Oceanic Birds OF SOUTH AMERICA

OCEANIC BIRDS OF SOUTH AMERICA

OCEANIC BIRDS OF SOUTH AMERICA

A STUDY OF SPECIES OF THE RELATED COASTS AND SEAS, INCLUDING THE AMERICAN QUADRANT OF ANTARCTICA BASED UPON THE BREWSTER-SANFORD COLLECTION IN THE AMERICAN MUSEUM OF NATURAL HISTORY

BY

ROBERT CUSHMAN MURPHY

ILLUSTRATED FROM PAINTINGS BY FRANCIS L. JAQUES PHOTOGRAPHS, MAPS, AND OTHER DRAWINGS

Vol. II

THE MACMILLAN COMPANY
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK

ILLUSTRATIONS

TEXT FIGURES

COLORED PLATES (UNNUMBERED)

These plates will be found together in a separate section at the back of the book.

NUMBERED PLATES

These plates will be found together in a separate section at the back of the book.

OCEANIC BIRDS OF SOUTH AMERICA

THE PETRELS

FAMILY PROCELLARIIDAE

THE FULMARS, CAPE PIGEONS, WHALE-BIRDS, GADFLY PETRELS, SHEARWATERS, ETC.

SUBFAMILY PUFFININAE

[CONTINUED]

SHOEMAKER

Procellaria aequinoctialis

Procellaria aequinoctialis Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 132 (Cape of Good Hope).

Names: White-chinned Petrel or Fulmar; Cape Hen; Night-hawk at the Falklands. Synonyms of the specific name include *fuliginosa*, *nigra*, and *conspicillata*.

Characters: The largest black petrel (excepting the youthful stage of the Giant Fulmar), with a sharply contrasting pale bill.

Adults (sexes alike): General color sooty black, the concealed portions of the feathers gray, producing a certain amount of indistinct mottling (disintegration and fading, furthermore, cause the feathers to acquire somewhat rusty margins, particularly on the breast); chin usually white in varying degree, some specimens showing only a minute white spot, with black feathers in front of it between the rami, as well as caudad; in others the white may cover the entire chin, fore-throat, and sides of face below the gape, while in the phase described as *conspicillata* it may also include a variable bar across the forehead, lores, cheeks, and auriculars. Iris seal-brown, separated by a narrow whitish ring from the cornea, which is brownish instead of white; bill pale yellowish or greenish horn-color (sometimes almost white) on the naricorn, latericorn, ramicorn, and the ungues of both mandibles, bluish black on the culmen, mandibular sulcus, and the very tip of the maxillary unguis; legs and feet black.

14 males from South Georgia, the South Atlantic, and the coasts of Argentina, Chile, and Peru: wing, 355–400 (385); tail, 116.3–131.5 (124); exposed culmen, 48.6–55.3 (51.7); tarsus, 60–68.2 (65.6); middle toe and claw, 78.6–83.7 (81.1) mm.

8 females from similar sources: wing, 357–383 (377); tail, 113–134.1 (123.7); exposed culmen, 48–51.6 (50.4); tarsus, 62.2–66.2 (63.8); middle toe and claw, 77–84.3 (80.6) mm.

Length in the flesh of one South Atlantic male and one female, 51.4 and 53 cm.; wing-expanse, respectively, 136.5 and 134 cm.

It is curious that the downy young of this abundant petrel seems never to have been fully described. Pagenstecher (1885, 22) states that the protoptyle down is "coffee-brown." In the collections studied I have found no specimens younger than fledglings.

The egg is white, fine grained, and of highly variable shape, some examples being short ovate and others greatly attenuated. In most nests they quickly become brown from mud stains. Average measurements of 19 eggs taken at Cumberland Bay, South Georgia, on November 28 and 30, 1912, are 83.5 x 54.6 mm. Examples covering the extreme dimensions measure: 90.3 x 54.9, 77.2 x 55.8, 86 x 52.8, 81.1 x 56 mm.

Distribution: Breeding at sub-antarctic and low antarctic islands, such as the Falklands, South Georgia, the Crozet Islands, Kerguelen, and a number of the sub-antarctic outliers of New Zealand. Ranges southward to the neighborhood of the antarctic circle in the Pacific to westward

of the Antarctic Archipelago, northward to about latitude 30° S. in the open oceans, ten or fifteen degrees farther in the eastern South Atlantic, casually to the neighborhood of Cape Frio, Brazil, and regularly in the Humboldt Current to northern Peru.

At South Georgia, where this large black petrel is extraordinarily abundant, I once asked a Norwegian whaleman why the bird was called "Shoemaker." He replied, "Because he sits in his shop and sings." There is no doubt about that, for the shrill chattering of the species probably makes up a greater volume of noise than the voices of any other petrels nesting at this antarctic island. During the active courtship season, in November, the peculiarly penetrating cries of the Shoemaker make the night air ring, and sound at a distance like a chorus of frogs. Kidder (1875, 25) well likens the high trill to the note of a water-whistle. It possesses that piercing quality which seems to set something within our ears in motion, so that we continue to hear the vibration for a time after the bird has actually ceased calling. Nor is the singing of these petrels confined to the night, for when one walks above the roofs of their homes in the daytime, footfalls among the tussock hummocks will be echoed by expressions of protests or interest from below ground. The Shoemakers' voices, however, seem to be reserved mostly for the breeding territory for, as Wetmore (1926, 52) remarks, the silence of these great birds at sea impresses one as uncanny. The only sound I remember hearing from a Shoemaker over the ocean was the almost terrifying scream of a wounded bird which I seized and hauled into my dory in mid-Atlantic.

The American Museum Collection contains a large series of Shoemakers from the oceans on both sides of southern South America, and also from the Australasian region. In appearance and dimensions all of these birds prove indistinguishable. The extent of white on the chin, in particular, is clearly without geographic significance. Among sixty specimens from four or five distinct oceanic areas, an approximately equal variation in this mark is present in each group.

For example, Beck's birds taken off Valparaiso, during November, 1913, include one specimen with no white whatsoever on the chin, and several others in which the white represents only a trace made up of half a dozen asymmetrically placed feathers. Other Valparaiso birds, however, have the chin entirely white, and several taken off Corral, Chile, and off various parts of the Peruvian coast, show the condition developed still further. The same variation appears among specimens collected along the Atlantic coast of Patagonia, except that none of these happens to have a chin without any trace of white. A male taken at Mar del Plata, Argentina, on October 21, 1914, has the fore-throat as well as the entire chin white, the area being carried up on to the feathered region behind the ramus of the mandible. This bird also has a spot made up of a few white feathers on the lower belly. Another male, captured during the Cleveland Museum Expedition in latitude 18° 37′ S., longitude 2° 38′ W., on September 8, 1925, has an almost equally extensive white throat-patch, as well as a few white feathers on the lower belly. The original description of the species *aequinoctialis* was based upon the figure of a bird without white on the chin.

Our series shows that such examples are still to be found, and that there is no justification for the several subspecific names that have been applied with reference to this genetically variable character.

The same variability leads, I have no doubt, to the rarer, spectacled condition which has received the specific name *conspicillata*. No two birds of this type appear to be exactly alike. Our only specimen is one without data in the Lawrence collection. In this the white spot on the chin is surrounded by black feathers, just as among many normal examples of *aequinoctialis*. A more or less irregular white line crosses the forehead and lores, loops back under the eye, and turns upward across the auriculars. The nature of this mark, in its general appearance and asymmetry, makes it seem entirely analogous with the variable white chin. The measurements of the specimen fit well into those of the general series.

In latitude 27° S., longitude 39° W., of the South Atlantic, I saw a Shoemaker of the *conspicillata* type mingling with many of the normal birds as they fed astern of my brig. It was distinguishable in no other way than through the appearance of its head. Gould (1865, 445) states that birds of the sort are to be observed off the Falklands and in the neighborhood of Tristan da Cunha, the latter not being a breeding station for any form of *Procellaria*. Pelzeln (1869, 143) records the capture of "*conspicillata*" in latitude 31° 40′ S., longitude 12° 41′ W., north of Tristan, on September 11, 1857. The specimen was a male with a wing-spread of 137 centimeters, exactly that of typical *aequinoctialis*.

From all of the above it seems certain that the white-headed birds represent merely a phase that crops out from time to time in the Shoemaker population, and not a rare or dwindling species, as suggested by Alexander (1922, 261). It is quite likely, nevertheless, that the white-bridled birds may exist in varying proportion during successive generations, and altogether possible that they may be at present less numerous than at some earlier period. Apparent cycles of albinism, or of other peculiarities in color or pattern, have been observed among numerous animal populations.

The distribution of the Shoemaker is both antarctic and sub-antarctic, but all of its known breeding grounds lie not far from the convergence between surface waters of the two zones. So far as we know, South Georgia is the most heavily glaciated island at which the species nests. The Falkland Islands, where it has only recently been found breeding (Bennett, 1926, 314), and such New Zealand islands as the Antipodes, represent the milder extreme of its breeding range. The factors controlling the distribution of the bird appear to be both subtle and inflexible, for it nests neither at the South Orkneys, where burrowing in the soil would be impossible, nor at Gough Island in the milder latitudes of the Sub-Antarctic Zone. Although a specimen was obtained at Gough by the 'Scotia' expedition, it was shot in the coastal waters of the island and there was no indication of its being a resident species (Clarke, 1913, 285). Furthermore, although the species is common at sea off South Georgia all the year round, its flight-range seldom extends into high latitudes of the circumpolar antarctic seas. Reichenow (1908, 553) and Wilkins (1923, 492) indicate that

the Shoemaker is likely to be encountered southward a little beyond 60° S. with more or less regularity, and during the summer season the birds penetrate somewhat farther toward the polar circle in the neighborhood of the Antarctic Archipelago, and in the permanently open waters to westward. Its presence near the South Shetlands may possibly be influenced more or less by whaling operations, which have tended to draw southward a considerable variety of sea birds that belong typically to milder oceanic regions. Everywhere, however, pack-ice forms a barrier which this species does not pass.

The northward range of the Shoemaker extends well toward the edge of tropical surface waters. In large numbers the birds are rarely seen north of about 30° S. latitude, but stragglers have been taken as far as 17° S. in the open ocean, and more frequently in cool-current regions, such as the neighborhoods of Cape Frio, São Paulo, Iguapé (von Ihering, 1907, 36) and more southerly parts of the Brazilian coast. In the Humboldt Current the Shoemaker is to be found throughout the year up to latitude 6° or 7° S., off northern Peru. I myself saw a group of five off Pimentel on January 16, 1921, which is the height of the normal breeding season for the species. Mr. Beck observed others off Eten during the same month of another year, and thereafter recorded and collected examples at every season southward along the coasts of Peru and Chile to Chiloé Island, along various shores of the Magellanic region, and as far off the continent as the waters around both islands of the Juan Fernández group.

The Shoemakers begin to come ashore at South Georgia before the middle of October. Von den Steinen (1890, 252) saw a large number which had arrived during a storm on October 15; the birds were moving about among the hummocks of tussock grass as if in search of the entrances to old burrows. They gave him the impression of being tired, as though from a long flight at sea although, as pointed out above, many of these petrels apparently remain close to South Georgia throughout the winter. Pairing seems to take place soon after landing, and the birds that do not take possession of the remains of burrows dating from previous years set about to excavate new ones. During my own field work I found that the greatest concentration of burrows in any colony or "warren" was always to be looked for in places where there is a good lee, such as inland- or eastward-facing slopes of hills. Grass-grown ground with good drainage, and especially the upper parts of steep banks, are favorite nesting sites. In such places the holes are sometimes so thickly clustered that there is little space between them. The burrows are often made directly under hummocks so that screens of drooping grass more or less cover the entrances. Excavation begins while much of the ground is still frozen, and lumps and spicules of ice are to be found in the black vegetal mould thrown out by the birds. Matthews (1929, 574), whose observations agree closely with my own, watched a Shoemaker in the process of digging, at the beginning of November. The bird first used its beak as a pick, and then scraped the loose earth out of the burrow with its webbed feet. The entrance to the burrows, after completion, are 25 to 35 centimeters in diameter, but they narrow to less than 20 centimeters at a short distance inside; in length they range from less than a meter to nearly two. I

have found tunnels with two entrances on either side of a tussock hummock but I suspect that this was due to one bird accidentally sapping into its neighbor's home. The tunnels may be level or they may slope either up or down; at the end is a roughly hemispherical nest-chamber, with a horizontal diameter of about 45 centimeters, large enough to accommodate both adult birds comfortably. It is often situated directly beneath a hummock of grass so that the rootlets appear through its frozen roof. The nest itself is a raised structure resembling, as Hall (1900, 21) points out, an inverted saucer. This platform is built of earth, more or less mixed with the wisps of tussock grass and other materials originally carried in as nest lining, and around its base is a deep gutter, which is usually half full of water. According to Stead, the Shoemakers build the nest platforms by standing heel-deep in mud in the middle of the chamber and raking the soil inward with their bills (Oliver, 1930, 133). The thawing snows on higher hills cause streamlets and waterfalls to come running and tumbling down between and over the front doors of the burrows, sometimes flooding them with icy water.

At Cumberland Bay, South Georgia, I found that many birds were still excavating homes at the end of November, while neighboring nests contained slightly incubated eggs. Far more surprising was it to discover both digging and egg-laying in progress at islands in the Bay of Isles as late as January 2, when incubation was far advanced in all the mainland colonies I had visited. The work of excavating is done in short shifts, and during intervals of rest the mud-smeared bird sits outside the burrow and preens its feathers, frequently uttering its chattering call. At such times it also utters a lower and harsher note, pointing the beak upward and causing it to vibrate rapidly, in albatross fashion.

Little is known about the courtship performance of the Shoemaker, and many of the earlier observations were probably insufficiently critical to be relied upon. Will (1884, 136) watched single birds, which he took to be females, being besieged by two or more presumed males which clung about the entrance to a burrow. Von den Steinen describes "fighting" between two birds, but his description of the Shoemakers lying flat on the ground, bill to bill, with their throats inflated and their beaks wide open, suggests a familiar type of courtship behavior rather than combat. While burrowing is under way, or before the egg has been laid, pairs of birds sit about more or less in the open air, close to the entrances of their homes, sunning themselves and facing each other, alternately or simultaneously nibbling with their beaks and uttering their shrill warbles. Their rapid breathing is indicated by tiny oily bubbles flickering at the nostrils.

It is never difficult to tell whether or not a Shoemaker burrow is occupied, for any announcement of a caller at the entrance brings immediate vocal response from within. Matthews states that if an arm is thrust in as far as the sitting bird, the latter does not at first bite the outstretched fingers. Rather these are gently touched by the bird's bill, with movements similar to the "fencing" performance which the albatrosses and other Procellariiform birds indulge in as part of their social or connubial behavior. This is followed by a gentle

nibbling, and only after the deceived Shoemaker has been seized, and forced to realize that it is not being greeted by its mate, does it start snapping and scratching. When pulled out of the burrow, it screams stridently and at the same time makes a curious grunting sound in its throat. While it is capable of biting severely, the long, sharp, and flinty claws are even more to be dreaded than the beak. If freed outside the burrow, the bird shows little disposition to fly. Rather it squats until it is approached once more, whereupon it stands up on straight legs, opens its mouth wide, and screeches further protests. After some minutes it may run off among the avenues of hummocks, or launch into flight. The Shoemaker walks strongly, with a fully digitigrade gait but, like the weaker-legged petrels, it rests frequently in the squatting posture. Several birds which I pursued to see how far they would run, soon attempted to take refuge in other burrows than their own, from which they were promptly driven out by the rightful occupants.

In nests without an egg I usually met with two adult birds. Large numbers of eggs were laid within a space of two or three days following the middle of November and after this I found only a single incubating bird at home. The adults alternate in the sitting function, but the régime of change has not been determined. Practically all eggs taken on November 28 and 30, 1912, were slightly incubated, with embryos up to 15 millimeters in length. The heat of the birds causes constant melting of ice from the walls of the nest-chamber, and therefore the egg becomes thickly plastered with mud within a very short time after it is laid. It would doubtless become buried altogether in cold semi-fluid soil, were it not for the fact that the nest is a raised structure, as already described. The first young were found by members of the German Expedition at South Georgia on January 15, and it is probable that incubation requires from 50 to 60 days. On January 30 I saw downy chicks which I judged to be a week or more old. Throughout February and March the parents still come nightly to feed the young, as Will determined by noting that holes had been pushed through a blanket of early winter snow which completely obscured the mouths of the burrows. Some time in April, apparently, the young are abandoned, but most of the fledglings do not leave their homes, and find their way toward the water, until May.

Because of the size and strength of the Shoemaker, adult birds are practically free from molestation by the skua. I have seen the latter in pursuit of a Shoemaker high in air, doubtless endeavoring to make it disgorge, but at any rate the birds are not in danger of being killed and torn to pieces by the enemy. For this reason, although primarily nocturnal petrels, they do not hesitate to show themselves freely by day. Not infrequently I have seen them flying back and forth between burrow and fiord during the broad daylight, something which no whale-bird or diving petrel could attempt without being gobbled up by a skua. Oliver (1930, 133) states that these petrels fight a dog more bravely than any other, generally coming out of a burrow hanging to its ear and warding it off successfully in the open. According to Olstad (1930, 6) the Shoemaker burrows at South Georgia are now used extensively by the introduced rats.

On November 26, 1912, I observed vast numbers of Shoemakers among other petrels on the whaling banks off South Georgia. These probably represented part of the nesting population at the moment on vacation. During the whole period of rearing the young, the birds are accustomed to fly about high in air, and in great flocks, over their colonies morning and evening, sometimes keeping up their ecstatic gyrations long after daylight, and beginning again long before dark. Since their quills are hard and stiff, a loud whistling sound is produced as the birds scale about in the wind. When flying thus over the nesting grounds, they often tuck one foot forward among the feathers of the belly and hold the other under the tail.

During my South Atlantic cruise, I found the Shoemakers both abundant and singularly conspicuous. Their aggressiveness in pursuit of a bait often prevented me from capturing other species which, from a collector's point of view, I regarded as distinctly preferable. They would drop among, and scatter, a group of cantankerous Cape Pigeons, to rob the latter of the prey over which they had been squabbling, and would, in fact, make place only for such competitors as Giant Fulmars and Wandering Albatrosses. On October 31, 1912, in latitude 27° S., longitude 39° W., I captured numerous Shoemakers on fishhooks. They would dive well below the surface in pursuit of sinking bait, and after being hooked, would fly high in the air, having to be hauled down like animated kites. They screamed loudly when finally caught in the hands, though not at earlier stages of the struggle. The voracious creatures learned nothing by seeing captives drawn on board the 'Daisy' before their eyes; even victims which had escaped from one hook after being hauled part way in, promptly snapped up another. That the Shoemaker has a well-developed sense of smell may be indicated by the fact that lines baited with pork fat were ignored so long as other lines in use at the same time offered the fresh meat and fat of a loggerhead turtle.

At sea I sometimes saw large bands of these birds settling on the ocean at dusk, as though to sleep. They floated high, like gulls. On one such occasion, a bird I had winged swam so fast that a long pull in the dory was necessary to overtake it.

All observers agree that the food of the Shoemaker consists chiefly of cephalopods, although crustaceans of various sorts have also been found in stomachs, and von den Steinen (1890, 254) reports vertebrae of fish. Birds which I took from the nests always ejected a quantity of oily fluid which was much greener than that of most South Georgian petrels. The same observation may have misled Loranchet (1915, 190) into believing that this species eats grass during the period of incubation.

PARKINSON'S PETREL

Procellaria parkinsoni

Procellaria parkinsoni G. R. Gray, 1862, Ibis, p. 245 (New Zealand).

Names: Black Petrel. In earlier literature this species has been listed under the name *aequinoctialis*.
Characters: Similar to *P. aequinoctialis* but smaller and with the entire plumage, including the

chin, sooty black. Bill horny or greenish yellow, the culmen, sulci, and usually the tip of the maxillary unguis, black; legs and feet black.

8 males from New Zealand and neighboring waters: wing, 326–359 (343.4); tail, 93–106 (101.1); exposed culmen, 39.4–43.5 (41.7); tarsus, 49.2–55.3 (52.9); middle toe and claw, 62.3–70 (67.8) mm.

4 females: wing, 336–347 (340.7); tail, 95.9–102.5 (100.6); exposed culmen, 39–41.2 (40.4); tarsus, 52.6–54.2 (53.5); middle toe and claw, 65.8–71.2 (67.9) mm.

The juvenal plumage is glossy blackish brown, with a "frosted" edging on the feathers of mantle and back. The bill in this stage is said to be ivory-white.

Distribution: Breeds at Little Barrier Island, off northern New Zealand, and perhaps in the mountains of North Island. Ranges over the South Pacific from Australia to the Galápagos.

This rather rare New Zealand petrel would be regarded as no more than an accidental straggler into the South American region except for the fact that its occurrence is based not upon one but upon three discrete records. The specimens were collected by Beck during the course of the Galápagos Expedition of the California Academy of Sciences, as follows: a female north of Chatham Island, October 14, 1905; a male near Charles Island, May 4, 1906; a male in latitude 2° 40′ S., longitude 91° 20′ W. The last locality is some distance directly southward of the Galápagos group (Loomis, 1918, 108).

Parkinson's Petrel has become rare even in its homeland because of the depredations of hogs, dogs, and cats, added to the toll regularly taken by the Maoris at Little Barrier Island. Furthermore, as pointed out by Falla (1934, 254), its close resemblance to the Shoemaker, and to *Pterodroma carneipes* and *P. macroptera*, introduces a note of uncertainty into many published sight records.

Judging by the latitudes of both its breeding and its flight ranges, Parkinson's Petrel is a bird of definitely milder waters than its larger relative, *Procellaria aequinoctialis*. Its breeding grounds are all well within the Sub-Tropical Zone, while those of *aequinoctialis* are confined entirely to waters far south of the Sub-Tropical Convergence.

The American Museum Collection contains 12 skins, of which 11 were taken by the Whitney South Sea Expedition in the New Zealand region during the months of November, December, and January. Most of these birds either had large gonads or showed evidences of being engaged in nesting. Plumage wear produces the same effect as in *P. aequinoctialis*, namely, a disintegration and bleaching of the terminal portions of the feathers, giving the black birds an almost reddish cast, especially on the belly. Most of our specimens were collected between latitudes 34° and 38° S., and between longitudes 176° and 180° W.

Falla says that Parkinson's Petrel is the latest species to breed in the northern New Zealand area. Cleaning out of old burrows has been observed during November, and the first eggs during the same month. The reproductive season may be exceptionally long, for young have been recorded at various dates between December and April. The down is dark brown. The young leave the burrows chiefly during the month of May, and many of them become washed ashore during the gales and fogs of that month and of early June.

The call of this petrel on its nesting ground is described as a whistling note, which suggests resemblance to that of *P. aequinoctialis*.

PEDIUNKER

Adamastor cinereus

Procellaria cinerea Gmelin, 1789, Syst. Nat., 1, p. 563 ("intra circulum antarcticum"; 48° S., New Zealand seas, designated as type locality by Mathews, 1912, p. 123).

Names: Pediunker or Paddyunker is the vernacular name at Tristan da Cunha, and may be derived from the call or song of this petrel. Other names are Night-hawk, Black-tailed Petrel, Gray or Brown Petrel. Synonyms of the specific name include *pallipes*, *melanura*, *typus*, *adamastor*, *gelidus*, and *haesitata*.

Characters: A gray-backed, white-breasted bird, to be distinguished from the Greater and Pink-footed Shearwaters, and from any of the races of *Puffinus kuhlii*, by the dark shade beneath its wings and tail.

Adults (sexes alike): General color above ash-gray, including the back, scapulars, and upper tail coverts; long scapulars and wing coverts slightly darker than back; bastard-wing and primary coverts ash-brown; primaries hoary gray, blackish on the outer webs of the outermost two or three, paler on the inner webs, the shafts ivory whitish toward the base; secondaries hoary gray, more or less white basally; tail brownish black, with hoary gray on the outer webs of the feathers, the shafts basally whitish; pileum and sides of head darker than the back, inclining toward slate-gray; ventral surface mostly white, but with a grayish wash infringing upon the chin, throat, and neck in fresh plumage; flanks and crissum tinged with brownish gray; the long tail coverts ash-brown, with faintly paler edges; axillaries and under wing coverts ash-brown, somewhat scaled by pale edges. Iris brown; bill generally horn-color, the latericorn varying between pale greenish yellow and bright yellow, the nasal tubes, culmen, cutting edge, and the broad sulcus of the mandible, black; inside of mouth fleshy red; legs and toes fleshy gray or fleshy white, darker on the joints, the outer toe, and outer side of tarsus, the webs yellowish gray with pinkish areas due to the blood vessels; claws blackish horn-color.

6 males (2 from the South Atlantic, 4 from New Zealand waters): wing, 341–350 (346); tail, 110–124 (115.6); exposed culmen, 45.6–47.7 (47); tarsus, 57.6–63.5 (60.3); middle toe and claw, 72.5–76.5 (74.3) mm.

5 females from New Zealand waters: wing, 340–355 (347); tail, 114–118 (116.2); exposed culmen, 45–49.4 (46.6); tarsus, 57.6–61 (59.2); middle toe and claw, 72–75.5 (73.5) mm.

A well-grown chick has a nearly bare face and throat, but is covered elsewhere with plumbeous gray down which is slightly lighter, shorter, and denser on the ventral surface than on the head and back. The entire integument of the bill, with the exception of the hard and corneous ungues, appears to have been soft in life.

An egg from Macquarie Island is ovoid, white, and measures 71 x 51.5 mm. (Oliver, 1932, 129); the average measurements of 7 eggs from the same locality are 70.6 x 51.4 mm. (Mathews, 1932, 30). Eggs recorded from Tristan da Cunha have apparently been misidentified (*vide infra*).

Distribution: A species of the Sub-Antarctic Zone of surface water, breeding at Gough Island and Tristan da Cunha, Kerguelen, Macquarie, and Antipodes Islands; ranging over the southern oceans between about 25° and 55° south latitudes, and regularly northward in the Humboldt Current to the coast of Peru; recorded as a straggler northward to California.

My first experience with the far-famed Pediunker came in the South Atlantic on November 4, 1912, in latitude 32° 28′ S., longitude 45° 42′ W., which is due east of the coast of Uruguay. Examples of this petrel suddenly joined the brig 'Daisy' and followed in our wake, together with at least twelve other species, which included Wandering, Black-browed, Yellow-nosed, and Sooty Albatrosses, Giant Fulmar, Cape Pigeon, Blue Petrel (*Halobaena*), Manx Shearwater, Shoemaker, Atlantic Petrel, and Wilson's and Black-bellied Storm Petrels (Murphy, 1914, 318). All of these sea birds were in pursuit of turtle meat which I trailed from the stern. Whenever the vessel paused in her course for an instant,

owing to the rolling seas, there would be a tremendous hurly-burly of birds battling over the treacherous baits. Although a number of species were thus captured on hooks or bent nails, I did not succeed in circumventing a Pediunker, either on this or on subsequent days of angling.

The Pediunkers continued to follow the 'Daisy' thereafter, day by day until November 15 when, in latitude 43° 18′ S., longitude 41° 10′ W., they abruptly left us. We saw, naturally, no sign of the species during the summer at South Georgia, but on the homeward voyage large numbers appeared again on March 17, at a point close to latitude 50° S., after which they accompanied us northward to latitude 43° 20′ S. The only specimen I succeeded in collecting during the voyage was a male, in company with Cape Pigeons and Atlantic Petrels (*Pterodroma incerta*), shot from a lowered dory on November 9, 1912, in latitude 36° 46′ S., longitude 46° 29′ W.

In addition to the specimen just referred to, the American Museum has a South Atlantic bird taken in latitude 40° S., longitude 3° 16′ E., during the voyage of the 'Southern Cross,' the old Lawrence skin from Monterey, California, and an excellent series from Antipodes Island and from neighboring parts of the western South Pacific. In the Berlin Museum and elsewhere I have also examined specimens from the Indian Ocean. All of these are alike in appearance, and more than ordinarily so in all dimensions. The careful color notes on Beck's New Zealand birds, obtained during the Whitney South Sea Expedition, indicate furthermore that no adequate basis has yet been pointed out for distinguishing two or more subspecies of this petrel upon criteria of bill coloration.

As already suggested, the Pediunker belongs to milder latitudes of the westwind zone, stopping short toward the convergence with antarctic surface water. The southernmost Atlantic record is perhaps that of a single example reported by Vanhöffen (1901, 310) not far north of Bouvet Island on November 19. The only nesting ground that lies on or close to the polar front seems to be Kerguelen, in the Indian Ocean; the species has not succeeded in making the next leap to Heard Island, which is short in distance but profound in zoögeographic significance.

The range of the Pediunker extends farther northward wherever cool currents affect the continental littoral than it does in mid-ocean. This is particularly true in the Humboldt Current, and also along the west coast of South Africa, where Alexander (1922, 261) saw great flocks not far from the shore on March 30, 1920. Even in the western South Atlantic, Alexander reports sighting many of these birds off the coast of Rio Grande do Sul, Brazil, on May 5, 1921, and Paessler (1909, 101) met with single examples in May as far north as latitude 24° S., longitude 45° W., a point at the edge of the continental shelf, just south of Rio de Janeiro and east of Santos. The correspondence between the dates of Paessler's and Alexander's observations is interesting, and the appearance of this species close to Cape Frio is entirely in accordance with the principles of sea-bird distribution in the South Atlantic, as already pointed out in the section dealing with the circumnavigation of the continent. The most northerly of all

Atlantic records is based upon a single example procured by the Scottish National Antarctic Expedition near the island of Ascension. This statement is made, at least, by Godman (1908, 158), although the specimen does not seem to be mentioned in the 'Scotia' reports.

Turning again to the southern or colder edge of the Pediunker's range, we have more data from the Pacific than from the Atlantic. Gain (1914, 129) saw a large number in latitude 55° S., to westward of Cape Horn, where the ocean is ice-free and where the Antarctic Convergence turns well southward of its mean latitudinal position. In longitude 107° 15′ W., on January 26, 1910, several flew near the French south polar vessel 'Pourquoi Pas?' as far southward as latitude 60° S. Furthermore, Buller (1893, 184) was a passenger on a vessel followed by a flock of these petrels in the South Pacific during a nine-day portion of a voyage, which brought the ship within sight of the Diego Ramirez Islands, south of Cape Horn, on March 16. On March 14, in latitude 56° 52′ S., Buller found the Pediunker to be the commonest of all sea birds. Toward the end of each day, in this part of the cruise, there would be hundreds about the vessel. On some days they remained well astern, and again they would fly across the ship. Their numbers diminished rapidly as the South American continent was approached, the last examples being observed in latitude 56° 52′ S., longitude 82° 10′ W., a day's sail west of Cape Horn.

These observations call attention to a fact which Buller has specifically stated, namely, that the Pediunker is to a peculiar degree a strictly pelagic petrel when absent from its nesting grounds, and is not given to the custom of entering bays and channels or even to skirting continental shores in the manner of so many of the Procellariiformes. Giglioli refers to these birds in the Gulf of Peñas (Godman, 1908, 158) but, in general, they have rarely been seen either from shore or from a ship within sight of shore.

This leads directly to an error that has been perpetuated in the literature ever since the date of publication of the Zoölogy of the 'Beagle.' It has to do with Darwin's alleged note on the Pediunker as he is supposed to have observed it in the channels behind Chiloé Island, and elsewhere along the southern coast of South America. The passage is quoted in full in the biography of the Sooty Shearwater (*Puffinus griseus*) where, in fact, it belongs. The mistake is due to a confusion of names which came about as follows:

Gould (1841, 137) quotes Darwin's notes on a species of shearwater which he lists under the name *Puffinus cinereus*. The entire context shows beyond doubt that the species referred to was not the Gray Petrel at all, but the Sooty Shearwater. Darwin writes for example, "I obtained specimens from Tierra del Fuego, Chiloé, the mouth of the Plata, and Callao Bay on the coast of Peru. It is likewise known to be common in the northern hemisphere." Later in the same paragraph he lists flesh colors which agree with those of the Sooty Shearwater, but not with *Adamastor*. If further proof were needed, one might call attention to the fact that in 1837, four years before the publication of Part III of the Zoölogy of the 'Beagle,' Gould had listed the Sooty Shearwater in his "Birds of Europe" V, Plate 444, Figure 2, under the name *Puffinus cinereus*.

Unfortunately, Darwin's notes relating to *Puffinus griseus* have many times since been quoted in accounts of *Adamastor cinereus*. The facts have already been pointed out by Mathews (1912, 123), who says that the quotation in Godman's monograph "undoubtedly refers to *Puffinus griseus* Gmelin, as can at once be recognized by one familiar with these birds in the Southern-hemisphere." One of the latest examples of this mistaken use of the data is in Bent's life histories of North American petrels (1922, 105).

Among the whalemen on the brig 'Daisy,' the Pediunker, or Night-hawk as they called it, had a special reputation for being good eating. Hutton (1865, 285) reports that a shipwrecked crew at Kerguelen subsisted largely upon these birds. In order to save themselves useless digging, the sailors would hold a living Night-hawk at the mouth of a burrow, teasing it until it cried out. If another bird was inside, the call would be at once answered, and the men could begin to tear up the ground with a certainty of reward. Hutton adds that at Kerguelen the species is almost exclusively nocturnal during the breeding season, and Carmichael (1818, 497) reports that at Tristan da Cunha, this petrel, like the Broad-billed Prion, never appears on the wing until after sunset. Both may then be caught in great numbers merely through kindling a large fire. Attracted by the light, the petrels approach and flutter around it like so many moths, many of them becoming dazzled by the glare, and dropping into the flames.

According to my own field observations, the Pediunkers were always distinguishable at sea by their style of flight from all other petrels of similar size. Giglioli has also said that they can be recognized afar by their "dipping flight," which Hall compares to the wheeling motions of an albatross (Godman, 1908, 158). All day long they would scurry back and forth over the ocean in the wake of the 'Daisy,' gliding a good part of the time as most shearwaters do; but when they beat their wings, it was with a peculiarly rapid, almost duck-like motion. Their movements were very graceful as they crossed and recrossed one another's courses. Toward nightfall we sometimes passed large bands of them resting on the water.

Alexander (1922, 261) watched flocks of Pediunkers feeding upon shoals of small fish. The birds were flying low over the water, sometimes rising and circling, and again shooting down diagonally to plunge beneath the surface.

> This bird is by far the best diver of all the sea-going Petrels. It seems even fond of it, and often remains under water for several minutes, when it comes up again shaking the water off its feathers . . . . Sometimes I have seen it, as it flies past, poise itself for a moment in the air (and hence perhaps its name) [referring to the name *haesitata*] at a height of about twenty or twenty-five feet above the sea, and, shutting its wings, take a header into the water. It dives with its wings open, and uses them under water much in the same manner as when flying (Hutton, 1865, 285).

Within our region, the Pediunker nests at the islands of the Tristan group and at Gough Island. Álvarez (1933, 7) alleges that it breeds also on islands just off the coast of Uruguay, close to the Gulf of La Plata. While this seems utterly improbable, the matter is at least worth investigation because of the frequently reported abundance of the bird in near-by parts of the South Atlantic.

At Tristan, the Pediunker, long valued as food by the inhabitants, was equally long of unsatisfactory identity to the scientific world. Certain writers have applied the name tentatively to the Greater Shearwater (*Puffinus gravis*), as well as to other petrels. Keytel, however, obtained specimens and eggs at Tristan in 1908, which were named by the residents and which are now preserved in the South African Museum; and Mathews (1932, 30) has examined skins, which were labeled with the name "Padiyunker," from both Inaccessible and Tristan Islands. Mathews also lists eggs, said to have been taken from burrows on the mountainside on April 6 and 26, but the measurements of these are so large that they must pertain to some other species. The average dimensions of the six listed by Mathews are 83 x 56 millimeters, or more than 12 millimeters longer than the average for eggs of *Adamastor*.

According to Barrow (1910, 275), the Pediunker returns to Tristan to lay during May and June. The date, like the April one suggested above, would seem to be the wrong season. Wilkins (1923, 508) obtained a male and female from separate burrows at an altitude of 550 meters on Gough Island, between May 28 and June 1. However, he calls special attention to the fact that many of the local petrels seem to occupy their burrows during other times of year than the breeding season. At the three islands of the Tristan group there are, nevertheless, many bits of evidence to suggest that the nesting season may be irregular, or at least extremely protracted, for a number of the resident sea birds.

Hutton reports that at Kerguelen Island the Pediunkers return from sea during September, burrow in wet, peaty earth, and in their nest-chamber construct a mound or cone upon which the egg is laid. The architectural plan sounds exactly like that of the Shoemaker's burrow, as described in another biography.

Moult of the wing and tail quills evidently begins before the young are abandoned, as indicated by the state of plumage of Pediunkers collected at and around Antipodes Island during February.

Falla has found lenses and beaks of cephalopods in stomachs of this species (Oliver, 1931, 30). The birds have also been observed catching fish.

PINK-FOOTED SHEARWATER

Puffinus creatopus

Puffinus creatopus Coues, 1864, Proc. Acad. Nat. Sci. Phila., p. 131 (San Nicolás Island, California).

Names: Cooper's, Coues's, or Red-footed Shearwater. On the west coast of South America the common name is "Fardela Blanca," which distinguishes it from the "Fardela Negra" or Sooty Shearwater. The only true synonym of the specific name seems to be *melanoleucus*.

Characters: A brown and white shearwater, with a high degree of variation in the markings of the ventral surface, some specimens being entirely white from chin to crissum, while others are so heavily freckled and barred as to appear gray-breasted; the lining of the wing likewise varies, in accordance with the general pigmentation, between nearly all white and prevailingly gray. The species is closely related to the northern-hemisphere races of *Puffinus kuhlii*, which nest within the Mediterranean and at eastern Atlantic islands such as the Azores, Madeira, the Canaries, and Cape Verdes.

Adults (sexes alike): General color of dorsal surface clear brown (slightly grayer than the mummy brown of Ridgway), lighter edgings to the feathers being inconspicuous except as a result of abrasion and fading; scapulars, and quills of wing and tail, blackish brown, perceptibly paler upon the concealed webs of the feathers; wing coverts like the back, the greater series narrowly fringed with whitish; pileum, hind neck, and sides of neck slightly darker than the back; region in front of and below eye slightly mottled with whitish; cheeks and sides of neck variably mottled, such mottling continuing in the form of wavy bars, or irregular freckles, to the gray sides of the upper breast, which extend ventrad to a greater or less degree toward the mid-line; ventral surface prevailingly white, the sides of the body variably freckled with ashy brown which, as noted, sometimes extends clear across the breast and belly; a patch of slaty brown feathers over the thighs; under tail coverts grayish brown, with a variable amount of white mottling; under wing coverts white, mottled with dusky black spots on the centers of the feathers, the relative amount of white or dark varying according to the general type of plumage pigmentation. Iris brown; culmen and margins of the bill brownish black, the remainder light yellowish flesh color; legs and feet light flesh color, the outer toe and outer side of tarsus brownish, and the claws whitish with brown tips.

22 males from the west coast of South and North America, and from Juan Fernández: wing, 321–342 (331); tail, 106.8–116.5 (111.7); exposed culmen, 40.3–46.5 (42.9); tarsus, 52.5–56.3 (54.4); middle toe and claw, 62.9–70.3 (67.7) mm.

16 females: wing, 322–340 (330); tail, 107–118.5 (112.3); exposed culmen, 39.9–43.2 (41.3); tarsus, 50.4–56.3 (54); middle toe and claw, 64.3–72 (67) mm.

A point of notable difference between *Puffinus creatopus* and the shearwaters of the *kuhlii* group is that the sexes of the former appear to be of equal size, while among all the races of *kuhlii* males are consistently larger than females.

Nestlings taken at Mas Atierra Island on January 31 and February 9 had not long been out of the egg. They are clad in protoptyle down of Quaker drab or almost purplish gray color dorsally, the same hue continuing around the neck and appearing in a patch on the lower belly. The remainder of the ventral surface is dirty white, and the face and throat are covered with fine and short down, instead of being bare. In life the bill was grayish blue and the feet flesh color.

Eggs taken at Mas Atierra on December 15 and January 19 include two normal and one imperfect or undersized examples. They are white, except for earth-stains, and have a finely pitted surface, and a rather elongate shape. Two measure 76.1 x 48.6, and 70.1 x 45.2 mm. The dimensions of the "runt" are 58.4 x 42.4 mm.

Distribution: Confined to the eastern Pacific Ocean of both northern and southern hemispheres. Breeding at Mas Atierra and Santa Clara Islands of the Juan Fernández group, and at Mocha Island (latitude 38° 25′ S.) off the coast of Chile; ranging northward during migration to the coasts of California, Washington, and Alaska.

This petrel was described in 1864 from a single specimen taken off the California coast, presumably not on but near San Nicolás Island. Its point of origin was then unknown, for it was not until a decade later that it was found breeding at Juan Fernández. During recent years, it has been learned that the Pink-footed Shearwater is a common bird from the vicinity of Chiloé Island, Chile, all the way northward to the coast of southern Alaska.

The species is an eastern Pacific representative of an Old-World shearwater (*Puffinus kuhlii*), which has races in the Atlantic-Mediterranean region and perhaps in the Indian Ocean. The alleged presence of a resident subspecies at Kerguelen Island suggests at least a somewhat remote connection between the present-day ranges of all these related forms. *Puffinus leucomelas*, of the western Pacific, is also a relative, though a more distant one. All in all, *Puffinus creatopus* may be regarded as extraordinarily isolated from its nearest of kin, and correlated with this fact is its marked specific distinctness, even though it is cer-

tainly to be considered a member of the same Formenkreis as *Puffinus kuhlii* (Murphy, 1924, 250).

The American Museum possesses a large series of Pink-footed Shearwaters obtained during the Brewster-Sanford Expedition, as well as numerous specimens from other sources. Among the latter are birds collected by D. S. Bullock at Mocha Island, Chile, which is a nesting station, during November, 1932; specimens from Penco, Chile, collected by Carlos S. Reed during December, 1903, and November, 1904; and birds from Monterey, and elsewhere along the California coast, collected by Beck and others during the months of June, July, September, October, and November.

On the west coast of South America this shearwater has been observed by Beck and myself, or by other members of American Museum expeditions, at many places between La Plata Island, Ecuador, and the Bay of Corral in Chile. I saw examples off La Plata on September 5, 1919, and offshore from the Gulf of Guayaquil in January, 1925. Additional dates and localities, taken from Beck's journal or mine, are as follows: off the Bay of Ferrol, Peru, December 31; near Mazorca Island, June 14; Pisco Bay, June 27; Mollendo, January 12; Valparaiso, Chile, many dates between November and March; Corral, many dates between September 17 and March 28. Examples taken by Beck between Valparaiso and Juan Fernández during November and December, 1913, and on or around the latter islands in January and February, 1914, were mostly in breeding condition. The incipience of this annual rhythm is shown by enlargement of the gonads among California specimens collected during September.

As Loomis (1926, 110) has pointed out in connection with California birds, the American Museum examples of the Pink-footed Shearwater from Chile and Peru show a wide range of pigmentation between the purely white-breasted and those with heavily speckled or barred ventral surfaces. Examples representing the extremes are highly different in appearance, for the darkest would scarcely be thought of in life as having white breasts or wing-linings. Rather both of these areas would appear as gray. Such extremes, however, are connected by every intermediate stage.

Birds of this species have been taken in the northern hemisphere during nearly every month of the year, and Loomis has made a detailed study of the plumage characters, including the moult, which seems to be protracted during the long migration of this species into the North Pacific. In South America the height of the quill-renewal period comes in midwinter, well after the end of the breeding season. In a specimen taken off Cerro Azul, Peru, on July 4, 1913, the two outermost primaries are still in the sheath, and the wing-length of the bird is less than 300 millimeters.

Off the west coast of the United States, the Pink-footed Shearwaters mingle with the Sooty Shearwaters and other visiting species, and are often numerous for 75 kilometers or more out to sea. Bent (1922, 64) remarks that their general appearance and behavior closely resemble those of the familiar Cory's Shearwater (*Puffinus kuhlii borealis*), of similar latitudes on the Atlantic coast. Dr. Cooper, who captured the first known specimen of *creatopus*, found the species

abundant and approachable about San Nicolás Island, where the water is shallow and where small fish are numerous. Here the birds congregated around shoals of fry, diving for a short distance in pursuit, and often resting on the water, swimming buoyantly but not rapidly. This species is an easier and more graceful flier than *Puffinus griseus*, making fewer wing strokes, at least when the breeze is light. The Pink-foots begin to be common on the California coast about the end of May, which corresponds well with what we know about the nesting season and the departure of the birds from their breeding grounds in the eastern South Pacific. However, Beck (1910, 65) saw eight at Point Pinos, California, on February 27, 1907, an early record for the northward migration. Most of them go southward again before the end of November.

At Mas Atierra Island, according to Lönnberg (1921, 11), this shearwater nests high up among the forests, occasionally below tree line but chiefly above an altitude of 200 meters. It burrows horizontally into sloping ground, sometimes to a length of 2 meters; little or no lining is added to the nest-chamber. Its eggs have been found during a relatively long season, namely from mid-December to the end of March. Reed (1874, 83), who writes of this species under the incorrect name "*Thalassoeca glacialoides*," does not give the date of his visit to Juan Fernández, but states that he was directed to the burrows by peculiar growling barks proceeding from the earth and, upon digging to a depth of 2 meters, he found pairs of the birds in each of six burrows.

Beck's account of the nesting of this species shows that it occupies a much wider altitudinal zone than stated by Lönnberg, and that growing vegetation is not a necessary part of the chosen site. He found the burrows to be distributed from near the shore of Mas Atierra up into the fern growth at an altitude of 500 meters or thereabouts. Most of the nests were close to the tops of successive ridges, and some of them were nearly 2 kilometers from the water. Beck's notes made at Mas Atierra, December 12, 1913, state that when he was out alone on an all-day hike, he found many burrows of Pink-footed Shearwaters, most of which penetrated so deeply into the steep hillsides that he concluded a pick and shovel would be necessary for reaching the nest-chambers. He managed, however, to trace one tunnel, which ran parallel to the surface of the ground, and found, about 2 meters from the entrance, a pair of adult birds. These made absolutely no sound until he had dug well in toward their nest. In some instances a cave-like hollow served as a sort of vestibule for three or four burrows. In front of many of the holes there was more or less excrement, while the tunnels and nest-chambers were entirely clean.

Beck's original notes, as quoted by Bent (1922, 62), are as follows:

> On December 12, 1913, I started out from the settlement on Masatierra Island, of the Juan Fernandez group (which lies about 400 miles to the westward of Valparaiso, Chile), to find the nests of the pink-footed shearwater. About four miles from the village many holes were found, but nearly all were too deep and long to be opened without pick or shovel. One hole 6 feet long was opened and a pair of birds was found at the end. Burrows were found from near shore up into the ferns at 1,500 feet elevation. On the 15th I went again to the colony with a man to dig for me. One burrow was followed for 10 feet. It then branched for the third time and went too deep to follow. Nearly all the burrows were 6 feet or more in length; sometimes a little grass was found

in the nest, but usually only bare earth in the enlarged end of the burrow. Three eggs only were taken, although a number of holes were opened. On the 31st of January we tried the colony again and found a few birds on eggs nearly ready to hatch. In two holes examined cold eggs were found containing young birds alive, though barely able to move. One young bird 3 days old was found in another burrow. Several single adult birds of both sexes were taken from holes and these on dissection showed small sexual organs. Some holes that showed fresh soil about them were opened, but no birds were found in them. On February 7th several rotten and a couple of fresh eggs were found where they had been scratched out of holes, and many holes showed signs of digging.

On the 19th of January, 1914, I visited Santa Clara Island 10 miles off Masatierra and found colonies of birds nesting in the soft ground on top of the island. Some of the burrows here were just below the grass roots and easily opened while others ran deep down. Nearly all the nests were nicely lined with foxtail straws and an occasional burrow also had a lining. Most of the eggs were well advanced in incubation and in one nest I found a bird sitting on two eggs. One of these proved however to be rotten and was probably a last year's egg. The pink-footed shearwater when disturbed on its egg becomes decidedly pugnacious picking wildly at any object and frequently at a single blow will break its egg before it can be removed from the nest. The birds about the island in the daytime spend most of their time sitting on the water in flocks, differing in this respect from their neighbors, the neglected petrels, which nest along the cliffs, and spend their daylight hours in swinging singly about over the ocean.

In the waters around Mas Atierra, Beck found the Pink-footed Shearwater to be by far the commonest of local sea birds, sometimes present in great flocks. Close to Mas Afuera, during late December, only a few were noted, although numbers of the two resident species of *Pterodroma* were about over the ocean. Two kilometers, more or less, off Mas Atierra, the Pink-footed Shearwaters were accustomed to settle on the water in a "raft" in order to cleanse their feathers of the mud and stain of the burrows.

Beck was unable to land upon the outer island, Mas Afuera. Lönnberg, however, infers that the Pink-footed Shearwater does not nest there. He says, furthermore, that neither this species nor any other petrel approaches this island during the day, perhaps because of the presence of their enemy, the "Blindado" (*Buteo erythronotus exsul*). This hawk is a native only of Mas Afuera, but examples occasionally fly across the water to Mas Atierra, where they remain a few days before returning to their own island. Several Pink-footed Shearwaters taken out of their burrows on Mas Atierra, and tossed into the air, were captured by these hawks before they had time to escape to the sea.

If further investigation shows that *Puffinus creatopus* does not reside at Mas Afuera, the case will furnish an interesting parallel to the distribution of certain other petrels in the Juan Fernández group, for example, the smaller representatives of the genus *Pterodroma*, of which one species occupies Mas Atierra and another Mas Afuera. It will also serve as an indication that the Pink-footed Shearwater is essentially a bird of the Sub-Antarctic Zone of surface waters, which might be sufficient reason for its selection of Mas Atierra, the adjacent island of Santa Clara, and Mocha Island, which lies much farther southward and close to the continental coast; and why at the same time it avoids Mas Afuera, which lies in waters that approach a sub-tropical character.

During the southern spring season of 1932, Mr. D. S. Bullock found the "Fardela Blanca" to be an abundant resident of Mocha. His manuscript states

that the bulk of these shearwaters spend the daylight hours at sea, and that toward nightfall they gradually move close to the land. Not until it is almost dark, however, do they begin to come ashore in their countless thousands.

In some parts of Mocha Island, the steep hillsides are literally honeycombed with the burrows of the Pink-footed Shearwater. The birds spend the nights in these holes, but at the first indication of dawn they return to the ocean. The favorite nesting sites are in the forest, particularly in places where the steep hillsides have steps or ledges of soil supported by the roots of trees and shrubs. Two photographs Mr. Bullock has sent well illustrate a number of such burrows, at an altitude of about 250 meters above sea level. The burrows are some 10 to 13 centimeters in diameter and they frequently reach to 3 meters in length.

On November 27, Mr. Bullock found a few pairs of Pink-footed Shearwaters in the nest-chambers, but apparently no eggs had yet been laid. He inferred, from observation and hearsay, that the height of the nesting season comes toward the end of December or during the first half of January. Residents of Mocha informed him that if a fire is kindled on the beach at night, the Pink-footed Shearwaters flutter in like moths and smother the flames with their scorched bodies.

