. Am. Ent. Soc., XL, p. 405, (1915).

America, northern South America, and the adjacent islands, and that this type does not divide into a multitude of closely related species, as has evidently been the opinion of many authors.

Chatham Island, February, 1906, 1 ♂.

GRYLLIDÆ

Four species of crickets are known from the Galapagos Islands. One of these is found almost everywhere over the American continent and adjacent islands. The other three are peculiar to the islands.

MYRMECOPHILINÆ

25. **Cryptoptilum erraticum** (Scudder)

1893. *Cycloptilum erraticum* Scudder, Bull. Mus. Com. Zoöl., XXV, p. 23, pl. III, figs. 6 and 7. [♂; Charles Island, Galapagos Islands.]

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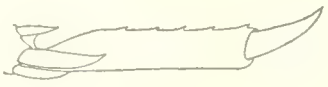

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Fig. 7.—*Cryptoptilum erraticum* (Scudder). Dorsal outline of male pronotum. Tagus Cove, Albemarle Island, Galapagos Islands. (X 6½)

Fig. 8.—*Cryptoptilum erraticum* (Scudder). Internal outline of caudal metatarsus and tibial and metatarsal spurs. Male. Tagus Cove, Albemarle Island, Galapagos Islands. (X 20)

1901. *Cycloptilum erraticum* McNeill, Proc. Wash. Acad. Sci., III, p. 505. [♂, ♀, juv.; Albemarle and Hood islands, Galapagos Islands.]

1901. *Cycloptilum lepismoide* McNeill, Proc. Wash. Acad. Sci., III, p. 505. (In part.) [♀; Abingdon Island, Galapagos Islands.]

A series of four males, two females and several immature individuals from the material recorded by McNeill, belonging to the Leland Stanford Jr. University, is before us.

Compared with the five other species previously assigned to *Cryptoptilum,* this species is found to be nearest *C. antillarum* Redtenbacher. The present is a more slender insect, with expansion of pronotum caudad not fully as decided, dorsal surface of abdomen scarcely darker than pronotum, widely spaced minute dark annuli of antennæ distinct, and female subgenital plate obtuse-angulate emarginate at an angle of slightly over ninety degrees.

In the more distinct antennal annuli, which in *antillarum* are subobsolete to obsolete, and the weaker emargination of the female subgenital plate, convergence toward *C. hesperum* Rehn and Hebard is indicated, the female subgenital plate in that species showing no emargination whatever.

The distribution of *antillarum* extends through the West Indies and southeastern United States, *hesperum* is known only from Lower California.

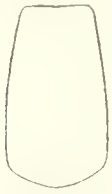
Individuals of the species of this genus are all heavily clothed with scales. These scales are very loosely attached, however, and frequent specimens are often taken which have lost a portion of this covering, while specimens which have been carelessly packed or placed in liquid preservative frequently lose practically their entire scale covering.

McNeill placed far too great importance on the apparent different degrees of scale covering in describing his *lepismoide* and referred the specimen of *erraticum* noted above to that species, apparently solely because it alone of the series of *erraticum* before him had retained an ample scale covering.

Length of body ♂ 7.8–8., ♀ 9.–9.8; length of pronotum ♂ 4., ♀ 2.3–2.7; greatest pronotal width ♂ 2.6, ♀ 2.2–2.6; length of caudal femur ♂ 4.8, ♀ 5.2–6.; length of ovipositor 4.8–5. mm.

26. Cryptoptilum lepismoide (McNeill)

1901. *Cycloptilum lepismoide* McNeill, Proc. Wash. Acad. Sci., III, p. 505. (In part[25].) [♂, ♀; Albemarle Island, Galapagos Islands.]



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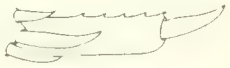

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Fig. 9.—*Cryptoptilum lepismoide* (McNeill). Dorsal outline of male pronotum. *Type*. Tagus Cove, Albemarle Island, Galapagos Islands. (X 6½)

Fig. 10.—*Cryptoptilum lepismoide* (McNeill). Internal outline of caudal metatarsus and tibial and metatarsal spurs. Male. *Type*. Tagus Cove, Albemarle Island, Galapagos Islands. (X20)

A male at hand, taken at Tagus Cove on Albemarle Island, March 23, 1899, belonging to the Leland Stanford Jr. University, is here selected as type.