Anthony (1925, 284) observes that the Pink-footed Shearwaters in California appear to feed entirely upon small fish, and that their numbers at any one point depend upon the concentration of the latter.

FLESH-FOOTED SHEARWATER

Puffinus carneipes

Puffinus carneipes Gould, 1844, Ann. Mag. Nat. Hist., 13, p. 365 (small islands off Cape Leeuwin, Australia).

Names: Pale-footed Shearwater. Several subspecies have been described but are not currently recognized.

Characters: A large, stout-billed, blackish, or almost "chocolate" shearwater, resembling *Puffinus griseus* but with a pale bill and feet and dark wing-lining.

Adults (sexes alike): General color of dorsal surface sooty or fuscous black, with faintly indicated edgings of ashy brown, which become enhanced through wear, particularly on the mantle and scapulars; longer scapulars, wing coverts, and quills of wing and tail blackish brown, darker than the back, the primaries somewhat paler in the usual style on their inner webs, their shafts pale basally; pileum, nape, and sides of head fuscous black like the back, with a slight tinge of ashy gray on the lores, infraorbital region, and ear coverts; cheeks and entire ventral surface sooty brown, with a distinct ashy gray or Quaker drab tinge on the throat, cheeks, and fore part of breast, and with a faint suggestion of the same on the flanks and abdomen in fresh plumage; under wing coverts and axillaries sooty brown, as dark as the breast. Iris brown; bill flesh color, with the tip and the anterior part of the culmen black; feet and legs flesh color, the webs somewhat buffy and the tarsus and outer toe externally brown.

6 males and 6 females, New Zealand and Lord Howe Island: wing, 317–329 (321.2); tail, 109–115.1 (113.2); exposed culmen, 37.6–43.3 (41); tarsus, 51.6–56.3 (54.2); middle toe and claw, 62.7–67 (65) mm.

A half-grown nestling is covered with sooty gray down, uniform above and below, and has dull fleshy pink feet and a fleshy purplish bill, dark at the tip.

Eggs, elongate-ovoid, white, 73 x 46, 72 x 44.5 mm. (Oliver, 1930, 116).

Distribution: Breeds on islands off southwestern Australia and northern New Zealand, and at Lord Howe Island; ranges to Japan and eastward to Juan Fernández and California.

This Australasian shearwater seems to be a bird of exclusively sub-tropical breeding range. From its headquarters, between Australia and the Chatham Islands, it goes regularly northward through the tropics to Japan. Somewhere in the North Pacific certain of the birds seem to lose themselves, so to speak, among the great flocks of migrant Sooty Shearwaters (*Puffinus griseus*), which subsequently travel southward down the longest and straightest seacoast in the world, namely that between Alaska and Cape Horn. This, at least, would be a logical explanation of why the Flesh-footed Shearwater seems to be a regular though not common visitor accompanying the Sooty Shearwaters down the west coast of North America, where Beck (1910, 66) has collected specimens off California during April, August, September, and November. That certain of the birds may continue southward across the equator in the eastern Pacific is indicated by Beck's subsequent capture of a male about 13 kilometers off the coast of Mas Atierra Island, Juan Fernández group, on February 9, 1914. This specimen had elongated and sharply pointed claws, such as are common among petrels long away from their nesting grounds. The gonads were reduced, and the bird was in worn body plumage but with recently renewed quills in the wings and tail. Its measurements agree in every way with those of specimens from New Zealand, Lord Howe Island, and the coast of California, as I have elsewhere pointed out (Murphy, 1930, 11).

Many fragmentary studies of the life history of this large and powerful bird have now been superseded by the recent work of Falla (1934, 249). According to this scholarly investigator, the Flesh-footed Shearwater appears annually off the northern coast of New Zealand early in September, after an absence at sea of three to four months during the southern-hemisphere winter. The nightly cleaning out of old burrows and excavation of new ones begins during the month after arrival. By early November the entire population seems to be coming ashore every night, and laying begins late in this month, continuing until about December 10. The first chicks hatch shortly before the middle of January, and half-grown nestlings have been found on March 10. Thereafter the chicks begin to feather rapidly and are fed less frequently, or not at all. By the beginning of May all the burrows are empty, and no more of the Flesh-footed Shearwaters are to be seen in coastal waters. This species, like the Gray-backed Shearwater, is at some nesting localities brought into close association with the far-famed tuatara (*Sphenodon punctatus*). Reptile and bird are sometimes encountered in the same burrow at islands in the Bay of Plenty.

Long before dark, during the breeding period, these shearwaters approach the land, but they do not actually begin to come ashore until dusk. In this respect, as in many others, their habits appear to resemble closely those of the Manx Shearwater, as quoted elsewhere in this volume from the investigations of Lockley. In early October many burrows contain pairs of the Flesh-footed Shearwaters at night and a few are to be found housing single birds during the day. By November the din associated with courtship and mating has waxed to a loud nightly chorus, the shearwaters beginning before they alight to utter their short mewing note, which is more or less like that of a kitten. This is

doubtless the call to which Buller (1884, 234) referred as a cry like that of a child in pain. Mating displays begin after dark on open ground near the burrows. A high pitch of excitement is rapidly reached, many birds ambling and wobbling about with swaying necks thrust forward, uttering all the while a guttural chuckling note interspersed with a sobbing intake of the breath. The climax of such demonstration is reached when paired birds strike an ecstatic attitude, with their beaks close together, and set up a duet of loud squeals.

During January, when the birds are changing guard, they arrive later in the evening, and when bringing food for the young, later still. On days of strong wind, the foraging Flesh-footed Shearwaters have a tendency to work directly away from their nesting ground into the wind. On one occasion, when a southwest breeze was registering a steady force amounting to five of the Beaufort scale, Falla observed many of the shearwaters feeding late in the afternoon at a point fully 135 to 140 kilometers to windward of their nesting ground. He remarks that petrels can obviously feed to best advantage when moving against the wind, besides which they are thereupon strategically placed to run before the breeze when they return, heavily laden with food for their offspring. It would be interesting to learn the effect upon food, and upon metabolism of such a necessarily long-delayed delivery. Stevenson (1933, 155) has shown that the last remnants of food in the full stomach of certain song birds will be voided in less than 2.5 hours. This, in connection with the habits of fish-eating birds, which sometimes bring their catch from a long distance to their young, raises the question as to whether sea fowl can in any way delay the digestion of the food they have swallowed in order to transfer it practically unchanged and in unreduced quantity.

Adult Flesh-footed Shearwaters collected in December almost invariably had the alimentary tract filled with a substance resembling bright green mud, the nature and origin of which have not been determined. Cephalopod beaks, too, are often found in the stomachs. This species is also fond of fish, which it seems better able to capture than many of its relatives. An explanation of this appears in the actions of the birds around fishing-boats, for, according to Falla, they will frequently dive and follow the bait of a sinking line to the extraordinary depth of from 3 to 5 meters, not infrequently hooking themselves during the process.

GREATER SHEARWATER

Puffinus gravis

Procellaria Gravis O'Reilly, 1818, Voy. Greenland Adj. Seas, p. 140, pl. 12, fig. 1 (Cape Farewell, Greenland, from first locality named).

Names: Hagdon. A synonym of the specific name is *major*, besides which the species has been listed under the name *cinereus*.

Characters: A large brown and white shearwater, with a white wing-lining and a conspicuously dark pileum, which is divided sharply on the side of the head from the white cheeks.

Adults (sexes alike): Pileum and entire head, above the line of the gape, dark sooty brown, except for a slight whitish mottling beneath and in front of the eye; remainder of dorsal surface generally sooty brown, most of the feathers broadly margined with a paler and more ashy brown, which is lightest and most conspicuous on the scapulars and inner secondaries; upper tail coverts

like back except that the longer underlying coverts are white, only slightly tinged or mottled with brown, the tips forming a conspicuous band above the rectrices; quills of wing and tail fuscous black, the concealed portions of the inner webs somewhat paler; greater wing coverts with a "frosted" appearance and narrowly edged with whitish; ventral surface, caudad to belly, white, the white cheeks being sharply defined from the dark lores, infraorbital region, ear coverts, and sides of nape; behind the brown cap the white encroaches dorsally so as to form a complete or nearly complete light collar; feathers of central lower breast and belly with ashy brown tips, forming a somewhat mottled elongate, dirty brown patch; flanks with a varying amount of brownish spotting on the tips of the longer feathers; feathering of thighs and under tail coverts sooty brown, the latter tipped with whitish; axillaries white, with brownish subterminal blotches; under wing coverts white, some of those along the bend and edge of the wing having brown shaft-streaks and centers. Iris brown; bill dark horn-color, sometimes blackish; feet flesh color, with the outer toe and the outer side of tarsus brownish black.

12 males from the coast of Argentina: wing, 317–332 (323); tail, 105.7–115.5 (110.5); exposed culmen, 43.2–48.5 (46.1); tarsus, 57.5–61.9 (59.3); middle toe and claw, 71.5–75.4 (73.3) mm.

11 females from the South and North Atlantic: wing, 309–337 (325); tail, 105–116 (111.6); exposed culmen, 41.8–47.2 (44.6); tarsus, 52.8–61 (57); middle toe and claw, 66.8–75.5 (70.7) mm.

I have seen neither a downy young nor a description of one.

Eggs taken at Inaccessible and Nightingale Islands, on November 11 and 14, together with others attributed, perhaps incorrectly, to dates in March, May, and September, are of the ordinary shearwater type, white, smooth, dull-surfaced, and variable in shape. Average measurements of 10, as recorded by Mathews, are 77 x 49 mm. His longest example measured 84.5 x 50, and the smallest 70 x 46.9 mm. Averages of four others, measured by Jourdain and recorded by Bent, are 77.7 x 48.6 mm.

Distribution: Breeds at the islands of the Tristan da Cunha group; ranges over the South Atlantic southward to the latitude of the Falkland Islands, and also migrates into the North Atlantic as far as European seas, Labrador, Greenland, and the arctic circle.

Although the Greater Shearwater is one of the most widely distributed of Atlantic sea birds, its only known breeding grounds, at the islands of the Tristan da Cunha group, have been but recently discovered, despite the fact that at least a proportion of the shearwater population remains in the South Atlantic throughout the period of northern-hemisphere summer. At this same season there are vast numbers of these birds on the Grand Banks of Newfoundland, and elsewhere in North Atlantic fishing-grounds. They are common, too, at times in the lower bay of New York, and the American Museum has specimens from as far north as Greenland, which is, in fact, the type locality of the species. As many Greater Shearwaters are to be found in the South Atlantic throughout the year, so, too, apparently, do others remain in the North Atlantic during the normal breeding season. In the Berlin Museum I have examined December specimens from the waters about Madeira.

Wynne-Edwards (1935, 254) has shown that in spring the Greater Shearwater, like the two other common visiting petrels from the southern hemisphere, migrates northward up the western half of the North Atlantic, after crossing the tropics with great rapidity. At about the 45th parallel the birds spread out, the movement reaching Davis Strait by early June and simultaneously beginning to extend northeastward. Prior to July there are no records to eastward of the great circle arc joining northern Ireland and the Azores, and it is probable that the species does not normally occur east of this line before the second week in August, by which time it has attained its maximum abundance in high latitudes.

After mid-September the numbers of Greater Shearwaters in the eastern North Atlantic for the first time become comparable with the earlier abundance in the west. The southward migration, on the other hand, is to a great extent concentrated in the eastern Atlantic, except for the return movement of the birds that have summered in American and Greenland waters. There is thus a sort of circulation of Greater Shearwaters on the same general plan as the circulation of the North Atlantic surface waters. The facile inference that this is in some way correlated with the movements of plankton is, writes Wynne-Edwards, likely to be wrong. It may conceivably be due, however, to a drift in the direction of the prevailing westerly winds, for which hypothesis Dixon (1933, 122) has found support in similar seasonal movements of birds confined to the southern oceans.

During a series of voyages from Southampton to Cape Town made, I judge from the context, chiefly during late summer and autumn, Swinburne (1886, 196) regularly observed Greater Shearwaters between the Bay of Biscay and latitude 9° S., where they thinned out for a time. In about latitude 20° S., however, he encountered them again, after which they became increasingly abundant toward the Cape of Good Hope, and particularly so between latitudes 40° and 45° S. On one occasion, near the Bijouga Islands (latitude 11° N.), he saw such dense flocks of this species that they were at first mistaken for land.

During my South Atlantic cruise in the 'Daisy,' I observed Greater Shearwaters frequently, and captured specimens in March, 1913, about halfway between the Tristan group and the coast of South America. The stations, together with those of many other South Atlantic records nearer the coast of the continent, and extending from Brazil to the Falkland Islands, are shown on the chart of Dabbene (1923, 27).

During the course of the Brewster-Sanford Expedition, Beck took 23 specimens off Mar del Plata, Province of Buenos Aires, on October 5, 1914. Here, at distances up to 30 kilometers from shore, the birds were mingled, in waters around the Argentine fishing fleet, with Manx and Sooty Shearwaters, Giant Fulmars, Cape Pigeons, Shoemakers, and Mother Carey's chickens. The association was similar in ecological composition, and partly the same in its make-up of species, as might have been encountered off the Strait of Belle Isle, Newfoundland.

The Mar del Plata specimens were all in fine plumage, as well as in breeding condition. The gonads were enlarged, without exception, and on many of the labels Beck has written, "ready to breed." The moult is well illustrated by numerous birds collected two or three months earlier in the year. Thus August examples from Labrador, and particularly a female collected at Julianehaab, Greenland, on August 7, have new primaries, the wings of some being as short as 265 millimeters, or only 80 per cent of the mean length for adults of the species.

The first strong clue to the breeding grounds of the Greater Shearwater came in January, 1906, when Lord Crawford's yacht, the 'Valhalla,' lay to for four days off Tristan da Cunha. Numbers of the shearwaters were observed about

the island and still more at a distance of a day's sail to eastward. In 1908, Mr. P. C. Keytel visited Tristan and made an expedition to Inaccessible Island, where he succeeded in obtaining breeding birds and a number of eggs (Bent, 1922, 66). According to Mathews (1932, 28), most of the known eggs have been collected during November, which seems to mark the height of the laying season. The suggestion by the same author that these shearwaters have been found breeding also during the months of March, May, and September is, as he himself suggests, probably due to careless labeling or careless memory on the part of the islanders. Bent, for example, refers to an egg said to have been collected at Tristan da Cunha on May 29, 1917. During the visit of Wilkins (1923, 499) to Nightingale and Inaccessible Islands, in May, 1922, many Greater Shearwaters were found in their burrows on the hillsides. The birds were betrayed by their croakings, but an examination of the gonads of several specimens collected showed no indication of nearness to the breeding season. Nevertheless, during the night these birds were flocking to the islands by hundreds, apparently to occupy many burrows observed to be empty during the hours of daylight. Such use of the nesting site by Procellariiformes during the non-breeding season is, as noted in other biographies, a relatively recent discovery, and one worthy of thorough investigation. The curious point in connection with the Greater Shearwater is that May 21, when Wilkins found so many on the nesting ground, is close to the average date of arrival of spring migrants in the latitude of the southern and middle Atlantic states in North America.

There has been more or less question as to whether this species is the famous "Pediunker" of the Tristan folk. Mathews believes that he has definitely connected that vernacular name with the Gray Petrel (*Adamastor cinereus*), and states that the Greater Shearwater is called merely "petrel."

The Greater Shearwater is, like many of its far-wandering congeners, a fishing petrel, which follows moving shoals of surface-swimming fishes as well as the squids that come to the uppermost layers of the ocean during the hours of half-light or on dark days. In pursuit of its prey, this shearwater stoops suddenly, flops against the water on its breast, and then plunges and literally flies through the dense medium, always coming into the air again to swallow its catch. Collins (1884, 313) states that Greater Shearwaters, following the dories of North Atlantic fishermen, will dive repeatedly even after the elusive bubbles made by oars. Whales or porpoises, according to Wynne-Edwards, invariably have an attendant flock. The birds seem to feed to some extent upon cetacean feces, which may account in part for the large numbers of cephalopod beaks found in their stomachs.

Collins says, furthermore, of this species that the migrants into the North Atlantic form great flocks when they first arrive in spring, and again before their departure in autumn. During most of the northern summer, however, they are far less gregarious, each bird working for itself and joining others only in scrambles for food, when they all appear audacious, quarrelsome, and insatiable. The cod fishermen formerly took advantage of their numbers to use the birds both as food and as bait. The Hagdons were lured within range by the expedient

of first chumming up the Mother Carey's chickens through the use of fish entrails. The smaller birds quickly attracted the larger, which sailed in, scattered the lesser petrels, and voraciously proceeded to snap up the food, all the while uttering harsh and raucous calls. They were then caught on mackerel hooks, and during the 'seventies of the last century it was not unusual to see from 200 to 500 of these birds hanging from the rigging of a Grand-Banker.

Such a toll of life, added to accounts of thousands found dead upon South Carolina beaches after an August hurricane (Wayne, 1894, 85), and the countless numbers which appear each summer off the Atlantic coast of North America, indicates an amazingly large breeding population for three such tiny dots in the sea as the islands of the Tristan da Cunha group, more especially since this shearwater has apparently become all but exterminated at Tristan itself, and is not yet known to breed at Gough Island, or at any other locality in the South Atlantic or elsewhere. The same problem of seemingly incredible productiveness applies, however, to numerous other oceanic birds, and I have sometimes suspected that the breeding grounds of certain insular petrels passed the peak of overcrowding ages ago, and than an annual breeding season may have become replaced by a longer reproductive rhythm. This would allow a multiple use of a limited breeding area. Such a hypothesis, while not yet demonstrable, would at least account for many adult but non-breeding petrels and albatrosses regularly encountered during the calendar nesting season in parts of the ocean far from their breeding range. Systematic banding operations, coupled with regular tabulation of the nesting periods through several seasons, would be the one way to solve such problems.

GRAY-BACKED SHEARWATER

Puffinus bulleri

Puffinus bulleri Salvin, 1888, Ibis, p. 354 (New Zealand).

Names: Also known as Buller's Shearwater.

Characters: Distinguished from other small shearwaters belonging to the field of this book by its gray back in conjunction with the dark crown, wings, and tail, and the white ventral surface. Buller (1888, 240) aptly says that the long neck and long tail of this species make it look like a diminutive shag.

Adults (sexes alike): 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 sub-terminal 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 (Loomis, 1918, 149).

Iris brown; bill blue or bluish, the tip and culmen black; feet and legs inwardly flesh color, including the two inner toes and the webs; outer toe and outer side of tarsus blackish brown. The blue of the bill may represent a heightening of color characteristic of the breeding season, for many non-breeding specimens are marked as having "grayish" beaks.

24 males and females from Chile, California, and New Zealand: wing, 275–300 (287.3); tail, 114–131.8 (125.3); exposed culmen, 39–44.6 (41.8); tarsus, 49–53.5 (51.5); middle toe and claw, 58.5–65 (61.5) mm.

Large downy nestlings from New Zealand are neutral gray, only slightly darker above than below. Their bills and feet are colored like those of adult birds, except that they are paler, with less pigment in the dark parts of the skin.

Eggs from Poor Knight's Island, New Zealand, are ovoid, white, and measure between 63 x 41.5 and 68 x 43.6 mm. The average of six is 66.4 x 42.8 mm. (Falla, 1924, 41).

Distribution: Primarily a shearwater of the Sub-Tropical Zone of surface water, breeding on islets off North Island, New Zealand, and ranging eastward to the west coast of South America and northward to California.

Until recently the Gray-backed Shearwater was regarded as one of the rarest of all petrels in collections. The example upon which Salvin founded the species was discovered on a New Zealand beach by Sir Walter Buller, in 1884. During the next thirty-eight years only a few more specimens were obtained, and then Mr. R. A. Falla observed the species in large numbers off Poor Knight's Island, east of the northern extension of New Zealand, and later discovered its breeding place at these islands. In the meanwhile, Beck (Loomis, 1926, 146) had collected a considerable number of specimens off Point Pinos, California. Here, between September 2 and November 8 of two different years, he found them fishing in company with Sooty and Pink-footed Shearwaters, both of which are migrants from southern South America. He also saw a lone Gray-backed Shearwater following a school of Spanish mackerel, as if the bird and fish were in search of common prey. When the fish sounded, the shearwater alighted on the surface of the water. On still another occasion, a foggy, drizzly day in the middle of October, he succeeded in luring Gray-backed Shearwaters within range of his gun, off Point Pinos, by tossing dead birds into the air. His California notes state that the flight of this small species is, in a light breeze, very similar to albatross flight, there being much less of wing-flapping than in the case of the Pink-footed Shearwater. Several of the California specimens taken during October had the gonads slightly enlarged.

To switch from the northern hemisphere to the southern, Beck encountered this species off Valparaiso, Chile, while on the Brewster-Sanford Expedition, during the southern summer of 1914, and collected a number of specimens between February 24 and March 12. All of these were moulting the quills and had resting gonads. The date might indicate that the birds had crossed the southern Pacific after the end of the New Zealand nesting season. On the other hand, a still undiscovered American breeding ground is at least possible.

Falla (1934, 250) has recently worked out the following interesting details concerning the life history of this species.

Off northern New Zealand the Gray-backed Shearwaters return from their wanderings to the vicinity of their native islands between late August and the end of September. Refurbishing their old burrows, or the task of excavating new ones, together with the collecting of nesting material, begins in October and has been observed until after the middle of November. The first week of December seems to be the uniform egg-laying season; most of the chicks hatch, according to Falla, before the end of the same month, but the incubation period suggested by this seems an incredibly short one for petrels. Falla's further comment that the chicks are still clothed in down and show no contour plumage as late as February 24, makes it appear that many of the young do not hatch before January at the earliest. Most fledglings leave the burrows about the end of March, and by a month later very few of them are to be seen in the coastal waters. The general breeding habits seem to correspond closely with those of the Flesh-footed Shearwater (*Puffinus carneipes*), with the difference that the Gray-backed species has not been seen to approach its nest before dark, as its larger relative sometimes does. Such differences in behavior are doubtless coördinated with difference in size, as the latter affects the relations of these two shearwaters with predacious birds, such as hawks or even certain gulls. The Gray-backed Shearwaters make a mewing call when they approach the land after dark.

On the Poor Knights the burrows are found mostly on slopes facing the sea, but a few were found by Falla under roots of trees half a mile inland. The burrows are three to four feet in length and near the end is placed the nest consisting of twigs, roots and leaves. Beyond the nest is enough space for the bird to turn round. . . . In some of the burrows the tuatara [*Sphenodon punctatus*] is found, the relation between bird and lizard usually being not amicable but apparently one of mutual toleration. Occasionally the tuatara may eat a young petrel, but as this lizard feeds at infrequent and often long intervals, little damage is done. Falla states that a tuatara even when hard pressed was unwilling to approach a sitting shearwater (Oliver, 1930, 121).

Stomachs of adult Gray-backed Shearwaters examined during September contained squid beaks and small sharp pebbles. Young taken from the nests later in the same month had a green substance in their alimentary tracts, which was perhaps not food but some secretion like bile. Many of the birds Beck shot off Valparaiso during February and March had their stomachs crammed with small crustaceans.

SOOTY SHEARWATER

Puffinus griseus

Procellaria grisea Gmelin, 1789, Syst. Nat. 1, pt. 2, p. 564 (southern hemisphere, 35°–50° S. = New Zealand).

Names: Dusky Shearwater; Black Hadgon or Haglet; "Fardela" and "Yegua" in southern South America; "Doña" or "Doñana" in Peru. This widely distributed petrel has been described under a variety of specific names, which include *fuliginosus*, *cinereus*, *tristis*, *chilensis*, *amaurosoma*, and *stricklandi*.

Characters: A dark gray or blackish bird, distinguished from other shearwaters of similar size by its prevailingly whitish under wing coverts, and from all within our present field, except *Puffinus tenuirostris*, by its dark bill and feet.

Adults (sexes alike): Color of the dorsal surface sooty brown, with obsolete paler margins on many of the feathers, the concealed portions generally gray; scapulars and wing coverts darker, inclining toward blackish brown, the median coverts more or less frosted with hoary gray; quills of wing and tail blackish brown, the primaries paler on their inner webs, the shafts basally ivory-white; lower back, rump, and upper tail coverts sooty brown like the pileum and mantle; sides of face paler and more ashy than the crown, a white stripe on the lower eyelid, and in some instances a faint whitish mottling beneath and in front of the eye; ventral surface close to deep mouse-gray in fresh plumage, becoming buffy or brownish with wear and fading; axillaries sooty brown, rather darker than the breast; under wing coverts mostly white, with blackish shaft-lines, and mottled or fringed with ashy brown.

Loomis (1918, 133) has shown that this shearwater exhibits a considerable dichromatic range in pigmentation. In 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 ventral surface a mottled appearance; the shorter axillaries are variegated with grayish white; the under coverts of the wing are white, with only slight indications of gray. In extremely 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.

Iris brown; bill blackish, but sometimes horn-color on the mandible; legs and feet externally blackish, but blue or purplish on the webs, inner toes, and the inner side of tarsus.

40 males and females from the Atlantic and Pacific coasts of North and South America: wing, 280–309 (293); tail, 84–99.2 (89.4); exposed culmen, 38–45.6 (41.7); tarsus, 52.5–59.5 (55.4); middle toe and claw, 50.9–71.5 (63.1) mm.

Loomis's figures, based upon a much larger series of specimens, substantially agree with these dimensions, and show that the sexes do not materially differ in size. The wing-expanse of a male taken off Rio de Janeiro on July 29 was 107 cm.

Chicks are covered with Quaker drab down, much longer and of looser texture on the dorsal surface than below.

Eggs collected by Beck at Wollaston Island, near Cape Horn, at the end of December, 1914, are thin-shelled and fragile, elongate, white, with a slightly pitted surface, and much stained from the soil. They measure 77.3 x 45.5 and 78.1 x 47.6 mm. Others, taken at Wollaston and Bayly Islands, at the same season of a subsequent year, are described as "thick-shelled, with a slight chalky coating and distinct pores. Average of seven eggs 73.4 x 47.7, max. 81 x 45 and 70.75 x 50.25 mm., min. 67.25 x 44.25 mm." (Reynolds, 1935, 92). Bent (1922, 86) gives extreme measurements of 34 eggs from a number of localities, but the variation is so wide as to cast doubt upon the identity of certain included specimens.

Distribution: Breeds in southern South America and in the sub-antarctic region of New Zealand; Magellanic Islands near Cape Horn are actual nesting sites, as well as (probably) various parts of the table-land of northern Chile. The flight-range extends from the southern Pacific and Atlantic Oceans northward to the neighborhood of the arctic circle, including the coasts of Kamchatka, Alaska, Labrador, Greenland, and Europe.

The Sooty Shearwater is an abundant sea bird throughout the length of the oceans on either side of the Americas, from the latitude of Cape Horn northward to arctic waters. It is particularly numerous along the Pacific coasts of North and South America. A hundred thousand birds, according to Beck, is a low estimate of the number one may see in the course of a single day when the migrating hordes are southward bound off California shores. Sooty Shearwaters have been taken at Point Pinos in every month in the year, but are particularly in evidence during the northward movement of April and May, and on the return flight in autumn (Beck, 1910, 65). The same is eminently true in South America, for there is neither a locality nor a season in which their passing bands have not been sighted between Panama and the southern tip of

the continent. Along the Peruvian coast they appear to confine themselves rather closely to the zone of cool upwelling water near the steep desert shore, and it is noteworthy that the expedition of the California Academy of Sciences did not encounter the species in the offshore waters about the Galápagos Islands. Farther southward, however, beyond the great bend in the South American coast that comes near the southern border of Peru, the path of the migrating birds spreads over a broader front, and during the Brewster-Sanford Expedition Beck found Sooty Shearwaters as far at sea as the neighborhood of Juan Fernández, where he collected specimens during February. On his voyage to these islands he observed that their numbers gradually thinned out as those of the Pink-footed Shearwater increased.

It would not pay to list the captures and sight records of Sooty Shearwaters along the west coast of South America, because the places named would represent an unbroken geographic series of localities, the dates would cover the entire calendar year, and the numbers of birds would be legion. Beck's field journal refers to particularly great flocks off Salaverry and Chilca, Peru, during January and June, respectively, and off Valparaiso and Ancúd, Chile, during February and March. Examples collected in November and December on the Chilean coast include many in breeding condition. Lane (1897, 312) observed a characteristic concentration of these shearwaters in the bay of Corral on November 3, 1890. The lines, he writes, were "miles in length. . . . From a distance they presented a remarkable appearance, numbers being settled on the water, whilst the air above was full of them, flying in regular succession from the rear to the front of the column." The following record from my own journal is one of a number that might be selected to illustrate the unfailing abundance of this species along the coast of Peru:

Independencia Bay, November 15, 1919. Late in the afternoon we passed into the Trujillana Channel, the northern entrance of the bay, our trawler, the 'Alcatráz,' pitching and covering us with spray as she nosed into the rolling seas. Smoky clouds, ripped from the concealed promontory of Isla Vieja, were scudding across our deck. Out at sea the day wind had already died down, and we could see far offshore the line of calm; but within the bay the gale seemed to be constantly increasing. Large flocks of petrels were playing in the wind close to the north point of Vieja. These included Mother Carey's chickens, Cape Pigeons and Silver-gray Fulmars, but the Sooty Shearwaters, or Doñas, were the most abundant of all the birds; there were certainly upwards of 10,000 in a single dense flock that passed us, the long-winged, graceful shearwaters flying high and low in the howling wind over the choppiest areas of water. Do they seek such whipped-up places because the wind and waves bring their food to the surface? Whatever the reason, they were marvelously at home in the terrific gusts, while small groups of cormorants, resting upon the water along our course, hesitated before even attempting to rise.

It is only in the warm-water zone, off Ecuador and Colombia, that our knowledge of the courses and seasons of the Sooty Shearwater is markedly deficient. Very likely the migrants tend to hurry across the tropical gap that

separates the cool upwelling waters of the Humboldt and California Currents. We know, at any rate, that this species is susceptible to the diseases incident to abnormally high ocean temperatures in the littoral of northern Peru. At times of the malady or "peste," which follows the incursions of the warm current known as El Niño, Sooty Shearwaters, no less than Peruvian Cormorants and other endemic species of the Humboldt Current, die and wash ashore by thousands. At intervals of years, the shores of the Gulf of Guayaquil become lined with their carcasses.

Darwin, as recorded by Gould (1841, 137), writes that he had never seen so many birds of any other sort together as he once saw of these shearwaters behind the island of Chiloé during January, 1835.

> Hundreds of thousands flew in an irregular line for several hours in one direction. When part of the flock settled on the water the surface was blackened, and a cackling noise proceeds from them as of human beings talking in the distance. At this time the water was in parts coloured by clouds of small crustacea. The inhabitants of Chiloe told me that this petrel was very irregular in its movements; sometimes they appeared in vast numbers, and on the next day not one was to be seen.

By many subsequent authors the above quotation has been applied to the Pediunker (*Adamastor cinereus*), but it clearly refers to the Sooty Shearwater, *cinereus* being the name which Gould had applied to the latter species in his "Birds of Europe" (1837). Furthermore, Darwin states that his notes refer to a petrel "likewise known to be common in the Northern Hemisphere." Finally, *Adamastor cinereus* certainly does not occur in the inland waters behind Chiloé. It is a bird of distinctly pelagic rather than coastal distribution, coming to land not in continental regions but at remote islands such as Tristan da Cunha.

About the southern end of the South American continent, and northward along the Atlantic coast, accounts give a similar picture of frequent aggregation of the Sooty Shearwaters in vast flocks. Thus Dabbene (1902, 384) reports thousands in Beagle Channel near Harberton Harbor, and the observations of Paessler (1914, 273), Aplin (1894, 212), Friedmann (1927, 144), Reid (1884, 273), and Collins (1884, 320) carry the record northward along the coasts of Argentina, Uruguay, Brazil, and into the North Atlantic to Bermuda and the Grand Banks of Newfoundland.

Upon the basis of comparison of New Zealand examples of the Sooty Shearwater with specimens from more than a score of localities along both coasts of South America, and with large series of migrants from the North Atlantic and North Pacific, I have shown that only one race appears to be determinable (Murphy, 1930, 8). The world-wide individual variation proves to be approximately the same as the individual variation of a fully representative series from a single locality.

Loomis's (1918, 133) specimens demonstrate that a complete moult of the plumage takes place on migration during the early months of northern-hemisphere summer. He also reports that the range of pigmentation in this species, leading in one direction toward examples with grayish white chins and throats, a mottled belly, and almost clear white under wing coverts, probably represents actual dichromatism rather than wear. Albinism, he states, is not uncommon.

The discovery of the American breeding grounds of the Sooty Shearwater was one of Mr. Beck's notable feats during the course of the Brewster-Sanford Expedition. The nests were unearthed at Wollaston and Deceit Islands, just north of Cape Horn, at the New Year season of 1915. Burrows on Wollaston Island were under dense shrubs, far up on a ridge, nearly 5 kilometers from the ocean, and some of them had evidently been abandoned before completion, because water had seeped into them from the surrounding soil. The least accessible of the burrows were located under boulders. Only two eggs were found, both heavily incubated, and lying in wet nest-chambers without lining except for a few feathers or straws. The sitting birds fought very savagely when hauled into the daylight, Beck describing their struggles and outcries as the most vigorous he had ever encountered among petrels of any sort. Such behavior seems to be typical of the species. Lane remarks that wounded birds, which he hauled into his boat off the Chilean coast, attacked everything most ferociously, not only biting oars and cordage but even each other, and screaming as they tore out feathers in wholesale fashion. Wetmore (1926, 52) also says that examples which blundered aboard his steamer at night gave raucous calls with widely opened mouths, and resented handling by biting savagely.

A more recent account of a visit to the breeding grounds near Cape Horn is that of Reynolds (1935, 92):

> The nights which we spent at Deceit and Wollaston were made hideous with the noise of Petrels passing overhead. I attribute the most ghastly sounds to this species, although it was always too dark to make certain, and at Wollaston Storm-Petrels were certainly seen flying over us at night. The following is an entry in the diary: —"22/12/32 at Wollaston, heard lots of Petrel noises like choking cats—"cha-whee-whoo"—grating and choking with noise like gurgling intake of breath and lancing, working often to a climax." The sound is not altogether unpleasant at a distance, but uttered by those birds passing at close quarters it is appalling.
>
> During the crossing to Barnevelt and back great flocks were passing towards Cape Horn, and late in the evening between Deceit and Herschel towards Wollaston. On Deceit, in spite of the noise at night, we searched unsuccessfully for the nests . . . —large mounds of *Azorella* covering a small headland were honeycombed with old burrows containing thick white egg-shells, which may have belonged to this Shearwater.
>
> On Wollaston we used the dog and took four sets of 2/2 and 2/1; the eggs were hard-set excepting in the supposed clutches of two. Two more clutches were taken on Bayly Island. . . . ♀ taken from burrow with hard-set egg at 10 a.m., stomach nearly empty, but a little grit and green slime in crop. . . .
>
> The birds peck vigorously, and our hands were badly cut in removing them from the burrows. I collected one . . . and the remainder, when liberated, flapped over the ground for some time before taking off towards the sea.
>
> This Shearwater breeds on steep ground at a height of 500 feet or more. The burrows vary from three feet to several yards in depth, and are well hidden under stunted trees growing about outcropping rock, and in much drier places than the holes of *Oceanites*. The nesting grounds, similarly to those of the Storm-Petrel, are extremely difficult to detect. The burrows frequently run beneath the roots of the evergreen beach.

No doubt the breeding grounds are extensively distributed throughout the seaward fringe of Fuegian islands, including Staten Island. During August, 1915, Beck saw great flights of Sooty Shearwaters which had recently concentrated along the northern coast of Staten Island, and on subsequent days an

irregular, steady, southward movement along the eastern coast of Tierra del Fuego. Bennett (1926, 314) records specimens from the Falkland Islands, and states that two have been taken from nesting burrows at islets covered with tussock grass, but thus far no eggs have been discovered. Mr. D. S. Bullock has sent to the American Museum a male taken at Mocha Island, Chile, on December 12, 1932, and I infer from his accompanying notes that a few pairs of the "Fardela Negra" may nest there, but that it is much less common than the Pink-footed Shearwater or Fardela Blanca.

Nothing else is known of the breeding of the Sooty Shearwater in America, except for the still somewhat inconclusive records from the coastal table-land of northern Chile, which have been referred to in Part I of this book. Stresemann (1924, 63) reports that a party of prospectors on the plantless pampa inland from Cobija, Chile, found during the month of June a colony of web-footed birds on the eastern slope of the Cerro de Colupito, at an altitude of 1500 meters. The nests were in the shelter of rocks and contained one chick each. The latter were slightly larger than pigeons, of a uniform gray color, and were tentatively identified as *Puffinus griseus*, a conclusion apparently justified by the nocturnal activities of other sea birds at neighboring localities during March and April, and by the finding of several buried and mummified specimens referable to this species.

On the western side of the Pacific, the Sooty Shearwater is the mutton bird of New Zealand, just as *Puffinus tenuirostris* is the mutton bird of Tasmania and southeast Australia. It is still economically important for its flesh and oil, for, when the Maoris ceded Stewart Island to the Crown, they reserved the express privilege of taking the shearwaters under authority of the New Zealand government. Oliver (1930, 123) states that at present about 250,000 young are annually collected and preserved, and that more than 300 persons are employed in the industry. According to Travers (1873, 220), the Maorioris of Chatham Islands went everybody one better in their use of the stomach oil. They regarded the fluid as a delicacy, and were accustomed to hold the young petrels over their mouths, allowing the oil to drain from bird to man by the most direct route. Highly significant, moreover, is the following sentence from Oliver's account, when it is considered in connection with the precise biological data obtained by Lockley during his study of the Manx Shearwater. "The evidence of the mutton-birders who, for instance, find an albino in the same burrows during several successive years, indicates that the same parents occupy the same burrows year after year."

Falla (1934, 251) states that the Sooty Shearwaters come ashore at islands off northern New Zealand during October, and that the species there burrows in harder ground, and also makes deeper tunnels than do other shearwaters. The chamber is usually well lined with sticks, dry grass, and leaves. That escape from the light is probably more important to this bird and other species than the seclusion or thigmotactic environment of a burrow, is indicated by several bits of evidence, including the fact that in one place at the Chatham Islands the Sooty Shearwaters occupy a dark cave, laying their eggs on the

sandy floor below the rock wall (Archey and Lindsay, 1924, 189). Falla states that the sitting birds sometimes utter a monotonous, crooning note during the day. Very much remains to be learned about the alternation of the incubating parents in this species as among other petrels. Stuart-Sutherland (1922, 58) records the interesting information that at Puysegur Point, New Zealand, where Sooty Shearwaters are frequently killed by striking the lantern of the lighthouse, all examples that he has picked up after one destructive night have proved to be male birds while on another such occasion they have all been females.

Falla has drawn the interesting conclusion that the extent of the annual migration has a close correlation with the schedule of breeding dates of various sub-antarctic petrels. Thus he finds that among New Zealand species none of those which annually cross the equator into the northern hemisphere lay their eggs earlier than November. Furthermore, there is a marked regularity about the egg-laying period of such species, and their preliminary behavior of courtship, burrowing, etc., occupies a relatively short period.

Species which are permanent residents in southern waters, on the other hand, have a far more extended breeding season, and show irregularity or a wide range in their dates of laying. Some such birds even nest during the winter.

Puffinus griseus is an excellent example of the first of these two categories, and *P. assimilis* of the second.

The food of the Sooty Shearwater apparently includes a wide variety of surface organisms. Stomachs of examples collected by Beck in the Magellanic channels were crammed with small fish, while in the same locality a stomach examined by Oustalet (1891, 162) contained only swimming crustaceans. Darwin noted organisms of both these types, and also cuttlefish. Specimens I dissected at various seasons along the coast of Peru contained, respectively, anchovies, the remains of ten or more squids, and the larvae of several types of crabs, including *Pinnixa transversalis* and *Cancer polydon*, one bird having eaten about fifty of the latter. One stomach also contained a mass of gravel. On a number of occasions I had an excellent opportunity to watch the birds feeding. On January 15, 1925, for example, when bound northward, about 15 kilometers west of Ferrol, in the early afternoon my vessel plowed through a flock of Sooty Shearwaters that covered perhaps a square kilometer of the ocean. The day was calm, and the birds in the steamer's path flopped or "ran" to either side, making frequent and frantic dives. I had a rare opportunity to watch them closely as they progressed beneath the surface, and to note that they literally "flew" while submerged, using their wings with slow, powerful strokes. Again, I have seen more distant and undisturbed rafts of the birds moving along, half in air, half on the water, in pursuit of shoals of anchovies or pejerreyes. In such cases the rear of the flock would continually pour forward over the vanguard, so that the whole formation seemed to roll like a flattened hoop across the water.

Bent's (1922, 87) general description of the flight and feeding of this species is as follows:

> The flight of the sooty shearwater is swift, graceful, and strong; like other species of *Puffinus*, it can sail for long distances on its long, stiff wings without even a tremor, except to adjust them

slightly to the wind, rising at will over the crests of the waves or gliding down into the valleys between them and turning as the albatrosses do by lowering the wing on the inner side of the curve and raising the wing on the outer side, both being held in a straight line, the angle of incline depending on the sharpness of the curve. It frequently flaps its wings, however, when occasion requires it and uses them freely in its squabbles for food. It sometimes experiences a little difficulty in rising from the water in calm weather, but ordinarily it does so very rapidly. It swims lightly and swiftly on the surface and dives below it occasionally in pursuit of food, using its wings freely under water. It has frequently been caught on the trawl hooks of the cod fishermen.

Not infrequently I have seen Sooty Shearwaters come thumping on deck at night and Mr. Charles Fagan, wireless operator of the S. S. 'Santa Elisa,' tells me that, on a foggy January night near Point Pariñas, he has seen these birds pile on deck until they were layers deep—in some places level with the bulwarks—so that seamen had to be ordered out to shovel them overboard with coal-scoops. After such a visitation, the decks were well smeared with regurgitated fish. Wetmore (1926, 51) saw forty or fifty come aboard a vessel near Lobos de Afuera Island, during the evening of May 7, when he made the following note upon the terrestrial progression of this bird:

Those that came aboard fell sprawling on deck and then scuttled along, half erect, with rapid awkward steps. The obliquely placed feet, with the comparatively slight flexure of which they were susceptible, made their stride short and stilted. Some hurried into dark corners; others attempted to clamber into the lighted passageways, pulling themselves over the raised thresholds of the doorways by aid of their bills.

SHORT-TAILED SHEARWATER

Puffinus tenuirostris

Procellaria tenuirostris Temminck, 1835, Nouv. Recueil de Planches Color. d'Ois., 5, text facing pl. 587 (seas north of Japan).

Names: Mutton Bird; Slender-billed Shearwater; Whale-bird in Alaska. Synonyms of the specific name include *brevicaudus*, *intermedius*, *curilicus*, and *obscurus*.

Characters: Closely similar to the Sooty Shearwater (*Puffinus griseus*), from which it is doubtfully to be distinguished in life by its lesser size, shorter bill, and usually darker wing-lining.

Adults (sexes alike): Dichromatic to a slightly greater extent than *Puffinus griseus*. The darker phase is thus described by Godman (1908, 152):

General color above sooty black, with obsolete margins of lighter brown to the feathers of the upper surface; wing coverts like the back, with the same obsolete paler edges, which are slightly grayer at the ends of the greater coverts and secondary quills; bastard-wings and primary coverts and quills black; the inner primaries slightly shaded with ashy gray, the secondaries rather browner than the primaries: tail feathers black; head like the back, sooty black; sides of face also sooty black, grayer on the lores, cheeks, and throat; under-surface of body sooty brown, with obsolete ashy edgings to the feathers; under tail coverts uniform sooty brown; under wing coverts dull ashy gray, mottled with sooty brown round the entire edge of the wing; axillaries sooty brown; quills blackish below, with an ashy shade along the inner webs for nearly the entire length.

Loomis (1918, 138) states that in the light phase the general aspect of the under surface of the wings is decidedly grayish white; the chin and anterior portions of the throat are likewise grayish white, sometimes mottled with gray; white, tinged with gray, also prevails at the bases of the feathers of the jugulum and breast.

Iris brown; bill blackish brown; legs and feet purplish black, with the outer toe and outer side of tarsus black.

8 specimens, 6 of which are males: wing, 263–277 (272); tail, 76.9–85.8 (80.9); exposed culmen, 32.2–34 (33); tarsus, 49.4–52.9 (50.9); middle toe and claw, 57.5–62.2 (59.6) mm.

Nestling clad in brown down. Two eggs from Bass Strait measure 72 x 44 and 73 x 47 mm. (Oliver, 1930, 124).

Distribution: Breeds at islands in Bass Strait and in neighboring districts close to Tasmania and southeastern Australia. Ranges northward and eastward to Bering Sea, the west coast of North America, and Panama.

The Short-tailed Shearwater, the famous "Mutton Bird" of the Furneaux Islands in Bass Strait, is an Old-World species which, like several of its congeners, appears from time to time along the American side of the Pacific. Mr. Beck, while collecting for the California Academy of Sciences, found it not uncommon off Point Pinos, California, between the months of October and January of several different years, the birds being sometimes especially numerous during November and December. A female taken in this region on December 2 had the ovaries functionally enlarged. Loomis (1918, 138), who reports upon these specimens, is inclined to regard them not as returning migrants bound for South American breeding stations but, rather, as "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." This assumption is likely to be correct, for the only Short-tailed Shearwaters yet reported from the field of this book are a number that Hallinan (1924, 306) found floating in an exhausted condition in the vicinity of Naos Island, Bay of Panama, on June 8, 1915. A male which he placed on ice revived and became active.

This species is one of the shearwaters characterized by dichromatism, some examples being much darker than others. Whereas most specimens have the under surface of the wing dark gray, those of the light phase have under coverts that are decidedly grayish white, a condition which would make such birds particularly difficult to distinguish in life from the Sooty Shearwater. The two extreme phases of the Short-tailed Shearwater are completely linked by birds of intermediate stage but, under any circumstances, both the form and the shortness of the bill serve adequately for the specific determination of examples in the hand. Loomis found that among 44 specimens of this shearwater the culmen measured between 29.7 and 35 millimeters, while among 165 skins of *Puffinus griseus* the range was from 38.3 to 47.3 millimeters.

In the region of Bass Strait the Mutton Bird is a species of ancient fame and of considerable economic importance. Not only do the young constitute the preferred food of the aboriginal islanders, but they are also salted and preserved in great quantity for shipment to Tasmanian and New Zealand markets. The shearwaters have been much studied at their breeding grounds, and the following summary is drawn chiefly from the writings of Davies (1846, 13), Elwes (1859, 397), Gould (1865, 459), Buller (1873, 315; 1888, 230), Montgomery (1898, 209), Littler (1910, 165) and Oliver (1930, 124). So far as the strictly biological aspects are concerned, the fact of outstanding importance is the remarkably close resemblance between the behavior of this southern-hemisphere species and that of the Manx Shearwater (*Puffinus puffinus*) in western Europe. Such correspondence furnishes at least a preliminary basis for valuable general conclusions.

The breeding Mutton Birds are protected by Tasmanian law, but on March 20 the open season begins, and the young may be legally taken thereafter until the surviving fledglings leave the breeding grounds in May. As recently as 1910 about half a million of the chicks were being captured and prepared as food each year.

Formerly the adults as well as the young were slaughtered in great numbers, the feathers no less than the oil and flesh being utilized. For a few days after the first arrival of the shearwaters, toward the end of September, fence-traps were constructed on the hillsides, leading to pits into which the birds tumbled after leaving their burrows at daybreak. By this means thousands were taken each morning and, according to Elwes, two men and a woman once collected during a single season a ton of feathers, representing some 56,000 birds. The surviving population was then left alone, but when the chicks were nearly full grown the petrels were made to yield a second toll.

In the commercial exploitation of the well-grown chicks, they are hauled out of their burrows and killed by squeezing, after which they are strung up by the head so that none of the stomach oil may be lost before it is intentionally drained off. The oil, which varies in quantity from a teaspoonful to about 200 cubic centimeters, is clean, pure, burns well in lamps, and is also used as a lubricant. More recently it has been refined and used medicinally for it is reputed to contain a high proportion of two or more vitamins, and to have virtues similar to those of cod-liver oil. At Launceston, Tasmania, it sells for four shillings per gallon. After the oil has been taken out, the young birds are split and salted.

The Short-tailed Shearwaters congregate in immense flocks about their home islands during September and, shortly after sunset, they begin to fly in toward their warrens. One of the earliest calculations regarding the numbers of the birds is that of Flinders, as quoted by Littler and Buller. Flinders witnessed the flights in Bass Strait during December, 1798, and describes a stream of shearwaters 50 to 80 yards deep and more than 100 in breadth, flying as compactly as their wing movements would allow, and continuing thus for one hour and a half at a rate little inferior to the speed of pigeons. By allowing 9 cubic yards of space for each bird, and assuming a velocity of 30 miles per hour, Flinders concluded that there were more than 150 million birds in the flock he observed! Similar flights, requiring the greater part of a night to pass a given point, have been witnessed as recently as October, 1909.

When the shearwaters first return to their breeding grounds, descending birds rest on the soil outside their burrows, doubtless in anticipation of the arrival of their mates. Their mouths and throats are at this time full of a pasty substance with the appearance and smell of tinned salmon This sounds like small crustaceans, and Walter (1903, 219) tells us that their food consists, in fact, largely of the shrimp-like creatures known as whale-feed, organisms which make the water look reddish over extensive areas; in their efforts to escape from the path of a vessel, the birds sometimes eject great quantities of these creatures.

On the nesting ground there is at first more or less struggling and bickering

over possession of the burrows, the preparation of which takes about six weeks after the return from migration. Both birds of a pair work at cleaning out the old homes or excavating new ones, making the sand and earth fly for some distance from the entrance. When the nests have been renovated, the population disappears for a space of a month or longer, after which it returns, the paired birds darkening the sky increasingly for four or five successive days. Indeed, the clouds of birds, flitting about the island at the beginning of the laying season, are so dense that they cause night to be ushered in before the usual hour. The din that they make can never be forgotten. The incessant sounds are variable but always harsh and unearthly. The departure of the shearwaters at the first streak of dawn is, however, as uncannily silent as the arrival is clamorous. Davies states that the Mutton Bird rookeries can be smelled at a distance of 11 kilometers from the islands.

At Green Island in Bass Strait, according to the same author, the numbers of the Short-tailed Shearwaters were formerly so greatly in excess of the available space for burrows that more eggs were laid among the shrubbery on the surface than underground. Montgomery reports that in well-populated rookeries there may be as many as nine entrances to burrows in each square meter of the surface.

Egg-laying begins late in November, and the young appear about January 15, the period of incubation being close to 50 days. The chicks remain silent in their burrows during the day. After dusk there is a rush of parents from sea, which soon becomes bewildering, for tens of thousands come whistling in like bullets, passing the head of an observer until it seems dangerous to stand up. This influx, which is, of course, long after the end of the courtship stage, is conducted in silence, but presently the ground begins to emit extraordinary gurglings, groanings, and laughter, as the hundreds of thousands of chicks are receiving their one meal during the twenty-four-hour period. About 10 o'clock the muffled clamor ceases, while the young, doubtless, are digesting, and the adults resting from their labors. Many of the latter come forth from the burrows to sleep in the open air. About half-past two in the morning, a rising murmur announces the awakening of the rookery, and the adults all scramble like an army of land-crabs or small mammals to the higher ridges of their island, where they stretch their wings high over their backs and launch into the air, always facing the wind before taking flight. The last of them disappear before daylight.

The full-grown young are abandoned by their parents late in April, and successive days of hunger eventually pull the trigger of the instinct which spurs them to find their own way to the water. The "birders" of Tasmania declare that the chicks devour more or less gravel as soon as they come out of their burrows. Mortality from diurnal enemies, or as a result of physical accidents on the rough terrain, is very high, but the surviving chicks cover the neighboring seas in rather sluggish black flocks, which spend many days upon the water, engaged much more in diving and surface-feeding than in flight. Later they break up into smaller aggregations and ultimately leave the coast.

MANX SHEARWATER

Puffinus puffinus puffinus

Procellaria puffinus Brünnich, 1764, Orn. Bor., p. 29 (Faroe Islands).

Names: Synonyms of the specific name include *anglorum* and *arcticus*.

Characters: A black and white shearwater, much larger than Audubon's or than any of the forms of *Puffinus assimilis*.

Adults (sexes alike): General color of the dorsal surface sooty black, including the head, wings, and tail; lores, sides of face, and ear coverts blackish, more or less mottled with white along the junction with the ventral plumage; a distinct infra-orbital, and a fainter supra-orbital, stripe white; cheeks, post-auricular region, and sides of neck and breast freckled with ashy gray (or with sooty brown in more worn plumage), owing to the presence of dark terminations on the otherwise white feathers; ventral surface white, the lower flanks and thighs, and the outermost under tail coverts, being boldly blotched with sooty black; under wing coverts and axillaries white, the latter with variable single or double spots of ashy or sooty black near their tips; a slight mottling all around the bend of the wing; quills of wing and tail glossy sooty black on the outer webs, paling considerably on the inner, the shafts basally lighter in color. Iris brown; bill dark horn-color, the ramus of the mandible grayish; back of tarsus, outer toe, and lower half of middle toe black; front of tarsus and remaining parts of toes light pink, the webs bluish gray.

7 males (4 from the South Atlantic, 3 from the British Isles): wing, 230–244 (237.6); tail, 68.6–76.4 (72.6); exposed culmen, 34–36.2 (34.8); tarsus, 43.7–46.3 (44.7); middle toe and claw, 47.8–51.1 (49.2) mm.

3 females (1 from the South Atlantic, 2 from the British Isles): wing, 228–238 (232); tail, 74.5–79 (76.1); exposed culmen, 35.1–36.6 (35.7); tarsus, 43.2–45.8 (44.2) mm.

Since the species reaches South America only as a migrant from the northern hemisphere, descriptions of the eggs and downy young are not pertinent.

Distribution: Breeds in the North Atlantic Ocean at islets off Iceland, the Faroes, British Isles, coast of Brittany, the Azores, Madeira, the Salvages and Bermuda. Migrates southward to the coast of Brazil and Argentina.

Only recently has the Manx Shearwater been recognized as a regular migrant into the South Atlantic, although there are numerous older records for the coast of Brazil to which sufficient attention has not been paid. During the South Atlantic cruise of the brig 'Daisy,' in November, 1912, I saw this shearwater frequently among other petrels. It dived freely for food that I tossed into our wake, and I might have captured many but for the fact that the aggressive Shoemakers (*Procellaria*) and other large petrels crowded the Manx Shearwaters away from my hooks. Finally, on November 4, in latitude 33° 28′ S., longitude 45° 42′ W., a position to eastward of Uruguay, I succeeded in capturing a female in brilliant unworn plumage on a fishhook baited with loggerhead turtle meat. Both the glossy feathering and the very slender bill of this specimen stamp it as probably a bird of the year. It exactly matches known fledglings from western Europe. On November 7, 1920, Wetmore (1926, 50) found an emaciated Manx Shearwater on the beach south of Cape San Antonio, Buenos Aires. During the course of the Brewster-Sanford Expedition, Beck saw many feeding about the Argentine fishing-boats, in company with Greater Shearwaters and other sea fowl, and on October 5 and 9, 1914, he collected four males off Mar del Plata. All of these are adults in which the quills appear to have been recently renewed, while the moult of the body plumage is under way. One is fresh and glossy, and three are more or less bleached and worn. All are indistinguishable from British and Bermudian specimens.

We have, of course, no clue to the source of these South Atlantic birds, for the breeding range of the Manx Shearwater has very wide latitudinal limits in the eastern North Atlantic. Evidently the bulk of the western European breeding population is supposed to remain chiefly within the Old World littoral district during the northern winter. Wynne-Edwards (1935, 268) writes:

> The Manx shearwater frequents the offshore zone rather than the pelagic. It is the commonest shearwater in British seas, where some at least are to be found at all seasons. Oceanic records are scarce, for the birds become decidedly rare beyond about 200 miles from the coast.

While the Manx Shearwater does not nest within the South American region, its life history has perhaps been studied more fully than that of any other member of its genus, and a summary of its behavior may prove illuminating in connection with innumerable unsolved problems in the régime of other more or less closely related Procellariiform birds.

Although primarily a breeding species of the eastern Atlantic, the Manx Shearwater is also resident at Bermuda, from where the American Museum has one specimen. A bird was found incubating an egg in a hole among the rocks on an islet in Castle Harbor during the month of April (Reid, 1884, 274). The character of the nesting site, the presence or absence of vegetal material as a lining in the nest-chamber, and many other details of the life history seem to be highly variable and to depend upon the particular environment. Thus Turle (1891, 8) reports that at the Blasket Islands, off the western coast of Ireland, he found these shearwaters' eggs lying without exception upon bare earth, while elsewhere vegetation serves not only as a mattress for the egg, but also as a sort of "property" used by the adult birds during the procedure of courtship. The most detailed investigations of this species are those of Lockley (1930, 202; 1931, 202). From his model studies the factual data in the following brief notes are summarized.

Upwards of 5000 pairs of Manx Shearwaters nest at Skokholm, a small island covered with heather, bracken, and grassland, and situated well off the coast of Pembrokeshire. The birds begin to arrive for spring and summer occupation of their breeding grounds as early as February 9. Toward the end of the month they are plentiful. In autumn the adults commence their exodus before the fledglings, and the last of the latter leave the island by the middle of October. This means that during two-thirds of the year the bulk of the shearwaters are resident, and that they devote, on the average, four months to a winter migration at sea. From coastal waters close to the nesting ground there are, however, records of occurrence during every month of the year except December and January.

Upon reaching the vicinity of their summer range, the Manx Shearwaters apparently experience an immediate impulse to go in search of last year's burrows. For a time these will be occupied by single birds. February snows or severe frosts may cause all of them to abandon the island for a few days, but they are back in force as soon as possible, and in March and April they begin to be found within the burrows in pairs. The holes are visited with great

regularity at night, but the circumstances governing the presence or absence of the birds by day are highly variable. Activity of the adults is greatest, or at least begins earliest, on dull and misty days, and also on moonless or overclouded nights. Few returned to Skokholm, for instance, and few remained in the burrows throughout the day, while the moon was waxing between April 3 and 7, 1930. Even later in the reproductive period, it is apparent that the liveliness of the birds is in inverse ratio to light, for a bright moon is sufficient to dampen considerably the volume of their calls, the general phrasing of which is recorded by Lockley as "kuk-kuk-kuk-oo." Furthermore, calm weather is unfavorable to the thriving of the shearwater colony. Strong wind, on the other hand, enables the incoming birds to advance freely and slowly against it, with their wings quivering like those of a kestrel, and to make easy landings. It offers equal advantages over quiet air when the shearwaters take off from the doors of their abodes to return to sea.

The observations of Lockley show that the Manx Shearwaters customarily form flocks toward evening on the ocean at some distance from the breeding ground, and there spend considerable time, especially in calm weather, resting, washing, and preening. Each addition of a new group to the flock brings about a general hectic rising, which is followed by a new settling down. Beginning about two hours after sunset, or earlier in dark weather, the influx toward the island begins, continuing well into the night. Nocturnal activity, with much calling, is then carried on in the open until about half-past two o'clock in the morning, when it ceases rather abruptly as the shearwaters all hurry either into their burrows or off to sea.

Evening after evening the homeward-bound shearwaters fly directly to their burrows, each usually dropping accurately at its own front door. If no sound is then forthcoming from the earth, the newcomer appreciates the significance of the silence and waits outside for its mate, after the arrival of which the two wrestle with and caress each other, and utter unearthly variations of their call. The character necessary for recognition appears to be inherent in the voice and, even to human ears, there is an almost infinite individual variation in tone or pitch—some birds have high notes, some low, some harsh, and others soft. Although the preliminary stages of courtship seem to be marked by a certain promiscuity or indefiniteness, Lockley believes that this is apparent rather than real, and that it means merely that certain migrants of early spring blunder into burrows haphazardly in order to escape the daylight. At any rate, his banding experiments reveal the astonishing fact that numbers of identical pairs are found mated at the same nests during successive years, and that there is much evidence for, and none against, the belief that these shearwaters mate for life. It remains to be determined whether such a relationship is due to direct interaction between individual birds of opposite sex, or only to a shared homing sense that leads each independently back to the site of the former season.

Since some burrows cave in during the winter, and since the shearwater population of Skokholm is now increasing, there is each spring a shortage of ready-made burrows. Furthermore, a certain proportion of the birds are neces-

sarily breeding for the first time, and one or both members of some pairs have in consequence no fixed locality-ties. This leads not only to the excavation of new burrows, but also to territorial struggles for old ones. Under such circumstances, mutually antagonistic pairs of shearwaters may occupy the same burrow for some time. Lockley finds that the first pair to produce an egg usually maintains possession and ousts the rival claimants.

Nest material, in the form of vegetation gathered near the entrance of the burrow, is collected a week or so before the egg appears, early in May. If an egg is removed, no second is laid, but the despoiled parents continue to frequent the burrow at intervals until well after midsummer. After egg-laying, the adult birds carry on their conversation and caresses entirely underground. One parent may remain for three or four, or even five, days in continuous incubation, obtaining its only relief by turning the egg and altering its own position at least once each day, and by meeting its mate in the burrow at night. As incubation progresses the birds become increasingly shy or wild with reference to a human intruder. This reaction overbalances any opposite trend such as might result from increasing familiarity.

On occasion both parents may be found together in the nest during the day, even well toward the end of the long incubation period, which Lockley discovered to last from 52 to 54 days. The young shearwater may begin to call within the egg a full day before breaking through the shell. The newly hatched chick is continuously brooded for a week or thereabouts, and is thereafter visited and fed regularly by both parents once in twenty-four hours. The feeding process takes place immediately after the nightly return of the adults, and before the beginning of any audible "conversation" among the family of three. If a parent is intercepted and caught as it is about to enter the burrow, it is only a matter of seconds before it disgorges all the food it is carrying.

The mesoptyle down of the chick sprouts at about the 16th day after hatching, and reaches its maximum length on the 35th day. By the 42d day the quills begin to project from the tips of their sheaths, and by the 60th, 61st, or 62d day the youngster is completely feathered, though with more or less down still attached to the tips. At this time it is suddenly, completely, and forever deserted by the parents, after which it remains for a time in its burrow, fasting and drawing upon its own reserve of fat. The remaining traces of down and the drying sheaths of the quills drop in a ring around it, but very little excreta appears during this period of starvation. After six days or thereabouts, the no doubt still-expectant chick makes its way to the mouth of the burrow, where it sits throughout the night. Later it plucks up courage to leave its home, and to wander about near the burrow, walking on its toes but with the tarsus forming a sharp angle with the ground, and moving with a curious springy gait, a few steps at a time. Very close to half-past two in the morning all such chicks invariably scramble back into their nests, to remain until the following nightfall. For a period of between 11 and 15 days the forsaken fledglings thus test the outside world, until hunger presently joins with instinct in spurring them to make a further bid for liberty. Therefore, at an age which is normally 72

or 73 days, they begin to head for the sea. They appear to know the shortest route toward the water, which may be through a positive reaction to the brighter sky over the ocean, or to the distant sound of waves.

If the wind is strong on the fateful night, the fortunate young shearwaters may undertake a successful first flight directly from burrow to ocean. But on a calm night their spasmodic efforts result in what Lockley calls a "flying walk," which may degenerate into a pathetic scramble over the bogs and rocks, and through the bracken, requiring not only the remainder of the dark hours but perhaps the next night as well, before they can reach the water. Under such circumstances, the chicks crouch beneath any convenient hiding-place at the approach of daylight, which reduces them to helpless torpor, and during this period large numbers of them fall victims to gulls, crows, and hawks. The average weight of healthy fledglings at this time is from 368 to 425 grams (453.6 grams = 1 pound). Many are lighter, particularly those which have delayed their exodus too long and which lack stamina to complete the short but essential step toward the first self-sustaining phase of life.

The outbound chicks, which demonstrate so well the fundamental pattern, including the nutritional stimulus, of a migration, blunder straight over the ledges and cliffs when they reach them, tumble or glide to the water, and at once swim and dive, flying beneath the surface with their wings, remaining below for periods as long as twenty-four seconds, and also drinking the water while they float, lifting the head as a young chicken does to allow it to run down their throats. They paddle, rather than fly, offshore, and form large and somewhat sluggish flocks on the ocean. When they do take wing, their flight is for a time distinctly more labored than that of adults.

Such a plan of life history, as worked out for the Manx Shearwater by Lockley, is doubtless applicable to many species of the genus, and in part to less closely related Procellariiform birds. It goes far, in fact, to give meaning to many random and hitherto puzzling observations regarding breeding petrels in various parts of the world, and it rationalizes the data I have given about the abandonment of fledgling albatrosses by their parents.

The moult of the Manx Shearwater takes place during the rearing of the young, a condition obtaining among many other species of petrels, in which the incubation and fledgling periods are prolonged.

The food of the birds of Skokholm comprises mainly young herrings. On the open sea west of Ireland, Jespersen (1930, 116) found remains of fish and small cephalopods in Manx Shearwater stomachs.

The Least Shearwaters

I have shown (Murphy, 1927, 2) that the smallest members of the genus *Puffinus*, with wings less than 22 centimeters in length, form two natural groups, one of which is made up of birds with "blue-black" and the other of birds with "brown-black" upper surfaces, and that these two groups are to be associated with distinct oceanic zones, one sub-antarctic, the other pan-tropical.

The distinctions may be more fully set forth as follows:

1.—Upper surface varying in the different races between slate color and slate black, fading greatly with extreme wear, but always without a trace of brown hue in fresh feathers; inner vanes of the primaries largely white; under tail coverts mostly white (entirely so among all forms examined except the Madeiran race); part of loral space between culminicorn and angle of mouth, white; color of legs in life, blue. Range: extra-tropical seas, chiefly in the temperate zone beyond 30° S. latitude, but with one north temperate race (at Madeira) . . . . . *Puffinus assimilis.*

2.—Upper surface varying from blackish brown to sooty black, but always brownish rather than slaty; inner vanes of primaries without white; under tail coverts largely or entirely dark; part of loral space between culminicorn and angle of mouth, mostly dark; color of legs in life, flesh color. Range: tropical seas, extending just north of the tropic of Cancer at the Bonin and Bahama Islands, and to an isolated northern outpost at Bermuda . . . . . *Puffinus lherminieri.*

Puffinus lherminieri has its typical race in the western tropical Atlantic, and another at the Galápagos Islands. A highly distinctive subspecies of *Puffinus assimilis* appears to be found along the northerly edge of the Sub-Antarctic Zone of surface water all around the globe. Within our region it breeds in the Tristan da Cunha area.

TRISTAN SHEARWATER

Puffinus assimilis elegans

Puffinus elegans Giglioli and Salvadori, 1869, Ibis, p. 68 (South Atlantic Ocean, latitude 43° 54′ S., longitude 9° 20′ E.).

The typical form of this subspecies was described from the western South Pacific, the reference being as follows:

Puffinus assimilis Gould, 1838, 'Synops. Birds Austr.,' part 4, Append., p. 7 ("New South Wales" = Norfolk Island).

P. a. elegans is, however, so well marked a race that it may be described without reference to the typical race.

Names: The members of this group of petrels have been badly confused and the present subspecies has been frequently listed under such names as *obscurus*, *affinis*, and *australis*. *Puffinus assimilis munda* (Salvin), described from the South Pacific, also appears to be a synonym. Mathews (1933, Bull. Brit. Orn. Club, No. 371, p. 25) states that the name *munda* is untenable and proposes a new name, *kuhliana*. However, nothing has been advanced to show that *munda* is not synonymous with *elegans*, and the latter name has priority over all others (Murphy, 1927, 5).

Characters: A large, but relatively short-billed, race of *Puffinus assimilis*, the feathers of the slaty dorsal plumage narrowly margined with white.

Adults (sexes alike): Entire upper surface close to slate color, the feathers of nape, sides of neck, back, wing coverts, secondaries, and tail coverts margined with white, most broadly (2 mm.) on the external and terminal parts of the secondaries; concealed portions of dorsal feathers grayish white; inner two-thirds of inner vanes of primaries white to within 20 or 25 mm. of their tips; pileum slightly more blackish than back, and lacking white borders on the feathers; lores speckled, white on their lower halves, the dark color of the pileum descending below and behind the eye, with a mottled boundary; a narrow white stripe on the lower eyelid; sides of breast covered with slaty, white-margined feathers which blend gradually with the uniform white plumage of the ventral surface; lining of wings and under tail coverts white like throat and breast. Bill blackish above and terminally, blue on the mandible and toward base of culminicorn; feet and legs blue, with the outer toe and outer side of tarsus blackish; webs yellowish.

The above description and the following measurements are based upon Pacific, not South Atlantic, specimens.

6 adults of both sexes: wing, 182–196 (190.5); tail, 64–69 (66.8); exposed culmen, 24–27.5 (25.8); depth of closed bill at base, 8.4–10; least depth of bill, 6–6.6; width of bill at base, 10–11.5; tarsus, 39–41.5 (40.3); middle toe and claw, 45–48 (47.1) mm.

Egg: Oval, smooth, and without gloss; the average measurements of an unstated number from Gough Island are 50 x 35 mm. (Mathews, 1932, 27).

Distribution: The Sub-Antarctic Zone of the southern oceans, breeding at Gough Island, and now or formerly at the islands of the Tristan da Cunha group. Pacific and Indian Ocean breeding grounds are still undiscovered.

The type locality of the *Puffinus elegans* of Giglioli and Salvadori is southeast of the Cape of Good Hope, and about equidistant from there and from Gough Island, but considerably south of the latter. Mathews (1932, 27) has examined skins and eggs from Gough. He adds that the bird appears to be little known among the present-day folk of Tristan da Cunha, but that he had received a single specimen from that group in the collection of Mr. J. G. Gordon, and also an egg without data said to pertain to the same bird.

During the visit of the 'Scotia' to Gough Island, in the month of April, a pair of these shearwaters was captured in a burrow in a steep grass-covered bank on the side of a ravine. The attention of the Scottish naturalists was drawn to the birds by their loud croaking. The bank was honeycombed with similar burrows, and numbers of the petrels were seen at sea around the island (Clarke, 1913, 284).

Practically nothing seems to be known of the life history of this subspecies, and little concerning other races of *Puffinus assimilis*. Jespersen (1933, 198) gives a chart showing positions in which alleged examples of *Puffinus assimilis* were sighted during a voyage across the Pacific Ocean. The latitudes of the records, however, taken in conjunction with the author's remarks on page 197, make it almost certain that all his observations relate rather to forms of *Puffinus lherminieri*.

The type specimen of this shearwater was collected on March 2, 1866. In both appearance and measurements it agrees exactly with seven examples of "*munda*" or "*kuhliana*" from the South Pacific, suggesting that the two are the same. Latitude, not longitude, is the principal geographic circumstance correlated with racial and specific differences among the southern Tubinares. Within the tropics each ocean may, indeed, have its own forms, but in the belt of westerly winds these birds may, as Gould was so fond of supposing, "make the circuit of the globe."

Banks collected specimens in the South Atlantic, near the coast of South America and north of latitude 41° S. (Hooker, 1896, 64). Salvin (1876, 236) records an example from latitude 48° 27′ S., longitude 93° west of London. It is also probably the race reported by Hutton (1867, 189) in May "about 300 miles north of the Crozet Islands."

In default of exact information about the life history of the subspecies *elegans*, the following notes on the typical race by Falla (1934, 253) may prove of value:

The wing-beats of this shearwater are very "rigid" in quiet air.

The protoptyle down of the chicks is light gray, the throat, breast and abdomen white, the mesoptyle dark gray above and below. Fledglings are not distinguishable from adults except by the immature bill characters. Re-

mains of small cephalopods and minute crustaceans have been found in their stomachs.

It is the first petrel to lay its eggs of all the species nesting on islands off northern New Zealand. A freshly moulted pair of adults has been found in a burrow, during the daytime, on April 17. On October 5, at Mokohinau Islets, a colony was found to be abandoned except for two belated chicks. Adults in worn plumage and young in fresh plumage have been collected at sea in mid-November. Present-day observations indicate that this shearwater is a winter breeder only, with a season from April till October, although some of the earlier observations are hard to reconcile with this.

AUDUBON'S SHEARWATER

Puffinus lherminieri lherminieri

Puffinus (sic) *Lherminieri* Lesson, 1839, Rev. Zoöl., 2, p. 102 ("Ad ripas Antillarum").

Names: In the English-speaking Antilles and in Bermuda this shearwater is known as the Pimlico, sometimes spelled Pimblico or Pemblyco. Common synonyms of the specific name are *obscurus*, *auduboni*, and *minor; assimilis* also often pertains to this species.

Characters (sexes alike): Upper surface blackish brown, almost black on the outer webs of the wing quills, and the primary coverts; concealed inner webs of wing quills much paler; lower half of lores white, the line of demarcation between dorsal and ventral plumage being mottled under and behind the eye, and along the cheeks and sides of neck, through a variable mingling of the dark and white feathers; a faint white stripe on the lower eyelid; flanks splashed with sooty or grayish brown, which appears variously as splotches, mottlings, or shaft-streaking on otherwise white feathers; at the sides of chest this dark color sometimes extends slightly toward the mid-line, the dark feathers in this region being mostly narrowly edged with whitish; ventral surface, from chin to crissum, including the axillaries, and the wing-lining except along its anterior border, white; lower aspect of wing and tail quills dark neutral gray, when fresh; longest under tail coverts blackish brown, the shorter coverts dark mouse-gray and white, some being one or the other, some parti-colored. Iris brown; bill black, bluish on the mandible and toward the base of culminicorn; feet and legs flesh color, with the outer toe and outer side of tarsus blackish.

26 adults of both sexes from various West Indian islands, the Bahamas, Bermuda, and the southeastern United States: wing, 200–216 (208.2); tail, 82–94 (87.2); exposed culmen, 26–32 (29.8); depth of closed bill at base, 9–10.8; least depth of bill, 6–7.5; width of bill at base, 10–13; tarsus, 39–43 (40.3); middle toe and claw, 43.5–48 (45.8) mm.

Half-grown downy chicks are of a fairly uniform dusky gray color above, whitish on the ventral surface.

Egg: White, fragile and not highly polished. The measurements of 39 average 52.5 x 36.2 mm., the eggs showing the four extremes measure 57.3 x 40.8, 49.2 x 35.2 and 50 x 34 mm. (Bent; 1922, 74).

Distribution: Breeds at Bermuda, the Bahamas, and many islands of the West Indies, particularly among the Lesser Antilles. Islets off Barbados, Grenada, and Tobago seem to be the closest breeding stations to the South American continent. The known range extends from the coast of British Guiana northward to about latitude 37° N., on the east coast of North America, and casually as far as Long Island, New York.

Audubon's Shearwater is or was an abundant bird at islands around the Caribbean Sea. During the course of the Brewster-Sanford Expedition, Beck observed numbers of these petrels feeding along the route of his passage from island to island of the Lesser Antilles in April. In July, 1916, he saw others not far from Trinidad, and at the end of the same month obtained several from their

burrows on an islet off Barbados. In the American Museum Collection there is an example from still farther southward, namely a male taken by Mr. Arthur Carlin about 160 kilometers off the coast of British Guiana, on December 2, 1931.

Southward beyond this point the distribution of Audubon's Shearwater passes into the realm of conjecture. It is, however, worth noting for the sake of subsequent determination that when Shackleton's last antarctic expedition touched at St. Paul Rocks, in the central part of the equatorial Atlantic, during the month of November, Wilkins (1923, 476) wrote, "From the appearance of some open holes under the rocks members of the petrel family may also breed there." Furthermore, I have already related in the account of the island of St. Helena that subfossil remains of a small shearwater have been found at this South Atlantic island, and that they have been listed as pertaining to the present species. *Puffinus lherminieri* has representative races in the Indian Ocean and the South Pacific, but it is, of course, impossible to infer what the extinct shearwaters of St. Helena may have been until the matter has been investigated further.

Audubon's Shearwater is the typical form of the group characterized by a "brown-black" upper surface and other features listed in the key. The material examined includes an excellent series in the American Museum of Natural History, as well as the type skin of *P. audubonl* Finsch, in the Berlin Museum, and other specimens in foreign collections. Localities represented by the measured skins comprise Barbados, Guadeloupe, St. Thomas, Florida, the Bahamas, Bermuda, Cobbs Island, Va., and Bellport, N. Y.

Downy young, in various stages of growth, are well represented in the American Museum Collection by birds taken at the Bahamas, St. Thomas, and Guadeloupe during the month of May. The down gives place to a plumage of the adult type, the dorsal surface being of a nearly uniform hue, close to blackish brown or fuscous black, without white feather margins except at the sides of the breast.

The lores in this subspecies are mostly dark, with no more than a narrow line of white from the bill to the angle of the mouth. The inner vanes of the primaries, as in all forms of the species, lack white; the lower tail coverts are mixed but prevailingly dark, and the axillaries and under coverts of the wing are rarely if ever without at least a few dark splotches.

Diminution in the numbers of Audubon's Shearwaters throughout much of the range is in part explained by the fact that the young are collected as food at many nesting grounds. Formerly, at any rate, dried and salted adults, and young birds in the down, were offered for sale in public markets of the West Indies. At Grenada they were called "Diablotins," the same name by which *Pterodroma hasitata* was known in the French islands of the Lesser Antilles. The natives of Greenville, Grenada, reported that the birds sold there were taken by fishermen from holes in an islet called Mouchoir Quarré (Lawrence, 1889, 19).

The nests of this shearwater are either tunneled through soil or placed in natural rock cavities, according to circumstance. At Bermuda and the Bahamas, for example, they occupy natural holes in the coral limestone, while at Little

Saba Islet, off St. Thomas, Beck found burrows in the earth under dry grass near the top of the island.

In common with many other pan-tropical sea birds, Audubon's Shearwater has developed a prolonged nesting season, as the following records will indicate. These also contain possible evidence that the petrels may resort to their hidden nest-chambers even after the young birds have flown.

Lowe (1911, 222) obtained eggs of this shearwater from Barbados in March. They came presumably from the only known local breeding station, a mushroom rock a hundred meters off the northern coast of the island. Beck persuaded a black man to swim to this rock on July 26, 1916, as noted above, and thus acquired four adult birds from their burrows. Feilden (1889, 66 and 503) found heavily incubated eggs and well-grown young on the same islet in March, and adults again in the holes during October. He states that for more than two centuries the islet, which is only about 20 meters in diameter by 10 to 12 in altitude, has been a locally famous breeding ground of the species.

Continuing the scattered jottings relating to breeding season, we may note that on March 4 and 11, Bradlee (1906, 217) found Bermuda Audubon's Shearwaters incubating their eggs, while in May, at the same locality, Plath (1914, 558) observed half-grown chicks. At Ship Channel Cay, in the Bahamas, Bryant (1859, 132) discovered many adults covering eggs on March 24, and at Washerwoman Cay both eggs and newly hatched chicks were in evidence during early May (Bonhote, 1903, 315). The latter condition also represented the status of the species at Labaye Rock, off Grenada, as early as April 2, 1888 (Lawrence, 1889, 19). At Little Saba Island, south of the western end of St. Thomas, Virgin Islands, Beck found chicks practically ready for flight on May 9, 1917, and also two adults in a burrow on August 21, 1916. The latter specimens, like the July adults from Barbados, had begun to moult, a process which seems to go on throughout the remainder of the northern-hemisphere summer.

At Little Saba, in late August, Beck observed numbers of partly completed burrows, the proper owners of which were absent during the daylight hours. From this, in conjunction with the foregoing dated notes, we may infer that—if breeding is not absolutely continuous and seasonless—the sequence is somewhat as follows: courtship and nest-construction, July to November; eggs, January or February to May; hatching of young, May to July. The data are highly fragmentary, and continuous observation is much needed before the life history can be satisfactorily outlined.

The following account is based upon the reports of C. W. Townsend (in Bent, 1922, 74), and of some of the ornithologists already cited in the biography of this species.

Whether the Audubon's Shearwaters are breeding in soft soil or among crevices of rock, the nest-chamber is usually within half a meter of the surface. The egg is sometimes laid on bare earth or stone and sometimes in a rudimentary nest loosely constructed of dried grass or small twigs. As among most other petrels, incubation is shared by the two parents, which are usually to be found together in the compartment during a period preceding the appearance of the

egg. For a few days after hatching, one adult remains with the chick, not covering it but merely sitting beside it. Thereafter it is left alone during the hours of daylight.

At their breeding grounds these petrels are very active during the night, but are rarely seen or heard at any other time. They enter and depart from their burrows only between dark and dawn. All night long during the courtship season their mournful cries, some of which are said to resemble catcalls, ring out in the free air or come as a muffled clamor from the depths of the tunnels. The nestling shearwaters utter a liquid chirping or peeping note. Brooding birds taken from nests on an island near Grenada remained quiet in captivity throughout the day, and took no food. At night, however, they fed willingly on scraps of fish, all the while scuffling about and uttering low howling notes.

Members of a community which have been relieved of the tasks of incubation and brooding remain at sea throughout the day, generally at a distance at least great enough for them to be out of sight of their home islet. They often rest for hours on the surface of the ocean in extensive flocks or "rafts" of birds, and have been seen in Bahaman waters, during April, mingled with large numbers of floating boobies and terns (Bryant, 1859, 132). Although ordinarily credited with being shy at sea, the Audubon's Shearwaters sometimes gather and scramble for food about the boats of West Indian fishermen.

Bent (1922, 75) quotes Audubon's classic description of these shearwaters, written as the great pioneer ornithologist was lucky enough to see the birds at close range, skimming over patches of gulf weed, near the southern tip of Florida. They would

> . . . flap their wings six or seven times in succession and then sail for three or four seconds with great ease, having their tail much spread and their long wings extended at right angles with the body. On approaching a mass of weeds, they raise their wings obliquely, drop their legs and feet, run as it were on the water, and at length alight in the sea, where they swim with as much ease as ducks, and dive freely, at times passing several feet under the surface in pursuit of fishes, which, on perceiving their enemy, swim off but are frequently seized with great agility. Four or five, sometimes fifteen or twenty, of these birds will thus alight, and during their stay about the weeds, dive, flutter, and swim with all the gaiety of a flock of ducks, newly alighted in a pond. . . . At times, as if by way of resting themselves, they alighted, swam lightly, and dipped their bills frequently in the water, in the manner of mergansers.

GALÁPAGOS SHEARWATER

Puffinus lherminieri subalaris

Puffinus subalaris Ridgway, 1897, Proc. U. S. Nat. Mus., 19, p. 650 (Chatham Island, Galápagos).

Names: This race has been listed under the same specific names as the preceding form, besides which *becki* is a subspecific synonym.

Characters: Resembling *P. lherminieri lherminieri*, but more heavily marked with dark feathers along the flanks, and without dark areas descending from the back onto the sides of the chest; furthermore, the tail in the Galápagos race is both relatively and absolutely shorter. An additional and curious feature, which appears to distinguish *subalaris* from every other form of the species, is that the nasal tubes are exceptionally firm and corneous, showing almost no trace of shrinkage in dried skins.

10 adults of both sexes: wing, 189–203 (194.8); tail, 68–75 (71.8); exposed culmen, 24.7–29

(27.7); depth of closed bill at base, 9–10; least depth of bill, 6–6.5; width of bill at base, 10.5–12; tarsus, 34–37 (36); middle toe and claw, 40–43.6 (41.3) mm.

Loomis (1918, 123) based a study of this race upon 104 adult examples, numerous chicks, and eggs. His measurements, which agree with those given above, show that the sexes exhibit no difference in size. The average length in the flesh of 5 males amounted to 296 mm.; that of 18 females to 299 mm. In wing-expanse one male measured 625 mm., one female 630 mm. The flesh colors agree with those of the typical race.

Among a number of downy nestlings the youngest is deep mouse-gray with grayish white patches on the abdomen and chest.

Eggs: Three from Hood Island are dead white, in form inclining toward elliptical-ovate, and measure 47.1 x 32.9 and 48.5 x 33.8 mm. (Loomis, 1918, 129).

Distribution: Confined to the Galápagos Archipelago; breeding at Hood, Indefatigable, and Wenman Islands, and probably at many of the other islands and their outlying rocks.

Loomis has given an excellent account of this subspecies, based upon collections and observations of Gifford and others made during the Galápagos Expedition of the California Academy of Sciences.

Perhaps the shearwaters of the Galápagos colonies do not wander far from their breeding grounds. Members of the California Academy Expedition, at any rate, saw them only within an area of ocean bounded by latitudes 5° 30′ N. and 2° 29′ S. However, the notes and chart of Jespersen (1933, 197) at least suggest that these birds may migrate or stray well to westward in the tropical Pacific, and Wetmore (1923, 171) records a specimen taken in December on the west coast steamship lane south of Panama. The problem is one which only future pelagic collecting can solve.

Loomis (1918, 123) writes of the habits of these birds at the Galápagos:

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 and Lord Rothschild and Dr. Hartert state that downy young were found on the same island in February and a great many eggs on Culpepper Island in July. It appears, therefore, that relays protract the breeding season, with the laggards causing it to cover most, if not all, 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, of 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.

GREAT-WINGED PETREL

Pterodroma macroptera macroptera

Procellaria macroptera A. Smith, 1840, Illustr. Zoöl. So. Africa, pt. 2, pl. 52 (seas off Cape of Good Hope).

Names: Gray-faced Petrel, Cape Parson, Mutton Bird; Black Eaglet at Tristan da Cunha. Synonyms of the specific name include *fuliginosa*, *atlantica*, *pacifica*, and *gouldi*. The last has a correct subspecific application.

Characters: A long-winged black petrel, with a gray throat.

Adults (sexes alike): General color sooty black, slightly paler and grayer about the base of the bill and on the throat; in the latter region the whitish bases of the feathers often become conspicuous through wear, producing a mottled whitish patch; quills of wing and tail black, the primaries ashy at the base of the inner web where the shafts also tend to become whitish. Iris brown, bill and feet black.

One male, and one of unknown sex, South Atlantic: wing, 302, 309; tail, 108.4, 123; exposed culmen, 35, 35.2; width of bill at base, 15.8, 16; length of maxillary unguis, 21.3, 21.4; tarsus, 41.8, 43; middle toe and claw, 56.7, 57.3 mm.

The length in the flesh and wing-expanse of the male were, respectively, 41 and 106 cm.

4 males of *Pterodroma macroptera gouldi*, from New Zealand: wing, 311–323 (319); tail, 121.5–132.1 (125.4); exposed culmen, 36.2–37.4 (36.9); width of bill at base, 16.1–16.8 (16.5); length of maxillary unguis, 23.2–24.5 (24); tarsus, 42.9–44.5 (43.6); middle toe and claw, 60.2–63.7 (61.7) mm.

Young from New Zealand are clad in sooty gray down, the juvenal plumage being indistinguishable from that of adults.

The eggs, according to Mathews (1932, 32), are white and smooth, without gloss; 6 from Tristan da Cunha average 68.8 x 48.2 mm., the largest measuring 69 x 49 mm.

Distribution: The species is circumpolar in sub-antarctic seas, and is said to breed as far southward as Kerguelen Island, as well as at the Crozets, Tristan da Cunha, and islands in the New Zealand region. The subspecies *macroptera* nests at Tristan, and is likely to prove peculiar to that group.

This petrel, which wears a black robe and has a more or less gray face, is said to have been called the "Cape Parson" by the old-time British sailors.

Judging by the limited material I have seen, however, the typical South Atlantic race—presumably the form to be seen off the Cape of Good Hope—is distinctly less "gray-faced" than the larger subspecies of New Zealand waters, which has been named *Pterodroma macroptera gouldi*. I know nothing about the status of the birds said to breed at high-latitude islands of the Indian Ocean. These may possibly be as gray-faced as New Zealand examples.

Godman (1908, 177) points out differences between South Atlantic birds and those from the New Zealand region, even though he was disinclined to attach any importance to the distinctions. He quotes Gould and Hutton to the effect that the form occurring in Tasmanian seas differs from that of the Atlantic in its larger size, longer wings, and grayer face. Godman's plate, moreover, is an excellent representation of the Atlantic bird, and differs markedly from the gray-faced form of New Zealand.

In all of this I concur. Our New Zealand specimens are larger, and have a pronouncedly longer maxillary unguis, than South Atlantic birds. The bills of even New Zealand fledglings are bigger than those of Atlantic adults. Furthermore, young birds from Cuvier Island, New Zealand, which are just shedding their down, have gray faces like those of their elders, but quite different from those of Atlantic birds.

Observers agree that the Great-winged Petrel is a handsome, dashing bird. Hutton (1865, 286) remarks that on the wing it resembles a gigantic swift. I believe that I saw it frequently during my cruise in the brig 'Daisy,' particularly in March, 1913, along the 30th meridian of west longitude, and between latitudes 33° and 43° S. At the time, however, I made the entries doubtfully in my journal because I was unable to collect a specimen, and because I had not yet become acquainted with the black phase of *Pterodroma arminjoniana*, a similar though smaller bird. The latter began to appear during our northward voyage in latitude 25° S., four days' sail to southward of South Trinidad.

The Museum collection possesses only two specimens of the Great-winged Petrel from the South Atlantic. One, a male, was taken by the Cleveland Museum Expedition in latitude 27° 50′ S., longitude 8° 26′ W., on August 27, 1925. The second is an unsexed bird collected by P. C. Keytel at Tristan da Cunha. Both of these look alike, and are of different appearance from our excellent series taken in the New Zealand region by the Whitney South Sea Expedition. The Atlantic birds seem smaller, with slenderer bills and without the distinct gray face. In color they are entirely sooty black except for a slightly grayer area around the base of the bill, including the forehead, lores, chin, and the fore part of the throat. In one the center of the throat shows more or less whitish mottling through exposure of the concealed parts of the feathers, which are whitish here and grayish over most of the rest of the body. The ventral surface seems to be as dark as the back, except that it becomes more rapidly dulled through wear, with the accompanying appearance of a faintly rufescent tinge on the margins of the feathers. Among our New Zealand specimens the gray mask is uniformly pronounced, the bills are heavier, and the maxillary unguis notably larger.

The records of Hutton (1867, 187), Dabbene (1923, 33), and others indicate that this sub-antarctic petrel is likely to be met with close to the 30th parallel in the southern oceans, from where it ranges southward to about latitude 50° S. It has never been recorded from the Falkland Islands, but it is reported to breed at Kerguelen, which is far more glacial than the Falklands, and lies on the convergence with the Antarctic Zone of surface water. The representatives of the species at Kerguelen are likely to prove at least racially different from those at Tristan da Cunha, the South Atlantic breeding ground, which is close to the Sub-Tropical Convergence. The species is not yet known from Gough Island, but I confidently expect it to be found there, too.

According to Barrow (1910, 275), the "Black Eaglet"—possibly a corruption of "haglet," a common seafarers' name for various petrels—reaches its egg-laying state at Tristan da Cunha about the first week in July. The season is far in advance of the springtime period of November and December, when so many of the resident Procellariiformes nest. Furthermore, Mrs. Barrow's additional notes seem somewhat confused, for she speaks of obtaining eggs of the Black Eaglets during both May and October. It may be, however, that the notes of Falla, which are summarized below, resolve all these difficulties. The zonal position of Tristan is very nearly the same as that of northern New Zealand, and at each of these localities the Great-winged Petrel becomes a bird of almost sub-tropical range, and hence may well have freed itself from the rhythm of a rigidly fixed breeding season. At Kerguelen Island, the life history would exhibit the usual type of calendar control, but at Tristan, as in New Zealand, there would be nothing surprising about a prolonged nesting period, with birds in residence practically throughout the year.

The 'Challenger' naturalists found Great-winged Petrels in their burrows at Nightingale Island during October, and Campbell (1877, 67) states that the slope of this island, at an altitude of 300 meters or more, was so honeycombed with their holes that the explorers sank up to their knees through the soil at every other step. Such high concentration of the burrows agrees with the report of Littler (1910, 173) from Little Barrier Island, New Zealand.

All exact data on the nesting habits of the Great-winged Petrel come from other parts of the world than the South Atlantic. Studer (1879, 109) states, for example, that egg-laying begins at Kerguelen about the first of November and that young birds appear in December. Far more detailed, however, are the recent admirable studies of Falla (1934, 25), from which the following account is drawn.

In northern New Zealand this petrel breeds at every island where burrows can be made, and it is equally at home along suitably inaccessible cliffs on the mainland. It is not strictly a colony-forming bird, as are so many of the shearwaters, but its abundance at any locality is due rather to the presence of soil adapted to a dense accumulation of individual families. Isolated single burrows are not infrequently found far inland.

The breeding season is about as long as would be possible in a temperate region. Within a month after the departure of the last youngsters from the burrows, a few adults can be found occupying them sporadically during Feb-

ruary and March. Such early arrivals come singly to the breeding ground, and in most instances they prove to be male birds. Between April and June mated pairs can be found together in increasing numbers, such birds often remaining in their nests throughout the day. The burrow is seldom much more than a meter in length, and the carrying in of vegetable matter for nest material is a sign of imminent egg-laying, which takes place during July and early August, the first chicks hatching before the end of the latter month. The youngsters reach their maximum size, and begin to put forth feathers, in late October. During November, which is the "mutton bird season" for this species, the young are still taken more or less regularly for food by the North Island Maoris. Half-fledged young weigh up to 624 grams, or fully 100 grams more than the adult birds, but this becomes reduced to less than adult weight before they fly. Frosted edges on the feathers of the mantle are noticeable in the fresh plumage of the young, as in the case of most dark petrels. By early January the chicks are full-fledged, and before the end of that month they all depart.

The courtship of this petrel has never been described. Pairs of birds seem to spend several days and nights continuously in a burrow, after which they may pass a similar period at sea. When the birds first appear in the coastal waters, particularly during May, they are often seen in pairs. Both sexes incubate, but Falla has found only males on the egg during the later stages of incubation, at any rate during the daytime. Males have likewise been found constantly in attendance upon the chick up to the time that the latter is ten days old, after which age it is visited only at night. Fledglings not infrequently come out of their burrows after dark to amble about in the free air, returning underground before daylight.

Littler (1910, 173) says that the call of this petrel, heard along the cliffs after sunset, is a melancholy *ohi-ohi*. The young make a whimpering noise while being fed.

The Great-winged Petrel has an extraordinarily extensive feeding range, and its subsistence appears to be quite independent of food in the coastal waters close to its nesting ground. Falla, indeed, states that it is rarely seen within 80 kilometers of the shore during the hours of daylight, and that its almost exclusive diet consists of pelagic cephalopods. Beaks, crystalline lenses, and sepia of the latter animals are constantly found in the stomachs of both young and old birds, and such material is often regurgitated when these petrels are disturbed.

BLACK-CAPPED PETREL

Pterodroma hasitata

Procellaria hasitata Kuhl, 1820, Beitr. Vergl. Anat., Abth. 1, p. 142 (no locality given = Dominica).
? *Pterodroma caribbaea* Carte, 1866, Proc. Zoöl. Soc. London, p. 93, pl. 10 (Blue Mountains, Jamaica).

Names: West Indian Petrel; "Diablotin." Synonyms of the specific name include *diabolica*, *meridionalis*, and *rubritarsi*. If the black petrel of Jamaica is of the same species, the names *caribbaea* and *jamaicensis* are to be included among the synonyms.

Characters: Commonly known as a white-breasted, brown-backed petrel, with whitish forehead, nape, and rump, but probably having also grayish or blackish phases represented by the so-called Jamaican Petrel.

Adults, black-capped phase (sexes alike): Dorsal coloration generally dark brown, the feathers with obsolescent margins of lighter brown, the longer scapulars and upper wing coverts rather blacker than the back, with scarcely perceptible paler brown edges; quills black, the primaries ashy brown on the inner webs, with the bases inclining toward whitish, the inner secondaries rather browner; rump and basal upper tail coverts black; lateral upper tail coverts at the base of the tail, and all the long coverts of this series, white; tail feathers black, white at the base, especially on the inner web; crown of head black, forming a cap; forehead and lores white, the center of the former black, mottled with white edges to the feathers; sides of face white, the feathers in front of the eye black, and spotted with black below the latter; cheeks and sides of neck pure white, extending in a broad white collar round the hind neck, which has a few brown-tipped feathers in the center; entire under surface of body white, including the under tail coverts; under wing coverts black, forming a broad band round the whole of the bend of the wing, the median and greater coverts and axillaries white; under surface of the quills black, gray on their inner webs, which have white bases. Iris brown; bill black; legs and feet parti-colored (flesh and black) in the usual petrel manner.

Adults ("*P. caribbaea*"): General color dark; dorsal surface sooty brown with a gray gloss caused by a dark slaty margin to the feathers; the longer scapulars, wing coverts, and secondaries sooty brown, with a faint edging of gray on the secondaries and greater wing coverts; primaries black, with a slight shading of gray, the inner webs for the most part ashy brown; upper tail coverts light ashy gray, with white bases, the center ones blackish, forming a patch, the longer coverts white, with an ashy tinge; tail feathers blackish brown; crown of head like the back, but slightly darker, with a shade of gray on the forehead and sides of face; under surface of body entirely dull ashy brown, the chin and upper throat decidedly gray; abdomen and under tail coverts hoary gray, the longer ones with dusky tips; under wing coverts blackish brown, with a slight gray shade; quills blackish below, ashy gray on the inner webs, and on the lower surface of the secondaries. Bill and feet entirely black.

Following is a list of the six specimens in the American Museum of Natural History, and of their measurements:

1. AMNH 98754, sex?, Cayuga County, N. Y., September, 1893.
2. Sanford 3971, ♂, Cincinnati, Ohio, October 6, 1898.
3. AMNH 111211, ♂, Central Park, New York City, January 8, 1912.
4. AMNH 6212, sex?, Florida (type of *Procellaria meridionalis*).
5. Uncatalogued fragments, Quogue, N. Y., July, 1850.
6. "*Pterodroma caribbaea*" Brewster-Sanford 5185, ♂, Jamaica, 1879.

The measurements are in the same order, the seventh representing a specimen in the Berlin Museum.

	Wing	Tail	Culmen	Width of bill at base	Tarsus	Middle toe and claw
1.	286	131	34.5	15.4	38	55.8 mm.
2.	294	121	31.1	13.4	35.5	51.1
3.	280	118	31.3	14.5	38.3	52.5
4.	290	126.5		14.2	37	
5.			35.2	14.5	36.6	53.2
6.	275	120.2	30	14.8	36	50.3
7.	295	124	34.5		37	56

The example of "*Pterodroma caribbaea*" (No. 6) is of the same proportions as the others, and has an exactly similar white spot above the tail. The bases of the rectrices are also white as in the white-breasted birds.

Distribution: Bred formerly in the mountains of Guadeloupe (both white-breasted and dark birds), Dominica, and Martinique, Lesser Antilles; probably still a rare resident of Dominica, and perhaps also of Hispaniola. If *caribbaea* is actually a synonym of *hasitata*, Jamaica and doubtless

other islands of the Greater Antilles were part of the original breeding area. At sea the range covers the Caribbean region and the western pan-tropical Atlantic Ocean between eastern Brazil and the coast of the United States.

That the Black-capped Petrel was not collected during the course of the Brewster-Sanford Expedition is due to no lack of effort on the part of Mr. Beck, as I shall record below. The species is still in existence and has been identified in the field by competent observers many times during the last twenty years. Not long since, Bond (1928, 526) warned against placing too much credence in the commonly accepted story of the complete extirpation of this petrel at Dominica. He called attention to the facts that large areas of the mountain known as Morne Diablotin were still unexplored, and that the mongoose, charged with the wiping out of certain West Indian birds, had, fortunately, never been introduced into the island. Proof that the Black-capped Petrel is, indeed, not extinct in the Lesser Antillean region, and that it almost certainly still breeds at Dominica, has since been forthcoming through the capture of an adult female at Roseau on May 2, 1932, as recorded by Hobley (1932, 17), who has published three excellent photographs of the living bird. Wetmore and Swales (1931, 63) have noted the capture of a specimen at Moca, an inland locality in Haiti, on May 15, 1928. In another paper, Wetmore (1932, 107) states that no less than four examples were taken and fully a hundred observed, on this occasion.

Notice of other slightly less up-to-date records of the Black-capped Petrel is given by Wetmore (1927, 276), who himself observed a number of the birds along the steamship course between New York and Rio de Janeiro, at a point southeast of Bermuda, during early June, 1920. Unlike the smaller petrels, he states, the Black-caps paid no attention to the wake of the vessel, although at times they approached within a distance of 10 meters before veering far out to one side. Their gliding flight was near the water, with frequent changes of course. Those seen at close range showed the dark crown, with a white line behind it, the more or less grayish cast to the back, the white rump, and a dusky tinge along the sides. The lower surface of the wings was white, outlined in black, with the dark margin heavier in front. It was in approximately these same latitudes that Nichols (1913, 505) observed a Black-capped Petrel at the opposite season of the year, namely on January 25. He states that the flight and appearance of the bird reminded him of the Greater Shearwater (*Puffinus gravis*), from which the Black-capped Petrel can readily be distinguished by the large patch of white above the tail.

Wetmore, in the paper cited above, indicates that the reduction in a former more extensive breeding range of the Black-capped Petrel evidently began at an early date, because he had identified as probably pertaining to this species a bone from an Indian kitchen midden at the island of St. Thomas.

During the West Indian work of the Brewster-Sanford Expedition, Beck hunted for the breeding grounds of the Black-capped Petrel in late April, 1917. They are known to have been abundant at Dominica as late as the year 1858, coming from sea each year in October (Lawrence, 1878, 68). A native guide,

whose parents had dug the birds out of their holes in the forest a half century before, accompanied Beck, and together they combed over the ground on the steep ridge below the crest of Morne Diablotin. They also spent the whole of one night and parts of others in the woodland, listening for calls of the birds, but without result. The only warm-blooded animal found in burrows of the forest floor, or in undermined recesses among the roots of trees on steep slopes, was an unidentified, rat-like mammal, which may possibly represent the species of opossum which, according to Nicoll (1904, 563), was introduced from Grenada or Tobago into Dominica some time since the latter part of the seventeenth century. Nicoll infers that this animal may well have wiped out most of the petrels at their nesting sites.