Two females, bearing the same data except that they were taken on February 4, 1899, are also before us. These specimens were apparently overlooked by McNeill. As this sex of the species has never been correctly recognized we would note that it differs from the female of *erraticum* only in its decidedly smaller size and subgenital plate which is less strongly emarginate meso-distad, forming there a strongly obtuse-angulation.

The male type shows that in this sex the pronotal expansion caudad is much weaker than in *erraticum*, approaching the condition found in the south Mexican *C. tubulatum* Rehn and Hebard, while the visible marginal portions of the tegmina are not darkened as in *erraticum*.

The maxillary palpi in this species have the fifth joint equal in length to the third, expanding evenly and weakly so that the greatest (distal) width is only two-fifths the greatest length, with apex weakly obliquely truncate.

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[25] The female from Abingdon Island, described by McNeill as this species, represents an individual of *C. erraticum* (Scudder). It is probable that the immature examples recorded also represent that species.

Length of body ♂ 6.2, ♀ 6.5–6.8; length of pronotum ♂ 3.9, ♀ 1.9–2.; caudal width of pronotum ♂ 2.1, ♀ 2.–2.1; length of caudal femur ♂ 3.7, ♀ 4.–4.1; length of ovipositor 3.6–3.7 mm.

Gryllinæ

27. **Hygronemobius speculi** (McNeill)

1901. *Nemobius speculi* McNeill, Proc. Wash. Acad. Sci., III, p. 503, figs. 43 and 44. [2 ♂, 20 juv.; Tagus Cove on Albemarle Island, Galapagos Islands.]

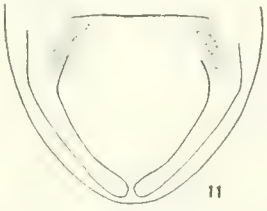

Fig. 11.—*Hygronemobius speculi* (McNeill). Dorsal outline of male subgenital plate and chitinous projections of titillator. *Type*. Tagus Cove, Albemarle Island, Galapagos Islands. (X 26)

Examination of the two adult males and twenty immature individuals of McNeill's series shows this species to be closely related to, but distinct from, *H. dissimilis* (Saussure). Our assignment of *speculi* to synonymy under *dissimilis*[26] is therefore erroneous.

We here select as type of *speculi* a male before us, belonging to the Leland Stanford Jr. University, taken at Tagus Cove on Albemarle Island, Galapagos Islands, on January 23, 1899.

Compared with males of *dissimilis* in the Philadelphia collections from Petropolis, Brazil, the following differences are noted. Maxillary palpi yellowish brown, with apex only of last joint suffused with a darker brown. Tegmina almost uniform dark brown, the veins and distal portion of the dorsal field being only very slightly paler[27]. Dorso-internal spur of caudal tibia equalling metatarsus in length. Titillator developed into two elongate slightly inbowed arms, the apices of which reach

[26] Ent. News, XXVI, p. 197, (1915).
[27] In the males of *dissimilis* before us the tegmina are as dark, with principal veins and broad caudal marginal portion of dorsal field strikingly buffy.

the apex of the subgenital plate and almost touch, thus enclosing an area roughly elongate-oval in shape[28].

28. **Gryllus assimilis** (Fabricius)

1775. [*Acheta*] *assimilis* Fabricius, Syst. Ent., p. 280. [Jamaica.]

1893. *Gryllus galapageius* Scudder, Bull. Mus. Comp. Zoöl., XXV, p. 22, pl. III, fig. 8. [♀, Albemarle Island; juv., Charles and Chatham islands; and all Galapagos Islands.]

The above synonymy was indicated by Rehn and Hebard at the time the genus, as found in America, was revised[29].

San Tomas, Albemarle Island, 1200 feet, October 30, 1905, 2 juv. ♂; Indefatigable Island, November 11 to 22, 1905, 1 juv. ♀; Chatham Island, October, 1905, 1 juv. ♂, 1 juv. ♀; Cormorant Bay, Charles Island, October, 1905, 1 ♀, 1 juv. ♂; and Hood Island, June, 1906, 2 juv. ♂, 1 juv. ♀.

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[28] In *dissimilis* the titillator is on each side produced caudad in a straight, slenderly conical process, about twice as long as its basal width. The inner margins of these processes, and the distal margin of the titillator intervening approximately form a semicircle.

[29] Proc. Acad. Nat. Sci. Phila., 1915, p. 296, (1915).