A generation ago, Ober (1881, 41) also scaled the precipitous sides of Morne Diablotin in vain, investigating traces of the petrels' burrows at a date when many natives asserted that they well remembered the bird. Other unproductive searches are referred to by Godman (1908, 185).

Most of our information relating to the life history of the Black-capped Petrel is from the ancient report of Père Labat (1724, 1, pt. 2, 109). We learn from him that the Diablotins nested high on the mountains, perhaps altogether on volcanic ridges above the zone of dense forests. There the birds burrowed in the earth like rabbits, and remained concealed throughout the hours of daylight in the customary petrel manner. Labat says that the Diablotins are goggle-eyed birds which can neither stand the light nor discern objects in it. They are, therefore, clumsy and helpless when pulled forth from the burrows. Yet such observations take no account of the obvious ability of these birds to fly about over the sea during the day; it is probably the sudden change from darkness to light which discommodes their eyes. At night in the mountains they could be heard crying continuously, as though calling and answering one another with mournful voices while in flight. The annual mating season began after the end of September, and eggs were probably laid during January, for the young were hatched by March. These were covered with thick yellow down, and were known to the blacks of the islands as "cottons." By the end of May the fledglings made their way to sea, and thereafter no Diablotins were seen in the neighborhood of the nesting grounds until the following September.

As recently as 1914, Noble (1916, 372) found an aged negro living on the slope of the Soufrière of Guadeloupe who had, in his youth, joined parties on the Nez Cassé to take the birds from their burrows. He stated that these petrels had formerly bred on the northern and northeastern slopes, but that none of them had been seen at Guadeloupe since the earthquake of 1847. They used to arrive in late September, to breed nearer the close of the year, the young remaining in the nests until March.

Labat's account is accompanied by an illustration of the "Montagne des Diables," showing negroes at work with their bird-poles in the treeless Soufrière of Guadeloupe. He states that in spite of the fatigues of the hunt, his curiosity led him to take part in one which lasted for more than 24 hours. The party followed the bed of a running stream inland as far as was possible, then

climbed the steep slopes of the mountain and camped for the night. Next morning the burrows were searched out, the occupied homes being determined through the aid of dogs with well-trained noses. The birds, for the most part, were dragged out by being teased into seizing with their bills the end of a pole thrust into the burrows. Before noon of the second day, the party of six men had captured 213 petrels, with which they returned to the coast. "One has to admit," writes Père Labat, "that a Diable right from the spit is a delicacy. I had thought that one bird would well satisfy my appetite but, whether it was due to the cold mountain air, the strenuous trip, or to the fact that the Diables of this island are more tempting and digestible than those of other regions, I felt constrained to do as my companions did and to eat a second."

Père Labat evidently had the instinct of a conservationist, for he wrote in his notes for the year 1696 that the reprehensible habits of the French settlers had nearly wiped out the Diablotins in the accessible regions of Guadeloupe. This, however, did not prevent him from recording that the birds are a sort of manna which God had sent the inhabitants of the island for an annual period of gourmandising. The "cottons" he describes as particularly tasty, and he gives detailed recipes for cooking both these and adult birds in several different ways.

The question has arisen many times as to the relationship of the Diablotin to the black petrel or "Blue Mountain Duck" (*Pterodroma caribbaea*) of Jamaica. It has been pointed out by Loomis (1918, 57) and others that *hasitata* and *caribbaea* may represent dichromatic phases of the same species, a condition familiar enough among petrels of this group. Dr. G. K. Noble has informed me that the two specimens of the Diablotin preserved in the museum at Guadeloupe are both light-colored, black-capped birds. Père Labat's observations were, however, made at this island, and Bangs and Penard (1919, 22) have called attention to the fact that Labat's plate and text both refer to a bird of uniformly dark plumage. But only a quarter of a century before Father Labat's visit to Guadeloupe, du Tertre (1667, **2,** 257), who had visited that island and apparently had witnessed the hunting and tasted the delicate flesh of the petrels, states with all clearness that the plumage of the birds was "a mixed black and white." A still further taxonomic complication is introduced by information advanced by Lafresnaye (1844, 167) and Noble (1916, 372), namely, that two different sorts of closely related white-breasted petrels formerly bred at Guadeloupe, the respective birds coming to nest at different seasons, and choosing quite different altitudes on the island for the sites of their colonies. Lafresnaye states that the inhabitants distinguished one as the "high petrel," the other as the "low petrel," and that the two kinds were of different sizes. Although such a distinction is not currently recognized, there seems to be a wide range in the dimensions of existing specimens of the Black-capped Petrel, and it is unlikely that the last word upon the subject has been said.

To return to the question of identity of the dark, Jamaican Petrel, I consider it highly probable that this bird and the Black-capped were color phases of the same species. Complete or prevailing segregation of two phases in distinct

though adjacent breeding grounds is a phenomenon known among other Procellariiformes, such as *Pterodroma neglecta* and *Puffinus pacificus*. It is likely that even in a single locality there is also a secular succession or alternation of prevailing plumage-types, as one genetic factor or another gains ascendancy in a breeding population. This might explain why du Tertre found white-breasted Diablotins at Guadeloupe during one generation, and Labat black petrels in a subsequent period. It is likely, furthermore, that the probably dichromatic petrel discussed in this biography was abundant and widespread in the West Indies, becoming exterminated in most places soon after the importation of large numbers of negro slaves and domestic animals. Our only knowledge of the dark phase, aside from the figures and text of Labat, is based upon the Jamaican representative, commonly known as *Pterodroma caribbaea*.

Scott (1891, 355) reports that in February, 1891, a black man named William King made a trip into the hills of Jamaica in search of a bird which he knew as the "dry land booby" or Blue Mountain Duck. This bird dwelt in holes in the cliffs, and had formerly been extensively hunted by the mountain people. King, himself, had eaten a pair not long before, and had been impressed by the sounds made by the birds in their holes at night.

After a six days' search, on the trip referred to, King reported that he had found the old breeding places, had dug out not less than 25 of the burrows, and had found a mongoose in some and nothing in the others. We need go no further in seeking an explanation of the disappearance of the petrel from Jamaica.

The American Museum's single specimen was obtained by Governor Newton, of Jamaica, during either April or November, 1879.

In most recent systematic lists the Black-capped Petrel is, in my opinion, widely separated from its nearest relatives within the genus *Pterodroma*. Its kinship with the species *phaeopygia* is obvious, and is discussed in the next biography. Indeed, a natural Formenkreis, the members of which differ chiefly in plumage characters of a simple and familiar genetic type, is clearly represented by the following four forms: *externa* of the southerly Pacific (and South Atlantic?); *phaeopygia* of the tropical Pacific; *hasitata* of the Gulf-Caribbean region; and the recently rediscovered *cahow* of Bermuda.

GALÁPAGOS PETREL

Pterodroma phaeopygia phaeopygia

Œstrelata phaeopygia Salvin, 1876, Trans. Zoöl. Soc. London, 9, p. 507, pl. 88, fig. 1 (Chatham Island, Galápagos Archipelago).

Names: Dark-rumped Petrel. Synonyms of the specific name are *alba* and *sandwichensis*, the latter being applicable to a Hawaiian race.

Adults (sexes alike): Dorsal surface generally brown, darkest on the crown, nape, and quills, which are fuscous black; feathers of the back, sides of neck, scapulars, and median coverts narrowly margined with grayish white, which largely disappears with wear; secondaries externally glossed with gray; primaries white basally and on the inner half of the inner webs; lower back and rump dusky brown, very slightly tinged with gray on the terminal margins of the feathers; upper tail coverts distally brown and basally white, the latter area showing as fairly conspicuous patches on

either side of the dark rump; feathers around eye like crown, except for a narrow white stripe adjoining each eyelid; forehead, lores, and cheeks white, slightly mottled at the junction with the dark plumage and also at the base of the culmen; sides of neck likewise freckled and mottled along the line between the white and dark plumage; a brownish gray area on the sides of neck and breast, continuous with the dark dorsal plumage, extending a variable distance toward the midline; throat, breast, belly, and under tail coverts white, with a slight dusky mottling along the flanks, and a more pronounced grayish patch over each thigh; under wing coverts and axillaries white, with a broad blackish brown border around the forward edge of the wing, some of the feathers of this band having whitish edges. Iris brown; bill black; feet proximally bluish flesh color, the distal portion of webs and toes, and the greater part of the outer toe, black.

2 males and 3 females collected off Chatham and Albemarle Islands: wing, 294–304 (299); tail, 134–137 (135.4); exposed culmen, 33–34.8 (34); tarsus, 37.1–39.3 (38.2); middle toe and claw, 48.4–50.3 (49) mm.

The length in the flesh of 24 males averaged 412, and of 22 females 407.5 mm.; wing-expanse of 17 males, 102.2, and of 13 females 102.1 mm. (Loomis, 1918, 102).

Of the two known eggs of this petrel, one was taken from the oviduct of a dead bird. The two are, respectively, ovate and elliptical-ovate, with a dull white shell. They measure 61.4 x 44.1 and 61.5 x 39 mm. (Loomis).

Distribution: Breeding at the Galápagos Islands, and migrating eastward and southward to the coasts of Peru and Ecuador and northward in the Pacific at least to latitude 10° N.

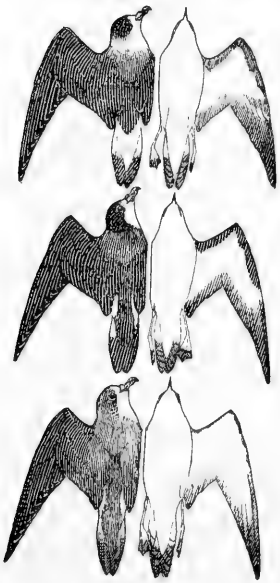


FIG. 62. Dorsal and ventral aspects of three forms of gadfly petrels, belonging to distinct oceanic regions, which appear to comprise a group of closely related, mutually representative species.

Upper, *Pterodroma hasitata* (West Indies, tropical district); middle, *P. phaeopygia* (Galápagos, anomalous equatorial district); lower, *P. externa* (Mas Afuera, sub-tropical South Pacific district).

The Galápagos Petrel is one of a group of closely related species which have a practically world-wide distribution in pan-tropical seas. Not only does a race inhabit the Hawaiian Islands, but the Juan Fernández Petrel (*Pterodroma externa*), and its subspecies in the western South Pacific and the South Atlantic, are among its near relatives, as is also *Pterodroma hasitata*. The last is the famous Black-capped Petrel of the West Indies and, in view of the well-known faunal affinities between the Antilles and the Galápagos, it is of particular interest to note the relationship between *hasitata* and *phaeopygia*, species which differ chiefly in such slight details of pattern as the color of the rump and the sides of the neck. The differences between these two are of the same nature, for example, as the differences between *Pterodroma externa externa*, of Juan Fernández, and *Pterodroma externa cervicalis*, of the Kermadec group. All of the petrels named breed in the higher and humid zones of islands which have many geographic similarities.

In the course of American Museum Pacific field work off the coast of northern South America, the Galápagos Petrel has been frequently observed by Mr. Beck, Dr. Chapman, and myself at various

positions between the Bay of Panama and the latitude of Point Pariñas in northern Peru. *En route* from the Canal to Talara during early December, 1924, for instance, I sighted examples from the steamer every day and at all hours. Again, I saw a large number a short distance to northward of La Plata Island, Ecuador, on September 4, 1919, and the bird has proved common in waters off the Gulf of Guayaquil during September and January of several subsequent years. Collections made on the Galápagos Expedition of the California Academy of Sciences, as reported by Loomis (1918, 97), show that this is one of a number of equatorial southern-hemisphere petrels which migrate northward across the equator. During July, August, and September examples have been taken near Clipperton Island, and at other positions well offshore from the west coast of Mexico.

About the Galápagos, according to Loomis, these petrels are present throughout the year. They are inclined to shun the bays and shores and to frequent rather the open sea where large gatherings are sometimes to be observed. The breeding grounds are in the foggy, humid zone of forests and undergrowth, where constant use of the machete is necessary for carrying out explorations. In this belt of Indefatigable Island, at an altitude of 335 meters, Beck found a male bird incubating a fresh egg on July 22, 1906, the burrow being more than a meter in length and driven through a soil thickly filled with the roots of ferns and vines. The nest-chamber, about 35 centimeters beneath the surface, was lined with dry leaves. The only other egg thus far obtained had already been taken from the oviduct of a female shot at sea on June 7. The gonads were considerably enlarged in specimens collected during April. These, and other observations of the California Academy party as noted below, indicate that the breeding period is seasonal, and that the Galápagos Petrels leave the islands during December or thereabouts, to return to land again in April.

Loomis continues his notes on the life history of this species as follows:

> 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 coelenterates 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 (Loomis, 1918, 98).

JUAN FERNÁNDEZ PETREL

Pterodroma externa externa

Œstrelata externa Salvin, 1875, Ibis, p. 373 (Mas Afuera, Juan Fernández).

Names: White-necked Petrel; "Fardela" in Chile.

Characters: The gray back, dark crown, and suggestion of a whitish collar distinguish this petrel from *Pterodroma phaeopygia* and other relatives in the Pacific.

Adults (sexes alike): Dorsal coloration generally grayish, the feathers being blackish with broad ashy gray margins, all having white bases, which are more or less exposed on the hind neck and upper mantle; wing coverts black, the greater series externally gray, except at the base, which is white; primaries black, the inner ones dark slaty gray, with black shafts and tips; all the quills white for the greater part of the inner web; secondaries slaty gray, white for the greater part of the inner web, and narrowly fringed with hoary white like the greater coverts; innermost secondaries dark brown, like the scapulars; rump and central upper tail coverts black, the lateral ones white with broad tips of brown or ashy brown, the longer upper tail coverts slaty gray with concealed white bases; tail feathers slaty gray, the inner webs browner, and also the tips, the outer feathers white at the base of the inner web, more extended on the outermost feathers, which are also slightly freckled with gray; crown of head blackish, tinged with gray; forehead and lores white, with a few blackish spots adjoining the crown; sides of face white, with a few black spots and streaks; upper and lower eyelid white; feathers in front of and below the eye black, extending over the ear coverts, which have a few white streaks; cheeks and entire under surface white, including the under wing coverts and axillaries; edge of the wing slightly mottled with black spots; on the lower flanks above the thighs, a patch of feathers with broad black tips; quills blackish below, white for the greater part of the inner webs, which are more or less shaded with gray. Iris brown; bill black; tarsi and base of toes flesh color, the terminal part black.

60 males from waters about the Juan Fernández Islands: wing, 302–333 (314); tail, 127.8–143.1 (137); exposed culmen, 34.4–39 (37.1); tarsus, 36.8–39.9 (38.9); middle toe and claw, 47.2–53.2 (50.1) mm.

34 females: wing, 311–320 (315); tail, 124.6–138.4 (133.1); exposed culmen, 34.5–38 (36.2); tarsus, 37.2–40.2 (38.6); middle toe and claw, 46.6–52.8 (50) mm.

Godman (1908, pl. 62) figures a chick covered with gray or brownish gray down. The egg seems to be still unknown, Mathews's (1932, 33) alleged description not pertaining to the subspecies of Juan Fernández.

Distribution: As a breeding bird, the race is confined, so far as known, to Mas Afuera Island, Juan Fernández group, from where it migrates northward in the Pacific at least to the latitude of Costa Rica. The species is characteristic of waters close to the Sub-Antarctic Convergence, with a well-marked subspecies (*cervicalis*) inhabiting the Kermadec Islands. In addition, a form has recently been described from Tristan da Cunha.

This petrel may prove to be a representative of a circumpolar species inhabiting islands in a temperate belt of the southern oceans. Formerly only the Juan Fernández and Kermadec forms were known, but in the Bulletin of the British Ornithologists' Club, **52**, p. 63, Mathews has recently given the following thoroughly inadequate description of the first example collected in the South Atlantic:

Pterodroma externa tristani, subsp. nov.

Differs from *P. e. externa*, from Masafuera Island, Chili, in being darker on the upper surface and on the wing-coverts. The bill is longer, 38 mm., as against 35 of *externa* measured the same way

(and they are constant). The bill also appears heavier. Wing 322 mm.; tarsus 40; middle toe with claw 51; tail 141. All these measurements exceed those of the same parts in the species.

From *P. e. cervicalis* it differs in not having the whitish collar on the back of the neck, and in having the under-wing lining all white.

Type.—Tristan da Cunha, ex the Jack G. Gordon Collection in 1919, now in the Royal Scottish Museum, Edinburgh, Scotland.

The describer certainly had insufficient evidence for his assertion that the differences in the length of the bill are constant, for I have shown above that the length of the culmen among 60 male birds from Juan Fernández ranges between 34.4 and 39 millimeters. The other dimensions of the Atlantic specimen likewise fit well into those of our Pacific series.

During the Brewster-Sanford Expedition, Beck was unable to land at Mas Afuera Island, but he found this petrel abundant in the surrounding waters—no less near Mas Atierra than around the island at which it nests. In December, 1913, and January, 1914, he collected many specimens in the neighborhood of Juan Fernández and at points between the islands and the continental coast. Most of the birds were breeding, as evidenced by the state of their gonads; some also showed traces of the mud of the burrows on their bills.

According to the investigations of Bäckström, this handsome petrel is the commonest bird of Mas Afuera, nests being abundant everywhere above an altitude of 500 meters. It burrows chiefly in the fern belt of the island, making tunnels in the soil that may attain a length of 3 meters. The nest is unlined, but fragments of ferns are often scattered in either chamber or passage. During the day no Fardelas are to be seen at the island, although great numbers may be in sight over the neighboring ocean. At dusk the incubating birds come forth from their underground homes, making a terrific noise.

Lönnberg (1921, 13), who records Bäckström's observations, lists one specimen from Mas Atierra, but I judge from the context that this means merely the shore waters of that island. Certainly this petrel has never been found breeding at more than one island of Juan Fernández. Bäckström collected downy chicks at Mas Afuera during February and March, 1917, and apparently observed the variable white eggs of the species at a somewhat earlier period, though neither dates nor measurements are recorded.

That certain examples of this species make a migration into the northern hemisphere is indicated by Mr. Beck's field work during the expedition of the California Academy of Sciences, when he shot 15 Juan Fernández Petrels a short distance northwest of Clipperton Island, on August 8, 1905, and 9 additional examples near latitude 14° 30′ N., longitude 107° W., in October, 1906. These specimens, reported upon by Loomis (1918, 95), show that a complete moult is undergone at sea during the summer and autumn season of the northern hemisphere.

Loomis gives in tabular form an excellent list of the characters differentiating the Juan Fernández and Kermadec subspecies. The two groups of islands have a practically identical zonal position, and the life processes of their respective subspecies apparently synchronize. According to Oliver (1930, 137), the population

of *Pterodroma externa cervicalis* breeds in small communities on the upper slopes of Sunday Island. During the day the birds are nowhere in evidence, but toward the end of October they begin to be noisy at evening. Permanent occupation of the burrows by pairs begins about the middle of November, and eggs are laid in late December and early January. The young leave the island in June.

I have referred elsewhere to the apparently close relationship of the species *externa* to *phaeopygia* of the Galápagos and *hasitata* of the West Indies.

ATLANTIC PETREL

Pterodroma incerta

Procellaria incerta Schlegel, 1863, Mus. Pays-Bas, 6, Procell., p. 9 ("Mers australes").

Names: Schlegel's Petrel. The species has also been listed under the specific names *inexpectata* and *haesitata*, and it may be the petrel described as *sandaliata* by Solander from a bird taken off the mouth of the Río de la Plata.

Characters: The rich brown coloration of the dorsal surface and lighter brown of the throat, in conjunction with the white breast and dark under-wing, distinguish this petrel from its congeners in the South Atlantic.

Adults (sexes alike): General color of dorsal surface brown (close to olive-brown from forehead to mantle, and to mummy brown on wings, rump, and tail) many of the feathers with slightly lighter margins, which become enhanced through wear; greater coverts with narrow but distinct pale external edges, which are gray only in fresh plumage; primaries fuscous black, paler on the inner webs and with black shafts; pileum, sides of face, and cheeks brown like the mantle, with a broad, somewhat ill-defined blackish stripe extending through and beneath the eye and continuing caudad across the ear coverts; throat and neck brown, the former, however, becoming rapidly mottled or whitish as a result of wear, leaving a pale brownish collar across the neck; remainder of ventral surface white, the sides and flanks very slightly washed with ashy brown, which concentrates to a definite patch over the thighs; under tail coverts brown, with whitish bases; under wing coverts and axillaries dark grayish brown. Iris brown; feet flesh color, with the outer toe largely brown and the other two toes brown at the joints.

6 males, South Atlantic: wing, 317–331 (323); tail, 121.5–138 (130); exposed culmen, 36–39 (37.3); tarsus, 44–46.5 (45.2); middle toe and claw, 59.5–63.9 (62.4) mm.

6 females: wing, 313–335 (322); tail, 127.3–135 (131.8); exposed culmen, 35–38.5 (36.6); tarsus, 43.5–45.5 (44.5); middle toe and claw, 58.8–64 (61.6) mm.

The young stages have never been described, and the only recorded egg, referred to in the text below, is not certainly to be associated with this species.

Distribution: Breeds at Tristan da Cunha and ranges throughout sub-tropical and sub-antarctic latitudes of the South Atlantic and western Indian Oceans.

That this handsome and extraordinarily abundant petrel should still be so little known is somewhat astonishing. Between the Cape of Good Hope and the neighborhood of the Brazilian coast close to the tropic of Capricorn, and from these latitudes southward to the northern boundary of the Antarctic Zone of surface water, it has been noted by many observers, though collected by few. During my own work in the South Atlantic I logged the species every day, and often in vast numbers, between latitude 33° 28′ S., longitude 45° 42′ W. on November 4, 1912, and latitude 49° 40′ S., longitude 35° 51′ W. on November 19. This was during the voyage toward South Georgia in the brig 'Daisy.' On our return we encountered the species in almost equal numbers in a more westerly portion of the South Atlantic, between latitude 49° S. and latitude 31° 24′ S.,

during the last ten days of March, 1913. I collected 11 examples on November 9, in latitude 37° S., longitude 46° 30′ W., and one on March 9, in latitude 39° S., longitude 31° 30′ W. During the course of the Brewster-Sanford Expedition Mr. Beck saw many examples of the Atlantic Petrel from a steamer about 400 kilometers to northward of the Falkland Islands, on February 3, 1916.

The first direct clue to the breeding ground of the Atlantic Petrel was that of Nicoll (1908, 64), who found it abundant about Tristan da Cunha during January, 1905, and subsequently between that island and the Cape of Good Hope. Mathews (1932, 33) records a skin taken by the Tristan people, together with an egg supposed to be properly associated with it. The latter is said to have come from a burrow on a hillside at the "Bluff" in June, 1918. It is dull white, bluntly oval, and measures 61.5 x 48 millimeters.

Our sailors on the brig 'Daisy' knew the Atlantic Petrel as one of several "mutton birds," and we found the skinned bodies of this species to be excellent eating.

Godman (1908, 196) considers this petrel to be merely a brown phase of *Pterodroma lessoni*. He calls attention to the similarity in dimensions and in the blackish mark through the eye. To this should be added the significant fact that *lessoni*, although an extraordinarily whitish petrel, has a dark under-wing and that the pattern of coloration on the legs and feet is exactly like that of *incerta*. All in all, the two forms look like genetic variants of a common stock. Since no examples of the gray-and-white or "*lessoni*" type are known to nest in the South Atlantic area, and since the zonal associations of this form appear to be with colder ocean waters, it may be that the two petrels should be regarded as representative subspecies. The matter had best be left, however, for further research into the differences of pigmentation or feather structure, or both, and until something more has been learned with reference to the possible place of "*lessoni*" in the Falkland avifauna. The type is said to have been taken at those islands, or in adjacent waters. So far as I can learn, there are no other alleged records for the South American region.

The practical identity in dimensions between the brown and the gray forms is illustrated by the following figures:

	Wing	Tail	Exposed culmen	Tarsus	Middle toe and claw
P. incerta, 6 males, South Atlantic . .	323	130	37.3	45.2	62.4 mm.
P. lessoni, 5 males, on or near Antipodes Island	307	128	37	45.1	62.2

KERGUELEN PETREL

Pterodroma brevirostris

Procellaria brevirostris Lesson, 1831, Traité d'Orn., livr. 8, p. 611 (no type locality = Kerguelen Island).

Names: Synonyms of the specific name include *lugens*, *grisea*, *unicolor* and *kidderi*.

Characters: A wholly dark gray petrel.

Adults (sexes alike): General color gray (close to the Quaker drab and purplish gray series of Ridgway's 'Color Standards'); most of the feathers with hoary gray bases, which fact produces

through exposure of these a certain amount of mottling; wing coverts brownish slate, with gray margins, particularly on the median and greater series; quills blackish brown, the inner webs paler; crown like the back but very slightly darker, the forehead and sides of head grayer, and with an indistinct blackish spot at the inner canthus of the eye; ventral surface slate-gray, palest on the throat; under wing coverts and axillaries gray, with faintly lighter margins and dark hair-like shaft-streaks. Iris brown; bill black; feet purplish gray.

One specimen, sex unknown, from Kerguelen Island: wing, 261; tail, 96.2; culmen, 26.4; tarsus, 37.1; middle toe and claw, 47.3 mm.

Nestlings are clad in sooty brown down, from which they moult into a plumage resembling that of the adult.

Mathews (1932, 34) records an egg from Kerguelen as measuring 50 x 38 mm.

Distribution: A petrel of the Antarctic Zone of surface water in the Atlantic and Indian Ocean regions, breeding at Kerguelen Island and recorded southward to about latitude 70° S.

The Kerguelen Petrel has been accepted by most recent writers as a resident species of Tristan da Cunha, but the only information upon which such conclusion rests seems to be the existence in the British Museum of a specimen purchased from Captain Carmichael and said to have come from Tristan (Salvin, 1896, 410). The authority is therefore very dubious, the more so since we now know that this petrel is a bird of the Antarctic Zone, ranging far to southward of Heard Island and into the icy waters of Weddell Sea. Since a dead example has been found on a west Australian beach after a storm (Mathews, 1928, 102), it is not unlikely that a stray bird might similarly visit Tristan da Cunha, but this petrel is almost certainly not a resident of any island in such low latitudes.

The 'Scotia' expedition took its first specimen of the Kerguelen Petrel in latitude 69° 33′ S., longitude 15° 19′ W., not far off the Coat's Land coast, on March 20, 1904. Thereafter the species was logged frequently, but nowhere to northward of about latitude 66° S. (Clarke, 1913, 262). Vanhöffen (1905, 506, 508) records it halfway between Heard Island and Kaiser Wilhelm II Land.

At Kerguelen Island various observers have found this petrel breeding between October and January. Kidder (1875, 29) obtained examples with eggs on October 11 and 21. The birds were occupying rather deep burrows, each of which contained a little pool of fresh water, presumably produced by the thawing of ice in the soil. A young bird in the down was found on December 13.

The American Museum has but a single specimen of this petrel, which was collected by Lieutenant Alexander Smith at Kerguelen on May 20, 1898. The effect of wear and bleaching shows in a faint buffy or rusty tinge, which probably has no place in fresh plumage.

KERMADEC PETREL

Pterodroma neglecta

Procellaria neglecta Schlegel, 1863, Mus. Pays-Bas, 6, Procell., p. 10 (Kermadec Islands).

Names: Neglected Petrel; "Fardela" at Juan Fernández. Synonyms of the specific name include *raoulensis*, *phillipii*, and *leucophrys*.

Characters: A dichromatic petrel, with both black and light brown phases, the two being connected by intermediates exhibiting a wide range of gray and dusky plumages. The lightest examples are white-bellied, and also have very light throats and heads. The darkest are nearly

black, though always with white areas on the throat, in the wings, and usually elsewhere. The concealed basal portions of the entire plumage are white in every phase, producing a certain amount of mottling even in the darkest examples. A uniform character in birds of every phase is that the shafts of the primaries, and the greater part of the inner web of each primary, is largely and conspicuously white. This serves to distinguish the species from all of its near relatives, including *Pterodroma arminjoniana* of the South Atlantic. The tail is less rounded than in most members of the genus *Pterodroma*.

Adults, light phase (sexes alike): Feathers of head, neck, sides, and entire ventral surface, basally white and terminally drab, producing a variously mottled appearance which may become almost white on the throat, lower breast, belly, and under tail coverts, and sometimes on the forehead, lores, and above and below the eye; mantle, back, rump, wings, and tail darker, between hair brown and chaetura drab; rectrices basally white and with largely white shafts; primaries with white shafts and inner webs, as noted above; feathers of crown and back with obsolescent, grayish, terminal borders, which are enhanced by wear; an indistinct dark patch beneath and in front of eye; wing-lining like exterior of wing, but slightly mottled with whitish. Iris brown; bill black, legs and feet proximally flesh color, distally black except on the outer toe.

(In an extreme light phase, the entire ventral surface of the body, except the tips of the under tail coverts, is pure white. We have many such examples from the central South Pacific, but I find none from the Juan Fernández group.)

Adults, dark phase (sexes alike): General color throughout varying between grayish brown and dark brownish black, mottled white areas appearing particularly on the throat, and to a lesser degree elsewhere; quills of wing and tail, including the white shafts, as above. Legs and feet black in the most heavily pigmented examples, but parti-colored in some of the less blackish birds.

49 males from Mas Atierra and Santa Clara Islands, Juan Fernández, and adjacent waters: wing, 290–307 (297.4); tail, 102–113.3 (105.8); exposed culmen, 29.2–32.5 (31); tarsus, 38.6–41.8 (40.3); middle toe and claw, 51.4–56.1 (53.8) mm.

31 females: wing, 290–309 (300.4); tail, 100.7–112 (106.1); exposed culmen, 29.3–32.8 (30.9); tarsus, 39.1–43.1 (40.4); middle toe and claw, 52–56 (53.6) mm.

Among six chicks taken at Mas Atierra, January 14 to February 9, 1914, the younger examples, not long out of the egg, are clad in a dense down close in color to the dusky drab of Ridgway. The second down is somewhat lighter; the largest specimen, collected on January 29, has feathers appearing upon the throat and back.

Eggs are of highly variable shape, though none of our examples are elongate. They are dull white, and more or less stained. The average dimensions of 11 are 65.1 x 46.7, measurements of the extremes being 67.9 x 45.7, 63 x 43.7, and 66.3 x 50.3 mm.

Distribution: Sub-Tropical Zone of the South Pacific Ocean; breeding at Mas Atierra and Santa Clara Islands of the Juan Fernández group, San Ambrosio, numerous islands of southern Polynesia, and at the Kermadecs and Lord Howe Islands in the western part of the ocean; ranges northward in the eastern Pacific into the northern hemisphere.

The Kermadec Petrel is a dichromatic, surface-nesting, sub-tropical species, which breeds from the two landward islands of the Juan Fernandez group westward along the southern fringe of Polynesia to islands in corresponding latitudes off the east coast of Australia. Mas Afuera is apparently skipped, being left to the exclusive occupancy of such related petrels as *Pterodroma externa* and *Pterodroma leucoptera masafuerae* which, in turn, do not nest at Mas Atierra and Santa Clara. The latter are inhabited, with equal exclusiveness, by *Pterodroma cookii defilippiana* as well as by *neglecta*. Furthermore, both of the last-named petrels also breed at one or both islets of the San Felix-San Ambrosio group, which lies more than seven degrees of latitude north of Juan Fernández.

In the waters about San Ambrosio, Mr. Templeton Crocker's party in the yacht 'Zaca' obtained eight adult specimens of this petrel on February 18, 1935.

In appearance and measurements these agree entirely with Juan Fernández birds. One is wholly dark except for the usual white patch formed by the bases of the remiges; four are gray, with whitish throats; two have fairly large white spots on the belly; and one is prevailingly whitish over the entire ventral surface, although most of the feathers are dark-tipped. In the darker birds the feet are entirely blackish brown. In the lightest example, the metatarsus and bases of the inner toes and webs are dark brownish, the distal parts and the outer toe blackish.

Dr. Chapin reports that no examples were observed at sea the day before making San Felix, and only a very few near that islet, where the species apparently does not nest. Halfway toward the neighboring islet of San Ambrosio, the petrels became common. About half-past four o'clock in the afternoon, hundreds of them could be seen circling about over the summit of San Ambrosio, an aërial performance which continued at least until dusk. No landing was made by the 'Zaca' party, the three female and five male birds being obtained over the water close to the cliffs of the steep island.

Loomis (1918, 102) has shown that the Kermadec Petrel migrates northward in the eastern Pacific to about latitude 15° N., where two examples were collected and others observed by Beck during October, 1906.

On the voyage between Valparaiso and Juan Fernández, Beck began to observe the Kermadec Petrels when his vessel was about halfway toward the islands. At Mas Atierra, on December 12, 1913, he saw the birds issuing from their hiding-places about four o'clock in the afternoon to sail along the cliffs, the majority of them keeping for a time at an altitude of 300 meters or more above the sea. He succeeded in shooting two at moments when they had swung in over the land, but most of them kept well out from the face of precipices that rose sheer from the ocean toward the peak known as la Centinela. *Kick-cow-ow-ow-ow* was their call as they flew, quite different, Beck remarks, from the note of the Pink-footed Shearwaters. From his high vantage point, Beck could also see Kermadec Petrels scattered over the ocean for a long distance from shore, mingling with storm petrels, Black-browed Albatrosses, and other sea birds.

On December 15 he found the first of these petrels on their nests, which were under the shelter and shadow of rocks and on ledges of the cliffs or steep slopes. Most of them were in sites which the sun could reach only at midday, if at all. Some of the birds were sleeping, their bills tucked under the wing coverts. They were thoroughly tame and could be caught on the egg, although they scolded and struck with their bills when they were disturbed. Iredale (1914, 423) also reports adults at the Kermadec Islands as being gentle and inoffensive at the nest, but he adds that the young birds are negatively conditioned against being touched, usually responding with loud outcries.

The first nest Beck found contained two eggs, one of which was ancient and rotten, suggesting that a last year's site had been used again, with no effort to get rid of the old egg. Eggs were common between December 15 and January 17. The nests, which were lined with more or less fine grass, by no means all contained eggs; in December Beck saw several pairs of the birds building together,

one of them occasionally standing up on straight legs to walk about restlessly for a few moments. About four o'clock in the afternoon of each day they began to take to the air, first sailing back and forth along the cliffs and then flying off to sea.

The majority of Beck's Juan Fernández specimens are relatively dark birds, though the lightest show a small white area on the belly that is almost or quite without bars or other markings. Not one has as much white on the ventral surface as have many adults from more westerly districts in the South Pacific. Chicks became common at Mas Atierra after early January. A "half-grown" example has been collected by Bäckström on March 13 of a subsequent year (Lönnberg, 1921, 12).

Bäckström estimated that the numbers of these petrels had become reduced to a few hundred at the date of his visit to Mas Atierra. It is not known to what extent the occupation of the island by sealers, convicts, ranchers, and lobster fishermen may have affected the population of the birds which, in the western Pacific, are eagerly sought as human food, but it is quite likely that the breeding area at Juan Fernández was once far more extensive than at present, and that the nests on the ledges of more or less inaccessible cliffs represent merely the residuum after long persecution by man and his introduced domestic animals.

In the Kermadec Islands there are very large colonies of this petrel which have been studied by Iredale and others. One inspection of the nesting birds at Sunday Island showed that, of 264 examples incubating eggs, about 40 per cent represented the light phase, an equal proportion the dark, while the remaining 20 per cent was made up of intermediates. Furthermore, among 35 mated pairs, 19 were observed to be composed of similar birds, and 16 of odd or dissimilar birds. In one instance, two black birds were mated, and in another, one black and one very dark gray bird. Iredale also noted the variable condition in the legs of this species, some examples of the dark phase having parti-colored or "sandaled" legs and feet, like those of birds in the light plumage, while in other dark birds the tarsi and feet were entirely black.

The nesting season is evidently somewhat prolonged at the Kermadecs; during January, when the majority of mated birds had eggs, there were also some half-grown young, and Cheeseman (1869, 225) refers to the same condition during the month of August. This, however, was at Meyer Island where, according to Oliver (1930, 138), the birds have a different breeding period from those of Sunday Island, correlated with certain differences in plumage and voice. At Sunday Island the petrels occupy flat ground, usually in the shelter of a fern-growth, but sometimes in the open. Iredale saw multitudes of them circling about trees just after sunset, uttering plaintive cries as if to let their mates know that they were returning. After dark most of the calls ceased, the period of mating being already past. The relieved birds would depart for sea just before sunrise. Territorial competition was observed whenever circumstance caused two families of petrels to nest inconveniently close to each other. In some such instances the respective pairs of parents would quarrel to the exclusion of properly feeding their young, dwarfed starvelings being produced as a result.

Oliver (1930, 141) states that the food of the Kermadec Petrel consists mainly of crustaceans and cephalopods. He adds the following comprehensive notes covering ten months' observation at Sunday Island:

The birds are first seen flying out at sea early in August. Each evening they appear to come nearer the island and by the 22nd a few were found on the ground. They breed on the surface, scratching a shallow hollow. This operation was actually observed by Bell who states that he saw a bird go under a log, fluff out its feathers, stand up and then lean forwards on its breast and scratch the earth backwards with both feet at once. In half an hour's time a hollow about eight inches across and two inches deep was made. The birds then collect sticks and leaves and make a nest. This completed, they leave the island for two or three weeks and then return to lay.

Eggs are plentiful in the beginning of November. Fresh eggs have been noticed as early as October 20th and as late as December 6th. The period of incubation is 50 to 52 days. The first young ones are to be seen about the middle of December. They are plentiful after December 20th, and most will be hatched by the end of January. They remain in the nest where they are fed by the parents for over three months, during which time they become very fat. Towards the end of May, the adult birds leave Sunday Island and the young are left to find their own way to sea.

After the parents cease to feed them, the young gradually get thinner, and in ten days or a fortnight's time walk away from their nest, climb up on to a stone or tree trunk and take their first flight. This is rather an unsteady one straight out to sea. Most of the young fly in April and May but a few late ones may be seen during the first week in June.

The alimentary tracts of all the examples obtained by the 'Zaca' expedition at San Ambrosio contained mandibles and pens of squids.

SOUTH TRINIDAD PETREL

Pterodroma arminjoniana

Aestrelata Arminjoniana Giglioli and Salvadori, 1868, Atti Soc. Ital. Sci. Nat., 11, p. 452 (South Trinidad Island).

Names: Synonyms of the specific name of this petrel include *sandaliata*, *wilsonii*, *trinitatis*, *chionophara*, and several earlier names of less certain application.

Characters: A dichromatic species closely related to and generally resembling *Pterodroma neglecta*, from which it differs notably in having dark quill shafts in all phases and in lacking the pronounced white area which, in *neglecta*, covers practically the entire inner web of the outer primaries. The dark phases of the two species, and some of the intermediate phases, are otherwise almost indistinguishable. The light phase of *arminjoniana* apparently always has a finely barred dusky collar dividing the white throat from the white breast.

Adults, light phase (sexes alike): Dorsal color ashy black, the feathers of the back, caudad from the nape, mottled with white bases; scapulars and wing coverts blackish, washed with slaty gray, the greater coverts for the most part slaty gray, with dusky margins; quills dusky black, ashy brown for the greater part of the inner web, the secondaries mostly blackish, ashy brown towards the ends of the inner webs, and mottled with blackish vermiculations toward the end of the outer web; upper tail coverts and quills blackish, with a slight ashy shade; crown of head and sides of face like the back, the feathers below the eye and the ear coverts slightly mottled through exposure of the white bases; throat white, slightly mottled with dull ashy bars, with which most of the feathers are tipped; remainder of under surface of body white, except for a broad collar of ashy brown across the fore neck, continued down the sides of the upper breast and sides of the body; on the latter a few bars of ashy brown, and also a few similar bars below the prepectoral collar; on the flanks a few blackish shaft-streaks, causing a streaked appearance; under tail coverts slaty black, with white bases and narrow white fringes at the ends, some of the basal coverts white, with a double or single bar of ashy gray near the end; under wing coverts dark brown, shaded with ashy, some of the inner median and greater coverts largely white; primary coverts white at the base; quills dusky brown below, more ashy on the inner web, which is white towards

the base and margins of the primaries, and on the secondaries extends along most of the inner web. Iris brown; bill black; tarsi and base of toes flesh color, remainder of toes, webs, and outer side of outer toe, black.

Adults, dark phase: Similar to the dark phase of *Pterodroma neglecta*, except for the wing characters noted above. Legs and feet black.

7 males: wing, 293–309 (301.5); tail, 109–116.5 (113.2); exposed culmen, 28–31.2 (29.6); tarsus, 35.5–40 (38.7); middle toe and claw, 45.7–50.4 (47.9) mm.

8 females: wing, 275–295 (286.1); tail, 108.2–112 (110.4); exposed culmen, 27.7–30.1 (28.6); tarsus, 35.1–37.7 (36.1); middle toe and claw, 44.8–50.4 (47.1) mm.

Lengths in the flesh of 9 adults ranged between 374 and 396 mm.; wing-spreads of the same birds between 949 and 1025 mm.

Young birds are described as clad in dark gray down. In a black fledgling of the American Museum Collection, the remaining patches of down lack entirely the brownish and sooty tone characteristic of *Pterodroma neglecta*.

Distribution: Breeding at South Trinidad Island and the neighboring Martin Vas Rocks. Normal flight-range apparently confined to contiguous parts of the South Atlantic, though the species is known casually to have reached the northern hemisphere.

The South Trinidad Petrel is clearly a representative in the Atlantic of *Pterodroma neglecta*. Possibly it should be regarded as a subspecies of the latter, although the differences are strongly marked, the most striking and constant distinction between these two highly variable birds being the fact that even the darkest examples of *neglecta* have white primary shafts and inner webs, while in all examples of *arminjoniana* these are relatively dark. Correlated with such characters of pattern, it appears that the South Trinidad Petrel occupies a warmer zone of surface water, somewhat nearer the equator than any part of the breeding range of the Pacific form. Both Atlantic and Pacific species are, nevertheless, definitely sub-tropical rather than either tropical or sub-antarctic.

The American Museum contains an excellent series of this petrel taken during my visit to South Trinidad in April, 1913, and others, including a downy chick and a fledgling as well as adults, captured during the South Atlantic Expedition of the Cleveland Museum of Natural History, between December 24, 1924, and January 5, 1925. All phases, from birds with white breasts and throats to those of entirely black plumage, are represented, besides which at least one specimen shows a tendency toward albinism on the head and neck. According to Simmons (1927, 27), the Cleveland Museum party found the species abundant at the middle island of the Martin Vas group as well as at Trinidad itself.

Lowe and Kinnear (1930, 137) have studied a series of these petrels in the British Museum, and have correlated their results with the field observations of Wilson and others. They find that the petrel population of South Trinidad is broadly made up of birds of three categories, as follows:

(*a*) A light phase with white and black feet and legs.
(*b*) A dark phase with all-black feet and legs.
(*c*) An intermediate phase with pink and black feet and legs.

They quote, furthermore, certain observations to indicate a segregation of color pattern in the field. Nicoll (1906, 672) remarks, for example, that the birds of the dark phase are rarer than the light ones, and that their nests are found only

at a higher altitude on the island. That the latter observation was merely a result of chance, however, is indicated by the testimony of both Dr. Wilson and the Cleveland Museum naturalists, who found black-breasted and white-breasted birds intermated and occupying the same niche. The relationship seems to be exactly as reported for *Pterodroma neglecta* at the Kermadec Islands. Furthermore, the data of Lowe and Kinnear as to breeding periods would seem to be inadequate, for there can be little doubt that at South Trinidad the nesting of this species continues throughout the year. That there may be certain nodes in productiveness is quite likely but, on the other hand, the fact that Wilson found eggs in September, and downy young but no eggs in July, may be nothing more than accidental.

Our American Museum specimens exhibit a greater diversity of plumage than is indicated in the paper by Lowe and Kinnear. I have already listed the six or seven recognizable phases between the blackest "*trinitatis*" stage and the mainly white "*chionophara*" (Murphy, 1915, 343). The two chicks in our collection represent both typical *arminjoniana* and "*trinitatis*" phases; they were collected, respectively, in the Cascade Valley and the Waterfall Valley, South Trinidad, on the same date, December 28, 1924. The light-breasted bird is a female and the black one a male.

During the cruise of the 'Daisy,' I first identified the South Trinidad Petrel on April 4, 1913, in latitude 25° S., longitude 30° 40′ W., nearly four degrees to southward of the island. The species became increasingly common during the next three days as we approached its headquarters. Birds of the black phase were noted chiefly in the immediate vicinity of the island, and none of any kind was seen after we had passed out of sight to northward.

Throughout my one day in the waters beneath the beetling cliffs of South Trinidad, April 8, 1913, these petrels, together with noddy terns, were the most numerous birds at and about the island. The petrels were incubating, or perhaps only resting, in water-worn cells of the inaccessible rocks. They frequently bickered with one another in the air, chattering with voices not unlike those of terns. They were perfectly fearless of men, but not in the least interested, so that their behavior was quite unlike that of the inquisitive noddies. Birds in the black or "*trinitatis*" phase seemed definitely less abundant than those of the white-breasted or *arminjoniana* type. The specimens I shot had evidently not long since bred, and there were large bare patches on their abdomens. When a remarkably white petrel flew over our boat, in passing from the sea toward the great basaltic column called the Ninepin, I recognized it as a bird of unfamiliar type. A fortunate long shot brought it hurtling to the water, and we reached it sooner than the sharks which had already succeeded in pulling under one or two of our prizes. The specimen proved to be a new and previously unknown plumage phase, characterized by a black-flecked, ermine-like cloak. It is doubtless a partial albino, though the symmetry of the pattern is unusual. The example is the type of "*Pterodroma chionophara*."

The South Trinidad Petrel has been reported at least twice from the northern hemisphere. One recorded by Lowe (1911, 223) struck the rigging of the yacht

'Zenaida' on December 31, 1905, in latitude 21° 51′ N., longitude 43° 35′ W., a point in mid-Atlantic almost equidistant from the Lesser Antilles and the Cape Verde Islands but to northward of either. As already noted in my section on birds and hurricanes, an example constituting the first record for North America was taken near Ithaca, New York, on August 24, 1933. After being forcibly fed with pieces of fish, this petrel learned to pick dead minnows from a pan of water, but made no effort to catch live ones. It lived a little over a week (Allen, 1934, 134). The specimen is preserved in the Cornell University collection and has been sent to me for examination. It is a typical example of the dark phase of the South Trinidad Petrel. The capture followed close upon the heels of a tropical cyclone, the course and duration of which I have already indicated. The storm struck the north Atlantic coast near Cape Hatteras on August 23 and continued due northward toward the Finger Lakes region of central New York and then on to the St. Lawrence valley. Smaller petrels of at least three species were found stranded in various parts of the Middle Atlantic States and Canada after the same disturbance.

SOFT-PLUMAGED PETREL

Pterodroma mollis mollis

Procellaria mollis Gould, 1841, Ann. Mag. Nat. Hist., 13, p. 363 (South Atlantic Ocean).

Names: Mutton Bird; this is one of the species called Night-bird or White-breasted Eaglet at Tristan da Cunha. According to Verrill (1895, 449), it is the Pediunker or "Paddy Unker" of that group, but Mathews (1932, 29) states that this name is restricted by the inhabitants to *Adamastor cinereus*. A synonym of the specific name of this petrel is *dubius*, besides which it has appeared in the literature under several names properly applicable to other species.

Characters: Distinguishable from most or all other small petrels of the South Atlantic by its gray dorsal color in combination with a white breast and gray under-wing.

Adults (sexes alike): General color of the dorsal surface slaty gray, with lighter indistinct margins on the feathers of the mantle; wing coverts and longer scapulars blackish brown, the greater coverts shaded with ashy gray and having more or less obsolete fringes of hoary white; primaries blackish brown, paler on the inner web and internally edged with whitish; secondaries of the same color externally, margined with ashy gray like the greater coverts; lower back and rump slightly more dusky than the mantle; upper tail coverts and central rectrices ashy gray, the three outer quills mostly white on their inner webs, and finely vermiculated with ashy gray; crown of head browner and slightly darker than the back; forehead with a mottled or scaled appearance, owing to the covering of feathers with dark centers and whitish margins; lores, sides of face, and lower cheeks white, sparsely speckled with dusky gray feather-tips; feathers in front of and below eye black, forming a broad stripe which extends caudad over the ear coverts; chin or interramal space mottled gray; remainder of ventral surface white, except for a partial or complete collar of gray bars or frecklings which extends ventrad from the sides of neck; a few variable ashy gray markings along the sides and flanks, sometimes taking the form of sagittate spots; under tail coverts white; under wing coverts dark slaty brown, with paler or whitish borders, the marginal coverts blackish brown; axillaries dark slate, with white bases, and sometimes freckled with white. Iris brown; bill black; tarsus and proximal third of foot flesh color or pinkish, the remainder and the whole outer toe deep brown.

7 males: wing, 247–268 (256); tail, 106.5–117 (110.5); exposed culmen, 26.8–29.2 (28.5); tarsus, 34–36 (35); middle toe and claw, 42.5–46.8 (45.2) mm.

2 females: wing, 250–262; tail, 108–112; exposed culmen, 26.9–28.3; tarsus, 35; middle toe and claw, 44.5–44.8 mm.

The length in the flesh of one specimen was 37 cm.; the wing-spread of 7 males ranged between 86 and 91 cm.

Downy young apparently remain undescribed. The egg is white and dull-surfaced, two examples measuring 63.5 x 49.8, 64 x 49.6 mm. (Mathews, 1932, 33).

Distribution: Breeds at the islands of the Tristan da Cunha group and at Gough, in the South Atlantic; at St. Paul Island in the Indian Ocean. It is also said to be a resident of Kerguelen, which needs verification. Its flight-range apparently covers the entire South Atlantic between latitudes 25° and 50° S. One or more very distinct races breed in the eastern part of the sub-tropical North Atlantic.

This abundant and familiar petrel of the South Atlantic and Indian Oceans has representative, or at least closely related, forms or species in several other oceanic areas. The typical race seems, however, to exhibit well-marked distinctions, and to be especially characteristic of sub-tropical and low sub-antarctic waters, close to the convergence of the two zones. For such reasons I doubt the presence of the same race at Kerguelen Island, which belongs to a totally different zone of surface water. That the species breaks down into local geographic races is indicated not only by the presence of a markedly distinct subspecies at the Cape Verde Islands in the tropical North Atlantic, but perhaps also by the fact that Mathews (1934, 178) has recently described a number of other races from various cooler parts of the same ocean.

During my South Atlantic cruise in the brig 'Daisy,' I saw the Soft-plumaged Petrel in large force during the months of November and March. When southward bound, we picked up the species in latitude 35° S., on November 5, 1912, after which examples were seen about the brig almost daily down to latitude 47° S., and eastward of the longitude of South Georgia. On the return voyage, in March, they were observed for 13 consecutive days, nearer the South American continent and in the latitudes of northern Argentina and southern Uruguay. The chart of Dabbene (1923, 30) demonstrates not only the extensive flight-range of this bird, but also that it is confined to a zone well to northward of antarctic surface water.

Contrary to Alexander's (1928, 54) statement that this petrel pays no attention to ships, I found it to be one of the species readily caught on a line baited with loggerhead turtle meat or other attractive lure. After taking the hook the birds would fly high, so that the process of capturing them was like hauling in a kite. Others have preceded me at this sport. Gould (1865, 454), for instance, was attempting to capture a petrel of this species with hook and line in the South Atlantic when a gust of wind blew overboard a piece of parchment, in a fold of which he kept his salmon flies. Next day, he tells us, "I succeeded in capturing the bird with a hook I had still left, and the reader may judge of my surprise when on opening the stomach I there found the piece of parchment. Here is one of many bits of testimony which should answer those who doubt that the same individual petrels sometimes follow ships day after day.

The largest flocks of this species were observed by me in latitude 37° S., longitude 46° 30′ W., on November 9, 1912. On March 22, 1913, in latitude 43° S., longitude 33° W., numbers of the birds followed us all day and continued after nightfall, when they could still be seen swooping about in the moonlight.

American Museum specimens include not only the series collected during my cruise, but also others obtained by the Cleveland Museum Expedition in waters more or less midway between Tristan da Cunha and St. Helena, during August, 1925.

The 'Challenger' expedition first reported the Soft-plumaged Petrel as a breeding bird of Nightingale Island in the Tristan group, where specimens were taken on October 17, 1875 (Sclater, 1878, 571). It appears also to be the "gray petrel about the size of a pigeon" referred to by Thomson (1878, 156) as nesting in patches of woodland below the cliffs of Inaccessible Island, the trees overhead being the sites of noddies' nests. The petrel burrows made the floor of the grove resemble a rabbit warren. Their entrances were more or less concealed among rocks and moss and the fallen limbs and boles of buckthorn trees. In this damp and tangled environment the muffled voices of the birds could be heard underground. According to information which Thomson doubtless obtained from the marooned Stoltenhoff brothers, these petrels first come to land in early September, begin their active courtship about the first of October, and lay their elongate white eggs early in November. Mathews (1932, 33) writes that the Soft-plumaged Petrel was found breeding at Tristan da Cunha during November, 1917, and all the known eggs, found in burrows on a slope, have been taken during the same month.

Wilkins (1923, 508) found three of the birds in hillside burrows near the beach at Gough Island, between May 28 and June 1, 1922. At evening during these days many others were observed coming in from sea. Since none of the captured examples were in breeding condition, we have here evidence of the interesting and only recently appreciated fact that certain sub-antarctic petrels are largely given to making use of their nesting sites as places of rest. In this connection, it is noteworthy that the staff of the Scottish National Antarctic Expedition observed great numbers of this species off Gough Island during the month of April, and secured three specimens (Clarke, 1913, 285).

The Small Petrels of the Genus Pterodroma

The smallest of the typical "gadfly petrels" comprise two species with wings not more than about 25 centimeters in length, which break up into numerous geographic races, some of which are very strongly marked. The group is sometimes segregated under the generic name *Cookilaria*. The two species are distinguishable as follows:

1.—Crown, nape, sides of neck and breast, concolor with back, and close to the neutral gray series of Ridgway's "Color Standards" . . . . . *Pterodroma cookii*.

2.—Crown, nape, sides of neck and breast, much darker than back, forming a sharp contrast, and mainly sooty black . . . . . *Pterodroma leucoptera*.

Examples of *P. cookii* always have more or less white on the inner vanes of the primaries; in *leucoptera* the condition is more variable. Moreover, the races of the latter species are mostly smaller, with relatively longer tails. A careful

study of coloration and proportions, however, shows that the simplest and most certain way to distinguish the two species is by means of the invariable characteristics noted in the above key. In other respects, the races of both exhibit a certain parallelism in the nature of their variations.

The distribution of both species is confined, so far as known, to the Pacific Ocean. *Pterodroma cookii* is in the main to be associated with the Sub-Antarctic Zone of surface water, although representatives of the species migrate across the equator into the northern hemisphere. *Pterodroma leucoptera*, on the other hand, is a bird of pan-tropical affinities. Both species come into close juxtaposition at the Juan Fernández Islands, Chile, where *P. cookii* occupies Mas Atierra, and *P. leucoptera*, Mas Afuera. It is very interesting that the nesting localities of the two petrels are thus mutually exclusive, and still more so that the sub-antarctic species inhabits the island closer to the cool littoral waters of western South America, while the pan-tropical species is confined to an island lying two degrees of longitude farther westward, and consequently in warmer seas.

The breeding grounds of certain subspecies of each of these petrels are still unknown. Four forms, apparently, have occurred within our region.

COOK'S PETREL

Pterodroma cookii orientalis

Pterodroma cookii orientalis Murphy, 1929, Amer. Mus. Novit., No. 370, p. 5 (200 miles west of Callao, Peru)

Since the typical form was described from the opposite or western side of the South Pacific, I give below the reference and description.

Procellaria Cookii Gray, 1843, in Dieffenbach's 'Travels in New Zealand,' 2, p. 199 (New Zealand).

Names: This species has been named in books Cook's or Blue-footed Petrel; sometimes, when combined or confused with *P. leucoptera*, it has been called White-winged Petrel. A synonym of the specific name is *velox*, besides which the bird has been listed under several subspecific names applicable to its races or to those of *leucoptera*.

Characters (of the species *cookii*): Defined on the preceding page, in comparison with those of *P. leucoptera*.

Adults, of the typical race, *P. cookii cookii* (sexes alike): Forehead, mainly white, but with a freckling of gray-centered feathers from the median base of the culmen, the gradual transition from white to gray plumage taking place on the anterior part of the crown, in the lores, and along the cheeks and sides of neck, which have a somewhat scalloped effect; crown, nape, interscapulars, lower back, upper tail coverts, sides of neck, and sides of breast, gray (slightly lighter and more slaty than the neutral gray of Ridgway), the feathers of all these parts more or less margined with white in fresh plumage, most persistently so on the anterior part of the crown and the sides of neck and breast; (prolonged wear exposes the darker subterminal parts of the feathers, causing the crown and back to appear somewhat spotted with dark neutral gray and to show the blackish streaks of the feather shafts); a large, roughly triangular, blackish brown patch on the rump; a narrow white infraorbital line, not easily discernible in all specimens, and beneath this a conspicuous broader stripe of dark neutral gray or blackish, which loops around the anterior canthus of the eye and extends caudad over the ear coverts, widening as it blends with the gray feathers along the side of the neck; the boundary between gray dorsal, and white ventral, plumage more or less mottled through the intermingling of the colors along the cheeks and sides of neck and breast, some specimens showing also a faint dusting of gray along the white flanks; wings, blackish brown (3), with horny brown quill shafts, becoming lighter basally; the greater coverts and sec-

ondary quills contrast with the remainder of the wing in that they have a distinct neutral gray bloom and are externally and narrowly margined with white; inner vanes of remiges largely white, the sharply marked white areas on the primaries extending as a pointed wedge from the base throughout about three-quarters of the length of each quill; central rectrices, largely neutral gray, terminally tinged with blackish brown; lateral rectrices, generally comprising the four outer pairs, somewhat variable, but as a rule white, heavily speckled with light neutral gray; inner webs of these quills sometimes pure white, sometimes pale gray, and sometimes showing an intermediate speckling; outer webs, usually either solidly gray or heavily speckled; entire ventral surface of body, from chin to under tail coverts, white; lining of wing, white, except along its anterior edge, where a mixture of blackish brown, white, and neutral gray feathers with white emarginations, produces a narrow, irregularly mottled border.

Considerable variability is noteworthy in the amount of white emargination on the dorsal plumage, the conspicuousness and extent of the blackish infraorbital patch, the extent of white feathering above the eye, which sometimes gives the appearance of a supra-orbital stripe, the general hue of the gray parts of the plumage (due mainly to wear), the conspicuousness of the rump-patch, which is in some cases only slightly evident, and the wide range in markings on the outer quills of the tail.

All forms of both *P. cookii* and *P. leucoptera* seem to have black bills and, of course, brown irides. The only differences in flesh colors are those of the tarsi and feet. In American Museum specimens of *P. c. cookii*, these are noted as "tarsus, upper third of foot, and inner toes, blue; remainder black."

Subspecific characters of *P. cookii orientalis:* Very similar to the typical form, but averaging larger, and with a more pronounced appearance of scalation on the dorsal surface, due to a broader and more general white emargination of the feathers.

19 specimens of both sexes: wing, 234–250 (239); tail, 85–97 (91); exposed culmen, 27.6–30 (29); tarsus, 30–32 (31); middle toe and claw, 38–41 (40) mm.

Distribution: Breeding ground unknown. Common off the west coast of South America, in the milder ocean waters to westward of the upwelling zone of the Humboldt Current. Examples have been collected from 80 to 700 kilometers off the coasts of Peru and Chile, between latitudes 5° and 34° S., and also in the eastern North Pacific.

This eastern Pacific representative of the petrel known in New Zealand as the "Titi" is a "weak" subspecies. Its distinguishing characters seem, however, to be constant, judging from the good series of specimens compared. If the breeding ground should subsequently be discovered at a New-World island, the puzzle regarding its status and distribution would be solved.

During the Brewster-Sanford Expedition, Mr. Beck saw the first examples of this petrel near Hormigas de Afuera Islet, west of Callao, Peru, on June 4, 1913. Subsequently he collected many far off the central part of the Peruvian coast, and in December took others within sight of Mas Atierra Island, Juan Fernández. It is certain that this subspecies does not nest at Juan Fernández, which is occupied by another subspecies of *Pterodroma cookii*. Hormigas de Afuera, about which the petrels were seen during southern-hemisphere midwinter, is an even more unlikely breeding ground, for the island is tiny, low, plantless, and more or less overswept by spray.

Furthermore, the nesting petrel of the islands of San Felix and San Ambrosio, north of Juan Fernández and close to latitude 26° S., is now known to be *Pterodroma cookii defilippiana*, the same form which inhabits Mas Atierra. Through the courtesy of Dr. Percy R. Lowe, I have been enabled to examine a British Museum specimen collected at San Ambrosio by Coppinger on July 21, 1879. Possibly *P. c. orientalis* nests in the higher parts of certain little-known islands

along the coast of south-central Chile. The environment here would be most like that in which the typical subspecies breeds in New Zealand.

P. c. orientalis is the closest to the typical form of any of the races of *cookii*. Beyond a doubt, the bird has more than once been confused with *defilippiana*. To an ornithologist with only one or two examples of each at his disposal, such confusion might be almost unavoidable. When, however, the two are represented by good series of specimens collected throughout the same oceanic region, and reinforced by breeding examples of *defilippiana* taken from their nests, such doubts are immediately resolved. *P. c. orientalis* has a slender and smooth black bill of exactly the same type as that of *cookii* from New Zealand. *P. c. defilippiana*, on the other hand, has a remarkably deep, heavy bill, in which the plates of the latericorn, unguis, etc., have a strong tendency to be rugose, and even to develop a laminated aspect, so that they are more or less marked with fine horny lines. The bills of fledgling young, as well as adults, of *defilippiana*, have, as a matter of fact, this characteristic appearance, and even in such early stages they are pronouncedly deeper and heavier than the bills of adult specimens of *P. c. cookii* and *P. c. orientalis*.

Under the subspecific name *defilippiana*, Wetmore (1923, 171) has recorded two petrels from the northern Peruvian coast, which prove, upon reëxamination, to be of the present race, *orientalis*. Both flew aboard the steamship 'Santa Elisa,' and were preserved by the ornithological wireless operator, Mr. C. L. Fagan, who is responsible for many interesting sea-bird records. The northernmost of the two specimens was taken north of Lobos de Tierra Island on July 31, 1922.

Bishop (1934, 77) has recorded an example of this petrel which was one of two to come aboard a ship during a storm in August, 1933, near Adak Island, of the Aleutian Chain, Alaska. I have examined this bird and find that it completely agrees with those from the eastern South Pacific. Furthermore, Loomis (1918, 94) has reported upon nineteen specimens, presumably of this form, which were collected by Beck on July 22, 1905, in latitude 22° 25′ N., longitude 112° 40′ W., during the Galápagos Expedition of the California Academy of Sciences. The locality is between the Revilla Gigedo Islands and Cape San Lucas, Lower California. These specimens were at this date passing through a complete moult of the plumage. I have not seen them, but the dimensions of thirteen, as tabulated by Loomis, substantially agree with my measurements of *Pterodroma cookii orientalis* from the type locality.

Since nothing whatsoever is known about the breeding habits of this petrel, I append a brief summary relating to the life history of its conspecific New Zealand race, *Pterodroma cookii cookii*.

Buller (1888, 217) states that the Cook's Petrels fly low over the ocean and often look like huge moths. Their dark wings contrast with the gray and white body plumage and make it easy to distinguish them from other small petrels. (It should be remembered, however, that this author and other observers of his day were wont to confuse a number of races of small gadfly petrels representing both this species and *P. leucoptera*.)

A well-known breeding ground is on Little Barrier Island, off northern New

Zealand. Here the burrows of the Cook's Petrels are mainly on sloping ground of the higher ridges, above an altitude of 400 meters which is about halfway between sea level and summit. The holes wind down deeply beneath the roots of trees, beyond the reach of foraging hogs, penetrating a rich, black forest humus, which is usually sodden with moisture. At their entrances they are from 10 to 15 centimeters in diameter. They vary in length from a meter to as much as three, but average a little more than two. Their course is often tortuous, especially where roots and stones are encountered, and at the end they are said to have two chambers, instead of the usual single cavity. These are both lined with leaves and grass, and the male bird has on several occasions been found in one while its mate was incubating an egg in the other. The native lizard-like tuatara (*Sphenodon*) has also been known to occupy one of the compartments, apparently without detriment to the bird in the other.

The call of Cook's Petrel, *ti-ti-ti*, rapidly repeated, has given it its Maori name. When the birds come to their burrows at night, they make also a different, gurgling sound.

Two eggs from Little Barrier Island are recorded as measuring 50 x 37 and 52 x 38.5 millimeters. Nestlings have pale bluish gray mesoptyle down on the dorsal surface, with the ventral surface white. The egg is laid during early November, and fledglings leave the nesting ground in March.

The above is taken mainly from Mathews and Iredale (1921, 38), Oliver (1930, 144), and Falla (1934, 257), of which the first two sources represent earlier compilations.

Falla found cephalopod beaks in the stomachs of all petrels of this species that he examined.

Jespersen (1930, 2) notes that during the cruise of the 'Dana' in New Zealand waters, this petrel was not observed to southward of the latitude of East Cape, North Island. His accompanying map, showing the "southern limit for northern breeding species" accordingly places the border of the pelagic range of *Pterodroma cookii* at about latitude 38° S. It is well, therefore, to call attention to the fact that I had already recorded specimens of the New Zealand race from latitude 47° S., longitude 175° E., a point far south of the Chatham Islands (Murphy, 1929, 3). These birds were captured during February. The point is on a line which would strike the South American coast about halfway between Chiloé Island and the Strait of Magellan, a region in which the breeding grounds of *Pterodroma cookii orientalis* should be looked for.

MAS ATIERRA PETREL

Pterodroma cookii defilippiana

Æstrelata defilippiana Giglioli and Salvadori, 1869, Ibis, p. 63 (off northern Chile).

Names: Also called De Filippi's Petrel.

Characters: Distinguishable from *Pterodroma cookii cookii*, and from all other forms of the species, by the great depth and robustness of the bill, and the exceptional length of the tail. The color of the feet seems to be as in typical *cookii* and in *orientalis*, with the tarsi and upper third of the two inner toes light blue.

The depth of the bill of *defilippiana*, in front of the nostrils, ranges from 8–8.5 mm., and the width of the maxilla at the base from 11–12 mm. In *P. c. orientalis* the respective measurements are: depth 6–6.8, width of maxilla 9.5 mm.

10 adults of both sexes: wing, 229–241 (235); tail, 97–108 (102); exposed culmen, 28.5–29 (29); tarsus, 29–31 (30.2); middle toe and claw, 34–37 (35.5) mm.

Young: The only nestling I have seen is a mummy of a chick found at Santa Clara Island, on January 20, 1914. It has lost most of its faded bluish gray down except on the flanks and the sides of the breast. We have also two fledglings, recently out of the nest, from San Felix Island. A little pale gray down still clings to their plumage, which seems to be indistinguishable from that of adults.

Two eggs from Santa Clara Island, Juan Fernández, measure 48 x 35 mm. (Lönnberg, 1921, 14). A third obtained by Beck is dull white and measures 48.5 x 35 mm.

Distribution: Breeding at Mas Atierra and Santa Clara (but not Mas Afuera), of the Juan Fernández group, and at San Felix Island. Ranges, chiefly well offshore in the Pacific from the latitude of Juan Fernández to that of central Peru. Specimens recorded from northern Peru by Wetmore (1923, 171) prove to be *Pterodroma cookii orientalis*.

This very distinct petrel was first taken during the cruise of the 'Magenta,' and was described as a full species in 1869. Giglioli and Salvadori state that it followed their ship to a point "not far from the Peruvian coast," but the longitudinal positions of their track show that they remained at all times hundreds of kilometers from the continental shore, and well outside the actively upwelling zone of the Humboldt Current. Furthermore, the sight identifications of these observers are not to be trusted in view of their lack of knowledge of this and related petrels at the time. Thus Salvadori states that *Pterodroma leucoptera* was not seen during the cruise of the 'Magenta,' whereas we now know that this vessel spent much time within the common oceanic range of at least three petrels between which that author could hardly have discriminated in the field, namely, *P. leucoptera masafuerae*, *P. cookii orientalis*, and *P. cookii defilippiana*.

During the cruise of the 'Alert,' Coppinger (1884, 86) found this petrel nesting at San Ambrosio Island, in July, 1879. I have examined a male he collected on its nest, which, he says, consisted of a few twigs and feathers in a rock crevice.

At San Felix the 'Zaca' party collected four adults and two fledglings on February 18, 1935. These agree completely with Mas Atierra specimens. Dr. Chapin's notes state that only two were sighted over the water on the morning of the landfall, and not many at the island itself. Both the chicks found had already left the nest, but gray down and bird bones were discovered in weathered niches on the slope of the Cerro Amarillo. One adult was seen to fly in and out of the cave near the landing place. The stomachs of the specimens contained whole squids 8 to 10 centimeters in length, mandibles and crystalline lenses of the same creatures, and remains of small fishes. Not a petrel of this species was observed near San Ambrosio, which proved to be the headquarters of the larger Kermadec Petrel.

Lönnberg (1921, 14) reports upon the observations of Bäckström at Juan Fernández. During his first visit to the islands, between December and April, the Swedish naturalist did not see this petrel. When he returned in August,

however, it had become plentiful. On August 9, 1917, he found examples nesting, with neither burrows nor nest linings, beneath the edges of large boulders along the shore of Santa Clara Islet. Two eggs were collected on that date. Residents of Mas Atierra informed him that eggs would become more common in September.

During the Brewster-Sanford Expedition, Beck found evidence that the Mas Atierra Petrels occupy both the main island and Santa Clara or Goat Islet. In January, 1914, he saw remains of old nests on Mas Atierra. On the 19th of the month he visited a breeding site on Santa Clara and picked up one addled egg left over from the previous breeding season. This was under an overhanging rock in a talus heap, and about 70 meters above the ocean. Numerous bodies of young and old birds were also among the stones. All of the adults killed during December and January had small gonads, showing that the egg-laying period had long passed by.

During the same season Beck took many specimens at sea around Juan Fernández, and between there and the continent. In June of the preceding year he had obtained others as far north as the latitude of Ancón, Peru, but at least 80 kilometers from the coast. They were more common 250 kilometers offshore. The pelagic range of *P. c. defilippiana* is thus extended much to the northward of previous records. Many of the specimens were collected in company with examples of *P. c. orientalis* but the two proved easily separable in the hand, though probably not in the field.

On March 31, 1914, Beck observed petrels having the appearance of this form fishing well out at sea a little north of Ancúd, Chile. He could be certain, however, only that they represented a small species of *Pterodroma*.

In the scanty information we have about the life history of this petrel, the most interesting item is that it is a surface-breeding bird, whereas its New Zealand relative is a burrower. Other examples are not wanting among the Procellariiformes to indicate that breeding habits, no less than morphological characters, may be subject to seemingly abrupt, and often surprising, germinal variations.

The length of the nesting period of *P. c. defilippiana* agrees with that of *P. c. cookii*, but in the case of the former the half-year of incubation and feeding young begins in August, while the New Zealand form lays its egg three months later.

MAS AFUERA PETREL

Pterodroma leucoptera masafuerae

Pterodroma (*AEstrelata*) *cooki masafuerae* Lönnberg, 1921, in Skottsberg's Nat. Hist. Juan Fernández and Easter I., 3, Zoöl., pt. 1, p. 14 (Mas Afuera Island, Juan Fernández).

The typical race of this petrel was described from Australia, the reference being as follows:

Procellaria leucoptera Gould, 1844, Ann. Mag. Nat. Hist., 13, p. 364 (Cabbage Tree Island, Port Stephens, New South Wales).

Names: White-winged Petrel. In the literature this form has often been listed as *cookii*, as was done by the original describer.

Characters (of the species *leucoptera*): Sufficiently defined on p. 713, in comparison with those of *P. cookii*.

Adults, of the typical race, *P. leucoptera leucoptera* (sexes alike): Forehead and greater part of lores, white, but freckled with a few black-centered feathers, especially along the mid-line from the bill to the anterior border of the crown, where the transition to dark plumage is abrupt; circumorbital region, except for a narrow white infraorbital stripe and a variable amount of speckling in front of the eye, sooty black; crown, and a definite mantle which includes the nape, anterior part of the interscapular region, sides of neck, and a large and conspicuous patch at the side of the breast, sooty black; back and upper tail coverts, close to light neutral gray, each feather with a faintly discernible dark shaft streak and, in fresh plumage, a narrow white terminal margin; a large, more or less triangular sooty black patch on the rump; wings, blackish brown (3), with a pointed, wedge-like white or mottled white area on the inner vanes of the quills, usually less definite and less extensive than in *P. cookii cookii;* greater coverts and secondary quills, neutral gray, externally margined with white; tail quills, neutral gray, the central pairs with sooty terminations, the outer pairs mottled gray and white, much as in *P. cookii cookii;* entire ventral surface, from chin to lower tail coverts, white; wing-lining, white, with the anterior margin mottled as in *P. cookii cookii*.

Subspecific characters of *P. leucoptera masafuerae:* Distinguishable from *Pterodroma leucoptera leucoptera* as follows: size slightly smaller, excepting the tail, which is apparently longer than in the typical race; crown less blackish, and the dark coloration more restricted, terminating rather sharply at the nape, whereas in typical *leucoptera* it extends caudad into the scapular region and very definitely into the patch at the sides of the breast (in *masafuerae* the latter areas are distinctly gray rather than sooty black); white feathering extending much higher on the forehead, usually terminating in a line drawn through the center of the eyes, some specimens having practically clear white foreheads (in the typical form the extreme breadth of the whitish forehead, measured from the base of the culminicorn, is about 12 or 13 mm.; in *masafuerae* it averages about 23 mm.); the tarsi are grayish black, instead of flesh color.

10 specimens of both sexes: wing, 216–230 (221); tail, 97–105 (100); exposed culmen, 24–26 (25); tarsus, 27–30 (27.2); middle toe and claw, 34–37 (36.4) mm.

Distribution: Known only from Mas Afuera Island, where it breeds, and the waters around the Juan Fernández group.

During the course of the Brewster-Sanford Expedition, Beck collected an excellent series of these petrels in the waters around the Juan Fernández Islands, between December 20, 1913, and February 9, 1914. Although as a breeding bird the form is known only from Mas Afuera, it proved to be common close to the coast of Mas Atierra Island, mingling with species which nest at the latter locality.

Owing to continual rough seas, Beck was unable to land at Mas Afuera, as

FIG. 63. Heads of two species of small gadfly petrels inhabiting the Juan Fernández Islands.

Left, *Pterodroma cookii defilippiana* (breeding at Mas Atierra, the neighboring islet of Santa Clara, and also at San Felix Island); right, *P. leucoptera masafuerae* (endemic at Mas Afuera).

has been stated in the narrative of the expedition published in Part I. Consequently he obtained none of these petrels at their nests. Among the specimens collected at sea during December there was evidence that the breeding season had not long passed, because the abdomens of some had bare brood-patches, even though their gonads were reduced in size.

Lönnberg (1921, 14) reports upon examples taken by Skottsberg and Bäckström at Mas Afuera in February, 1917, and gives a partial account of the breeding habits, although he describes neither eggs nor chicks, which seem to be still unknown. He states that this bird nests only in the highest parts of the southern half of Mas Afuera. The burrows resemble those of the larger resident petrel, *Pterodroma externa*, but are much shorter. They are found only in dense fern groves, especially among masses of the roots and fallen stems.

In this petrel, therefore, as in the case of the Mas Atierra Petrel, the breeding habits seem to have departed widely from those of the Old-World representative form. In the present instance, however, it is the American subspecies which is a burrower, while the Australian race is said to nest merely among crevices of a stony surface densely covered with vegetation. Perhaps, in certain instances the type of terrain, as determined by relative dampness, hardness, texture, and plant cover, is sufficient to control the type of nest that a petrel uses. Nevertheless, since a proclivity to burrow is presumably instinctive and heritable, one would expect the trait to show up at least sporadically under favorable circumstances, unless in the course of evolution it had been entirely eliminated.

According to Mathews (1912, 17), the typical subspecies of *P. leucoptera* nests at Cabbage Tree Island, New South Wales, in December. Selecting sites on high ground well covered with growths of cabbage palm and vines, the birds here lay their eggs under overhanging rocks or in crevices between stones well concealed by forest litter. Sometimes a call-note from under a mass of fallen fronds will lead to the discovery of an incubating bird among the stones beneath.

The large series of *P. c. masafuerae* in the American Museum exhibits a wide variation in plumage, which seems to be correlated with moult and wear. Thus December specimens have very gray backs, scaled with white feather edgings. The line of demarcation between the back and the darker gray of crown and nape is very sharp. Through the effect of abrasion the white margins on the back disappear rapidly, so that they show scarcely at all among birds collected during February or late January. The back becomes progressively spotted with black, owing to the appearance at the surface of the dark feather-shafts as the distal margins of the feathers wear away; for the same reason the line of demarcation between nape and back becomes less distinct. Variation is also great in the relative whiteness of the forehead, the speckled area being more extensive in some specimens than in others. Again, the tail quills also vary widely, those of some birds being clear gray even to the outermost, while in others the outer pairs are heavily speckled. The central rectrices are practically black distally.

WHITE-THROATED PETREL

Pterodroma leucoptera brevipes

Procellaria brevipes Peale, 1848, U. S. Expl. Exped., 8, pp. 294, 337 ("Lat. 68° S., Long. 95° W.," probably an error for a tropical Pacific locality; see below).

Names: This petrel appears in the literature under many synonyms, including *cookii*, *leucoptera*, *torquata*, *desolata*, and *aneiteimensis*.

Characters: Smaller than any of the other races of *P. leucoptera*, except in length of tail, in which it equals or slightly exceeds the typical form; occurs in two phases, of which the gray is diagnostic; white-breasted examples are distinguishable from other subspecies by one or more of the following characters: primary quills entirely dark; white forehead very narrow; a tendency toward fine, dark gray peppering of the white ventral plumage, apparently always present at the sides of the breast, and extending in many specimens as a band across the breast and along the whole length of the flanks. In fact, the varying density and extent of this dark speckling produces every stage of intergradation between white-breasted and gray-breasted phases of the subspecies. Tarsi and upper part of the feet flesh-colored in nestling birds, and blue in adults, the distal parts of webs and toes being black. The long mesoptyle down of chicks is plumbeous gray on the dorsal surface and whitish on the ventral surface.

13 adults from the Fiji and New Hebrides Islands, western South Pacific (sexes alike): wing, 207–226 (218); tail, 91–99 (95); exposed culmen, 22–26 (24.3); tarsus, 26–28 (26.5); middle toe and claw, 32–35 (34) mm.

Distribution: Tropical South Pacific; breeding at Melanesian islands, such as members of the Fiji and New Hebrides groups, and ranging northward and eastward to the vicinity of the Galápagos Islands.

The only claim that this petrel has to a place in the South American region is based upon the capture of eight specimens by Beck during the course of the Galápagos Expedition of the California Academy of Sciences (Loomis, 1918, 93). This was on June 11, 1906, in latitude 4° 20′ S., longitude 93° 30′ W., a position about 5 kilometers southwest of the nearest point of the Galápagos Islands. Many small flocks were seen moving about on the date of the record. Loomis has compared the specimens with the type of the race in the United States National Museum. The measurements which he publishes agree closely with those of American Museum birds from breeding grounds in Fiji, etc.

Next to nothing is known about the life history of this petrel. Examples have wandered far from their proper range in the tropical zone of the Pacific, and one has been captured off the coast of Wales! I have remarked elsewhere (Murphy, 1929, 15) that it is odd that the alleged type locality of Peale's "*Procellaria brevipes*," which is near Peter Island in the eastern South Pacific, south of the antarctic circle, had not long since been questioned. Peale's published remarks are as follows: "Two specimens were shot on the 21st day of March, in latitude 68° S., longitude 95° W. . . . The labels having been displaced after the specimens were sent home, the sex cannot be given with certainty now, but they are believed to be males." This comment, written some years after the reported capture of the specimens, is enough to throw doubt on all of the data. The race is unquestionably equatorial in its normal distribution, even though a record made in the antarctic may be no more remarkable than the one made in the British Isles.

BLUE PETREL

Halobaena caerulea

Procellaria caerulea Gmelin, 1789, Syst. Nat., 1, part 2, p. 560 (Southern Ocean, latitude 48°–58° S.).

Names: By sailors not distinguished from the prions, and consequently called "Whale-bird" (Green, 1887, 31). In the Falkland Islands, this petrel is known as the "Fire-bird" because of its habit of flying into a light or bonfire at night. The name, however, is a loose one, sometimes being applied to other species as well. Synonyms of the specific names are *forsteri*, *similis*, *murphyi*, and possibly several others.

Characters: Distinguishable from all other petrels by the white tips of the central tail quills; differs from the species of *Pachyptila* in the shape of the tail, which is nearly square instead of cuneate. *Halobaena* is closest in appearance to *Pachyptila belcheri*, from which it differs in having a distinctly white, even though slightly mottled, forehead, and in lacking the pronounced white post-orbital stripe. Furthermore, in *Halobaena* the crown of the head is of a much darker color than the back, a condition approached only in the Broad-billed Prion.

Adults (sexes alike): General color of the dorsal surface bluish gray (very close to the deep gull-gray of Ridgway), except for the crown of the head and the nape, which are much darker and somewhat brownish; the longer scapulars are also subterminally sooty, with narrow whitish terminal borders; marginal and lesser wing coverts brownish black, the greater series very narrowly edged with whitish; bastard-wing and primary coverts blackish, the four outer primaries externally blackish brown, their inner webs more or less hoary white; inner primaries and secondaries of the color of the back, with darker shafts, the secondaries tipped and externally edged with whitish; lower back, rump, and upper tail coverts like the back; rectrices similar but slightly more dusky on the central feathers, and lighter or mottled with white on the outer quills, the outermost pair being almost entirely hoary white except for the shafts; tail with a terminal white band, which is broad and conspicuous on all save the two or three most lateral quills; crown, nape, and hind neck, as well as the sides of the latter, brownish gray, a hue extending around the eye, beneath and behind which it is slightly mottled with white; forehead, lores, sides of face, and ear coverts white, the region between the forehead and vertex being mottled because the feathers have blackish centers and white margins, producing a scaled effect; ventral surface white, the sides of the chest and upper breast being bluish gray like the back; under-wing and axillaries white, except along the partially dark border. Iris brown; bill blue, with the culmen and nasal tubes black, and the ramicorn of the mandible gray; tarsus and toes blue, the webs whitish or flesh color, with central reddish areas due to the network of blood vessels, and gray borders; claws blackish.

4 adults, of which 1 is a male, 1 a female, and 2 not sexed (2 from the South Atlantic and 2 from Kerguelen Island): wing, 209–217 (211.5); tail, 82–89 (84.4); exposed culmen, 25–26.5 (25.6); width of bill of one specimen, 10.6; tarsus, 32–34 (33.1); middle toe and claw, 41.2–43 (42.3) mm. Length in the flesh of 6 Kerguelen specimens, 273–317; wing-expanse, 641–695 mm. (Kidder, 1875, 34).

Young birds may be recognized by a less cinereous or bluish gray tinge of the upper parts, which tend more or less strongly toward brownish; the forehead, moreover, is not pure white but is mixed with an ashy hue (Coues, 1866, 164). The nestling is covered with slaty down, the region about the base of the bill being largely bare.

The egg which is variable in shape, as among most petrels, has a thin, homogeneous shell with a finely granular surface without color markings. Measurements from various sources, chiefly from eggs taken at Kerguelen Island, fall within the following ranges: 44 x 32, 49 x 38 mm.

Distribution: Circumpolar and widespread in the west-wind zone of the southern oceans, breeding at the Falkland Islands and at Kerguelen Island. Dabbene (1923, 126) indicates that the limits of the known flight-range are as far apart as latitudes 33° and 70° S.

Halobaena, the Blue Petrel, has usually been grouped with the whale-birds of the genus *Pachyptila*, but there seems to be little beyond a superficial resemblance to indicate such particular relationship. The cobalt blue of bill and feet

add to the resemblance, but in the conformation of the bill, in the long wing which out-measures that of any *Pachyptila* of equal size, and in the general plumage-pattern, including the scaled appearance of the feathers on the forehead, etc., the Blue Petrel bears a closer resemblance to the smaller petrels of the genus *Pterodroma*. Most of the latter have cuneate tails but so do the whale-birds; the squarish tail of *Halobaena* is *sui generis*.

Although the Blue Petrel has an enormous range, and is reported from many parts of the southern oceans all around the globe, it is a surprisingly rare bird in collections. During the course of the Brewster-Sanford Expedition, Mr. Beck collected a single male in breeding condition over the ocean to eastward of the Falklands. This was taken on September 20, 1915, during very stormy and drizzly weather, and he was unable to capture a second. About a week later, he saw many others in waters east of Staten Island, and subsequently within sight of the north coast of that little-investigated locality.

The pelagic wanderings of this species, according to Vanhöffen (1901, 315), are limited on the north by the boundary of the zone of westerly winds and on the south by pack-ice. Gain (1914, 155) saw three examples in latitude 61° 23′ S., longitude 116° 56′ W., which is a long way west of the South Shetland Islands and not far from the position ascribed to the mythical Dougherty Island. Again, in latitude 56° 52′ S., longitude 102° 30′ W., he encountered the birds in numbers on January 27, and from this point eastward he saw them as far as Cape Pilar, at the entrance of the Strait of Magellan. Paessler (1913, 43) found the species along the Chilean coast during the winter, up to latitude 35° S., which is north of Talcaguano. In November he met it again in flocks off Santa María Island and, in July, throughout a long stretch of the South Atlantic between the Strait of Magellan and the Río de la Plata. Beck's experience shows that the Blue Petrels are to be found plentifully in this region and, according to Gould (1865, 457), they are usually in evidence about midway between the Tristan da Cunha group and the coast of South America. Farther eastward in the Atlantic, Vanhöffen (1901, 310; 1905, 503) picked up examples not far from the Cape of Good Hope, and in the months of November and December they followed his ship, the 'Gauss,' southward from the vicinity of Bouvet Island. During the British National Antarctic Expedition of 1901–1904, Wilson (1907, 104) noted the first Blue Petrels in latitude 45° S., longitude 48° E., on October 24, when a heavy sea was running before high winds. From this date the birds were continually with the vessel until it had penetrated well into the pack-ice. On the homeward voyage the Blue Petrel was seen between latitudes 60° and 55° S. in the Pacific west of Cape Horn, and again in the South Atlantic. The 'Scotia' naturalists captured specimens as far south as latitude 69° S. in Weddell Sea, and observed birds believed to be of this species in latitude 71° 28′ S. (Clarke, 1913, 264). In the log of the 'Scotia,' however, the Blue Petrel was not generally distinguished from the prions. Since it flies constantly in company with the latter, its identification involves close observation of the tip of the tail, which is white in the Blue Petrel and black in all whale-birds.

Since the Blue Petrel nests at the Falklands and Kerguelen Island, I am inclined to believe that it does not inhabit such ice-covered antarctic islands as South Georgia and Bouvet. Mathews (1934, 171) states that it is not resident at Macquarie, which had formerly been credited as a nesting station. Much misinformation on this subject seems to have crept into the literature. There is no good reason for including South Georgia within the breeding range, since the example from Stromness Bay of that island, said to have been obtained during the summer of 1913, was presented to Brooks (1917, 146) from a miscellaneous collection of curios at Port Stanley, Falkland Islands. The specimen may well have been captured at or near South Georgia, the waters about which are frequented by numerous sea birds which certainly do not nest at the island. Since then, several Blue Petrels have been seen on the wing off the entrance to Cumberland Bay, on November 30, 1926, but the species has not been found breeding locally. Bennett (1926, 316) states that Blue Petrel colonies are to be found at "selected spots" at the Falklands, but he names none. There is no doubt, however, of its place in the Falkland avifauna, and it probably inhabits also Staten Island and some of the exposed islands along the windward coast of Tierra del Fuego.

Most of what we know about the breeding habits of the Blue Petrel has been recorded at Kerguelen, and appears in the writings of Kidder (1875, 34) and Eaton (1879, 142). The birds inhabit slopes not far from the shores of that island. Such hillsides seem deserted during the day, but become perfectly alive at dark, with these birds and other petrels flying irregularly about and filling the air with their calls. *Halobaena* seems to be the latest of the petrels to issue above ground after nightfall, when its calling becomes incessant, ringing out both from the air and from the burrows. The note much resembles the cooing of pigeons, *kŭk-kŭk-kŭk coo-coo*. Eaton states that, while this note is very similar to the song of the species of whale-bird that nests in the same territory, the flight-calls of the two are quite different. During September the Blue Petrels keep flitting about in the neighborhood of their burrows, alighting here and there, and then taking wing again like swarms of bats. Such restlessness seems to be very characteristic of many courting petrels; in the same manner the Snow Petrel (*Pagodroma*) flits about ice-covered slopes on the coast of the antarctic continent. After the middle of November, a reduction or cessation of the loud night calling of the Blue Petrel indicates that its pairing season has passed.

The burrows of *Halobaena* at Kerguelen are excavated beneath clumps of *Azorella*, and since they are mostly in soft dry ground, eggs can be taken without much trouble. About the size of a man's wrist in diameter, the tunnels run straight inward for a distance, turn to the right or left, and then slope downward to an enlarged cavity lined with fibers, leaves, or twigs. The mated pair is to be found in the nest-chamber until the egg is laid. The first egg was discovered by Kidder on October 23, and the first young bird on November 12, which indicates that the beginning of the egg-laying season must extend back into September. Eaton collected a full-fledged nestling on February 9.

When Kidder set adults free in the daytime, he observed that their mode of flight was highly erratic, as if they found the light confusing. They always came down on the water after flying offshore. Werth (1925, 588) found, by keeping several living examples in captivity, that they would hide quietly in the corners of boxes throughout the day, but at night would scuffle about in lively fashion. Since they would take no food in captivity, they soon died. Stomachs examined by this observer contained beaks of cuttlefish and remains of small crustaceans. Some of the adult birds disgorged a green fluid or paste.

THE STORM PETRELS

SUBFAMILY HYDROBATINAE

Despite the obvious similarities among all the small storm petrels, the members of this group were formerly divided into two families. One of these, centering about the genera *Hydrobates* and *Oceanodroma*, was considered to be closely related to the larger petrels, while the second group, represented by such long-legged forms as *Oceanites*, *Fregetta*, and *Pelagodroma*, was regarded as a very distinct family, the Oceanitidae. Such a system of classification necessarily attributed to convergent evolution the similar black-and-white pattern and the general resemblance in habits between, for example, Wilson's and Leach's Petrels.

Such an academic division was not without an alleged anatomical basis, which had been studied by Garrod, Forbes, Salvin, and other able authorities. Lowe (1926, 1433) has reviewed the whole subject, offering a critique of earlier classification, and presenting new information on deep-seated cranial characters. His conclusions go to show that many of the morphological distinctions among the storm petrels are of exceedingly slight or doubtful importance, and that even such ponderable differences as the number of secondary remiges, the relative proportions of wing and leg bones, and the number of cervico-dorsal vertebrae, lose weight when we take into consideration the fact that Forbes and other investigators had not examined a number of species which might have altered their conclusions.

Lowe decides, in short, that no taxonomic line of cleavage should be drawn through the more or less divergent but apparently primitive or generalized petrels known collectively as Mother Carey's chickens. He returns, rather, to the pioneer classification of Coues, a step which I believe to be in harmony with our still very limited knowledge of this group of birds. Finally, it should be pointed out that the petrel which has been known as *Oceanodroma melania* is a long-legged member of the so-called short-legged group, and to this degree it makes a connecting link between the two branches of the family. Mathews has recently given it generic status, under the name *Loomelania*, a step which is no doubt well warranted (*cf.* p. 744).

The Mother Carey's chickens belong to all oceans and zones. As regards migratory movements, they are of exceedingly diverse habit, a few forms being

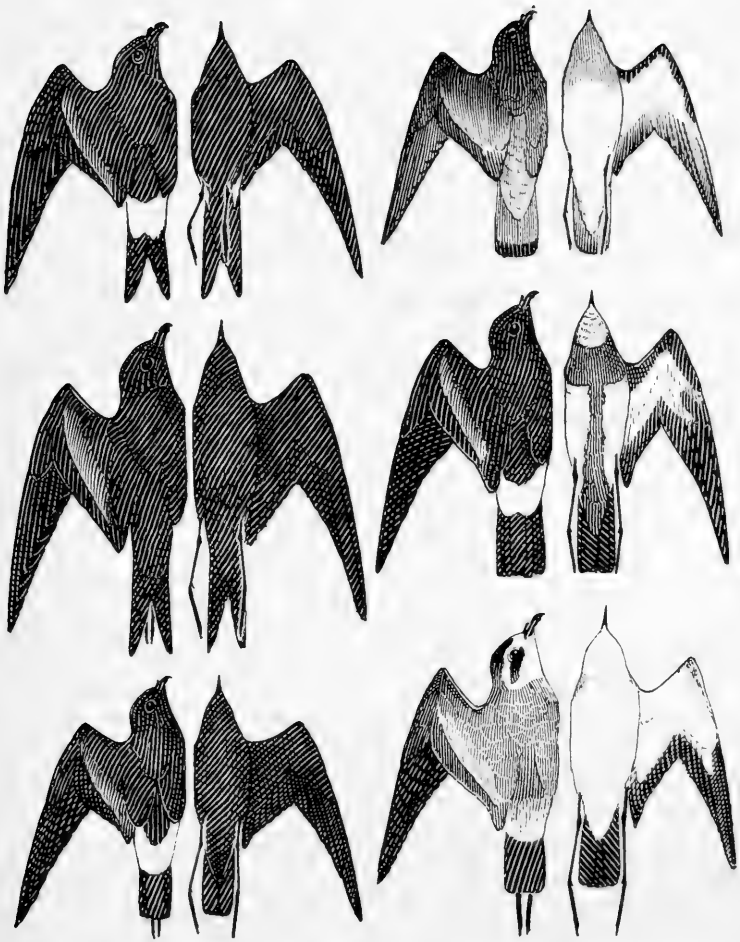


FIG. 64. Dorsal and ventral aspects of six genera of Storm Petrels, to illustrate patterns and proportions.

Reading downward: left row, *Oceanodroma leucorhoa*, *Loomelania melania*, *Oceanites oceanicus;* right row, *Garrodia nereis*, *Fregetta tropica*, *Pelagodroma marina*.

apparently bound closely to areas of surface water of uniform physical characteristics, while others, such as *Oceanites oceanicus*, travel annually across the pantropical oceans from the antarctic south to the sub-arctic north. The breeding grounds of certain forms are highly restricted with relation to the climatic zones, while certain other species, such as *Oceanodroma castro*, nest throughout a very broad latitudinal range which includes such unlike insular environments as the Azores, Madeira, the Cape Verdes, Ascension, and St. Helena. A particularly large number of species are confined to the littoral waters along the west coast of the Americas. These include petrels of widely varying appearance and water-temperature predilections, such as *Oceanites gracilis*, *Oceanodroma tethys*, *Oceanodroma macrodactyla*, *Oceanodroma markhami*, *Loomelania melania* (erroneously recorded from the Asiatic side of the Pacific), *Oceanodroma homochroa*, *Oceanodroma hornbyi*, *Oceanodroma furcata*, and *Halocyptena microsoma*.

All of the Mother Carey's chickens seem to have many traits in common as regards nesting habits, although our knowledge of even the best-known species is no more than casual and fragmentary. Much pleasant literature has been written regarding their courtship, night singing, etc., but there is a great dearth of objective description concerning just what takes place in the reactions and behavior of these primitive and extraordinarily interesting birds. Many problems remain to be worked out, for example, in connection with the place of the sexes in incubation. It seems likely that the male of certain species has more to do with the hatching of the egg than the female, and that males in general show the more pronounced development of the bare brood-patch on the belly. The majority of specimens that have been captured upon the egg seem to be males, although the data are more or less conflicting. The size relationship of the sexes also deserves further investigation, for among some species the females are consistently larger, as is true in the case of boobies and certain other Pelecaniformes.

All of the storm petrels probably have nocturnal habits at sea no less than at their nesting grounds. Coppinger (1884, 88) and Green (1887, 21) have long ago pointed out that from a ship twice as many may be captured at night as during the day by means of weighted threads trailed from the taffrail. More than any other ocean birds, too, they sometimes "rain" on board ships at night, being misled by the lights, especially in foggy weather.

Additional collecting of storm petrels is needed in several parts of the world in order to settle numerous problems of distribution and subspecific relationship. We need still more, however, an exhaustive study of the life history of any single species by an observer or group of observers prepared to camp at the nesting ground before the date of arrival of the first birds, and to keep a detailed, matter-of-fact account of their mysterious comings and goings and their mutual reactions and territorial, social, and parental behavior during the extraordinarily long period between the beginning of the courtship and the exodus of the whole population.

LEAST PETREL

Halocyptena microsoma

Halocyptena microsoma Coues, 1864, Proc. Acad. Nat. Sci. Phila., p. 79 (San José del Cabo, Lower California).

Names: There are apparently no synonyms of the specific name.

Characters: Small size, the wedge-shaped tail, and the uniformly dark color, without any white areas, should distinguish this petrel from any other occurring within the same range.

Adults (sexes alike): Sooty black, the ventral surface slightly browner, the greater wing coverts paler and forming a wing-patch; quills of wing and tail black; under wing coverts dark sooty brown, those around the edge of the wing forming a scarcely distinguishable black band. Iris brown; bill and feet black.

Measurements of 11 adults of both sexes from San Benito Island, taken during the months of July and August, are as follows: wing, 118–125 (121); tail, 50–56 (53.4); exposed culmen, 11–12 (11.4); tarsus, 20.5–22 (21.2); middle toe and claw, 17–20 (18.8) mm.

Worn claws, as if from scratching the abrasive surface of the nesting ground, result in, perhaps, unduly small figures for the length of toe and claw. There is no determinable difference in the size of the sexes among the specimens measured.

The young are covered with sooty or slaty black down.

Eggs: The eggs are of variable shape as in most other petrels. They are white, with a rosy flush before being blown, and in many of them a ring of dark specks encircles one end. The pigment of these is easily rubbed off, the slightest touch leaving a smudge. Measurements of 40 average 23.4 x 19.4, the eggs showing the four extremes measuring 28.2 x 22, 23 x 18.5 and 25.2 x 18 mm. (Bent, 1922, 124).

Distribution: Breeds only at San Benito Island, off the Pacific coast of Lower California. Known from the vicinity of its nesting ground, the Gulf of California, Mazatlán, Panama, and the coast of Ecuador.

The only South American record for this relatively little-known species is that of Salvadori and Festa (1900, 48), who captured a male and a female of the Least Petrel in latitude 1° 30′ N., off the coast of Ecuador, during the month of February. The birds flew aboard the steamship 'Quito' during the night, attracted by the electric lights.

The only known breeding ground is San Benito Island, where eggs have been taken during July, August, and early September, and newly hatched young between August 12 and September 8. The eggs are not laid in burrows but in bare sites under slabs of rock, or in the crevices and niches of ledges where only subdued light can reach the incubating bird. The call-notes of the Least Petrel are said to resemble the whirring of a rapidly revolving cogwheel (Anthony, 1925, 285).

GALÁPAGOS STORM PETREL

Oceanodroma tethys tethys

Thalassidroma Tethys Bonaparte, 1852, Beilage no. 7, Tagebl. Deutsch. Naturf. und Aerzte, Wiesbaden, p. 89 (Galápagos Islands).

Names: This species has apparently always been listed under its correct specific name.

Characters: Very similar in appearance to the European Storm Petrel (*Hydrobates pelagicus*), but with a forked instead of a square tail and with all white instead of black-tipped upper tail coverts. In consequence of the latter condition, the white rump of the Galápagos Storm Petrel is triangular rather than nearly rectangular.

Adults (sexes alike): Sooty black, with a slight plumbeous gloss in fresh plumage, the ventral surface a little less dark, or more grayish, than the back; greater wing coverts brownish (or rapidly

becoming so with wear) forming a wing-patch; lower rump and upper tail coverts white, with hair-like black shafts; a small white patch at the sides of the vent; quills of wing and tail black; entire lining of wing dark, like the breast. Iris brown; bill and feet black.

13 males and 9 females from the Galápagos Islands: wing, 129–139 (134); tail, 55–64 (59.5); exposed culmen, 12–14 (12.9); tarsus, 21–24 (22.8); middle toe and claw, 18–20 (19.4) mm.

Downy young are entirely gray, similar to those of *Hydrobates*.

An egg from Tower Island, Galápagos, believed to be of this species, is inclined toward an elliptical-ovate shape, white, with a few very minute dark dots so small and scattered as to be hardly perceptible. It measures 26.7 x 19.9 mm. (Loomis, 1918, 153).

Distribution: Breeds at the Galápagos Islands and ranges northward through the tropical Pacific at least to latitude 23° 32′ N., longitude 113° 4′ W., off the southern coast of Lower California, and southward to at least 4° 25′ S., longitude 93° 30′ W.

The American Museum Collection contains eight males and six females of this storm petrel from the vicinity of the Galápagos Islands, collected between the months of January and August, and one male taken a short distance southwest of Cocos Island on September 2. I have also examined the series in the Berlin and British Museums, including in all specimens from six islands of the Galápagos group. Measurements show that the typical race is consistently larger than the next subspecies, which is confined to the Humboldt Current region of the west coast of South America.

Most of our information regarding the Galápagos Storm Petrel is derived from the report of Loomis (1918, 151) which records observations made during the expedition of the California Academy of Sciences. On the voyage this species was encountered at sea between a position off the coast of Lower California, during July, southward to the Galápagos Archipelago from where it has been reported during every month of the year. It was also found well to southward of the Galápagos in June, 1906, but, in quoting various still more southerly records for the west coast of South America, Loomis has gone into the range of the well-marked subspecies of the Peruvian and Chilean littoral.