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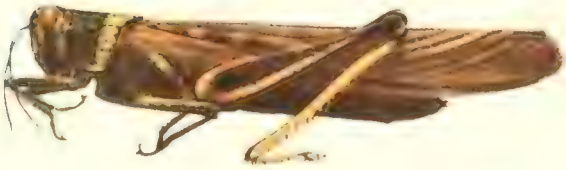

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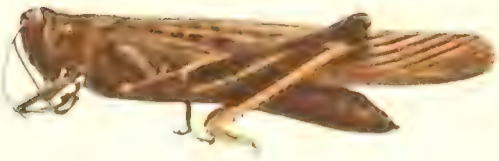

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EXPLANATION OF PLATE

Plate 18

(The figures on this plate are all natural size.)

Fig. 1.—*Schistocerca melanocera* (Stål). Lateral view of female. *Topotype.* Charles Island, Galapagos Archipelago.

Fig. 2.—*Schistocerca melanocera* (Stål). Lateral view of female. James Island, Galapagos Archipelago.

Fig. 3.—*Schistocerca melanocera* (Stål). Dorsal view of female. Villamil, Albemarle Island, Galapagos Archipelago.

Fig. 4.—*Schistocerca melanocera* (Stål). Dorsal view of male. Villamil, Albemarle Island, Galapagos Archipelago.

Fig. 5.—*Schistocerca melanocera* (Stål). Dorsal view of male. Cowley Mountain, Albemarle Island, Galapagos Archipelago.

Fig. 6.—*Schistocerca intermedia* Snodgrass. Lateral view of female. *Topotype.* Duncan Island, Galapagos Archipelago.

Fig. 7.—*Schistocerca literosa literosa* (Walker). Lateral view of male. Chatham Island, Galapagos Archipelago.

Fig. 8.—*Schistocerca literosa punctata* Scudder. Lateral view of male. *Topotype.* Hood Island, Galapagos Archipelago.

Fig. 9.—*Schistocerca literosa hyalina* Scudder. Lateral view of male. *Topotype.* Tower Island, Galapagos Archipelago.

Fig. 10.—*Halmenus eschatus,* new species. Dorsal view of male. *Paratype.* Wenman Island, Galapagos Archipelago.

Fig. 11.—*Halmenus eschatus,* new species. Dorsal view of female. *Paratype.* Wenman Island, Galapagos Archipelago.

PROCEEDINGS

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XVIII

EXPEDITION OF THE CALIFORNIA ACADEMY OF SCIENCES TO THE GALAPAGOS ISLANDS, 1905-1906

THE BEES AND ACULEATE WASPS OF THE GALAPAGOS ISLANDS

BY

FRANCIS X. WILLIAMS

Honolulu, Hawaii

This paper deals with the bees and aculeate wasps collected in the Galapagos Islands while I was field entomologist to the Expedition of the California Academy of Sciences to those islands in 1905-1906. It also includes the few bees and wasps taken *en route* on islands between San Francisco and the Archipelago. Added to the list are other species of wasps taken on other expeditions to the Galapagos.

The Galapagos Archipelago lies about 600 miles from the west coast of South America. Though crossed by the equator, a branch of the antarctic current bathes these islands and renders their climate a comparatively mild one. The lower

islands are commonly barren but the higher ones intercept, in their upper portions, the moisture-laden atmosphere and thus not infrequently possess a luxuriant vegetation there.

There yet remains a great deal to be done on the land invertebrates of the Galapagos and this is especially true of insects, whose habits and distribution are often specialized and restricted. The scanty list of bees and wasps shows a series of insects which have, I believe, reached their destination by the flotsam and jetsam method, and by flight. They certainly represent a very commonplace lot, easily adaptable to transportation to, and settlement in, such a territory. So far as I know the species, they do not show very much modification from mainland forms related to them. This is in sharp contrast to the bees, wasps and other groups in general, of the more ancient and far more isolated Hawaiian Islands, for example. As in the Hawaiian group, insect immigrants are constantly arriving in the Galapagos. Beebe (Galapagos—Worlds End) noted the common milkweed butterfly *(Danais plexippus)* on Chatham Island in 1923 and this is the first record of that conspicuous and strong flying insect in the islands.

The large carpenter bee *(Xylocopa colona* Lep.) and the Eumenid wasp *(Pachodynerus galapagensis,* n. sp.) are among just the sort of Hymenoptera one should expect in the Galapagos. One might well ask, however, why there are no social bees and wasps there when on the coastal mainland of Ecuador, 600 miles away, they are among the most conspicuous and abundant of insects. Social insects such as these require a large amount of plant and insect food, a commodity not so abundant nor varied in the Archipelago; this, I believe, is an important reason for their absence there.