The Galápagos Storm Petrels nest in holes in the cliffs and among the lava blocks of Tower Island, and doubtless in similar situations at many of the other islands of the archipelago. Examples taken in April near Albemarle Island had enlarged gonads, indicating the advent of the egg-laying season. It seems probable from descriptive data on the labels that the height of the breeding period is reached in June. The only egg obtained by the California naturalists was an addled example found on September 15. A complete post-nuptial moult begins among these petrels in July and is completed by October. It appears likely that the nesting chambers are used as places of rest during parts of the year when the birds are breeding. The same phenomenon has been observed among other Procellariiformes at Gough Island, Tristan da Cunha, and elsewhere. It seems to be characteristic of the sedentary or stay-at-home members of species which ordinarily make migrations to parts of the ocean at considerable distances from their breeding headquarters.

The members of the California Academy Expedition report that these petrels are extraordinarily silent, even when following a vessel and picking up turtle fat or other food thrown overboard. Their flight is said to be butterfly-like and

more erratic than that of Lowe's Storm Petrel (*Oceanites gracilis galapagoensis*), with which they associate. Galápagos Short-eared Owls are their principal enemies so far as known, remains of the petrels being often found in pellets regurgitated by these birds of prey.

PERUVIAN STORM PETREL

Oceanodroma tethys kelsalli

Thalassidroma tethys kelsalli Lowe, 1925, Bull. Brit. Orn. Club, 46, p. 6 (Pescadores Islands off Ancón, Peru).

Names: Known in Peru as "Danzarín," though probably not distinguished from other small species of Mother Carey's chickens.

Characters: Averaging slightly smaller in all dimensions, particularly in wing-length, than the typical race of the Galápagos Islands. The describer, who refers only to the shorter wing, writes: "I think the fact that birds found along the western shores of Peru and in the neighbourhood of Panama appear to run smaller than the form from the Galápagos is sufficiently interesting to be recorded, especially as exactly the same thing occurs in *Oceanites gracilis*."

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
8 ♂, coasts of Peru and Ecuador . . .	122.4	56.6	12.7	21.4	18.6 mm.
6 ♀, including the type, same localities .	125.8	57.1	12.2	21.7	18.9
Minimum of the series	117	54	11	20	17.5
Maximum of the series	128	63	13	23	20

Chicks are clad in gray down (close to the deep neutral gray of Ridgway), the mesoptyle down being longer and more complex than the natal coat. At all stages they closely resemble the young of *Hydrobates*, the European storm petrel.

Six eggs from the Pescadores Islands, Peru, are of variable shape, ranging between short-ovate and elongate-ovate, white, without dots or marks of any kind other than slight stains, and measure: 26.1 x 20.6, 26.6 x 19.6, 27.1 x 19.6, 28.6 x 19.6, 27.8 x 19.2, and 27.7 x 19.9 mm.

Distribution: Breeding at islands off the coast of Peru (Pescadores and San Gallán), and ranging in the Humboldt Current to a distance of at least 300 kilometers from shore, between northern Chile and the coast of Ecuador, and perhaps northward to Panama.

The type specimen of this petrel, which is now in the British Museum, is one of a series collected by Mr. Beck during the Brewster-Sanford Expedition at the Pescadores Islands, off Ancón, a little to northward of Callao, Peru, between May 8 and 13, 1913. From this locality the American Museum has breeding adults, newly hatched nestlings, and eggs. Older nestlings were obtained at San Gallán Island, off Pisco, about two months later. Other specimens were collected to westward of the coast between Callao and Cañete, at distances as great as 300 kilometers offshore, during the months of May and June. On September 13, 1922, Dr. Chapman preserved four specimens which were not in a breeding condition, and which flew aboard his steamer at night in latitude 1° S., off the coast of Ecuador. Wetmore (1926, 52) obtained one in the same manner to westward of La Plata Island, Ecuador, on May 9, 1921. Dr. Lowe, the describer of the race, states that it evidently ranges at times northward to Panama, where a specimen was collected during the 'St. George' expedition. If this is of regular occurrence, the pelagic range of the Peruvian coastal race comes into close contact with that of the Galápagos race.

The differences between these two subspecies are very well marked, *O. t. kelsalli* averaging smaller in all dimensions than the typical form, the difference in length of wing being especially noteworthy. In fact, the maximum wing-length in *kelsalli* is less than the minimum measurement among more than 70 Galápagos specimens as recorded by Loomis.

Our September specimens from Ecuador are in fresher plumage than the breeding Peruvian birds taken during midwinter (May–June). The former lack the pronounced wing band, which develops with wear and results from disintegration and bleaching of the tips of the greater coverts. Among some of the incubating adults from Peru the moult of the wing quills is just beginning.

Beck first found these petrels nesting on small islets known as Guaca and Gallinazo, of the Pescadores group, during early May. The nest sites were situated in crevices between boulders and slabs of rock, at a distance of a half meter or more from the chinks by which the petrels entered. No nest was constructed, other than a slight hollow scraped in the soil and guano that had sifted into the crack. Nests of Inca Terns and Peruvian Diving Petrels were in close proximity among the interstices of the rock, while above several of them boobies and cormorants were nesting in droves.

Curiously, Beck saw practically none of these petrels over the ocean in the neighborhood of the Pescadores Islands, although Fuegian and Elliot's Petrels were about in flocks. He encountered *kelsalli* chiefly while cruising a long distance from shore. Large numbers were observed near the Hormigas de Afuera Islets on June 4, and others still farther westward during the next week. Beck noted that this species flies in the typical *Oceanodroma* manner "with longer wing strokes, perceptibly slower than those of Wilson's Petrel, and more like a Night-hawk." I have myself likened the flight of other species of *Oceanodroma* to that of a Night-hawk (*Chordeiles*), as the best character by which it can be told at long range from the aërial movement of *Oceanites*.

The chicks of this petrel are practically indistinguishable from those of *Hydrobates*. The size and probable age of fledglings taken at San Gallán Island, on July 3, when correlated with the eggs and newly hatched young found at the Pescadores in early May, would indicate a similar rate of development. The incubation period of *Hydrobates pelagicus* is known to be not less than five weeks, after which the young bird remains in the nest for at least eight to nine weeks more.

Wetmore (1923, 170) has received a female Peruvian Storm Petrel taken during the evening of November 17, 1922, at a point about halfway between Iquique and Cobija, Chile, by Mr. Fagan, wireless operator of the S. S. 'Santa Elisa.' Paessler (1914, 273) also records the race in latitude 20° 6′ S.

MADEIRAN STORM PETREL

Oceanodroma castro castro

Thalassidroma castro Harcourt, 1851, Sketch of Madeira, p. 123 (Desertas Islets, Madeira).

Names: Harcourt's Petrel. "Andorinha das Tormentas" is recorded as a vernacular name in Brazil, though it probably applies to any small petrel. Synonyms of the specific name include *cryptoleucura* and *jabe-jabe*, the latter being one of the native names at the Cape Verde Islands; *melanogaster* has also been used through erroneous identification.

Characters: Distinguishable from *Oceanodroma leucorhoa* by its slightly lesser size, square tail, and the fact that the white upper tail coverts are always black-tipped and the bases of the outer tail feathers white. I have learned no way to distinguish these two species apart in the field.

Adults (sexes alike): Sooty black, with a plumbeous gloss in fresh plumage; upper tail coverts white, with broad black tips, some of the center feathers with a subterminal black spot; outer tail quills basally white; wings mostly black, but the greater coverts and inner secondaries somewhat ashy and narrowly fringed with white; head and neck more ashy than the back; ventral surface inclining toward sooty brown; lateral under tail coverts white, or white shaded terminally with ashy; a patch of white feathers on the lower flanks uniting with the white under tail coverts. Iris brown; bill and feet black.

12 males and 2 females from the Cape Verde Islands, Ascension, and St. Helena: wing, 147–159.5 (153.7); tail, 68.4–78 (72.7); exposed culmen, 14.5–16.5 (15.5); tarsus, 22.2–23.5 (22.8); middle toe and claw, 21–23.5 (21.8) mm.

The range in dimensions among birds from any one of the above localities is practically as great as that from all of them. The wing-expanse of 10 examples in the flesh ranged between 440 and 495 mm.

Chicks from Ascension are clad in down of a deep mouse-gray hue. The second down is apparently slightly darker than the protoptyle coat.

Two eggs from Razo, Cape Verde Islands, are pure white and measure 31 x 24 and 31 x 23.6 mm.

Distribution: Breeds throughout a wide sub-tropical and tropical belt in the eastern and central Atlantic, including the Azores, Salvajes, Cape Verde Islands, Ascension, and St. Helena; ranging to various parts of the coast of America, at least when transported by tropical storms, and recorded from the vicinity of Pará, Brazil. Identical or closely related petrels are found in the eastern tropical Pacific.

The Madeiran Storm Petrel is apparently only a straggler to the coast of America, but it has an extraordinarily wide breeding distribution among Atlantic islands both to northward and southward of the equator, these varying, moreover, in climatic status between tropical Ascension and the north-temperate Azores. The closest nesting station to South America is probably Ascension, and the species has been recorded by Snethlage (1914, 77) from Pará, Brazil, upon the basis of two specimens. In Part I of this book I have discussed the frequency with which the Madeiran Storm Petrel has been carried by cyclonic disturbances to the southerly coasts of North America, and even to such high latitudes as the interior of Canada.

Like so many of the other petrels, this species varies its nesting habit according to circumstance and either burrows into soft soil or makes use of chinks among the rocks. Both styles of nesting are represented, for example, in the Cape Verde Islands (Murphy, 1924, 237).

During the South Atlantic Expedition of the Cleveland Museum of Natural History, the Madeiran Petrel was collected at two South Atlantic islands, namely, Ascension and St. Helena. At the former locality it was found breeding on Boatswain-bird Islet, where downy chicks were taken on December 8. In all probability an egg recorded from a rock crevice of the same locality by Penrose (1879, 282) referred to this species, although that author listed it tentatively under the name "*Procellaria melanogastra*." At St. Helena the Cleveland Museum party obtained nesting examples during October, and at the Cape Verde Islands in April. Meliss (1875, 97) was doubtless referring to this species when speaking of a small Mother Carey's chicken which lays its egg at St. Helena in November.

BANGS'S STORM PETREL

Oceanodroma castro bangsi

Oceanodroma castro bangsi Nichols, 1914, Auk, 31, p. 388 (latitude 1° N., longitude 93° W., just northwest of the Galápagos Islands).

Characters: Alleged by the describer to have a heavier and more strongly hooked bill than the typical race of the Atlantic. The status of the form can be determined only after further comparison of adequate series from both oceans.

27 males and females from Galápagos waters: wing-expanse, 455–485 (467); wing, 148–166 (157); tail, 65–74 (70); fork of tail, 3–12.5 (7.8); exposed culmen, 14–16.3 (15.4); depth of maxilla, 4.5–5.6 (5); tarsus, 19–22.4 (21); middle toe and claw, 20.1–24.6 (22.8) mm. (Loomis, 1918, 159).

The natal down of chicks is mouse-gray, the secondary down of somewhat darker tone.

Two eggs from Cowley Islet, Galápagos, are white, more or less discolored through incubation, ovate and elliptical-ovate, respectively, and measure 32.4 x 23.4 and 33 x 21.4 mm.

Distribution: Breeds at the Galápagos, and probably at Cocos Island, and has been taken in waters adjacent to each.

No one has yet brought together a sufficient number of specimens of *Oceanodroma castro* from the eastern Atlantic, the Galápagos district, and the Hawaiian district, to determine the status of the three subspecies which have been proposed.

The species as a whole has long been pointed out as exemplifying sea-bird distribution which antedates the latest junction of North and South America through the uplift of the Middle American land-bridge. Such suppositions, however, deal rather irresponsibly with enormous periods of geologic time—going back, indeed, well into the Tertiary. To be sure, *castro* occupies a broad median oceanic belt, which extends from the Azores and St. Helena on the east to Hawaii on the west. We must remember, however, that a bird which is not infrequently carried by tropical storms from the eastern Atlantic to the Caribbean and even to the interior of North America might, through similar agencies, be forced to cross the Isthmus of Panama, and thus come to populate parts of the Pacific.

The subspecific merits of the birds inhabiting the Galápagos region can be determined only through additional research. However, since the Pacific part of the population seems to be extremely isolated from that in the Atlantic, it may for the present be separately considered.

The eastern Pacific bird is known chiefly through the investigations of the California Academy of Sciences, as reported upon by Loomis (1918, 156). The petrels were noted in the vicinity of many islands of the Galápagos group throughout the year. Examples with enlarged sex organs were collected during May, and a breeding colony was discovered at Cowley Islet, east of Albemarle Island, on August 13, 1906. The eggs were deposited in slight hollows in the soil, among boulders or inside small caverns. Downy chicks were found on the same date.

LEACH'S PETREL

Oceanodroma leucorhoa leucorhoa

Procellaria leucorhoa Vieillot, 1817, Nouv. Dict. Hist. Nat., 25, p. 422 (Picardie, France).

Names: Fork-tailed Petrel. Synonyms of the specific name include *leachi*, *bullocki* and *scapulata*.

Characters: Probably indistinguishable over the ocean from the Madeiran Storm Petrel, from which it differs in the pronounced forking of the tail and in that the bases of the outer rectrices are dark rather than white.

Adults (sexes alike): Sooty black, with a plumbeous gloss in fresh plumage, the upper tail coverts usually, though not always, entirely white, forming a distinct patch; median and greater wing coverts drab-brown, becoming more definitely and extensively so with wear and abrasion, and thus producing a pronounced wing band; greater coverts and inner secondaries narrowly margined with whitish; a few more or less white feathers on either side of the rump; quills of wing and tail mainly black, the inner secondaries somewhat brownish, and the wing-lining somewhat ashy brown; ventral surface generally browner than the dorsal, the gray or plumbeous cast being most conspicuous on the throat, face, and sides of neck. Iris brown; legs and feet black.

Adult birds exhibit wide variation in the amounts of white and black on the upper tail coverts. In some birds these feathers are entirely white, while other specimens show broad dark tips almost like those of *O. castro*. Some coverts are parti-colored on opposite vanes, and some show hardly a trace of the black hair-like shafts. One of the breeding petrels from Bird Rock, Gulf of St. Lawrence, has coverts which are nearly all dark, except for the lateral feathers; a Greenland specimen also has a large admixture of dark feathers. Such departures from the white-rumped condition are paralleled among the other subspecies of *O. leucorhoa*. Among Atlantic specimens in good plumage, the fork of the tail amounts in some instances to as much as 25 mm.

The following measurements are based upon birds from South Greenland, Newfoundland, Quebec, New Brunswick, Long Island, N. Y., the South Atlantic (latitude 3° 15′ S., longitude 33° 40′ W.), the eastern tropical North Atlantic, and the Mediterranean.

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
8♂	157	82.4	16.9	24.5	25.3 mm.
5♀	156.6	78.8	17.1	24.2	24.7
Minimum of the series	153	76	16	23	23
Maximum of the series	164	85	17.8	26	26

Long series of figures for both Atlantic and North Pacific birds, as published by Loomis (1918, 165) and others, agree essentially with these.

The wing-spreads of four specimens taken in the tropical North Atlantic during December measured between 438 and 470 mm.

Distribution: Breeds on both sides of the North Atlantic Ocean from Massachusetts and the Mediterranean northward to Newfoundland, southern Greenland, and Iceland; in the Pacific on Alaskan islands, the Aleutian, Commander, and Kurile Islands. Migrates southward in winter across the equator in the Atlantic Ocean and the eastern Pacific.

Leach's Petrel reaches South America chiefly as a winter migrant from the north, although it is likely that both first-year and senile birds may be found within the tropics at all seasons. During late April, 1913, I collected and observed numerous examples south of the equator, in waters near Fernando Noronha and Rocas Reef. Their "springy" flight distinguished them even at long range from the Wilson's Petrels which were also about in numbers. Furthermore, the Leach's Petrels settled very frequently on the water, holding the tips of their wings high while they swam about for a few moments at a time. In the Berlin Museum I have examined a male taken midway between Fernando Noronha and St. Paul Rocks on February 26. During October, 1912, I also collected birds which came aboard the brig 'Daisy' in the tropical Atlantic, about halfway between St. Paul Rocks and the nearest part of the African coast. The species has been recorded from the middle of the Caribbean Sea on June 19 (Wetmore, 1923, 170), from near Barbados (Murphy, 1915, 172), and from the coasts of British and Dutch Guiana (Chubb, 1916, 86).

On the Pacific side of the continent, three specimens were collected by the California Academy Expedition to southward of the Galápagos Islands, on June 11, 1906 (Loomis, 1918, 164). Several races of this petrel have been described from the west coast of North America, and Loomis gives no opinion as to which of these the southern-hemisphere examples represent. Their dimensions are, however, as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
♂	150	76	17	22.3	25.7 mm.
♂	153	73	16.5	23.9	24.3
♀	156	77	16.5	22.7	24.5

These figures, allowing for the slight difference in the length of the tarsus which I usually find between Loomis's measurements and my own, indicate that the birds are of the typical or northernmost race, *leucorhoa*, which evidently enters the southern hemisphere in the Pacific exactly as in the Atlantic.

I have mentioned above the distinctive style of flight of Leach's Petrel—distinctive, that is, of the genus rather than of the species. As I was perhaps the first to point out (*l. c.*, 171), this differs so strongly from that of Wilson's Petrel that the two can be told apart practically as far as they can be seen. This is confirmed by Wynne-Edwards (1935, 279), who states that Leach's Petrel does not habitually follow ships, and adds that it

> . . . springs and bounds through the air in the strangest erratic manner, now gliding like a miniature shearwater, now beating on buoyant wings like a nightjar, or turning with incredible swiftness as it is caught and borne on a stronger gust down the breeze.

The studies and careful compilations of Wynne-Edwards indicate that the Leach's Petrels do not usually return to their breeding grounds in northeastern North America until well into the month of May. Perhaps they linger for a time offshore, for the early but excellent account of Ambrose (1864, 34) states that the Nova Scotian fishermen on the route toward the West Indies were accustomed to encounter the vanguard along the edge of the Gulf Stream during the latter part of March. Before the end of June the birds occupy their insular breeding stations in the Maritime Provinces and eastern New England, in the vicinity of which they remain until September or later. At all times they seem to be absent or scarce in the middle reaches of the North Atlantic. Adults taken on their southward passage immediately after the end of the breeding season are almost invariably found to be undergoing a full moult of the quills. Replacement of the body plumage is, on the other hand, pre-nuptial.

Much remains to be learned about the courtship and territorial relations of the Leach's Petrels. Research carried on during several years by Gross* and

*As this work goes into page proof, the extraordinarily illuminating study of the life cycle of Leach's Petrel by W. A. O. Gross (1935, 382) appears in 'The Auk.' The communication becomes essential to an understanding not only of this species but of the habits and reactions of all the Mother Carey's chickens, and of petrels in general.

others may ultimately make the species the most studied and best known of storm petrels, but the findings have not yet become available. A point of special interest, concerning which further information is awaited, has to do with the fact that male birds are so frequently to be found alone in the nest-chambers before the appearance of the egg, and that they perhaps also carry the major share of incubation.

The nest of this storm petrel may be made among deep recesses of rocks or excavated in soft, damp soil, sometimes in the floor of a forest-covered island, again in a bare field or pasture. The galleries usually run more or less zigzag, parallel with the surface of the ground, and at a depth of 15 centimeters or so beneath it. Their course is naturally altered by obstructions such as stones and roots. A little nest material in the form of pebbles, feathers, grass, or leaves is sometimes used, but eggs are also commonly laid directly on the soil. Normally the members of a family come and go only after nightfall, and I have always discovered, to my surprise, that the birds are rarely to be found by day in waters close to their nesting grounds. Along the coasts of Maine and Nova Scotia, Wilson's Petrels, which are migrants from the other end of the world, may be seen during the summer in every bay and cove, as well as through a broad littoral belt, while one may search the same waters in vain for the species which lives on these very shores and makes the earth ring with curious sounds at night.

In digging the burrows, according to Ambrose, Leach's Petrel uses its bill as a pick and then kicks the loose earth out very rapidly, working one webbed foot after the other, and thus pressing and wallowing along with the soil flying out behind. When the roofs are lifted from their burrows by human hands, the birds cower back into dark corners and, if disturbed further, they sometimes squirt the familiar oily fluid from their throats and nostrils. After the appearance of an egg, only one petrel is to be found at the nest, the relief between mates taking place under cover of darkness. The twittering of the petrels below ground sounds like the squeaking of mice. It may go on through much of the night, but it ends abruptly before sunrise. A few days after the hatching of the chick, both parents cease to remain at the nest, coming only at night to feed their offspring. The young Leach's Petrels, according to Norton (1891, 50), lie at full length in the nest-chamber, with the tip of the bill resting on the ground and the feet extending forward beneath them. In this position only their rapid breathing testifies that they are alive. The protoptyle down is of grayish sooty brown, slightly paler on the ventral surface, soft and long, covering the entire body except the lores, the region around the eyes, and the chin and upper throat. The second down thinly covers these areas, where it remains shorter than elsewhere; over most of the body it inclines to be slightly darker and of closer texture than the first down.

Norton says the adults return during incubation very early in the evening to relieve their mates, the first nasal petrel squeaks coming just after the last tern's voice is hushed. The hour doubtless varies with the sun; Forbush (1928,

146) found on a July evening at an islet off the coast of Maine that the petrels did not begin to return until about nine o'clock. After this, "tender chucklings, crowings, stammerings and formless sounds that seemed like billing and cooing filled the air." These notes, which might be called the song of greeting or arrival, were succeeded later in the night by a different chorus, softer and more liquid, which was probably uttered at the mouths of the burrows.

The following description by Norton (1921, 1) of a night among the breeding Leach's Petrels not only gives an impression of their voices, but also probably presents a pattern of general behavior applicable to many other species of Mother Carey's chickens about which we know even less than of this one.

> Here within Night's dominion in the midst of a no less funereally garbed throng of flitting forms, seeming to speak most earnestly in a subhuman, unknown tongue, which is answered by their encaverned mates in purring tones and pleading wails, the mind may readily picture a most animated gathering of the black elves of old, hurrying to and fro for the accomplishment of some important mission, ere dreaded Day begins . . . .
>
> The wide-ranging birds from the sea have returned to land to relieve their brooding mates, and the air seems full of them, calling on every hand; the scene seems a hopeless chaos of activity, but soon by careful observation it is resolved to one of orderly purpose. As each flying bird passes over its nest, it calls in a hurried gibberish, to be answered by its brooding mate in an energetic purr often ending with a coaxing wail; the flying bird dashes on and swings away to leeward again coming up the wind, and again as it passes its nest calls as before to be answered again; time and again this is repeated, each passage over the nest finding the flying bird lower and lower in its flight, until it finally drops to the entrance of its burrow to meet its anxious mate. Now from the dank weeds and grass, like great June bugs others are rising, or crawling to a convenient place to rise. One is in the very midst of their activities. From one's feet to twenty feet overhead they swarm, often dashing against one's person in their haste.
>
> But with the coming of the dawn, calm, damp and chill, this strange vision of the night has faded as a dream.

Do the nocturnal habits of these birds make them utterly strange to the creatures of the day at their nesting grounds? Forbush noted on several occasions that when Leach's Petrels were released in the daytime on islands at which gulls or terns were breeding, the appearance of the petrel on the wing at once silenced their cries, and caused them to fly away. This is particularly curious, since the presence of a hawk, an owl, or a cat will cause gulls and terns to swarm with a great outcry to assail the intruder, "but the small and apparently inoffensive petrel is avoided as if it were ghost or banshee."

Ambrose found that the musky smell of the Leach's Petrels so permeated Green Island, Nova Scotia, that it was perceptible even at a good distance to windward, while light breezes sometimes carried the odor as far as 25 kilometers to leeward.

Definite stomach contents of this species include small fish, copepods, amphipods and other crustaceans, and cinders. Elsewhere I present evidence to show that certain storm petrels feed actively at night. Wynne-Edwards suggests, however, that Leach's Petrel may be wholly diurnal while at sea, citing as evidence a bird which fell on the deck of a ship, and which, although completely quiescent through the hours of darkness, became extremely active as the first streaks of dawn appeared.

MARKHAM'S STORM PETREL

Oceanodroma markhami

Cymochorea markhami Salvin, 1883, Proc. Zoöl. Soc. London, p. 430 (latitude 19° 40′ S., longitude 75° W., off Pisagua, Chile).

Characters: An "all black" storm petrel (*i. e.*, without a white rump); difficult to distinguish in life from *Loomelania melania*, from which it differs chiefly in having a much shorter tarsus.

Adults (sexes alike): Dorsal surface sooty black, with a pronounced plumbeous gloss on the head, neck, and mantle, in fresh plumage; ventral surface, caudad from the neck, and wing-lining blackish brown, becoming almost fuscous with wear of the plumage; scapulars narrowly edged externally with whitish; most of the wing coverts hair-brown, the external edges rapidly whitening with wear, producing a conspicuous and broad grayish bar which usually extends much closer to the wrist or bend of the wing than the somewhat similar mark in *Loomelania melania;* upper tail coverts grayish basally and with white shafts for half their length (unlike the condition in *Loomelania*). Iris brown; bill and feet black.

Measurements of 12 specimens are as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
6♂, coasts of Chile and Peru	172.7	92.7	18	23.9	25.6 mm.
5♀, coast of Peru	169.8	89.4	18.1	24.2	25.1
♀, Type, off Tarapacá, Dec., 1881	175	92	17.5	25	24.5
Minimum of the series	163	87	16.8	23	23
Maximum of the series	181	97	19	25	25

The fork of the tail in birds of good plumage ranges from 30–34 mm.

An egg taken from a bird shot over the ocean 75 to 80 kilometers west of Huacho, Peru, on June 13, 1913, is pure white, smooth-surfaced but without gloss, and measures 34 x 23.9 mm.

Distribution: Coastal and offshore waters of Peru and Chile, to a distance of at least 300 kilometers from the coast; occurring regularly in the Humboldt Current between latitude 33° S. and northern Peru, and known to migrate into the North Pacific as far as the vicinity of Clipperton Island. Breeding ground unknown.

Present knowledge about Markham's Storm Petrel is highly anomalous. We are, for example, well acquainted with its range at sea. We know from the collections and notes of Mr. Beck that its breeding season comes during the southern-hemisphere winter, for the females he shot in latitudes close to that of Callao, during the first half of June, 1913, were at the point of laying eggs, and both sexes were, characteristically, undergoing a moult of the quills at the same time. One example taken far offshore on June 13 contained in its oviduct an egg "ready to lay to-night," as Beck expressed it on the label. This egg, with a completely formed shell, is the one I have described and measured, as noted above. Yet despite the fact that we have a fully labeled egg of this petrel, and all of the other data just mentioned, the whereabouts of its nesting grounds is still wrapped in a mystery which is deepened, rather than clarified, by Beck's discovery.

Most of the islands off the Peruvian coast have been thoroughly examined, the only exception being the little cluster called Hormigas de Afuera which lies 67 kilometers to westward of Callao, with its ledges rising not more than 8 to 9 meters above the level of the ocean. It seems incredible that a species as numerous as Markham's Petrel could possibly have its principal breeding center

in such an insignificantly small bit of territory. Nevertheless, certain other petrels are known to have an existence which hangs by a similar slender thread, and Hormigas de Afuera deserves an early investigation of its bird life during the months of June and July. It is, of course, possible that Markham's Petrel nests on no islands whatsoever, but rather in remote and inaccessible parts of the maritime cordillera, as Hornby's Petrel is believed to do.

Due to a hasty and unfortunate identification of which I was guilty, Chapman (1926, 183) has recorded three examples of this species from the coast of Ecuador. On subsequent examination of the material, I learned that the specimens are in reality examples of *Loomelania melania*, a migrant from the North Pacific. Markham's Petrel, however, must also pass the Ecuadorian coast, for Loomis (1918, 174) has recorded the species in latitude 13° 28′ N., longitude 108° 52′ W. (northwest of Clipperton Island) on August 1, 1905, and just south of Cocos Island a month later.

The American Museum Collection contains about fifty specimens of Markham's Petrel taken during the Brewster-Sanford Expedition, including a number from approximately the type locality, off Tarapacá. We also have two males collected by Mr. Charles L. Fagan in latitude 25° S. (north of Taltal), on October 15, 1925. Beck's southernmost record is represented by a bird taken on the voyage between Valparaiso and Juan Fernández, during early December, 1913, at a distance of more than 150 kilometers from the Chilean coast. Paessler (1913, 49; 1914, 277) and Wetmore (1923, 170) have reported on this petrel from various points off the southern Peruvian and northern Chilean coasts. I found it common between Mollendo and Pacasmayo during the first half of January, 1925, and later saw others off Point Pariñas and Talara. When, however, the countercurrent, El Niño, began to flow southward, stopping upwelling and raising the temperature of the coastal water, Markham's Petrels seemed to be replaced in this region by the Black Petrels (*Loomelania*). On other occasions I have seen Markham's Petrels close to Macabí Island, and in a flock off the southern point of Lobos de Tierra, but it is unlikely that either of these islands is a breeding station of the species.

Beck's notes report Markham's Petrels in company with Hornby's, and also with *Oceanites oceanicus*, *Oceanites gracilis*, and *Oceanodroma tethys*. He found the style of flight of each of these birds to be fairly distinctive, that of *markhami* being described as slow beats, with frequent lifts to a meter or more above the water, and then a sail. Both species of *Oceanites*, in contradistinction, flew with more rapid beats, followed by a shorter sail.

Peters (1931, 73) and certain other recent writers treat Markham's Petrel as conspecific with *Oceanodroma tristrami*. I believe, however, that there are no adequate grounds for regarding these two birds as other than thoroughly distinct species. *Oceanodroma markhami* has also been confused occasionally with *Loomelania melania*, an error I myself have made, as noted above. The latter two species are of approximately the same size, but the different lengths of their respective tarsi show that they are far apart in structure and relationship.

In the British Museum I have examined the type specimen of *Oceanodroma*

markhami. It bears no sex mark, but the describer states that it was a female. The data on the label agree with the original description. Godman (1907, 27), through a slip of the pen, reports an erroneous position which would locate the *terra typica* in the heart of the Peruvian Andes. The coast off which the type was actually taken should be called Chile, although it was Peruvian territory at the date of the original description.

HORNBY'S PETREL

Oceanodroma hornbyi

Thalassidroma Hornbyi G. R. Gray, 1854, Proc. Zoöl. Soc. London for 1853, p. 62 ("northwest coast of America" = west coast of South America).

Names: A synonym of the specific name is *collaris*.

Characters: A highly distinctive, gray-backed, white-breasted storm petrel, with a pronounced collar across the breast, a dark cap, and a deeply forked tail.

Adults (sexes alike): Crown, nape, and circumorbital region dark neutral gray, forming a pronounced cap; back and interscapular region neutral gray, continuous with a slightly more brownish band encircling the breast and becoming mouse-gray or somewhat darker toward the mid-line; a whitish transverse stripe on the upper back, just caudad to the nape, is produced in certain specimens by wear of the feathers; back and proximal wing coverts close to fuscous, the median and distal coverts hair brown or ashy brown, these as well as the outer edges of the secondaries and scapulars fringed with whitish; rump like back, blending into grayish upper tail coverts, which are basally and laterally whitish; wing quills dark blackish brown, those of the deeply forked tail somewhat grayer but without white except at the extreme bases of the feathers; forehead, lores, throat, sides of neck, and entire ventral surface, including the under tail coverts, white, with a few obscurely grayish feathers on the flanks; axillaries and wing-lining gray, in some instances with whitish borders to the feathers. Iris brown; bill and feet black.

The following table of measurements is based upon the type specimen, 19 others collected off central Peru during June, and 2 from Ecuadorian waters collected, respectively, in September and January.

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
11 ♂	161.8	82.4	18.8	26	25.3 mm.
10 ♀	161	90	18.6	25.7	25.1
Sex?, Type	168	96	17	26	23.5
Minimum of the series	157	76	17	24.5	23.5
Maximum of the series	169	96	19.2	27.5	27

The average lengths of wing and tail in this series may be somewhat less than normal, for most of the Peruvian specimens are in exceedingly worn plumage, with replacement of the quills just beginning.

Young Hornby's Petrels are known only from one or more natural mummies found in Chilean nitrate pampas, and the down has not been described. The egg is still unknown.

Distribution: Breeds presumably in the coastal desert mountains of Chile, and occurs along the west coast of South America, mainly to westward of the coolest upwelling water in the Humboldt Current. Recorded from between latitude 1° S., off Ecuador, and 32° S., off Chile, and to a distance of 300 kilometers or thereabouts offshore from the coast of Peru. Northern-hemisphere records are probably erroneous.

In 1922 I published an account of the fifty specimens of the hitherto little-known Hornby's Petrel which had been taken by Beck during June, 1913, off

the coast of Peru, between the latitudes of Ancón (11° 47′ S.) and Cerro Azul (13° 4′ S.), but mostly far from shore (Murphy, 1922, 60). In the same paper I referred to Philippi's probable record of the nesting of the species in the mountains to eastward of Taltal, Chile, and also to Paessler's capture or identification of examples along many parts of the South American coast between Islay, Peru, and Coquimbo, Chile.

Since the date of the paper referred to, I have observed Hornby's Petrel 30 kilometers west of Point Pariñas, Peru, on January 21, 1925; Wetmore (1923, 170) has published notes about examples taken near the Lobos Islands, Peru, during July, September, and November; and Chapman (1926, 183) has recorded a specimen collected off the Gulf of Guayaquil, on January 16, 1925, and another which flew on board his steamer in latitude 1° S., off the Ecuadorian coast, on September 13, 1922. The last-named bird was a female with reduced ovaries. Chapman writes that on the date of its capture many petrels of the species were noted along the steamship lane between the southern side of the Gulf of Guayaquil and the equator. The southernmost records for the species still seem to be those of Paessler (1913, 43), who knew this unmistakable bird very well, and who observed a few only a short distance to northward of Valparaiso in mid-July, and of Beck, who saw two together about halfway between Valparaiso and Juan Fernández early in December, 1913. A bird representing a more southerly station than any of the Brewster-Sanford specimens is one I have examined in the Field Museum of Natural History, which was captured off the international border between Peru and Chile on July 30, 1924.

From all of these data it would appear that there is little or no indication of seasonal movement. Hornby's Petrel seems likely to occur at any period of the year in any part of its range which, so far as known, is roughly the Humboldt Current zone between Valparaiso and the neighborhood of the equator.

Mr. Beck first became acquainted with Hornby's Petrel in the waters about Hormigas de Afuera Islets, on June 4, 1913, a fact which emphasizes once more the desirability of investigating these bare rocks, of which our ornithological knowledge still amounts to almost nothing. Unlike Markham's Petrels, however, the Hornby's Petrels taken in this vicinity were evidently not about to breed, for the notes on all the labels describe the gonads as small. Throughout the remainder of this month of June, which proved so eventful in the discovery of new or little-known sea birds, Beck constantly encountered Hornby's Petrels in company with many other small species but always well offshore, to wit, at distances between about 40 and 300 kilometers from the continent. Most of the specimens collected had recently completed moult and renewal of the flight feathers, though some of them were still midway in the process. Not a single example yielded any information as to the probable date of the breeding season.

Beck's notes describe the flight of Hornby's Petrel as typically *Oceanodroma*-like, a few rather slow strokes being followed by a period of scaling. Chapman, however, who observed the birds flying in a stiff breeze south of San Gallán

Island, on June 23, 1916, writes that this species is "the most erratic flier I have ever seen . . . like a bat, swift, and nighthawk in one. They were skimming here, flitting there, then suddenly swung off with the wind a hundred yards or more so quickly one nearly lost sight of them" (Murphy, 1922, 62). An item in Beck's notes states that they were particularly conspicuous during hours while the sun was still low, because their white breasts shone like silver as the birds darted back and forth among the various species of black or black-and-white petrels. The only example which I have ever watched at close range was feeding while working up the wind, and it seemed almost to be creeping along the surface of the water as it rounded the bow of my launch at a distance of only a few paces.

Since the date of my earlier publication, Stresemann (1924, 61) has added certain information of great interest regarding the probable breeding habits of this species. He has received at the Berlin Museum a petrel mummy of recent age, which he believes to be an example of *Oceanodroma hornbyi*. It was found in December, 1923, as a result of the blasting of a saltpeter pit near Santa Luisa, Chile, a locality on the nitrate pampa about 50 kilometers from the coast and 1600 meters above the level of the sea. The mummy is in excellent condition, with the skin and horn still clinging to the legs and beak, with much of the plumage, including the shafts of the wing and tail quills, well preserved, and the skeleton entirely undamaged. Stresemann refers to Philippi's earlier records of two examples from the same general region, one of which was a chick still covered with down.

Wherever Hornby's Petrels nest, it seems almost certain that they must congregate in very large numbers during the appropriate season, or else that their breeding area is extraordinarily large. The discovery of the nesting grounds, and the ultimate working out of the life history offers, therefore, a problem of extraordinary fascination.

The stomach of a Hornby's Petrel collected off the coast of Ecuador was filled with small fish (Chapman, 1926, 183).

BLACK PETREL

Loomelania melania

Procellaria melania Bonaparte, 1854, Compt. Rend. Acad. Sci. Paris, 38, p. 622 (coast of California).

Names: A synonym of the specific name is *townsendi*.

Characters: Largest of the wholly black storm petrels of the west coast of America. A long-legged, *Oceanodroma*-like species, with a deeply forked tail, the distance between the tips of the shortest and longest rectrices amounting to as much as the length of the tarsus (approximately 32 mm.).

Adults (sexes alike): General color sooty black on the dorsal surface, warm blackish brown ventrally; scapulars and median and lesser wing coverts paler brown externally, with an almost whitish edge, a condition enhanced by rapid fading and disintegration of these borders; quills of wing and tail, and primary coverts, black, always with a rich fuscous or almost reddish tone; head, neck, and mantle with a slight plumbeous gloss in fresh plumage only; wing-lining like belly, an almost rusty brown which contrasts with the blackish brown border of the wing. Iris brown; bill and feet black.

The measurements of a series from near California breeding grounds, in comparison with those of a series from the tropical Pacific between Panama and northern Peru, are as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
5 ♂, San Benito and Coronados Islands, and off Monterey	171	82.6	15.9	32	28.3 mm.
5 ♀, Coronados Is.; San José del Cabo, L. C.	173	82.6	16	32.6	28.8
Minimum of the series of 10	168	80	15	31	27
Maximum of the series of 10	177	86	16.5	34	30
♂, Ecuador (lat. 1° S.), Sept. 13	170	87	16	33.2	28.5
♂?, Ecuador (lat. 1° S.), Sept. 13	168	84	15.5	33	27.5
Sex?, Ecuador (lat. 1° S.), Sept. 13	174	86	16	33	29
♂, W. of Pacasmayo, Peru (lat. 7° 30′ S.), Jan. 15	168	73	15	33	28
♂, Balboa, C. Z., March 24	161	78	17	32	28.5
♂, Balboa, C. Z., March 24	157	87	16	32	29

Both Panama specimens were moulting the quills, which accounts for the short wing, etc.

Chicks are covered with long, soft down of a uniform fuscous color, darker basally. The mesoptyle is darker than the protoptyle down.

The eggs are described as smooth and lustreless, white, usually unspotted, but sometimes with a faint suggestion of lavender or reddish speckles about the larger end. Measurements of 61 average 36.6 x 26.7 mm., examples exhibiting the four extremes being 38.5 x 25, 36.5 x 27.5 and 32.5 x 24.2 mm. (Bent, 1922, 157).

Distribution: Breeds at islands off Lower California (San Benito and Los Coronados), and migrates southward along the western coast of America at least to latitude 8° S., off northern Peru. (Erroneously recorded from Japanese waters.)

The Black Petrel is a very distinct bird from its nearest relatives. Although sharing many characters of the genus *Oceanodroma*, and having the same peculiar "leaping" style of flight, it is, nevertheless, a remarkably long-legged petrel. In the latter respect it constitutes a sort of nexus between the two groups of Mother Carey's chickens which were formerly divided into two families known, respectively, as the "Hydrobatidae" and the "Oceanitidae," or into subfamilies representing similar aggregations. Because of the peculiar morphology of the Black Petrel, particularly as shown in the length of its tarsometatarsus, I accept the generic name *Loomelania* recently proposed by Mathews (1934, 119), regretting, at the same time, the obscureness and bastard derivation of the word.

Mathews's characterization of the genus is as follows:

Tarsus longer than the middle toe and claw, and almost twice as long as the culmen; the tail is forked for over 20 mm., and is just less than half the length of the wing.

The axial skeletons and the bones of the wing show remarkably similar proportions among all the storm petrels. The bones of the legs, on the contrary, illustrate a wide range of diversity. The least variable element is the proximal one, as represented by the length of the femur. Among typical species of the genus *Oceanodroma*, the tarsometatarsus approximates a length of one and one-half times that of the femur. In *Oceanites*, a long-legged storm petrel, the tarsometatarsus is more than two and one-quarter times as long as the

femur. *Loomelania* represents an intermediate condition. The following table shows the relations among three elements of the leg in five species, the cnemial crest being included in the length of the tibia. In each instance the length of the femur represents unity.

	Femur	Tarsometatarsus	Tibia
Oceanodroma leucorhoa	(16.3 mm.) 1	1.48	2.31
Oceanodroma hornbyi	(15.35 mm.) 1	1.56	2.34
Oceanodroma macrodactyla	(18.2 mm.) 1	1.30	2.26
Loomelania melania	(17.45 mm.) 1	1.85	2.59
Oceanites oceanicus	(14.65 mm.) 1	2.33	3.42

Bonaparte's type of the Black Petrel, which is now in the Paris Museum, probably came from the vicinity of Los Coronados Islands, Lower California, which are still an important breeding station. Our knowledge of the winter range of the species has been extended successively southward to Guerrero and Panama, and recent expeditions of the American Museum of Natural History prove that the bird's migration carries it into the South Pacific, at least as far as the central Peruvian coast.

As noted in my account of *Oceanodroma markhami*, a misidentification, for which I was responsible, led Chapman (1926, 182) to record as that species three petrels from Ecuador which are in reality examples of *Loomelania*. Wetmore (1923, 170) has reported on two specimens taken near the Lobos Islands, Peru, on September 22 and November 24, respectively. Through a *lapsus calami* he speaks of the localities as "southern Peru," although they both lie close to latitude 7° S. In the same waters I saw very many Black Petrels on September 7, 1919, and between January 4 and 15, 1920. In the course of my field work along the coast of Peru during the latter period, I found the Black Petrels to be abundant along the warm-water side of lines correlated with abrupt changes of temperature in the northern part of the Humboldt Current region. During January and February of 1920, for example, *Oceanodroma markhami* was one of the common sea birds in the cooler upwelling waters close to the coast of the continent, while farther offshore it was replaced by *Loomelania melania;* to northward of Salaverry, in February, *melania* seemed to supplant *markhami* altogether and, coincidentally, the unwonted warmth of the water showed that an advance of the countercurrent had more or less changed the temperature of the littoral everywhere off northern Peru. The Black Petrels were likewise abundant from this region all the way to Panama. During a still more notable advance of the countercurrent, in March, 1925, I found Black Petrels feeding in the rain very close to desert shores that had begun to turn green, between Zorritos, Peru, and the Gulf of Guayaquil.

Hallinan (1924, 306) observed and collected examples close to the Pacific entrance of the Panama Canal, on March 24, 1915, a locality where I also observed the birds on December 4, 1924. Chapman found them abundant off the Gulf of Guayaquil in mid-September, subsequently capturing an example that came aboard his steamship in latitude 1° S., off the coast of Ecuador.

Under the name of this species, Kuroda (1922, 310) has tentatively described

a new race, *Oceanodroma melania matsudariae*, from Japanese waters. Comparison of this author's measurements with those of American birds shows, however, that he was not dealing with any form of *melania* but rather with a petrel characterized by a long wing, long tail, and very short tarsus. The recorded measurements approximate those of *Oceanodroma tristrami*. For example, Kuroda's figures for the length of the tarsus range between 26 and 28 millimeters. Those for specimens of *melania* are from 31 to 34 millimeters, despite the fact that the wings and tails are much shorter than in the Japanese birds referred to. It seems clear, therefore, that *Loomelania melania* is not yet known from localities far from the west coast of the Americas.

The habits of the Black Petrel at its northern-hemisphere breeding grounds are well described by Anthony (1898, 140; 1925, 287), Van Rossem (1915, 74), Howell (1917, 32), and Loomis (1918, 175). At the north island of Los Coronados group, off Lower California, this species has held its own, even though the competition of auklets and of a white-footed mouse (*Peromyscus*) has driven out some of the other nesting petrels. The Black Petrels breed in small scattered colonies or in isolated pairs, and they apparently make no original burrows of their own but use either the abandoned diggings of other birds or natural crannies among the rocks. For such reasons, perhaps, they are better able to stand the pressure of rivalry than are the burrowing and highly gregarious petrels. In some cases the nests of the Black Petrels may be close together among piles of slabs and boulders, but each pair seems quite as content to nest in remote situations. The birds may excavate a little earth to enlarge the home of which they have taken possession, but their only nests in actual burrows seem to be those they have preëmpted.

The nesting season is evidently prolonged, for eggs have been found between early June and September. The mating of the birds is under way at Los Coronados well before the end of April, and at this season the night air rings with their calls, which sound like *tuc-a-roo*, *tuc-tuc-a-roo*. The egg is laid on bare soil, without nesting material of any sort. Young have been noted as early as July 4, but eggs are not uncommon even as late as August 13. When disturbed, the Black Petrels act in the usual manner of their family, ejecting streams of orange-colored oil, striking savagely, and even biting their own wings in their rage.

The principal food of the Black Petrel near its breeding grounds seems to be composed of the larval free-swimming stages of spiny lobsters. Softer marine organisms have been reported by Hallinan, and the birds have been observed to dive well beneath the surface in search of their prey. Along the Peruvian coast they appear to be interested in refuse from steamers. Their principal natural enemies at the nesting grounds are falcons, and introduced creatures such as cats, rats, and mice.

GRAY-BACKED STORM PETREL

Garrodia nereis

Thalassidroma Nereis Gould, 1841, Proc. Zoöl. Soc. London for 1840, p. 178 (Bass Strait, Australia).

Names: In common with other small petrels, this species is in some places called Night-bird and Fire-bird. Synonyms of the specific name include *saltatrix* and *longipes*.

Characters: A small, square-tailed petrel resembling *Oceanites*, but lacking a white patch above the tail and with an entirely white belly.

Adults (sexes alike): General dorsal color ashy gray, darkest on head and nape, where it is somewhat sooty or brownish, and lightest on rump and upper tail coverts; feathers of mantle, scapulars, and adjacent wing coverts narrowly margined with white in fresh plumage; remainder of wing blackish, with a grayish or silvery gloss on the webs of the quills, and with narrow white terminations to the secondaries and inner primaries; the dark hair-lines of the feather shafts are more or less conspicuous over the entire dorsal surface, from mantle to tail; rectrices gray like the rump, with a broad blackish terminal band, least conspicuous on the lateral feathers; head, neck, and upper breast grayish black, slightly brownish on the forehead; remainder of ventral surface, axillaries, and inner wing coverts white, except for a few mottlings of gray on the feathers of the flanks and under tail coverts; marginal coverts of under-wing grayish black, like the outer surface. Iris brown; bill and feet black.

10 specimens of both sexes from the Falkland Islands and New Zealand seas: wing, 123–135 (129.2); tail, 59–66 (62.7); exposed culmen, 11.7–14 (12.9); tarsus, 30–34.5 (31.9); middle toe and claw, 24–28 (26.4) mm.

Young moult from Quaker drab mesoptyle down into plumage resembling that of the adult.

Eggs from the Falkland Islands are white with fine reddish dots which, as in so many other petrels, are sometimes generally distributed and again confined mostly to a ring around the larger end. Two examples measure 32 x 23.4 and 31.5 x 22.7 mm.

Distribution: Of sub-antarctic and low antarctic distribution, penetrating most deeply into the Antarctic Zone at South Georgia. It nests also at the Falklands, Gough Island, and Kerguelen Island in the southern Indian Ocean; also at Macquarie, Auckland, Bounty and the Chathams, as well as at islets closer to New Zealand.

The American Museum Collection contains 12 specimens of this petrel, of which 8 are from the Falkland Islands and neighboring waters, and 4 from the New Zealand region. Other examples have been examined in the British and Berlin Museums, besides which I have borrowed for comparison the series belonging to the California Academy of Sciences, the United States National Museum, and the Museum of Comparative Zoölogy.

The material studied does not bear out the differentiation of the species into several subspecific forms. Four adults from the Falkland Islands, for example, are indistinguishable in dimensions, pattern, and shade of coloration from four from the New Zealand region. The latter, taken at sea during the Whitney South Sea Expedition, have slightly more worn quills than the Falkland nesting birds, but one of the New Zealand specimens has the longest wing measurement in the whole series, although Mathews (1912, 18) has based a Falkland race upon the reputed greater length of the wing. Eight skins from Kerguelen Island also entirely agree with the others. The sexes in this species show no appreciable discrepancy in size.

During the Brewster-Sanford Expedition, Beck encountered the Gray-backed Storm Petrel for the first time in the Strait of Le Maire on May 9, 1915. In September of the same year he saw many at sea around the Falkland Islands, and found that they behaved like the Wilson's Petrels in responding to the lure of bait laid upon the water. His notes also speak of numbers of Gray-backed Petrels hovering over rafts of floating kelp in a heavy sea and a gale.

Later, at Cochon and Kidney Islands of the Falklands, he found nests of the species in hummocks of the tussock grass. There was no actual burrow, but

rather a space enlarged in the more or less dead plant tissue and vegetal mould of the basal clump or pedestal of the plant. A small hole indicated where the birds entered and departed from the hummock, and Beck located the nests by running his hand into such openings and rummaging about among the dry grass stalks. On November 5 and 6, at Cochon Island, he shook out the first incubating bird, a female, and its fresh-laid egg. Its tussock hummock stood in the midst of a colony of several thousand Rockhopper Penguins, and Falkland Diving Petrels were also occupying burrows round about. On November 19, at Kidney Island, he took a slightly incubated egg from a similar site, except that in this instance the petrels' nest was directly above the burrow of a Magellanic Penguin. Four downy young petrels, just beginning to show their contour plumage, were collected in the same neighborhood at Kidney Island on January 13, 1916. Their feathering, in so far as it shows, is indistinguishable from that of adult birds.

Oliver (1930, 98) records the eggs of this species from New Zealand as considerably larger than ours from the Falkland Islands, his figures running up to 37 x 27 millimeters. If this be correct, there is doubtless a considerable range of variation in egg size, for I have already shown that birds from the New Zealand region are not different in size from those taken at the Falklands.

At South Georgia the Gray-backed Petrels also nest among the hummocks of tussock grass (*Poa flabellata*), as reported by Pagenstecher (1885, 18), Lönnberg (1906, 84), and von den Steinen (1890, 242). The last-named, however, found one bird of this species in a rock crevice on the south slope of Mt. Krokisius, at Royal Bay. Nesting evidently begins at South Georgia during early November, and the adults and grown young, according to Pagenstecher, leave the vicinity of the island about the end of April.

The right of this species to a place in the avifauna of Gough Island is based upon a specimen shot by firelight, while it was flying over the beach, about June 1, 1922 (Wilkins, 1923, 508). It is, of course, barely possible that this example was merely a pelagic bird that had been attracted ashore by the blaze.

At Kerguelen Island, according to Kidder (1875, 31), the Gray-backed Petrels were found in their burrows on October 28, and the first eggs were discovered on December 12. Eaton, as quoted by Sharpe (1879, 129), describes the night singing of one of these petrels, a custom doubtless associated with courtship. On November 6 he was aroused from sleep by the faint cry of a strange bird. Going out to search with a lantern, he discovered a Gray-backed Petrel, which proved to be a female, sitting on the open ground and uttering a crake-like call. It made no effort to escape, and was picked up by hand.

WILSON'S PETREL

Oceanites oceanicus oceanicus

Procellaria oceanica Kuhl, 1820, Beitr. Vergl. Anat., Abth. 1, p. 136, pl. 10, fig. 1 (no type locality given; South Georgia designated by Murphy).

Names: Mother Carey's Chicken; "Pampero" or "Petrel de Tormenta" in Spanish-speaking South America, and "Alma de Mestre" in Brazil. The principal synonym of the specific name is *wilsoni*.

Characters: A square-tailed, black storm petrel, conspicuously white above the tail, and with long legs which bring the extended feet beyond the end of the tail.

Adults (sexes alike): General color blackish brown, slightly paler on the throat and belly and darkest on the wings and tail; a leaden or grayish gloss on the dorsal surface is not conspicuous, and is present only in fresh plumage; median and greater wing coverts lighter than remainder of wing, being of an ashy brown, outwardly fringed with whitish in fresh plumage, and forming a pronounced band on the wing; inner secondaries likewise ashy brown and thus lighter than remainder of quills; upper tail coverts white, a few of the black rump feathers adjacent to them white-tipped, the whole forming a broad, roughly quadrangular band across the base of the tail; lateral rectrices basally white in a narrow strip on the inner web adjacent to the shaft, which is likewise proximally white for about half its length; large white patches on the lower flanks and thighs, together with more or less intermingling of white feathers in the lateral lower tail coverts, the whole forming a continuous area with the white above the tail; lining of wings substantially like the breast. Iris dark brown; legs and feet black, the webs largely orange-yellow for about three-fourths of their length from the base.

Whitish feathers in the lores, and narrow whitish borders on the feathers of the belly, are included in a description of adults by Witherby (1924, 417). So far as I can judge, however, both of these marks appear to be confined to juvenal plumage.

Measurements based upon nearly 100 specimens collected in many parts of the North and South Atlantic, including breeding grounds at South Georgia, are as follows (Murphy, 1918, 127):

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
97 ♂ and ♀, Atlantic	144.9	63.7	12.6	34.6	27.5 mm.
Minimum of the series	136	56.5	11.1	31.3	25.3
Maximum of the series	155.5	73	13.2	36.8	30

Fifteen additional skins in the American Museum Collection were obtained by Mr. Beck along the coast of Patagonia, and in the region between the eastern entrance of the Strait of Magellan and the Falkland Islands, during May, September, and October, 1915. These include specimens in juvenal plumage as well as adults, their average dimensions being:

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
9 ♂, 6 ♀	139.7	61	11.8	34.4	27.2 mm.

In Beck's material are also 10 typical examples taken off Mar del Plata, Argentina, between September 28 and October 21, 1914. Most of these had swelling gonads, and were doubtless southward bound toward nesting areas.

Finally, the Museum has received from Mr. A. G. Bennett, of Port Stanley, Falkland Islands, a series of breeding adults collected at Deception Island, South Shetlands, between December, 1921, and March, 1922. The measurements of these are as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
9 ♂	148.2	66.9	12.9	34.3	28.1 mm.
8 ♀	151.3	68.3	12.9	35.1	29.2
Minimum of the series	144	62.5	12.1	33.6	26
Maximum of the series	158	73	13.8	36.5	31.2

The figures compare well with those of 12 breeding birds from South Georgia recorded by Murphy (1918, 125).

Wing-spreads of 6 specimens collected in the tropical Atlantic during October, or shortly after the completion of the moult, ranged between 383 and 412 mm.

Valette (1906, 61) gives the length in the flesh of a breeding example at the South Orkneys as 170 mm.

The nestling down is uniform grayish black. Unlike most petrels, this species has a distinctive juvenal plumage, the marks of which comprise white edgings on the feathers of the belly and a whitish spot in the lores. These marks are lost through wear of the terminations of the feathers, and it is probable that no post-juvenal moult occurs until the petrels are about one year old.

The egg is an elongate oval of dull white, peppered chiefly around the larger end with tiny dots of reddish brown. Measurements of 15 average 32.2 x 23.2 mm.; the eggs showing the four extremes measure 33.5 x 23.5, 33 x 24, 28 x 23 and 32.5 x 22.5 mm. (Bent, 1922, 168). It is possible that some of the eggs included in the above summary pertain to the slightly smaller Fuegian race, discussed in the next biography. Eight eggs from the South Orkneys, which undoubtedly represent the typical subspecies, average 33.7 x 24 mm.; the largest is 36 x 24 and the smallest 32 x 23 mm. (Clarke, 1913, 235). Bennett (1927, 79) records the average of a series of South Shetland eggs as 32.9 x 23.6 mm.

Distribution: Breeds at South Georgia, the South Orkneys, South Shetlands, and islands of the Antarctic Archipelago, probably southward to the shores of the continent; migrates northward to the northern North Atlantic; the species nests also at other islands in the circumpolar antarctic ring, including Kerguelen in the southern Indian Ocean and Heard Island (Moseley, 1879, 230), but the subspecific status and winter range of Old-World Wilson's Petrels have not been satisfactorily determined.

In an earlier paper I have reported at some length upon the Wilson's Petrels collected by myself at South Georgia, as well as those obtained during the course of Beck's South American field work. We are justified in believing that birds from all parts of the North and South Atlantic represent a single subspecies, which migrates from breeding grounds at islands of the Scotia Arc, and perhaps also from Bouvet Island and other antarctic localities still very imperfectly known. Migrants in the eastern part of the Pacific, however, seem to represent a smaller race, the sub-antarctic breeding grounds of which were discovered during the Brewster-Sanford Expedition. These will be considered in the next biography.

Along the east coast of South America, Wilson's Petrel is a familiar and often abundant sea bird from the Caribbean southward. Beck observed northbound migrants near Dominica and other islands of the Lesser Antilles, and south of Porto Rico, during April and May, 1917, and Beebe (1909, 74) reports one blown by a storm into an estuary of the Orinoco on March 25. Between April 15 and May 1, 1916, Beck collected many young birds off Bahia, Brazil. By these latter dates the vanguard of the spring migrants has already reached temperate North Atlantic latitudes. It may well be that birds of the year make less extensive migrations than their older fellows. At any rate, specimens determinable as in juvenal plumage are rare in collections of North Atlantic birds, although very common in those from the tropics. The Wilson's Petrels observed by Beck along the Brazilian coast were also notably given to the practice of resting on the water in groups, a custom apparently not characteristic of adult birds. The species has been commonly reported in the harbor of Rio de Janeiro (Goeldi, 1894, 588), at São Paulo (von Ihering, 1907, 36), and

southward to the Atlantic coast of Patagonia, where Beck collected examples during May, September, and October of 1915.

Most of the specimens taken along the tropical coasts of South America and Africa, during the months of northern-hemisphere spring, appear to be young birds. The majority collected offshore in the same season and latitudes are, on the other hand, fully adult. This suggests that the fledglings may follow the coast lines of the southern continents during their first northward migration. That the adults, on the other hand, do not preferably migrate along the conformation of land masses is known from abundant data. The naturalists of the 'Scotia' found the species in numbers in the vicinity of Gough Island in April, 1904, the season of northward migration. This locality lies about as far from a continent as it is possible to go in the South Atlantic.

The whereabouts of the first-year birds during the northern winter, or breeding season, is a matter of considerable uncertainty. The fact that the young undergo no moult until after they have left the North Atlantic, and probably not until their second summer, tends to confirm an inference drawn from examination of breeding birds from South Georgia, namely, that yearlings do not breed. Perhaps, therefore, they spend their entire first year at sea, a supposition which would explain the occurrence of *Oceanites* in the tropical Atlantic during November and other winter months.

Wynne-Edwards (1935, 285) shows that the migration into the northern hemisphere reaches its extreme bounds at about latitude 50° N. in the Atlantic. The migrants head for the Gulf Stream, annually reaching Cape Hatteras about April 18, and making an almost simultaneous invasion into the mild waters along the entire Atlantic coast of the United States. During May and June they gradually work inshore. They are rare in the Sargasso Sea, as known from Jespersen's observations, but thick in Gulf Stream waters. In the eastern Atlantic they do not appear at all until well into May. Wynne-Edwards writes:

> All three of the southern Procellariidae which regularly visit the North Atlantic, namely the Greater Shearwater, Sooty Shearwater and Wilson's Petrel, agree in appearing first in North American and lingering last in Afrıco-European waters. This is scarcely likely to be a coincidence.

Throughout a round trip between New York and South Georgia, I saw Wilson's Petrels on all but a few days, as shown in a tabular record already published (Murphy, 1918, 133). I observed the birds under many conditions of wind and weather, and in company with a large number of other species. I found that the simplest and most reliable way to distinguish Wilson's Petrels from other Mother Carey's chickens was by their peculiar style of flight, which consists of an alternate gliding and fluttering, producing a forward movement of very different appearance from the "leaping" strokes of Leach's Petrel or other members of the genus *Oceanodroma*. I learned, too, by feeding these birds with bits of fat from the stern of my brig, that they can dive very skilfully to a depth of several times their length, almost invariably recovering sinking bits of food and then leaping forth dry into the air. Schools of feeding surface fish, such as carangids, cause the Wilson's Petrels to gather rapidly and to skip along

in search of scraps from the slaughter. After following a vessel all day long, the travellers sometimes become doubly active toward sunset when, ceasing for a time to hunt for food, they dash hither and thither, sometimes shooting upward almost as high as the masthead and then plunging down at high speed. Such behavior, which I observed only on the southward voyage during October, may have been prophetic of courtship, although it is hardly likely that mating takes place until after the selection of territory at the breeding grounds.

Like all small dark petrels, this species is difficult to see against water ruffled by the wind, and only rarely does it rise above the horizon of a person standing on the deck of a ship. The birds therefore often rush into the field of vision and appear at close range after the observer has been vainly scanning the water in the distance. During calms, when the ocean is silvery, they are silhouetted against it and are visible from afar. When following a vessel, they skip along the surface as they approach, giving a vigorous kick on the lee side with both feet whenever they touch the water. When they "stand" to feed, the wings are held rigidly and they face the wind; the momentum necessary to keep them from being blown away is furnished by the webs, the legs sinking to the heel as they work backward in unison. Why their almost weightless bodies are not whisked off to leeward like fluffs of down is a good deal of a mystery. Regardless of the strength of the gale, however, they contrive to move forward in the apparently effortless, dreamlike manner that seems to defy both wind and gravitation.

Although Wilson's Petrel is to be found north of the equator well into the month of October, the returning migrants reach their West Antarctic breeding grounds early in November. At Paulet Island the species was first observed by Andersson (1908, 47) on November 8. At the South Orkney Islands the first arrivals have been seen on November 11 and 12 of successive years, the great bulk of the population coming not more than ten days later, after the breaking up of the sea-ice. Here the first egg was found on December 11 (Clarke, 1913, 234).

During January, 1909, members of the French Expedition discovered 20 nests among the rocks at the southern end of Petermann Island. They were situated mostly under great stones, or in deep crevices sheltered from the sifting snow. The first eggs were found early in January. The last birds of the species were observed about this locality on April 20, and the first arrival of the next autumn returned on November 23 (Gain, 1914, 124). Bennett found eggs at the South Shetlands on December 26. Racovitza (1900, 195) records the species nesting southward as far as De Gerlache Strait.

The type of nest depends in part upon the nature of available material. At the South Orkneys eggs have been found in completely unlined cavities. At Kerguelen Island the nests are built of plant stalks, while in the Ross Sea region and in West Antarctica they have been found to be made of a comfortable collection of penguin feathers.

At South Georgia this petrel appears, according to Matthews (1929, 577), in November and remains until May, congregating about the whaling stations

in particularly large numbers during February and March, so that the water of the fiords sometimes becomes black with them. Matthews continues:

It lays its egg in crevices of the cliffs and amongst the stones of screes. No nest is made but the same burrow is returned to year after year, so that a quantity of debris—feathers, dead young and so on—is accumulated on which the egg is laid. The eggs are difficult to obtain, as those in the cliffs are usually inaccessible, and among the screes they are so far in that it is often impossible to remove enough stones without causing a land slide. The sitting bird makes a low whistling cry which is very difficult to locate. At dusk the birds flit about near the entrance to the nesting hole and produce a harsh grating noise. The eggs are laid in early December and both sexes take part in incubation. When captured the birds squirt from the mouth and nostrils a dark red oil with an evil odour. They are unable to stand with the tarsi erect and shuffle in and out of the burrows with the whole length of them on the ground.

The above account agrees substantially with Clarke's description of the nesting habits at the South Orkneys. At the latter islands, unusually cold summers apparently cause very high mortality, and it is probable that during certain years only a small proportion of the eggs hatch. The period of incubation is not shorter than 35 days.

When I reached South Georgia on November 23, 1912, Wilson's Petrel was already common in the fiords and enormously abundant on the whaling banks offshore. On December 1, just at dusk, great flocks were seen feeding in King Edward Cove, Cumberland Bay. I failed, in spite of patient search, to discover a nest, but many of the birds I shot were undoubtedly incubating.

At the Bay of Isles, near the northwestern end of South Georgia, the crew of the 'Daisy' engaged extensively in sea elephant hunting, with the result that quantities of blubber lay soaking in the water alongside the vessel much of the time. This attracted flocks of *Oceanites*, especially during gales, when groups estimated to comprise as many as six hundred birds often foraged for globules of oil washed out of the soaking blubber.

Over the headlands and tussock flats along the Bay of Isles, the birds were frequently seen flying back and forth like martins, but I never spied one in the act of alighting at its nesting site. On the morning of Feb. 1, I watched a single bird for a quarter of an hour while it dashed to and fro and up and down before a steep, rocky bank near the bay. It flew precisely as though it were hawking winged insects, which was, of course, very unlikely. For several minutes it was chased in all its gyrations by a pipit (*Anthus antarcticus*), the latter trying vainly to keep close behind it. Finally it flew off without disclosing the nesting site, if indeed it were in the neighborhood.

A most interesting point about *Oceanites* at South Georgia is a fact of an ecologic nature, namely, that this species, practically alone among the smaller water birds, enjoys absolute immunity from the aggressiveness of the skua (*Catharacta*). Lönnberg has recorded this before but my observations of the actual conditions were none the less a source of considerable surprise to me. The skua is to most of the birds, large or small, a wanton and relentless ogre. It is forever watching for neglected young of penguins, cormorants, and even albatrosses; it attacks at sight the endemic teal, the diving petrel, and the *Prion*. To the last two species, it is such a terrible foe that they dare not show themselves in the fiords or over the land between daylight and dark; nevertheless, the skuas succeed in capturing so many of them that their dismembered carcasses strew the ground over their subterranean colonies. But *Oceanites* flies about with impunity in broad daylight. I have seen one almost brush a skua with its wing as the latter bird stood on a rock in the kelp fields, and both species sometimes fed together when stormy weather had washed away pieces of seal blubber from the supply floating alongside our brig.

Why does the skua ignore this petrel? It is surely as conspicuous as the diver (*Pelecanoides*) and seemingly less difficult to capture than the fleet-winged *Prion*. The protective character cannot be in an offensive taste, for the skua is quite ready to pounce upon and devour a dead or disabled

Oceanites. Possibly, however, its body affords too small a morsel to warrant any effort on the skua's part. It is noteworthy that the latter grants a like immunity to one other still smaller bird, the pipit (*Anthus*).

Wilson's petrels were present in apparently undiminished numbers when we left South Georgia on March 15, 1913. As the 'Daisy' stood to sea from Possession Bay, I had occasion to make a trip in a whaleboat to a neighboring whaling station for the purpose of posting mail. Shortly after sunset we started on a ten-mile pull to the brig offshore, and, as soon as we were well out from the land, our boat was continually in the midst of innumerable small Tubinares flocking over the quiet sea. *Oceanites* made up a considerable proportion of these birds, which fluttered all about us. Their indistinct forms kept flashing above the skyline, but their myriad numbers were revealed still more by a chorus of twittering and the soft unbroken sound of winnowing quills (Murphy, 1918, 142).

The voice of Wilson's Petrel at sea is expressed in soft peeping and rasping notes. Their calls at the nesting ground, which are kept up all through the hours of darkness, have been described as cooings, twitterings, low whistles, harsh screaming chuckles, etc. At Kerguelen, according to Hall (1900, 19), their croaking begins very actively about eight o'clock in the evening, when the parent birds change shifts on the egg.

The food of Wilson's Petrel comprises a wide variety of marine organisms, especially crustaceans of many orders. Examples shot in the antarctic pack-ice are usually well filled with small euphausians. The place of small fishes or squids as food is often indicated by otoliths and crystalline lenses in the stomachs of the birds. They take also whatever food they can pick up from the destructive work of large fish or of whalemen. At South Georgia I saw them constantly foraging about the carcasses of whales, and even snatching at tiny bits of carrion shaken from the beaks of Giant Fulmars and other large species. Oil or fat of any sort, spread upon the water, will quickly attract these petrels if any are in the neighborhood, a fact of which Beck took full advantage during his collecting off Mar del Plata, Bahia, and elsewhere. When following a ship, Wilson's Petrels are interested in practically every kind of refuse from the galley.

FUEGIAN PETREL

Oceanites oceanicus chilensis, new subspecies

Subspecific Characters: Differs from *Oceanites oceanicus oceanicus* of the Atlantic Ocean in its smaller size, especially in the length of wing and tail.

Type.—No. 3316, Brewster-Sanford Coll., Amer. Mus. Nat. Hist.; ♂ad., nesting; Wollaston Island, Fuegia, Chile, Jan. 1, 1915; R. H. Beck.

Measurements of 11 birds collected on or near breeding grounds at Wollaston and Morton Islands, Nassau Bay, and at Magallanes in the Strait of Magellan, between December 17, 1914, and March 6, 1915, are as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe with claw
8♂	133.9	57.7	11.6	34.6	27.5 mm.
3♀	138.3	61.3	11	35.7	27.5

The tables below are based upon specimens collected off Corral, Chile, and at various points west of Valparaiso, up to a distance of 250 kilometers from shore, between September 17, 1913,

and March 16, 1914; and upon others taken off Callao and Ancón, Peru, from the coast to about 75 kilometers offshore, between May 1 and June 16, 1913.

	Wing	Tail	Culmen	Tarsus	Middle toe with claw
12♂, Chile	140.6	59.5	11.7	33.8	27 mm.
5♀, Chile	143.6	61	10.5	33.3	25.8
13♂, Peru	134	58	11.6	35.1	27.2
10♀, Peru	136.2	59.2	11.6	35.6	27.1

Dimensions based upon the whole series of 51 measured specimens are as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe with claw
51♂ and ♀	137.2	59	11.5	34.7	27 mm.
Minimum of the series	130	55	10	33	24
Maximum of the series	146	63	12.5	36	29

Comparison of the summarized data in the last table with figures pertaining to the typical race of *oceanicus* shows that *chilensis* is consistently smaller in the lengths of wing, tail, and culmen. The fact that certain extreme measurements overlap does not invalidate the distinction.

The wing-spread of a female collected off the Chincha Islands, Peru, October 22, 1919, measured 353 mm.

Egg: An egg taken by Beck at Wollaston Island, Chile, just north of Cape Horn, on January 1, 1915, is dull white, with an indistinct wreath of very fine purplish red spots about the larger end; it measures 31.9 x 22.9 mm. Eight others, from Deceit and Herschel Islands, are described by Reynolds (1935, 95) as "thin-shelled, white, finely peppered with reddish-brown and underlying pinkish-lilac, forming in the majority a zone about the larger end. Average of eight eggs 32.1 x 22.9 mm., max. 34.75 x 22, and 31 x 24 mm., min. 31 x 23 and 34.75 x 22 mm."

Distribution: Breeds on islands near Cape Horn, and ranges throughout the Magellanic waterways and northward along the western coast of South America at least to central Peru. Probably resident also at the Falkland Islands.

The name *Oceanites oceanicus chilensis* was first published by Alexander (1928, 86), who gave no description but stated that the subspecies breeds on "islets off Cape Horn." Both Peters (1931, 68) and Reynolds (1935, 94) have pointed out that the name has hitherto been a *nomen nudum*. In describing herewith this small, sub-antarctic race of Wilson's Petrel, it behooves me to explain the prior use of the trinomial.

During the preparation of Mr. W. B. Alexander's "Birds of the Ocean," this author worked for several weeks in the American Museum of Natural History. At that time I had prepared the description of this petrel in manuscript, and had designated a type specimen by attaching the usual red label. In studying and listing the storm petrels, Alexander naturally assumed that a valid diagnosis of this race had been published, and therefore included it in his account.

More than sixty skins of this subspecies were collected by Beck in the Fuegian region and along the coasts of Chile and Peru. Comparison with a thoroughly adequate series of typical Wilson's Petrel shows that it is characterized by markedly and consistently smaller size than the widespread Atlantic form. The

fact that the new race nests among the islands bordering Tierra del Fuego is of particular interest because it brings a representative of the species *oceanicus* within the Sub-Antarctic Zone of surface water as a nesting bird. In all other parts of the New World the species is known to breed only in the Antarctic Zone. Kerguelen Island of the Indian Ocean, however, lies practically on the Antarctic Convergence, and furnishes a parallel to the zonal conditions obtaining near Cape Horn. It would not now be surprising to find the Fuegian race also nesting at the Falkland Islands where, in fact, Bennett (1926, 313) indicates that its eggs have perhaps been found.

The lesser size of specimens of *Oceanites oceanicus* from the west coast of South America has been noted before, for Giglioli once (1870, 36) resurrected Bonaparte's name *wilsoni* for small examples collected off Chile. Bonaparte's description, however, referred to the Atlantic bird, and his name is preoccupied by Kuhl's *Procellaria oceanica*, for which reason *wilsoni* is not available for the subspecies occurring in the eastern Pacific.

Mr. Beck encountered this petrel at its breeding ground near Cape Horn during December, 1914. On New Year's Day, 1915, he collected a male bird, which I have selected as the type, sitting on its egg in a crevice between large boulders just above the shore line of Wollaston Island. He had every reason to believe that the petrels were nesting also at Ildefonso and Hoste Islands. On January 2, at Deceit Island, just northwest of Cape Horn, one of the birds came in during the daytime while a strong gale was blowing, and entered a hole under a great rock close to the water. This example, which likewise proved to be a male, was drawn out with a stick, as was also a fresh-laid egg that was later broken and lost. On subsequent dates Beck found these petrels in breeding condition near Chanticler and Hall Islands. During the same season he also saw and collected many in Nassau Bay, the Brecknock Pass, and northward through the inland waters to the Strait of Magellan. Oustalet (1891, 165) likewise records specimens taken in the Magellanic region between October and March, one of them being obtained at Gable Island in Beagle Channel.

A recent account of experiences with the Fuegian Petrels during December, 1932, is that of Reynolds, who writes:

> Storm-Petrels were common in Nassau Bay, and a few were met with even near Ushuaia in the Beagle Channel. At Freycinet and Herschel they came flying close along shore late in the evening, and some were seen east of Deceit during the day. Near Cape Austin on Deceit I found a breeding burrow with the entrance well hidden in a mound of *Azorella* partly covered by *Empetrum*. There was some attempt at a nest of *Empetrum* twigs at a depth of about 3 feet, and on this a male (the specimen collected) was brooding a nearly fresh egg . . . .
>
> On Herschel the dog accidentally discovered a nest, and next day six eggs were found with his aid. The burrows were in surprisingly wet situations, and were often natural holes where the surface of peaty turf, with its covering of *Empetrum* and other plants, had become raised from sodden clay by the roots of stunted shrubs of the evergreen beech. The nests were rather scattered on comparatively low ground at little distance from the shore, and each contained a fresh egg.

To northward of the nesting area, Beck's notes record numbers of Wilson's Petrels, presumably of this race, in the Gulf of Peñas on July 4, 1914, and over

the ocean between Valparaiso and Juan Fernández during November and December as well as in February and March. Still farther northward we have records and specimens from many parts of the Chilean and Peruvian coasts, as far as Callao, Ancón, and the Guañape Islands.

The Peruvian specimens, taken during May and June, were undergoing moult of the quills. November and December birds, from off Valparaiso, have full-grown, unworn quills, and the longest average wing-length. March birds from Fuegia are in freshest body plumage, with broadly white-edged secondary coverts. Many of Beck's central Chilean specimens had enlarged gonads, and the collector believed that some of those shot off Valparaiso may have been nesting birds. Their claws, however, are all long and pointed, whereas those of specimens taken on known breeding grounds among the Fuegian islands have claws which have been worn more or less blunt, as if by burrowing.

This race exhibits all of the juvenal plumage characteristics which have been described for the Atlantic bird. A young male collected north of Talcaguano, on March 1, 1925, for example, has conspicuous white loral or preorbital spots, extensive white edgings on the feathers of the belly, and gray, white-edged inner secondaries.

I collected additional specimens of this petrel in the Bay of Pisco, Peru, in October, 1919, and observed the form farther northward during the midsummer period, *i. e.* the height of its breeding season. All examples taken here, however, had small gonads.

On its northward migration this subspecies is primarily a bird of the cool Humboldt Current. Whether or not it ever crosses the equatorial regions is still to be determined, for Loomis (1918, 180) gives no description of the specimen of *O. oceanicus* captured at Monterey, California, in August.

The stomachs of my Pisco Bay specimens contained cinders, bits of fish, numerous nereid worms, and a few feathers. One of them also had two air-vesicles of a seaweed, and another hundreds of small, uniform, chitin-covered objects which appear to be the eggs of a mollusk.

ELLIOT'S STORM PETREL

Oceanites gracilis gracilis

Thalassidroma gracilis Elliot, 1859, Ibis, p. 391 ("west coast of America" = coast of Chile).

Names: In Chile and Peru this and other small storm petrels are known as "Bailarines" (ballet dancers), or "Felices."

Characters: Similar to *Oceanites oceanicus*, but smaller; middle of abdomen white.

Adults (sexes alike): General dorsal color sooty black, or dark brownish black, usually darkest on crown, lower back, and the quills of wing and tail; white upper tail coverts are partly obscured by more or less white-tipped feathers of the rump, producing a somewhat lunate white patch or band across the tail; wing coverts mainly like the back, but the median series somewhat grayish brown, with narrow whitish edges in fresh plumage, these feathers, as wear and fading progress, producing a rather conspicuous grayish or whitish wing-bar; primary coverts and quills of wing and tail black, the lateral rectrices basally white on the shafts and inner webs; throat, chest, and sides of body sooty brown, somewhat lighter than the back; middle of lower breast and abdomen, and the entire vent, white, some of the feathers more or less smudged with sooty brown; the white

of the vent is continuous with the dorsal white band of the upper tail coverts; under tail coverts sooty brown, the lateral feathers more or less white. Iris brown; bill and feet black, with a triangular yellow spot on each web.

Females appear to average slightly larger than males, at least in the length of the wing.

	Wing	Tail	Culmen	Tarsus	Middle toe with claw
20 ♂, Peru (Chilca to Lobos de Tierra I.).	123.5	55.5	11.1	30.5	22.3 mm.
20 ♀, Peru (Chilca to Lobos de Tierra I.).	128	56.6	11.1	29.6	22
3 ♂, Chile	125.7	54.7	10.9	28.8	21.8
3 ♀, Chile	129.3	54.3	11.2	29.2	22.2
Minimum of the series	117	48	10.5	28	21
Maximum of the series	132	57	11.6	31.5	23

Distribution: Known from the Humboldt Current region of the west coast of South America, between the latitude of Valparaiso, Chile, and Point Santa Elena, Ecuador.

The storm petrel originally described by Dr. Daniel Giraud Elliot, founder of the department of birds in the American Museum of Natural History, is now known to break up into two reasonably well-marked subspecies, of which the typical form is a characteristic bird of the Humboldt Current region, along the coasts of Peru, Chile, and southern Ecuador. Its nesting grounds, however, are still undiscovered. The second and larger race is known only from the vicinity of the Galápagos Islands, where it undoubtedly breeds, although the searching of many visitors to that archipelago has not yet unearthed a single nest. The Museum possesses excellent series of both forms.

Elliot's Petrel was collected in littoral waters practically throughout the length of the desert coasts of Peru and Chile during the Brewster-Sanford Expedition, besides which I subsequently obtained others in the course of my own field work. On May 19, 1913, Mr. Beck came as close as possible to discovering the nesting ground of this petrel, without actually being successful. In other words, he found that birds taken off Ancón, Peru, had fully enlarged gonads, and that one female carried in her oviduct an egg almost ready to lay. At the neighboring Pescadores Islands, another species of storm petrel (*Oceanodroma tethys*) had eggs in its burrows at this date, but a careful search by Beck disclosed no sign of nesting Elliot's Petrels. Curiously enough, the latter was far more common over the ocean around the Pescadores Islands than was the species which proved to have its home there. Within a period of a week or more, Beck collected 60 small petrels of various sorts a short distance off these islets; the majority represented *Oceanites gracilis*, while only a single example was of the resident species. I have noted a corresponding anomaly at the breeding grounds of Leach's Petrel (*Oceanodroma leucorhoa*) along the coast of Maine. For days together not a single example of this abundant and resident petrel is to be seen over the neighboring waters, while Wilson's Petrel (*Oceanites oceanicus*), which comes as a migrant from the other end of the world, is present at all hours in every cove and channel.

Beck's Peruvian specimens of Elliot's Petrel, which make up the bulk of our

series, were all taken fairly close to the continental coast, mostly within a distance of 50 kilometers. He observed a few of the birds near the Hormigas de Afuera Islets, which are 67 kilometers off Callao and which deserve a thorough ornithological reconnaissance in a search for the unlocated nesting grounds of several petrels peculiar to the west coast of South America. Farther out at sea Beck makes no mention of Elliot's Petrel in these latitudes, but during a subsequent voyage from Valparaiso to the Juan Fernández group in the month of December, he found it to be a common species at distances of 150 kilometers or more off the coast of Chile. It is perhaps hardly likely that Mas Afuera may yet prove to be a nesting station, but San Felix and San Ambrosio deserve further investigation no less than Hormigas de Afuera.

It should be emphasized that the collections and observations of Beck and myself were made at every season of the year, and that an egg was ready for laying in the latter part of May, which is close to midwinter. Furthermore, the birds in breeding condition were at the same time undergoing a moult of the wing and tail quills at this season. Wetmore (1926, 53) also notes that a number of Elliot's Petrels which came aboard his steamer to westward of Lobos de Afuera Island, on May 7, 1921, had recently moulted the outermost primaries. The four birds he captured were males. On deck they were helpless, and barely able to walk with the aid of their wings. When handled, they uttered a low chirping call.

Close to Lobos de Afuera I observed examples of this petrel on January 4, 1920, and about ten o'clock in the evening of a later day one flew into the stateroom of my steamer off Pimentel, Peru. Again, during the foggy night of January 15, 1925, I saw large numbers come on board another steamer 45 kilometers due west of Pacasmayo. The rank odor of their regurgitated stomach oil made the whole deck smell musky, and clung to the skin of my hand even after repeated washings. Later in the same month I found these petrels very common off Point Pariñas, the westernmost projection of the South American continent. Here I saw great numbers of them flock into the wakes of two whales, which were leaving oily streaks on the surface wherever they rolled out. My northernmost record is of a bird observed at close range from a launch in the Bay of Santa Elena, Ecuador, on February 11, 1925.

The stomach of a specimen I shot off the Chincha Islands, Peru, during October, contained well-digested and unidentifiable animal tissue, together with a considerable mass of fine cinders. The latter objects most of the storm petrels seem to be fond of picking up from the surface of the ocean.

LOWE'S STORM PETREL

Oceanites gracilis galapagoensis

Oceanites gracilis galapagoensis Lowe, 1921, Bull. Brit. Orn. Club, 51, p. 140 (Charles Island, Galápagos Archipelago).

Characters: Lowe's description points out the larger size of the Galápagos race, the "uniformly lighter coloration, and the more diffuse and less conspicuous arrangement of the white on the abdomen."

Among the examples in the American Museum, and others examined at London, Berlin, and Frankfurt, these characters hold in varying degree, that of size being quite constant. The average length of the wing among 14 specimens of *O. g. galapagoensis*, for instance, is greater than the maximum dimension among 46 specimens of *O. g. gracilis*.

The average measurements of 14 adults from the vicinity of Charles, Albemarle, Indefatigable, Abingdon, James, and Narborough Islands, collected during the months of February, March, April, August, November, and December, are as follows:

	Wing	Tail	Culmen	Tarsus	Middle toe with claw
7♂, 7♀	135.3	57	11.2	30.7	22.9 mm.
Minimum of the series	130	53	10.5	28.5	21.6
Maximum of the series	146	60	12	32	24

The figures agree well with those of 85 specimens recorded by Loomis (1918, 182). The latter show that, as in the Peruvian race, females average slightly larger than males. The length in the flesh of 7 females ranged between 142 and 147 mm. The wing-expanse of 6 females was from 350–370 mm., the average being 359 mm.

Distribution: The Galápagos Archipelago.

Loomis reports, upon the basis of collections and notes made during the expedition of the California Academy of Sciences, that this storm petrel is common throughout the year at the Galápagos, frequenting both the bays and the open seas. It was never observed at a distance of as much as 100 kilometers from the islands. No nesting places were discovered, but the gonads of these birds were observed to have begun the enlargement incident to the breeding season by the end of April. They were at their maximum in early July, and were again reduced to the resting condition by November. The post-nuptial moult, which involves the quills of wing and tail, takes place at the latter season, namely between November and January. The petrels commonly came about the schooner 'Academy' for refuse tossed overboard. The remains of very small fish were taken from the stomach of one bird.

WHITE-BELLIED STORM PETREL

Fregetta grallaria grallaria

Procellaria grallaria Vieillot, 1817, Nouv. Dict. Hist. Nat., 25, p. 418 ("Nouvelle Hollande" = west coast of South America).

Names: Synonyms of the specific name include *fregetta*, *segethi*, *lawrencii*, and *leucogaster* although, according to Mathews (1933, 41), the last should be regarded as a distinct species.

Characters: A square-tailed storm petrel with a wholly white belly and a conspicuous white patch above the tail.

Adults (sexes alike): Grayish black with a brownish tinge, which increases with wear and fading, on head, neck, upper breast, mantle, back and scapulars; the feathers of back and mantle narrowly margined with white, which completely disappears as a result of wear; median wing coverts grayish brown, broadly edged with whitish; lesser wing coverts and remainder of wing black; rump and upper tail coverts white, a few of the feathers sometimes subterminally spotted with black; tail quills black, the four lateral feathers basally white on the inner webs and shafts; lower breast, abdomen, axillaries, and inner under wing coverts white, the marginal under wing coverts black or blackish gray; sporadic blackish spots occasionally appear on the white feathers of the crissum and lower flanks; under tail coverts black with white bases and occasionally with narrow whitish tips. Iris brown; bill, legs, and feet black.

The following measurements show the size range within the typical race, and indicate that females average slightly larger than males, which seems to be true of this entire group of petrels:

	Wing	Tail	Culmen	Tarsus	Middle toe and claw
51 ♂	155.4	73.3	13.1	35	21.6 mm.
12 ♀	156.4	73.5	13.4	35.6	21.5
Minimum of the series	146	71	12.6	33	20
Maximum of the series	163	77	14	37	22.6

The downy young are thickly covered with long soft mesoptyles of Quaker drab color. Specimens taken at Santa Clara Islet on January 19 are of different ages, some of them being almost in the fledgling stage. The first contour plumage is like that of the associated adults, except that the scapulars and wing coverts are very broadly edged with white. This same condition, however, is found in new plumage of adult birds, the edgings subsequently disappearing through wear.

An egg from Santa Clara is elongate-ovate in form, dull white, with a sprinkling of faint pinpoint marks over most of its surface, and a heavy concentration of more definite marks, reddish brown or vinaceous in color, at the apex at the larger end. These form not a ring but a patch about 14 mm. in diameter. The egg measures 34.3 x 24 mm. Two others, of more nearly oval form, have less dotting and measure 34 x 25 and 32.5 x 25 mm.

Distribution: Breeds at Mas Atierra and Santa Clara Islands, Juan Fernández, and apparently at San Felix and San Ambrosio Islets. Known also from various points off the Chilean coast, and from the open Pacific "about 500 miles northwest of Mas Afuera."

Juan Fernández is now accepted as the breeding station of the typical race of *Fregetta grallaria*. Hellmayr (1932, 416) is incorrect in stating that birds from the Chilean coast are decidedly larger than those from Australian seas; the reverse is true among all specimens I have seen.

During the course of the Brewster-Sanford Expedition, in December, 1913, and January, 1914, a series of more than 60 specimens of this petrel, most of which are males, was collected by Beck off Valparaiso, Chile, and on and about the islands of the Juan Fernández group. Both eggs and half-grown chicks were obtained at Santa Clara, or Goat Island, off the southwestern end of Mas Atierra, on January 19 and 20.

Another adult in the Museum collection is the bird noted above as being taken at sea far northwest of Mas Afuera. During the cruise of the 'Zaca,' Dr. Chapin noted numerous examples within a day's sail of San Felix Island, and collected on February 17, 1935, a specimen which matches the Juan Fernández birds. Next day, about sunset, many more were observed in the waters close to San Ambrosio. Representatives of the species, though probably not of the same race, have been collected much farther northward, close to the Galápagos Islands, as will be mentioned hereafter. Furthermore, Mathews (1933, 45) refers to a skin in the museum at Stockholm labeled "Patagonia, February 20, 1850." In its measurements the latter agrees closely with Juan Fernández birds, but Mathews's text does not indicate whether "Patagonia" means the Chilean or the Argentine coast of the continent.

During the voyage between Valparaiso and Juan Fernández in early December, 1913, Beck began to encounter White-bellied Storm Petrels before he was halfway toward the nearer island. Many came astern of his schooner on December 4,

and he notes that, except when flying directly to windward, the feeding birds would use only the leeward leg to maintain their momentum, kicking themselves into the breeze with this and holding the other stretched out behind. At Mas Atierra he found the petrels foraging close under the cliffy shore during rough weather, but when the sea was prevailingly calm he would encounter them only sparingly within sight of land, and in much greater numbers at a distance of a day's sail or more.

According to Lönnberg (1921, 10), the White-bellied Petrel breeds at all the islands of Juan Fernández. Beck found the nests only at Santa Clara, where they were under boulders close to sea level along the lee side of the island. Bent (1922, 174) quotes as follows from Beck's notebook:

> Though the fishermen of Juan Fernández told me they had never found the nest of this bird I found the nests quite close to the beach on Santa Clara Island, which lies about 10 miles from the west end of Masatierra Island. The nests were usually in rock piles under a good-sized rock. The few nests examined were lined with straws or a few twigs from bushes. One nest with its downy occupant was plainly visible without moving the overshadowing rock. On January 19, 1914, the date of my visit, I found more nests with young birds than with eggs. As with other species of petrels the downy young of this species is left alone during the day.

Fledgling young of the Juan Fernández birds are of a much darker gray color than young in the same stage of the larger race which nests at Rapa Island in southern Polynesia. The latter is the subspecies that I have described as *Fregetta grallaria titan*, and it possibly enters our region in the Galápagos area. During the cruise of the schooner 'Academy,' as recorded by Loomis (1918, 182), Mr. Beck shot a White-bellied Storm Petrel in latitude 4° 20′ S., longitude 93° 30′ W., on June 11, 1906. The position is southwest of the Galápagos and in the latitude of Talara, Peru. The bird was not a stray, for no less than ten other examples were seen in the same vicinity during the next few days. The specimen taken was undergoing a complete moult. Its length in the flesh was 225 mm. and its wing-expanse 480 mm. It has been measured both by Loomis and by Mathews (1933, 45), and while the two sets of figures made from the same skin do not exactly agree, they both indicate that the dimensions of this equatorial specimen were considerably greater than the maximum among a large series of *Fregetta grallaria grallaria* from Juan Fernández. They are substantially the same, in fact, as measurements of 27 birds from Rapa (Murphy, 1928, 5). Mathews apparently regards the White-bellied Petrels occurring near the Galápagos as representatives of the subspecies *titan*, but since I have seen no specimen I should prefer to let the matter stand for future research.

TRISTAN STORM PETREL

Fregetta grallaria (tristanensis ?)

? Proc. aequorea Kuhl, 1820, Beitr. Zoöl., p. 138 (off the mouth of the Río de la Plata).

? Thalassidroma leucogaster Gould, 1844, Ann. Mag. Nat. Hist., 13, p. 367 (latitude 36° S., longitude 6° 47′ E., South Atlantic).

Fregettornis grallaria tristanensis Mathews, 1932, Bull. Brit. Orn. Club, 52, p. 123 (Inaccessible Island, Tristan da Cunha group).

Names: Storm Pigeon at Tristan da Cunha. Synonyms for this form are uncertain, but *melanoleuca* may be one.

Characters: "Head blackish; throat and upper chest dark blackish brown; the feathers of the throat are uniform brown, those on the upper chest have white bases to the feathers; lower hind neck, back and adjoining wing coverts dark brown, each feather with a white edge; some of the primary coverts black with white edges to the feathers; primaries black, with white bases, the smaller primaries and secondaries the same, but with a greyish wash; the secondaries have white edges to the feathers; rump white, like the under surface from the chest to the vent; the vent feathers are white with brownish black tips; the longer ones blackish with large white bases to the feathers; some few are also tipped with white; tail even and black, the central pair all black, the remainder with white bases on the inner web. The under aspect of the wing has the feathers surrounding the bend of the wing from the axillaries to the primaries blackish, those immediately above the primaries with white edges; remainder of the inner wing coverts white; under primary coverts grayish, all but the first edged with white; the primaries show matt brown from the underside, not black as from above" (Mathews, 1933, 45).

Total length, 193 mm. A discussion of other dimensions of this form is reserved for the following text.

Distribution: South Atlantic Ocean, breeding at one or more islands of the Tristan da Cunha group.

Despite the voluminous writings of Mr. Gregory M. Mathews in his "Birds of Norfolk and Lord Howe Islands" (1928), "The Birds of Tristan da Cunha" (1932), and "On *Fregetta* Bonaparte and Allied Genera" (1933), I remain unconvinced regarding the "generic" or even specific distinctions between the species *grallaria* and *leucogaster*. Mr. Mathews's text makes very obscure and difficult reading, being filled with inconsistencies and with somewhat misleading presentation of data. His detailed drawings of the legs and feet of the petrels of this group show, in many instances, products as like as two peas except for minute differences in scalation, relative length of claws, etc., such as one frequently finds as individual or seasonal variations in any series of petrels. The length and consequently the relative shape of claws, for example, depend very much upon whether a petrel has recently been scratching out a nest-chamber or whether it has been, on the contrary, months at sea. Furthermore, it is amply shown by our large series of white-bellied storm petrels from several parts of the world that the width of the white edgings on the feathers of the dorsal surface varies greatly with wear, even among birds from the same breeding locality. Yet Mathews makes the width of such edges a key character for discrimination between two species.

In writing of the form of the White-bellied Petrel which inhabits Tristan da Cunha, Mathews (1932, 25) has been guilty of publishing utterly misleading text, for his account of the eggs and the plumage of young birds is set down with scarcely any indication that the data refer to Juan Fernández petrels and that the text is, in effect, quoted from Bent. The eggs and young of the Tristan form have not yet come into the hands of an ornithologist.

I have seen but one example of this petrel from the South Atlantic, namely, a female with the following dimensions, which are uniformly larger than the norm among eastern South Pacific birds: wing, 166; tail, 77; exposed culmen, 15.6; tarsus, 42.3; middle toe and claw, 28 millimeters. Combining these with those of Tristan da Cunha birds recorded by Mathews (1933, 45 and 46), I derive the following figures, based upon about seven adults; while the measurements were made by several different persons, they give some sort of approxi-

mation of the size range: wing, 156–170 (162.7); tail, 71–82 (77.2); exposed culmen, 14–15.6 (14.6); tarsus, 36–42.3 (38.9); middle toe and claw, 23–28 (24.8) millimeters.

According to Mathews (1933, 25), the "Storm Pigeon" is well known to the people of Tristan da Cunha. Two skins to which he refers were taken at Inaccessible Island on April 28, 1923. He concludes with the following somewhat inexplicable statements ". . . no eggs have been sent as yet. The egg is described as measuring 33.5 x 25 . . . while the nest is of dry grass in a burrow 18 in. long."

BLACK-BELLIED STORM PETREL

Fregetta tropica

Thalassidroma tropica Gould, 1844, Ann. Mag. Nat. Hist., 13, p. 366 (latitude 6° 33′ N., longitude 18° 6′ W., Atlantic Ocean).

Thalassidroma melanogaster Gould, 1844, Ann. Mag. Nat. Hist., 13, p. 367 (southern Indian Ocean).

Names: Except through misidentification, this species has been listed only under the specific names *tropica* and *melanogaster*.

Characters: The longitudinal dark band on the belly, with conspicuous white areas on either side, distinguish this storm petrel from its congeners. It is, however, surprisingly difficult to differentiate in life as it follows a ship or dances upon the ocean.

Adults (sexes alike): Dorsal surface and also head, neck, and breast, sooty black, darkest on the head; feathers of the back, scapulars, and median wing coverts narrowly fringed with white; feathers of the middle of the abdomen, and the under tail coverts, terminally sooty black; upper tail coverts, sides of body, and flanks white, as are also the inner under wing coverts and axillaries; small coverts around the margin of the wing sooty black. Iris brown; bill and feet black.

6 specimens, including the type from the Atlantic: wing, 160–167 (164.3); tail, 73–77 (75.5); exposed culmen, 15–16 (15.5); tarsus, 39–41 (40.1); middle toe and claw, 26–29 (27) mm.

Egg: Dull white, minutely and sparingly dotted with small pinkish or brownish spots, which sometimes form a ring at the larger end. Examples from the Auckland Islands, New Zealand, measure: 37 x 27 and 38.5 x 27 mm. (Oliver, 1930, 101). The average size of a number of eggs from the South Shetland Islands was 36.5 x 26.1 mm. (Bennett, 1927, 79); a single egg from the South Orkneys, 36 x 25.5 mm.

Distribution: Of pan-antarctic circumpolar breeding range, nesting in West Antarctica (South Georgia, South Orkneys, and South Shetlands), the Falkland Islands (possibly), Bouvet Island, the Crozets, Kerguelen, and some of the sub-antarctic islands south of New Zealand. Ranges northward during migration into low latitudes of cool-current regions and, perhaps casually or accidentally, into the northern hemisphere. Records of breeding at Ascension Island appear to be without foundation. Those attributed to St. Paul and Amsterdam Islands in the Indian Ocean, and to the Tristan group in the Atlantic, are open to serious doubt.

Fregetta tropica seems to be a thoroughly misnamed bird, for its entry into tropical waters is doubtless only in the rôle of a migrant. As I shall show below, all its known breeding grounds are in the far south. Sperling (1872, 75) understood this when he wrote that from its numbers and tameness this bird might well be called the "sparrow of the South Atlantic"; in latitude 5° S., 30° W., he adds, about thirty of them were playing around his ship, perhaps enticed northward beyond their normal range by food they found in the wake.

Sheer juggling of scientific names has reached a climax in the taxonomic

treatment of the Black-bellied Storm Petrel. Statements regarding the range of the bird which have no foundation in fact have been repeated many times in the literature, and it has been intimated that there are two distinct subspecies, one of tropical distribution and the other native to islands of high latitudes in the southern oceans. Peters (1931, 70), by the way, has misquoted the type locality of this petrel, placing it in latitude 33° N. near Madeira, whereas it is in reality as indicated above in the citation of Gould's description, namely, latitude 6° 33′ N., not far off the coast of Sierra Leone. Mathews's (1933, 39) statement that "this form does not appear to wander far from the type locality" is made out of imagination, as is also his remark that it perhaps breeds at Ascension Island.

Mathews is the latest reviewer of the group, and on page 41 of the paper referred to he publishes an alleged key, designed to distinguish between a tropical race (*tropica*) and a pan-antarctic race (*melanogaster*), the distinction amounting only to size and extent of the dark stripe on the ventral surface. After examining the type specimen, and a large number of others from many parts of all the oceans, I am prepared to maintain that these differences are purely individual or are due to wear of the plumage. Thus far no adequate grounds for subspecific division of this petrel have been advanced. Neither is there any tropical race breeding at Ascension or elsewhere. On the contrary, the species is one belonging exclusively to the Antarctic Zone and the higher latitudes of the Sub-Antarctic Zone. It is in effect a cold-water representative of its near ally, the White-bellied Storm Petrel (*Fregetta grallaria*), which is confined to lower latitudes and occurs as a breeder at islands close to the convergence between sub-antarctic and sub-tropical waters.

The six Atlantic examples of the Black-bellied Storm Petrel I have examined agree completely in appearance and measurements, except as regards slight individual variation in the feathering of the throat and the extent of the dark mark on the belly. One of these birds is the type specimen; a second is a British Museum bird taken just south of St. Paul Rocks; a third is from South Georgia; a fourth was captured west of the Cape of Good Hope, and the last two near Cape Horn. Dabbene (1922, 247) lists various other well-substantiated South Atlantic records.

In the course of the Whitney South Sea Expedition, Mr. Beck collected a large series of Black-bellied Storm Petrels in waters near latitude 49° S., longitude 179° E., during the middle part of February, 1926. The locality is between Bounty and Antipodes Islands. These specimens show a normal range of variation, and they are indistinguishable, so far as I can tell, from South Atlantic birds and from a single immature male collected by Beck off the coast near Cañete, Peru, on June 26, 1913. The last-named specimen has a slightly longer tail than any of the birds from the New Zealand region, but the difference seems insignificant. Furthermore, it has been pointed out that birds in juvenal plumage frequently have longer rectrices than in their subsequent adult stage. The measurements of the New Zealand birds show, moreover, that females average slightly larger than males, a condition which has previously been noted

as a characteristic of this group of petrels. The following measurements are important for comparison with those of Atlantic birds:

	Wing	Tail	Culmen	Tarsus	Middle toe with claw
20♂, 49° S., 179° E.	160	73.9	15.1	41.1	28.2 mm.
Minimum of the series	154	72	14	40	27.5
Maximum of the series	167	77	15.8	41.8	29
6♀, 49° S., 179° E.	163.3	74	15.1	42.8	28.8
Minimum of the series	158.5	72	14.5	42	27.5
Maximum of the series	167	76	15.7	43.5	29.6
♂ immature, off Cañete, Peru	162	82	14.7	39	28

The nesting place of the Black-bellied Storm Petrel was first found at Kerguelen Island, where its habits have been studied by Eaton (in Sharpe, 1879, 131), Studer (1879, 109), Werth (1925, 592), and others. Subsequently it was found breeding at South Georgia by the German Expedition of 1882–1883 (von den Steinen, 1890, 242), and more recently at the South Orkney Islands (Clarke, 1913, 235) and the South Shetlands (Bennett, 1927, 79). Vanhöffen (1901, 310) presents evidence to show that it is also a resident of Bouvet Island, in the waters about which it was found abundantly during the month of November. Its occurrence as a nesting species at the Falklands, as suggested by Bennett (1926, 313) and by the record of a supposed egg of this petrel obtained during the 'Challenger' expedition (Oates, 1901, 151), is open to doubt, while the repeated statement that it breeds at islands of the Tristan da Cunha group has not yet a leg to stand on.