SAN MARTIN ISLAND (Off Lower California)

APIDÆ

Four white banded bees, probably *Anthophora* sp., July, 1905.

REVILLAGIGEDO ARCHIPELAGO

SAN BENEDICTO ISLAND

LARRIDÆ

1. **Tachytes exornatus** Fox

One female taken July 26, 1905, on this rocky islet.

It agrees perfectly with the unique female in the collection of the Academy of Natural Sciences of Philadelphia, and labeled: "type, L. Cal." I did not go ashore on San Benedicto Island, but the wasp was said to be common there and doubtless the young of a large short-horned grasshopper *(Schistocerca ?)* furnished the food supply for its young.

SOCORRO ISLAND

BEMBECIDÆ

A discolored *Bembix* sp. doubtfully referred to this island. July 26, 1905.

COCOS ISLAND

Family EUMENIDÆ

2. **Odynerus (Pachodynerus) nasidens** (Latr.)

There are four females from Wafer Bay, Cocos Island, September, 1905. One of these specimens has been deposited in the U. S. National Museum. The propodeal crests show a slightly stronger outward bend at their inferior end than in most of the *P. nasidens* I have examined from elsewhere.

GALAPAGOS ISLANDS

Family Bethylidæ

3. **Scleroderma galapagensis** Brues.

This insect was described in the Proceedings of the California Academy of Sciences, 4th Ser., II, pt. II, No. 16, June, 1919, from six females. They are small wingless insects, 2.5-3 mm. long, and superficially rather resemble ants. It seems that these insects when collected were placed in a vial containing ants from the same locality, James Island, at about 2000 feet, December 27, 1905, and naturally a mis-interpretation has arisen about their association. They were found to be parasitic on beetle larvæ, for in cutting open decayed trunks of a species of *Scalesia,* one of the endemic Compositæ that reaches its best development in the upland forests where it attains the dimensions of a tree, I exposed a number of rather large beetle larvæ and some pupæ, the great majority of which belonged to a genus near *Parandra* (Spondylidæ), or to that genus. A few of these larvæ and one pupa were parasitized externally by small wasp grubs doubtless those of *Scleroderma,* adults of which were taken in these same beetle borings.

Family Thynnidæ

4. **Agriomyia vagans** Smith

One female from Charles Island taken on the voyage of H. M. S. "Peterel" to the Galapagos Islands.

The Thynnidæ are best developed in part of the Australian region, but are also well represented in subtropical and temperate South America.

Family Mutillidæ

5. **Photopsis galapagensis** Williams, new species

Male. Holotype. Length 8.5 mm. Slender. Pale brown, with most of the second abdominal and of the following segments, except the apex of the body, a darker brown; mandibles

dark apically; compound eyes nearly black; ocellus enclosing a blackish area; legs very pale, almost straw color; wings hyaline; stigma brown. Head smooth, only sparsely punctate; antennæ with article three shorter than four, which is about equal to five; right mandible with one rather reduced and two distinct, apical teeth, left mandible with two distinct apical teeth, the inferior one the longer; inferior margin of mandibles notched about mesad so that the basal is wider than the apical portion; clypeus gently rounded out at the sides, then continuing towards the transverse middle portion as a nearly straight line; the middle portion with a small tubercle on either side. At the middle base of the clypeus is a large rather low tubercle. Thorax shining with rather large well separated punctures; forewings with the third submarginal and the third discoidal cells incomplete on the outer side; stigma fairly large; venation of hind wings quite indistinct. Propodeum with rather large though not coarse reticulations, a few of the transverse carinulæ lacking mesad towards base; at each side at the distal end the propodeum is armed with a rather fine spine. First abdominal segment (pedicel) smooth, about three-fourths as long as the hind femora; its base flaring laterally into a spine; dorsally it is well arcuate, laterally gently, while its ventral profile is nearly straight and smooth, only slightly punctuate (for reception of hairs). At the apex, which is not constricted, the pedicel is about two times as wide as at base.

The insect is sparsely clothed with pale erect hair; antennæ with very short pile. A male paratype is about 8 mm. long, and another of the same size lacks the head. The ocelli of the males of these nocturnal insects are very large. The females are apterous and not commonly taken. They are most abundant in arid or semi-arid regions with warm summers, and frequently come to light in large numbers.

Type: Male, No. 1870, Mus. Calif. Acad. Sci., taken by F. X. Williams, November, 1905, on **South Seymour Island**, a low, dry bit of land near Indefatigable Island. *Paratypes*, two males, same data.

Family PSAMMOCHARIDÆ

6. **Aporinellus galapagensis** Rohwer

This species has been recently described by Rohwer (Zoologica, Vol. V, No. 16, p. 174-175) from a single male collected on South Seymour, Galapagos, April 23, 1923, by the Williams Galapagos Expedition. Dr. William Beebe, chief of that Expedition, mentions in his book "Galapagos, Worlds End", page 337, a small black wasp that he saw on Tower Island, but that he could not catch, dragging off a spider. This may have been the female of this species. In January, 1906, at Wreck Bay, Catham Island, I captured a single specimen of an *Aporinellus,* probably *galapagensis.* The spider it was dragging away is preserved but the wasp itself unfortunately was destroyed in being shipped from New York. The following is the description I made of it:

Female. Length 7.5 mm. Fairly thickset. Black, marked with pale gray sericeous as follows: most of face, back of head, anterior, posterior and lateral parts of pronotum, the posterior quite narrowly; spot each side of scutellum, the postscutellum except the middle; propodeum except most of the disc and posterior face and lower sides; the thoracic pleuræ, coxæ and largely the rest of the legs; abdomen with a large subtriangular median spot near middle length and posterior borders of two and three, and probably also of four and five (these being greasy). Mandibles red mesad. Some long hairs at base of head, near neck. Clypeus gently emarginate mesad; interocular space at vertex rather narrow, about equal to the antennal joints two and three, or a little less; joint three longer than four; inner spine of hind tibiæ nearly two-thirds the length of the basitarsus. Primaries with two submarginal cells, dark colored at apical fourth.

This species seems closely related to *Aporinellus intermedius* Banks of Southern California, but differs from it, at least in the distribution of the sericeous markings on the abdomen.

Nearly all the Psammocharidæ prey on spiders, from small ones to the giants of the American tropics. Many of the wasps

dig their own burrows, others utilize those of their victims; a third class are mud daubers and are addicted, one might say, to cutting off their victims' legs, wholly or in part.

Family Eumenidæ

7. **Odynerus (Pachodynerus) galapagensis** Williams, n. sp.

Very like *Pachodynerus nasidens* (Latr.) in form, pattern and sculpture.

Female. Holotype. Total length 9 mm. Black, with yellow markings as follows: spot on each clypeal tooth, base of mandibles, between antennæ and eyes, above base of antennæ, anterior and posterior margins of pronotum, small spot on pronotal lobe, the knees and a stripe along anterior side of tibiæ, transverse band on postscutellum, lateral crests, superior valves (near pedicel) of propodeum, abdominal segments two to six with apical band, that of five sinuate. Antennæ reddish brown beneath; tegulæ testaceous, forewings ferruginous, greyish black apically; hindwings more hyaline, pale ferruginous about costa. Segment one of abdomen with some pale brownish testaceous laterally. Clypeus rather shallowly emarginate striato-punctate except the sides. Most of the head and thorax with deep separate punctures; thorax reticulate-punctate laterally and nearly smooth where the legs fold back against its sides; postscutellum with a delicate, serrulate transverse ridge; posterior face of propodeum concave, shining, with a low, smooth median carina, somewhat fusiform and with oblique imperfect striæ therefrom; lateral crests at first subhorizontal, becoming at length vertical and terminating outwardly at inferior end nearly at right angles, as a *free and conspicuous subspatulate scale;* valves large, the upper auriform. Abdomen above weakly punctate, except at apex of segments, segment six finely reticulate; beneath with the abdominal puncturation coarser and more scattered. Clothed with pale silky golden hair, mostly appressed and finer and less conspicuous on abdomen.

Male. Allotype. Total length 10 mm. Much like the female. Clypeus margined with yellow except at base, the yellow being much narrowed at apex, the color extending well into the emargination of the eyes; scape of antennæ yellow beneath, flagellum brownish beneath. Abdomen with yellow bands on two to seven, that of seven subapical. Clypeus nearly truncate, the emargination being very shallow. Genital armature very like that of *P. simplicicornis* Sauss. from Hawaii. There is a low thorn on the mesopleura. This male unfortunately was subsequently almost wholly destroyed in transit through the mails.

Type: Female, No. 1871, Mus. Calif. Acad. Sci., collected in January, 1906, by F. X. Williams at **Wreck Bay, Chatham Island.**

This insect is closely allied to *Pachodynerus gaulter* Brèthes, from Venezuela which also has the propodeal crests well developed though hardly as strongly as in *galapagensis.*

Pachodynerus is a subgenus of *Odynerus* and was erected by Saussure for a group of stout-bodied wasps, the males of which have the antennæ ending simply, i. e., not terminating in a hook. The subgenus is peculiar to temperate and tropical America.

The Odyneri usually prey upon caterpillars which they store in burrows in the ground, in wood, in mud cells or in cells of other material. The egg is suspended from the roof or side of the cell by a fine thread.

Family Crabronidæ

The adult of this fly-catching wasp was not seen, but its easily recognized cocoons containing larvæ were found at low altitude in cells in a decayed branch of an *Erythrina* tree, August, 1906, at James Bay, James Island. The cocoons were of the typical crabronid form such as occur in the Hawaiian Islands, and the single Galapagos cocoon preserved shows the remains of muscoid flies fastened at its smaller or basal end.

The wasps of the family Crabronidæ are noticeable for their massive heads. They make burrows in the ground or in wood and store these, in most cases perhaps, with flies, though at least two species catch small moths, and one captures "book lice" (Corrodentia).

Family Larridæ

8. **Nitela darwini** Turner

This unique specimen measures 3.5 mm. long and was taken on Charles Island, Galapagos, by Charles Darwin on the voyage of the "Beagle."

All the wasps of this genus are of small size and active and undoubtedly many species still remain to be described. Not much is known of their habits. They nest in dry wood and are sometimes found running on the trunks of trees. Homoptera seems to form the provisions for some; but Bridwell took a South African species storing her nest with wingless Psocidæ (Corrodentia).

Family Larridæ

9. **Tachysphex galapagensis** Rohwer

This insect was described in Zoologica, Vol. V, No. 16, p. 173-174, 1924, from six females and fifteen males, the localities being Albemarle Island, March 21, 1899, and South Seymour Island, April 23, 1923.

The wasps of this genus are exceedingly active insects and prey on orthoptera, chiefly on short-horned grasshoppers of which the young of the Galapagos *Sphingonotus* or *Schistocerca*, would be suitable. Most commonly they dig short, one-celled burrows and not infrequently provision several of these in a day.

Family APIDÆ

10. **Xylocopa colona** Lepeletier.

This large carpenter-bee has been taken on many of the Galapagos Expeditions and is to be found on probably all the larger and on some of the smaller islands of the group. The female is blackish and the male tawny brown; this sexual dimorphism being common in the genus. The males are faster fliers and have a more highly pitched buzz than the females.

There are numerous examples in the collection of the California Academy of Sciences, taken in 1905 and 1906, from Chatham, Charles, James, Indefatigable, South Seymour and Albemarle Islands.

The species in the Galapagos has gone under several names, viz., *X. mordax* Smith, *X. brazilianorum,* and *X. colona* Lep., but I have followed Rohwer who had Galapagos specimens compared with *X. colona* from the Galapagos, in the British Museum. The genital armature of specimens from several of the islands of the Archipelago were dissected out and compared by me and proved to vary to a small extent. There is, however, a tendency for insular variation in this insect noticeable in the tint of the wings in the females, those in the collection of the California Academy of Sciences show a greenish blue iridescence from Charles, Chatham and James Islands, with those taken on Albemarle, Indefatigable and its small neighbor, South Seymour Island, exhibiting a distinctly bluish purple tint.

This bee is rather a common insect and occurs chiefly at low levels and even along the sea beaches. It nests in wood, the several-celled borings having been found in the branches of *Hibiscus tiliaceous, Croton* sp., *Bursera,* and particularly in the very soft wood of *Erythrina.* Its larva is parasitized by the grub of a cantharid beetle which has a hypermetamorphosis, the young active larvæ and the quiescent arcuate larvæ being several times found in the bees' burrow at James Bay, James Island. More recently Beebe (Galapagos, World's End) found the triungulin stage of what was probably this

cantharid beetle to the number of over 100 clustered about the wing bases of this bee from South Seymour Island. This observation induced me to examine the 1905-1906 *Xylocopa colona* more carefully and one male from Post Office Bay, Charles Island, was found harboring nine or ten of these small parasitic beetle larvæ.

Mites or Acari, sometimes in quantity may be present on these Galapagos bees.

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