The details of nesting at various islands between the Antarctic Archipelago and the New Zealand region agree remarkably well. According to the nature of the terrain, and the local temperature conditions, this Mother Carey's chicken either burrows into the soil or nests among interstices of the rocks. Thus at Deception Island of the South Shetlands, on January 13, 1927, Bennett found the sites of the Black-bellied Petrels mingled with those of *Oceanites oceanicus* under boulders of a talus slope in situations well sheltered from the violent winds. No nesting material was used, unless the dead bodies of chicks of earlier years can be classed as such. The egg, according to Bennett, is slightly larger than that of *Oceanites*, or has at any rate greater bulk even though that of the smaller petrel may sometimes be the longer.

At South Georgia the only known egg was taken on December 30, when many pairs of the birds were still engaged in courtship proceedings. The first South Orkney egg was discovered in a rock crevice at Laurie Island, 5 meters above the sea, on December 5, by Dr. Pirie of the Scottish Antarctic Expedition. The nest-cavity contained a fresh egg together with an addled egg of an earlier year, an indication of the high mortality to which this species, as well as Wilson's Petrel, is subjected in regions which experience such extreme periodical cold as the South Orkneys. At Kerguelen eggs have been found between January 3 and 30, and newly hatched young as early as January 25.

At the South Orkneys and many other localities, observers have referred to the whistling sound which originally led to the discovery of the nest of this petrel. The extraordinary notes are thus described in detail by Eaton, as he heard them at Kerguelen Island:

Occasionally late in the evening and during the night a piercingly shrill piping note repeated singly at intervals of four or six seconds used to be heard on the hills about Observatory Bay. Generally the sound changed its direction, showing that the bird which uttered it was flying. This call might be imitated on a piccolo fife in the key of G or F. In its complete form it consists of a series of single notes separated by pauses of four seconds or more, followed by a jerky succession of notes in the same tone.

One night the sound was traced to a crevice in a cliff beneath an immovable rock. The place was marked by a pile of stones, and visited early the next morning. While efforts were being made to move the rock the bird within the recess became alarmed, and uttered a cry somewhat like that of a kestrel hawk in its tone, but not nearly so loud. On another night the sound was followed up to a hill. Every now and then the bird ceased piping, but it recommenced whenever the call was imitated with the lips. Its nook was therefore easily discovered (Sharpe, 1879, 131).

The noisy chorus apparently ceases or becomes greatly reduced in volume as soon as the courtship season has passed, although Bennett states that a peculiar whistle is uttered whenever the parent Black-bellied Petrels approach their nest in the darkness.

There are few data on the food of this species, but Sperling (1863, 283) states that off Cape Hanglip, to northeastward of Cape Town, the mouths of examples captured on October 8 were filled with "dull ruddy spawn, which floated on the surface of the sea all round us in large blood-red patches."

WHITE-FACED STORM PETREL

Pelagodroma marina marina

Procellaria marina Latham, 1790, Index Orn., 2, p. 826 (Southern oceans = off the mouth of the Río de la Plata).

Names: Frigate Petrel. Synonyms of the specific name include *fregata*, *hypoleuca*, and *aequorea* (?).

Characters: This petrel has the longest and heaviest legs among all the storm petrels, and also the straightest bill, with the least pronounced unguis.

Adults (sexes alike): Crown, nape, and a broad infraorbital stripe which extends across the cheek, dark mouse-gray, the stripe proceeding from a dense blackish spot in front of and partly encircling the eye; back and wing coverts brownish gray (close to hair-brown in fresh plumage); upper back and sides of breast somewhat grayer, whitish bases of worn feathers producing in some instances a distinct light transverse mark between nape and back; rump and upper tail coverts light neutral gray, forming a patch contrasting with the back and rectrices; tips of the upper tail coverts, as well as those of the tertials, secondaries, and greater wing coverts, terminally edged with white, a character which, however, rapidly disappears with wear; quills of wing and tail sooty black, lighter on their concealed portions, the inner vanes of the remiges more or less flecked with white; forehead, lores, and a broad supra-orbital stripe continuous with them, white except for a few dusky feathers at the base of the culmen; ventral surface from chin to crissum, and likewise the wing-lining except for a few dark marginal feathers, white; under tail coverts white, the longer and the lateral feathers somewhat flecked and barred with gray; a tuft of dusky feathers on the thigh. Iris brown; bill black; legs and feet black, the webs yellow except at their edges.

3 specimens (sex unknown) taken from burrows on Nightingale Island, Tristan da Cunha group: wing, 150–153 (151.7); tail, 71–75 (73); exposed culmen, 16–16.2 (16.1); tarsus, 40–42 (41.2); middle toe and claw, 33–35 (34) mm.

Fledglings are clad in pale gray down, from which they moult into a plumage resembling that of the adults.

Although I find no descriptions of eggs of the Tristan da Cunha race, those of other frigate petrels have a fine white texture with little trace of gloss, and a varying amount of fine brownish or vinaceous freckles, mostly toward the larger end. Measurements of 22 recorded by Bent, and presumably from the eastern North Atlantic islands, average 36.2 x 22.03 mm.

Distribution: Breeds at islands of the Tristan da Cunha group; the Atlantic range is uncertain because specimens upon which many records are based have not been critically studied. The species is not known from Gough Island, the distributional status being sub-tropical rather than sub-antarctic. Closely related forms are found in the eastern North Atlantic and the Galápagos area of the eastern tropical Pacific.

The White-faced or Frigate Petrel has a wide distribution in the southern hemisphere, and a race of the species also enters the eastern North Atlantic to breed at the Cape Verde and Canary Islands. The subspecific status of examples seen or collected in various parts of the South Atlantic has not been satisfactorily determined. It is altogether possible, for instance, that birds from northern-hemisphere breeding grounds migrate to the coast of Argentina, for winter journeys of similar type are freely made by certain other sea birds of the eastern North Atlantic, such as the Manx Shearwater (*Puffinus puffinus*).

Dabbene (1922, 247) cites the known South American records from the neighborhood of the Río de la Plata, and from the offshore waters of Patagonia in the latitude of the Gulf of San Jorge. One of these specimens represents the type of the species, for it is of record that this bird, obtained during a voyage of Captain Cook, was collected opposite the Plata estuary (Salvin, 1876, 228). Several Frigate Petrels were seen by Aplin (1894, 212) at a point "113 nautical miles out from Montevideo," on June 10, or midwinter. The only other pelagic record I can find for the South Atlantic is of an example that flew aboard the 'Novara' at night, on September 16, 1857, in latitude 33° 49′ S., longitude 0° 43′ E., a position slightly north and well to the eastward of Tristan da Cunha (Pelzeln, 1869, 144).

For the present, we may at least make the assumption that the generally distributed South Atlantic Frigate Petrels are those which take their origin from the Tristan group, where the 'Challenger' expedition obtained the first examples from burrows at Nightingale Island on October 17, 1873. In the British Museum I have examined three birds of this source, and find that they appear to represent a race with well-marked differences from that inhabiting the Cape Verde Islands, being of smaller size in most dimensions, particularly in the length of the tarsus. It should be added that the subspecific characters of other races of this petrel, in parts of the western Pacific for instance, exhibit still more strongly marked differentiating characters both of a quantitative and a qualitative nature. The generic group as a whole is much in need of revision. A recent list, which recognizes four forms, is that of Peters (1931, 69), but this makes no provision whatsoever, either by name or by an indication of range, for the representatives of the species which have been taken in the neighborhood of Cocos and the Galápagos Islands.

The Frigate Petrel, according to Thomson (1878, 157), is one of the "Night-

birds" of the Tristan settlers. This visitor states also that the birds breed in the wooded foreshores below the cliffs of Inaccessible Island, in the same territory as that occupied by whale-birds (*Pachyptila*), and that they often make use of abandoned burrows of other petrels. At Nightingale the 'Challenger' party found, with the aid of dogs, the specimens mentioned above.

Mathews (1932, 23) reports that there is no recent information regarding this petrel at the island of Tristan da Cunha itself. It is, however, one of the species which would most quickly have been wiped out by the great invasion and multiplication of rats, which ran its course at Tristan but which, fortunately, has not affected Nightingale or Inaccessible. It is not clear from Mathews's text whether or not the egg description that he publishes is based upon specimens from the Tristan group or those from some other part of the world. He is incorrect, furthermore, in stating that Bent (1922, 179) gives measurements of eggs of the "typical form." Bent, as a matter of fact, heads his biography with the name of the North Atlantic race (*hypoleuca*), but neglects to give any indication of the provenance of the eggs listed.

The following summary of the habits of the White-faced Petrel is based upon observations relating to races in various parts of the world.

At sea these birds have an exceedingly erratic flight, and their long dangling legs are conspicuous during the periods of their pattering upon the water. When they flit over the land *en route* to their nesting grounds, they just "tip" it with their toes, and bounce along, giving the impression of being full of springs. Owing to the extraordinary length of their legs, they are about the most awkward and helpless of all the Mother Carey's chickens when it comes to terrestrial locomotion. Usually they make no sound while on the wing, but as soon as they enter their homes a mouse-like squeaking begins to come forth, at least during the breeding season (Littler, 1910, 160). They burrow chiefly in grassy areas and in soft soil. In places where the population is concentrated, there may be an entrance to a burrow in each square meter of the surface. It is estimated that there are not less than 50,000 nests on Mud Island, off Port Phillip Bay, south coast of Australia. Marking experiments show that during incubation by no means all of the mated petrels are relieved in any one night. The young make a purring note of welcome when the adult enters the burrow (Campbell and Mattingley, 1907, 185).

Falla (1934, 247), who has recently made important biological studies upon the habits of New Zealand sea birds, reports that the Frigate Petrels reappear in his region about the middle of August, after an absence at sea of five months. Egg-laying takes place during the last ten days of October, and the young hatch at the end of November. The nestling down is of a uniform ash-gray, very long and bushy on the pileum whereas the chin and throat remain practically naked. The first teleoptyles begin to appear during January, and by March 1 the young are flying. Diagnostic features of the juvenal plumage are the grayish edgings of the secondaries, and the white tips of the longer wing coverts.

During September these birds of the islands off northern New Zealand approach closely to their ancestral breeding grounds, and engage more in mating

activities, which include erratic pursuit flights, than they do in feeding. In foggy weather during this period, many lose themselves and fly against lighthouses or fall on board passing ships. The burrows that these petrels subsequently make, or clean out, vary greatly in length. They use a larger quantity of nesting material than most other species, which results in the egg being kept especially dry and clean. A very few eggs are laid upon the surface of the ground, and Falla has found at least one that had been well incubated in such a situation. The Frigate Petrels come to their homes only after dark, usually not sooner than an hour after the last trace of daylight. When they arrive to feed the young they are not at first noisy, uttering only a low twittering note while alighting. An hour or two before midnight, however, loud squeaking calls begin to issue from most of the burrows. Only one adult has been found in the nest-chamber after the hatching of the chick, and Falla believes that possibly only one of the parents visits it during any one night.

Stomachs of incubating adults contained nothing but small pebbles. At other seasons Falla has found cephalopod beaks in these petrels. The food-contents of nestlings consisted mostly of a paste of minute crustaceans. Fledglings ready to leave the nest discharged, when handled, about six cubic centimeters of clear reddish orange oil.

GALÁPAGOS FRIGATE PETREL

Pelagodroma marina, subspecies

In the monograph on the avifauna of the Galápagos Islands by Swarth (1931), no mention is made of the Frigate Petrel. I find, however, a number of records and specimens which indicate that some form of the species is probably resident in the eastern tropical Pacific not far from the coast of South America.

The first published notice is that of Loomis (1918, 182), referring to a specimen collected by Beck on June 18, 1906, in latitude 2° 40′ S., longitude 91° 20′ W. This position is due south of Albemarle Island. A second record is one of Beebe (1926, 329) of an example which flew on board his ship in latitude 4° 30′ N., longitude 87° W., about 100 kilometers southwest of Cocos Island on a direct line toward the Galápagos. In the Dwight collection of the American Museum, there is a male bird marked "Chatham Island, Galápagos, December 15, 1905." I do not know whether this was collected on the island or offshore. Finally, the United States Biological Survey collection contains a specimen which flew on board a steamer just west of Point Santa Elena, Ecuador, on the evening of June 23, 1922 (Wetmore, 1923, 171).

There is little to distinguish the eastern Pacific specimens I have seen from Frigate Petrels inhabiting the South Atlantic. Their measurements are very similar, the average of those of the two Galápagos birds and the one from Ecuador being as follows: wing, 150.6; tail, 74.3; exposed culmen, 16.3; tarsus, 40.8; middle toe and claw, 36.2 millimeters. These figures are for the most part strikingly smaller than the dimensions of North Atlantic specimens, but

not unlike those of the three Tristan da Cunha birds I have examined. The status of the eastern Pacific birds can only be determined by further research.

The stomach of the specimen collected by Beebe contained remains of insects, the marine water-strider (*Halobates*).

THE DIVING PETRELS

FAMILY PELECANOIDIDAE

The diving petrels comprise a homogeneous, monogeneric, strikingly distinct group of Procellariiformes, the members of which exhibit few characters that might indicate their relationships with other divisions of the order. They have therefore always presented a somewhat puzzling problem to taxonomists. The entire family has been monographed by Murphy and Harper (1921, 495), whose study furnishes the basis for the present treatment of the South American species.

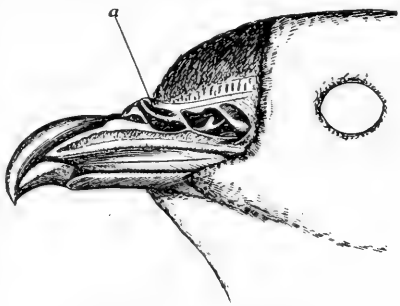


FIG. 65. Sagittal section through the left narial passage of *Pelecanoides garnotii*, showing the paraseptal process (*a*).

From Murphy and Harper (1921)

Confined wholly to the southern hemisphere, where they are the biological analogues of the auklets and murrelets (Alcidae) of the northern oceans, the diving petrels have become distributed through a broad south-temperate and pan-antarctic belt; one species alone has moved its range northward into the tropics along the west coast of America, following the route by which penguins, austral cormorants, and many other cold-water organisms have likewise entered the narrow, coastwise tongue of the Humboldt Current region.

Short-winged, characterized by "whirr-flight," like that of the auklets, rather than by gliding flight, and given to diving from above the surface of the water, the Pelecanoididae have little resemblance to typical petrels. A correlation between structure and their peculiar habits is evident in numerous morphological details. Their nostrils point upward to an even greater extent than those of shearwaters, and the nasal orifice is divided, and probably protected, by a curious lateral flange. In the trunk skeleton, the sternum and rib-basket have become extended further caudad than among petrels of other groups, producing an excellent structural adaptation for plunging and subsurface progression, and resembling to a remarkable degree the condition in the auklets.

The entire distribution of the diving petrels, excepting the Humboldt Current bird (*Pelecanoides garnotii*), is confined between the parallels of 35° and 60° S. Excluding again the range of *garnotii*, practically all the regions inhabited by

diving petrels are characterized by tempestuous weather, a high scale of cloudiness, and heavy precipitation. All the habitats, even that of *garnotii*, are situated in relatively cold oceans, in which the annual variation in surface temperature nowhere exceeds 6.6° C. Furthermore, the shores of all the breeding grounds are bathed by effluents of the west-wind drift, only slightly tempered, in a few instances, by warm countercurrents.

Murphy and Harper (1921, 550) have shown that two of the most southerly species of diving petrels have a more or less circumpolar distribution along parallels of latitude, with widely separated races on or close to common isothermal lines. Representatives of all the known species, except *Pelecanoides exsul* of the southern Indian Ocean, occur within the American region. *P. georgicus* belongs to the Antarctic Zone, *P. urinatrix* and *P. magellani* are sub-antarctic, while *P. garnotii* occupies the continental littoral of western South America. Alone of all the family, the last-named species inhabits a mild region of rainless, relatively placid seas, with an invariable surplus of accessible food. The factors which inhibit increase of size in the more southerly species are apparently not effective, and this largest and most northerly of diving petrels has, moreover, overcome the limitations of a fixed breeding season, and has assumed the continuous breeding habit common to many sea birds of tropical latitudes. Throughout the whole family of diving petrels there is a tendency toward decrease in size with decrease in temperature of the habitat, an apparent contradiction of the correlation expressed in Bergmann's law, which has been discussed in the life histories of the penguins.

The forms of diving petrels living at remote oceanic islands, such as *georgicus*, *exsul*, and most of the races of *urinatrix*, appear to make migrations of considerable extent, or at least to lead pelagic lives during part of the year. The continental species, *garnotii* and *magellani*, on the other hand, seem to be strictly littoral and practically sedentary. Neither of these two latter species has been recorded from any offshore locality; *P. garnotii* is unknown at Juan Fernández; *P. magellani* has not invaded the territory of its near neighbor, *P. urinatrix berard*, which nests at the Falkland Islands. Further evidence of the permanent residence of *garnotii* and *magellani* within the environs of their breeding ranges is to be found in their notably uniform plumages, a condition contrasting strongly with the wide amplitude of individual variation in *P. georgicus*, for instance. This is in accord with the recognized principle that, other factors being equal, so-called stationary species exhibit a lesser degree of individual variation than species which undertake long periodic migrations.

Murphy and Harper have presented evidence that the diving petrels are of American origin. All the species except *P. exsul* are indigenous within a relatively short distance of the southern extremity of South America. It would seem as though the agencies which have been determining the course of evolution within the family have been most active in the region referred to, and that the point of original dispersal may not have been far from Cape Horn. In this locality we find today *Pelecanoides magellani*, the most strongly marked and distinctive of all diving petrels, and in this sense the most advanced member

of the genus. The more distant *Pelecanoides garnotii* has, except for its increase in size, differentiated much less from the family type. Still more distant and isolated examples, such as *Pelecanoides georgicus*, *P. exsul*, and the remote races of *P. urinatrix*, share with one another strong superficial resemblances of color and pattern, small size, etc., which are probably due not to close relationship, nor to convergence, but rather to the retention among these peripheral forms of primitive, non-adaptive characters. In any group of organisms, we should look to the point of origin for advanced present-day types rather than for primitive present-day types, and, upon this criterion, southern South America fulfils the requirements.

POTOYUNCO

Pelecanoides garnotii

Puffinuria Garnotii Lesson, 1828, Manuel d'Orn., 2, p. 394 (coast of Peru, north of San Gallán Island).

Names: Garnot's, or Peruvian, Diving Petrel; "Potoyunco," presumably of aboriginal source, is the vernacular name in Peru and Chile. An untenable race has been described under the subspecific name *lessoni*.

Characters: The largest member of the family; nearest to *P. magellani*, but much larger, especially in length of bill, wing, and tarsus. Bill relatively slender in proportion to length (exposed culmen exceeding twice the width of bill at base); outline of combined nasal orifices broad and cordate, the walls of the tubes horny and firm, the nostrils appressed; claws relatively blunt and stout. Natal down whitish.

Adults (sexes alike): Upper surface black, each feather with a terminal band of glossy black, preceded by a grayish black area, which shades into the grayish white basal portion; the shafts mostly dark; scapulars mostly dusky neutral gray on outer web, grayish white on inner web, more or less concealed by the plumage of the interscapulum, but forming in many specimens an irregular, blotchy diagonal stripe; wings glossy black, more or less tinged with brownish, especially on primaries; secondaries narrowly tipped with whitish; inner webs of primaries clove-brown; under wing coverts whitish, more or less washed with light mouse-gray, the shafts mostly dark; rectrices glossy black, fading to glossy brownish black, paler on the under surface; anterior part of forehead and lores suffused with clove-brown; under surface white; auriculars and malar region chaetura black; a fuscous area extending from the sides nearly to the middle of the breast, and sometimes extending entirely across as a faint mottling; axillaries dark mouse-gray to black; sides and flanks strongly washed with deep mouse-gray, the feathers sometimes narrowly tipped with whitish; feathers of tibia mouse-gray; down plumules and aftershafts over entire body deep mouse-gray. Paraseptal processes situated at the longitudinal center of the septum. Bill black; iris brown; tarsus and toes bluish; webs black.

20 males: length (skins), 217–238 (228.7); wing, 130–141 (136); tail, 33–43 (36.7); exposed culmen, 19–22 (20.4); width of bill, 8.5–10.5 (9.6); depth of bill, 7–9 (8.3); tarsus, 30–34 (32.9); middle toe and claw, 34–39 (36.9) mm.

20 females: length (skins), 209–239 (221.9); wing, 130.5–144 (136.6); tail, 33.5–41 (36.5); exposed culmen, 19–21 (19.7); width of bill, 8.5–10 (9.2); depth of bill, 7–8 (7.6); tarsus, 32–34 (32.5); middle toe and claw, 34.5–40 (36.3) mm.

The natal down of the newly hatched Potoyuncos is very light colored, between pale gull-gray and white. It is attached to the tips of the mesoptyle down which is mouse-gray, but which fades appreciably before it is finally moulted. The first contour plumage resembles that of adults. Immature examples are, however, apparently determinable even when they are more than a year old, for while at this age they have mostly acquired new quills, the rectricial moult is often still incomplete, and one or more of the bleached tail quills, abraded as only the plumes of young petrels are wont to be, contrast strongly with their heavily pigmented successors. Such old rectrices are much more weathered and frayed than the corresponding year-old feathers of adult birds.

Egg: Six collected at San Gallán Island, Peru, on July 4, 1913, range in form from short-ovate to elongate-ovate, one being extremely pointed at the smaller end; white, thin-shelled, lustreless; measurements, 48.5 x 33.6, 46 x 34.5, 46.7 x 34.2, 48 x 37, 47 x 34, 45 x 33 mm. (average, 46.8 x 34.4). Average volume of the six, 24 cubic centimeters. Egg measurements recorded by Coker (1919, 465) entirely agree with these.

Distribution: Endemic in the Humboldt Current; western coast of South America, from Lobos de Tierra Island, Peru (latitude 6° 27′ S.), to Coronel, Chile (latitude 37° S.), and casually farther southward.

The Potoyunco, like the Pájaro Niño or penguin, has suffered a great diminution along the coasts of Peru and Chile owing to the transformation brought about on the rocky islands by removal of the ancient blanket of guano. Early recorders, such as the Peruvian naturalist Raimondi, credited these curious sea birds with being highly important producers of guano in former times. About the middle of the last century they inhabited the Chincha Islands, and other groups off the central part of the Peruvian coast, in vast hordes. They no longer nest commonly upon any of the low islands which are regularly worked for their guano accumulation, because most of the surface into which the petrels are capable of burrowing is gone, leaving only a thin crust of guano upon the native rock. Since the condition applies to nearly all the islets of the west coast, between northern Chile and Lobos de Tierra, it is probable that only a few high islands, which have considerable sand and soil upon their tops and flanks, now afford homes to the bulk of the surviving population of Diving Petrels. Such lofty islands include San Lorenzo, Fronton, San Gallán and Vieja, in Peru. Paessler (1922, 440) and Stresemann (1922, 130) report that this Diving Petrel also breeds, in all probability, at Santa María Island in the Bay of Arauco, Chile, a point which apparently marks the southern limit of its nesting range.

At Vieja Island, which forms the outer barrier of Independencia Bay, I first found the Potoyunco's nests, at altitudes of between 180 and 300 meters, during November, 1919. The burrows were not evenly distributed, but made scattered colonies, like the settlements of kangaroo-rats or other desert rodents. They were always in soft soil at this locality, never piercing the crust of alkaline salt which formed the walls of many crests and gulches. Moreover, they were all situated on windward, that is, southerly, exposures, and wherever an east-to-west ridge cut across the island, the burrows on more northerly ridges were invariably enough higher to raise them out of the lee. Such choice of sites, determined by the prevailing wind, doubtless gave the Potoyuncos an advantage in taking flight from their thresholds, a feat perhaps more difficult for them than for longer-winged petrels.

During the same month I also visited the mountainous island of San Gallán, off Pisco Bay, Peru, which is close to the type locality of this petrel. As I stood at the very summit of the island, where the aneroid registered an altitude of 402 meters, and looked down the slopes and valleys, the most striking marks were the innumerable clusters of black specks which represented the round mouths of Potoyunco burrows. The aggregate number of birds on this island must be enormously great in spite of Condors, "Gallinazos" or Turkey Vultures,

marauding fishermen, and the "zorras" or wild dogs, which occur only upon San Gallán of all the Peruvian islands. From a meter or so above sea level to the pinnacles, in the damp soil of seepage areas behind the beach, in the detritus at the base of the precipices, on the hard upper slopes of the hills, and in the midst of the succulent vegetation of the cloud zone, the island is indiscriminately drilled full of holes. By day there are nothing but burrows and bones to suggest the existence of the Potoyuncos, and the large proportion of empty nests might give even a naturalist the impression of extinction; but at night the air rings with their purring voices and vibrates with the whirring of their wings.

I remember vividly the evening at San Gallán when, on strolling from the campfire to the base of a hill which rose from the beach, I first became aware of the living presence of myriad ghostly creatures which were soon determined to be Diving Petrels. Out of the talus came low, froggish songs. Whichever way I turned along the slope, the chorus of elfin voices continued to resound in my ears. When I fetched a lantern I soon found the crevices that led to the burrows, for the weird songs were not interrupted even by a light at the entrance, and flying birds, perhaps attracted by the glare, fluttered past and darted into the ground. It was not practicable to get at the nest-chambers here, because of the protection afforded by the rocks, so my Peruvian companions and I made a trip in the darkness to the entrance of a flat valley. Except where the earth was encrusted with salt, we could now dig into the petrel homes very easily, and we captured a dozen or more specimens. The tunnels were variable in course and depth, but most of them led down steeply from the entrance for about 30 centimeters before beginning their level, twisted path to the enlarged nest-chamber. The blissful singing of the birds continued while the digging progressed, but when they were hauled out they screamed angrily. A few of the burrows proved to be empty, but within most of them we found either a bird and an egg, a bird and a chick, a chick alone, or two adults. The noisiest holes, if they may be so described, usually contained a love-making pair without egg or offspring. When the captive birds were put into a burlap sack, some of them resumed their song, but not so contentedly. All the while additional Potoyuncos were streaming in from the sea.

During the course of the Brewster-Sanford Expedition, Mr. Beck observed and collected Potoyuncos during nearly every month of 1913. The localities mentioned in his notebook include Salaverry, Ancón, Callao, Chilca, various parts of Pisco Bay, Arica, Iquique, Taltal, and Valparaiso. On October 22 he ran out to sea in a motor-boat from Corral, the port of Valdivia (latitude 40° S.), but could not find a single example of the species. Paessler (1922, 440) however reports that this species of Diving Petrel was observed by him southward to the latitude of Ancúd, Chile, or almost to 42° S. He records the birds also from Coronel, Corral, Taltal, and Islay. Among the large number of specimens I have examined, are examples from Coquimbo, Chile, and from the following Peruvian guano islands, at all of which the Potoyunco formerly nested abundantly: Lobos de Tierra, Macabí, Guañape, Pescadores, and Ballestas. Beck found a single family breeding on one of the Pescadores Islands on May 8, 1913.

Nothing is known about a regular migration of the Potoyuncos and it is probable that their movements are mainly sporadic, as are those of most other endemic birds in the Humboldt Current where the physical environment is so little related to latitude. One sees them chiefly in small groups on the water, or flying just above it for distances of 100 to 200 meters. They seem usually to be working to windward, but since the breeze on the coast of Peru is nearly always from a southerly quarter, it is clear that the birds must also travel northward, either during the almost daily calm periods or along tracks farther from the coast. Perhaps there is sufficient directional compensation in the fact that both wind and current tend to carry them rapidly northward while they float on the surface.

Paessler states that during the southern summer the Potoyuncos are more common in the Peruvian and Chilean bays than in winter, when many of them go 10 to 20 kilometers offshore. Beck, however, found them still farther from the coast of Peru in January, which is midsummer. All observations agree that the species is at all times confined to the zone of cool, upwelling water, relatively close to the land.

The Potoyuncos often concentrate with other oceanic birds about the shoals of anchovies and silversides (Atherinidae), with which their stomachs are sometimes found to be crammed. Furthermore, they congregate in areas of ocean water discolored by clouds of *Munida* or other free-swimming crustaceans. Of twelve stomachs of the birds which I submitted to the United States Biological Survey, the majority contained only traces of gravel and a varying content of small crustaceans, identified merely as the megalops stage of a crab. More than 120 of these organisms were in one stomach. Beck found that the Diving Petrels paid little or no attention to the bait which he often spread on the water.

In common with many other native sea birds of the Humboldt Current, the Potoyuncos breed throughout the year. In early July, at San Gallán, Beck took adults on their nests, both fresh-laid and heavily incubated eggs, and chicks varying in age from a few days to several weeks. Coker and I each found eggs and young at other seasons.

The courtship of the species has not been reported, although Paessler observed a pair chasing each other in circles on the surface of the bay of Taltal. Their nest-chambers are usually lined with a few feathers, sometimes derived from other species of birds, but the probable use of such objects in the courtship behavior is still unverified. The eggs I have seen have in common with those of most petrels a remarkable variation in shape. In volume, however, six of them are relatively uniform, the average contents being 24 cubic centimeters. Four eggs of the South Georgian Diving Petrel (*Pelecanoides georgicus*) average only 16.2 cubic centimeters, and those of most forms of *P. urinatrix* are apparently of about the same bulk. The period of incubation of the Potoyunco is not known. Beck observed in more than one instance that Diving Petrels and Inca Terns shared a common entrance, leading to their respective nests.

How little the Potoyuncos are dependent upon the power of flight is shown

by the fact that they moult their wing quills all together, and thus for a time each year become exclusively aquatic. A study of the large series in the Brewster-Sanford collection indicates that normally a complete moult occurs between August and October. Most of the November specimens are in new bright plumage, while from this month forward the series as a whole shows progressive wear of the feathers up to and including the following winter season (July). The stomachs of the naturally "crippled," temporarily penguin-like Diving Petrels, which have lost all their flight feathers, prove to be as well filled with crustaceans or small fishes as those of their flying contemporaries. They capture their prey by making shallow dives, apparently effected without any preliminary leap into the air like that of cormorants, grebes, etc. Beneath the surface they literally fly with their wings, whether or not the remiges are full-sized, and they remain under water for only relatively brief periods; a considerable series of observations which I made showed that the birds were ordinarily below for lengths of time varying between three and twenty seconds. Thus, so far as feeding is concerned, they might just as well be flightless birds. The only indispensable use of full-grown primaries would seem to be to bear the Potoyuncos to and from their nesting burrows on the islands.

Little is known of the natural enemies of the Peruvian Diving Petrels while they are at sea, but Paessler saw one being persecuted by either a skua or a jaeger. The petrel dived as often as its enemy swooped at it, but the outcome of the attack was not observed.

The following is abridged from Coker's (1919, 462) excellent account of the Potoyuncos, as he observed them during nearly two years' field work along the coast of Peru.

In favored locations on the islands they are breeding at all seasons and the guano left in their subterranean chambers is considered particularly rich in nitrogenous matter. My first acquaintance with these birds was when at night in a small boat we often sailed close by them floating on the surface of the water. On the islands, as far as my observations go, they are strictly nocturnal, coming and going only after daylight has gone and before the light of morning. They are more readily recognizable by sound than sight, and, as they fly obscurely about over the island, uttering their little croaks, they are very suggestive of bats.

The nests are made in the side of the hill, often just beneath a large rock or sheltered under the hard salty crust. It is an odd experience to sit at such a place and hear the mysterious sounds from subterranean homes. Over and over again, with the voice of a frog, unvaried in pitch or rhythm, they repeat the sequence of notes—two longs, a short and a long, the last note slightly longer than the first two. Another more complicated sound is made by some and it is possible that the calls are distinctive of the sexes.

The potoyunco is comparatively small, measuring about 10 inches in full length from end of bill to tip of tail and weighing half a pound. The body is thickly covered with feathers, beneath which is a thick gray down, the dense coat making the bird appear to possess a very large body. Viewed from below, the body is oval in form—like a large white egg—the wings and the short, stout neck seeming disproportionately small appendages.

A number of the nests were observed at the Ballestas North Island, and the birds were heard on the Chinchas, but the lofty San Gallan was the chief island for potoyuncos, as the potoyuncos were easily the principal bird of this large island.

San Gallan, 2.5 by 1.5 miles, is mostly dry, barren, and dusty, but with high hills reaching well into the clouds, and only there, in the moist altitudes, teeming with plant life. Everywhere

over the island are large spots perforated by the holes of the potoyuncos, as they undermine the hard, dry crust of the lower hillsides or burrow back underneath the vegetation of the cloud-wrapped peaks more than a thousand feet above sea level.

Searching for these birds in the daytime one is guided only by the openings of the burrows, for their voice is rarely heard during the day. One may try quite a number of nests without result, as the burrow may either be unoccupied or, more often, too deep for the arm to reach to the nest. Still, so abundant are the nests on San Gallan, that a considerable number of birds or eggs may be captured in an hour or two. Once reached, the birds are easily taken, as they make almost no effort at resistance. Sometimes, after they are out, they try to bite, but without inflicting injury. Occasionally they would rush into the hands held at the mouth of the burrow.

At night it is much easier to take them, when guided by the voices one may avoid exploring the unoccupied homes. It is thus that the laborers and fishermen catch them abundantly, for the potoyunco is valued for food in fresh or salted condition.

If liberated they run rapidly over the ground flapping their wings, but unable to rise except after a run of 10 or 20 feet. Then, with exceedingly rapid movement of their short wings, they make for the ocean with a queer zig-zag flight. Reaching the ocean they fly low over the water a little distance, settle upon the surface, and then swim away with short, shallow dives.

When placed on the ground in my tent, the petrels displayed peculiar movements. The body is covered with a very thick coat of feathers so that lying on the ground the body seems to flatten out remarkably, while the wings, pushed a little out on the sides, increase the apparent width until the body has quite a turtle-like form. As they crawl rapidly along, the legs are spread well out to the sides and the body is barely, if at all, lifted from the ground. I noticed that with some the body was slightly raised; with others not at all. In any case the movement is a reptilian creep rather than a walk. When I started one under my sleeping bag it began to burrow, with strong backward sweeps of the feet, used alternately and sending the dirt flying with great force. Two birds were placed outside in holes in the ground, each secured by a line attached to the leg. They made a little effort to burrow, but soon stopped. At 10 o'clock at night I found them trying to go toward the water. Placing them back in the holes I left them again, hoping to ascertain the rate of excavation. Unfortunately, in the morning only the bones of the legs remained, and the tracks of gallinazos accounted for the disappearance of the birds.

Presumably both condors and gallinazos (buzzards) may be accounted enemies of the potoyuncos, although their subterranean life and nocturnal flights give them substantial protection from predatory birds. Certainly the chief enemy is man. About the signs of old campfires numberless wings of the potoyuncos were often observed. For a while I was puzzled by the many signs of sacks having been dragged down the hillsides, until it was observed that these trails led in almost every case to the grounds where there were burrows of potoyuncos, even to those near the very tops of the peaks. The ground was not torn up as if guano had been the object of search, and the abundant evidence of discarded wings of potoyuncos completed the story. The fishermen assured me that these birds were very good when salted, and that the laborers on the islands regularly brought back quantities of potoyuncos salted down.

A "pichon," or fledgling, at the stage when the wing feathers are first appearing, is a large shapeless mass of fat and down, with nearly the dimensions of its parents and of equal weight (about 7 ounces). Its soft coating of gray down measures 3–4 cm. in thickness. If a single tuft of down is pulled out, there is found growing out of the blue sheath the delicate feather, which for about 1 cm. is white (if from the lower side of the body) or black (if from the back); many of its barbs are tipped with delicate plumes of down, which are dark gray for about 2 cm. and possess white tips of 1 cm. length. The head protruding from the great ball of down appears almost bald having only a close crop of gray down.

Valued as they are for food and readily open to capture, the potoyunco must eventually be brought near to extinction unless effective efforts for its protection are made. It will be unfortunate, indeed, if the potoyunco and the penguin, two water fowl which produce a fertilizer of high quality, shall, through mere human negligence or wastefulness, become lost to the guano industry. Valuable the potoyuncos may be as food, or the penguins for the skins or fat, and we may impose little personal blame on those who desire the food or the skins or the oils; but the fact remains that

when the food or the skin and oil is taken the bird is lost to the future, while the removal of the guano is a benefit gained without loss. With due care each of these important species may not only be preserved to the future, but may be restored to a condition of far greater abundance and value than at the present time.

MAGELLANIC DIVING PETREL

Pelecanoides magellani

Puffinuria garnotii magellani Mathews, 1912, Birds Australia, 2, p. 239 (Strait of Magellan).

Names: Magellanic, or Fuegian, Diving Petrel; "Petrel Zambullidor" is the South American book name. The species has been reported upon in the literature under several other specific names, such as *urinatrix*, *berard*, *garnotii*, and *tenuirostris*, of which only the last is a true synonym.

Characters: Nearest to *garnotii* in general form of bill, to *urinatrix* in size. Differs from all other members of the family in the possession of white tips to feathers of back, upper rump, and wing coverts (in fresh plumage), and in having a conspicuous falcate whitish area extending from the side of the neck to the occiput; the upper breast, moreover, is always pure white (never crossed by a mottled collar). Bill relatively slender in proportion to length (exposed culmen about equal to twice the width of bill at base); walls of the nasal tubes moderately thin and often somewhat warped in dried skins; nostrils widely divergent posteriorly. Claws relatively sharp and slender. Natal down unknown.

Adults (sexes alike): Upper parts glossy black; feathers of the back and upper rump with narrow white tips, which disappear with wear (showing best in August specimens, entirely absent in some March specimens); scapulars dusky neutral gray (lighter on the inner web), with a terminal band of white (broader on the inner web); the scapulars forming a broken but distinct diagonal stripe of white; wing coverts and secondaries glossy brownish black, the former with narrow, the latter with conspicuous, white tips and edges, which largely disappear with wear; primaries blackish brown, slightly glossed, becoming paler on the inner web; under wing coverts white, a few feathers near the edge of the wing with dark shafts and splashed with blackish mouse-gray; rectrices black (fading to blackish brown), paler on the under surface, and several of the lateral feathers with narrow white tips, which disappear with wear; lores and anterior part of forehead suffused with clove-brown; under parts white, cheeks and sides of neck dark mouse-gray, the feathers with narrow white tips, except in worn plumage; a more or less distinct patch of white, falcate in shape, behind the cheeks, extending from the throat to the occiput; axillaries varying from dark to blackish mouse-gray; sides and flanks washed or broadly banded with dark neutral gray, the feathers with white tips, and the shafts black subterminally; feathers of tibia fuscous; down plumules and aftershafts over entire body deep neutral gray. Paraseptal processes situated posterior to the longitudinal center of the septum and not prominently developed. Bill blackish; iris brown; tarsus and toes bluish, webs black.

20 males: length (skins), 204–218 (209.8); wing, 120–133.5 (125.7); tail, 36–44 (40.5); exposed culmen, 15–17 (16); width of bill, 7.5–9 (8.1); depth of bill, 6–7 (6.4); tarsus, 26–30 (28.1); middle toe and claw, 31–36.5 (34) mm.

20 females: length (skins), 197–227 (208.5); wing, 121–132.5 (128); tail, 34–43.5 (39.3); exposed culmen, 15–17 (16.2); width of bill, 7–8.5 (7.9); depth of bill, 6–7 (6.2); tarsus, 27.5–29.5 (28.2); middle toe and claw, 31.5–36 (34.1) mm.

The eggs and chicks of this species are apparently still undiscovered.

Distribution: Patagonian, Fuegian, and southern Chilean coastal and inland waterways, from Cape Horn northward on the Atlantic side to the vicinity of Puerto Deseado, and on the Pacific coast to the Gulf of Ancúd and other waters around Chiloé Island.

The Diving Petrel inhabiting the complex of Fuegian waterways is a very well-marked species, probably the most distinctive and certainly the handsomest representative of its family. It is surprising that so many naturalists should have confounded it with the smaller and more plainly colored species,

P. urinatrix, until Mathews, as recently as 1912, distinguished it, and yet signally failed to recognize its proper rank, by describing it as a subspecies of *Pelecanoides garnotii*.

In the revision by Murphy and Harper, and in Peters's "Check List" (1931, 76), Trinidad Channel, in latitude 50° S., is given as the northern limit of the range of this species on the Pacific coast of South America. Since my former study, however, I have examined in the Zoölogical Museum of Berlin two males of this species collected by Plate in December, 1894, bearing upon their respective labels the locality names of Calbuco and the Gulf of Ancúd. Stresemann (1922, 130) identifies these two birds as specimens which had been erroneously reported as *P. garnotii* by both Plate and von Schalow.

In the same paper Stresemann refers to an example taken by Paessler in the Atlantic on June 17, 1913, in latitude 49° S., longitude 65° 3′ W., at a point 177 kilometers off the Argentine coast. Furthermore, Tschudi (1844, 46 and 308) long ago testified that this or another species of diving petrel was a common bird in the Bay of San Carlos, on Chiloé Island.

The best published account of the Magellanic Diving Petrel in nature is still that of Charles Darwin, who supplied Gould (1841, 138) with the following note:

> This bird is common in the deep and quiet creeks and inland seas of Tierra del Fuego, and on the west coast of Patagonia, as far north as the Chonos Archipelago. I never saw but one in the open sea, and that was between Tierra del Fuego and the Falkland Islands. This bird is a complete auk in its habits, although from its structure it must be classed with the Petrels. To the latter Mr. Gould informs me, its affinity is clearly shewn by the form of its beak and nostrils, length of foot, and even by the general colouring of its plumage. To the auks it is related in the general form of its body, its short wings, shape of tail, and absence of hind-toe to the foot. When seen from a distance and undisturbed, it would almost certainly be mistaken, from its manner of swimming and frequent diving, for a grebe. When approached in a boat, it generally dives to a distance, and on coming to the surface, with the same movement takes flight: having flown some way, it drops like a stone on the water, as if struck dead, and instantaneously dives again. No one seeing this bird for the first time, thus diving like a grebe and flying in a straight line by the rapid movement of its short wings like an auk, would be willing to believe that it was a member of the family of petrels. . . . I observed at Port Famine, that these birds, in the evening, sometimes flew in straight lines from one part of the sound to another, but during the day, they scarcely ever, I believe, take wing, if undisturbed. They are not very wild: if they had been so, from their habit of diving and flying, it would have been extremely difficult to have procured a specimen.

Reynolds (1934, 333) also likens the Magellanic Diving Petrels to grebes. He writes of three which he watched swimming in still water off the Isla de los Conejos, near the western end of Beagle Channel. They glided through the water almost without leaving a ripple. When they took flight, however, they seemed to leave the surface with difficulty and only by beating the wings extremely rapidly. In the air, with the head erect and the body drooping somewhat more than is common with sea birds, they reminded the observer of a small rail.

The general likeness of the diving petrels and the auklets has been mentioned in the literature many times since Darwin wrote the paragraph quoted above, but it was not until the time of the Brewster-Sanford Expedition that the striking resemblance between the plumage of this species (*Pelecanoides magellani*) and

the winter plumage of the Dovekie or Little Auk (*Alle alle*) was fully recognized. The remarkable similarity between these two unrelated birds involves not only size, the approximate proportions of the limbs and tail, and absence of the hind toe, but also the color and texture of the whole dorsal and ventral surfaces, the common possession of a falcate white area at the sides of the neck, and the presence of white markings on the proximal flight feathers and their coverts. Indeed, the homoplastic resemblance of the Fuegian Diving Petrel and the Dovekie constitutes one of the best examples of convergent evolution known among vertebrates.

Mr. Beck saw a great deal of this Diving Petrel during his several wanderings among the intricate Magellanic channels, where he collected 78 specimens. He did not succeed in finding an egg or nestling, although on Hermite Island, just northwest of Cape Horn, a dog scratched at a crevice under a large boulder, and Beck believed that a Diver was nesting within. A native sealer told him that he had once found a nest of this bird on one of the islands to westward of Cockburn Channel. It was 100 meters or more above sea level, and was unearthed by his dog while they were searching for otter holes on a rocky hillside.

At the western end of Cockburn Channel, in the vicinity of the Horn, and off the east coast of Patagonia, Beck often saw birds of this species flying straight-away for long distances—quite out of sight, in fact. This does not support Nicoll's (1904, 47; 1909, 180) opinion that their flight is a feeble fluttering, and that they are much less strong-winged than the Diving Petrels of Tristan da Cunha. Beck reports that when the Magellanic birds fly low they sometimes strike the crests of choppy waves, being checked for a moment in their course and then recovering. His notes further state that this species does not feed in flocks like the whale-birds (*Pachyptila*) but, rather, individually or in very small, scattered groups. They appeared to feed particularly in "streaks" on the water caused doubtless by the effluvia of their prey. Beck occasionally saw single birds pop into flight from beneath the surface. The stomachs of some that he shot were distended with invertebrates. Nicoll found small fishes in examples taken in Molyneux Sound.

The following notes are extracted from Mr. Beck's Journal.

Magallanes, July 8 and 9, 1914. Diving petrels scattering; about thirty collected in the strait north of the town.

Nov. 17. Coming by steamer from the Atlantic into the Strait of Magellan; a few diving petrels off Cape Virjenes. Within the strait they were much less common than they had been three months before.

London Island, at the western end of Beagle Channel, Nov. 30. Diving petrels came into the protected bay for shelter from a williwaw; several shot.

Caroline Island, Dec. 7–14. Two diving petrels collected.

Lort Bay, False Cape Horn (Hoste Island), Dec. 26. Out in boat for two hours, and shot twenty diving petrels, which were common. Many came into the bay from the northward to feed.

Between Hermite and Wollaston islands, December 28. One diver seen.

London Island, Jan. 18, 1915. Rain and squalls all day, but diving petrels did not come into the bay as they usually do in such weather. Only one seen and collected.

Junction of Beagle Channel and Magellan Strait, western Tierra del Fuego, Jan. 21. A few diving petrels seen.

Thirty kilometers north of Magallanes, March 6. Fifteen or twenty shot.

Lort Bay, April 7, 8, and 9. Where dozens of diving petrels had been seen in December, only one was noted during these three April days.

Lort Bay, April 20. Two seen.

At sea, 125 kilometers east of San Sebastián Bay (east coast of Tierra del Fuego). High southwest winds. Three diving petrels seen.

Off Río Gallegos, Patagonia (95 kilometers north of the eastern entrance of the Strait of Magellan), May 11. Strong south wind. Diving petrels were common offshore in the heavy sea.

Between Río Gallegos and Río Santa Cruz, May 24. Many diving petrels among other fishing birds, 30 kilometers offshore.

Six kilometers off Cape Vírjenes, May 26. Two diving petrels noted.

Strait of Magellan, east of Magallanes, June 11. A few diving petrels seen.

Ushuaia, Beagle Channel, July 15 (midwinter). One or two seen.

False Cape Horn, July 25. Two seen.

Off the mouth of the Río Gallegos, Argentina, Aug. 8. A strong offshore wind, and a swift tide, during the forenoon. Several diving petrels were noted, keeping within five kilometers of the land.

At sea, 80 kilometers northeast of Río Gallegos, Sept. 10. Three or four diving petrels seen.

At sea, 60 kilometers east of Puerto Deseado, Sept. 13. Two seen.

At sea, lat. 48° 27′ S., 65° 36′ W., Sept. 15. Several diving petrels collected.

Punta Delgada, Strait of Magellan, Oct. 4. Many diving petrels flying within the Strait.

The Brewster-Sanford series of *Pelecanoides magellani* comprises specimens collected during the months of January, March, July, August, September, November, and December. Adults shot in November and December had enlarged gonads and bare brood-patches; a female taken at London Island on November 30 contained an "egg ready to lay within two days." By March some of the young birds leave the nest. A fledgling female collected at Magallanes on March 6, 1915, shows the diagnostic characters of the species, *i. e.* the very black dorsal surface, pure white throat, falcate area behind the cheeks, and broad white edgings on the proximal wing feathers. It lacks, however, the beautiful white terminations of the dorsal body feathers, which markings are thus proved to be indicative of maturity. Fledglings have, moreover, weak bills and small claws such as are characteristic of young Procellariiformes in general.

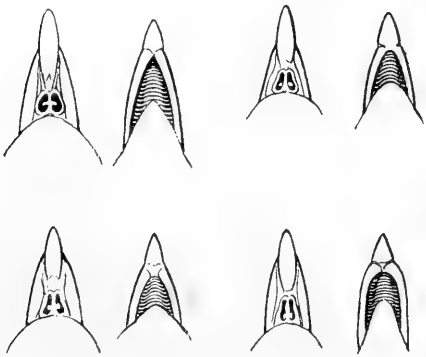


Fig. 66. Dorsal and ventral aspects of the bill in four species of Diving Petrels, drawn to the same scale. Specific differences are revealed in the form of the mandibular rami and nostrils, the position of the paraseptal processes, etc.

Reading from left to right: upper row, *Pelecanoides garnotii*, *P. magellani;* lower row, *P. georgicus*, *P. urinatrix*.

The annual moult of the Magellanic Diving Petrel is carried

out between the first of April and the end of June. Four specimens taken in July are all in very bright plumage, with new quills and with the delicate, white, lunulate terminal markings distributed all over the interscapular region and upper rump.

From July onward the abrasion of the plumage is so uniform that it is easy to guess, with approximate closeness, the dates of capture of individual specimens merely by noting the condition of their plumage. March birds are relatively worn and dingy, and in nearly all instances the white edgings on the back have entirely disappeared.

The series of nearly a hundred specimens which I have examined includes birds from the coast of Chiloé Island, from Antonio Islet in Trinidad Channel, from Molyneux Sound, from five insular localities close to Cape Horn, from various parts of the Strait of Magellan, from the inland body of water known as Última Esperanza, and from the Atlantic coast of southern Patagonia. The series presents considerable evidence that the young birds do not moult their contour feathers during the first season. Specimens taken during December, the beginning of southern-hemisphere summer, for instance, are of two kinds, namely, birds with moderately worn plumage which are evidently adults, and others with feathers very much worn and frayed which I judge to be the young of the preceding breeding season. Some of the latter examples have particularly ragged quills and they all lack the white interscapular markings. The plumage sequences in this species therefore appear to be virtually the same as those of *Oceanites oceanicus*, the commonest migratory petrel of the North and South Atlantic (Murphy, 1918, 118).

SOUTH GEORGIAN DIVING PETREL

Pelecanoides georgicus

Pelecanoides georgica Murphy and Harper, 1916, Bull. Amer. Mus. Nat. Hist., 35, p. 66 (Cumberland Bay, South Georgia).

Names: Diver is the whaleman's name at South Georgia. In the literature this species has been listed under the technical names *urinatrix*, *exsul*, and *berard*, from all of which it is in reality distinct.

Characters: Size small, approximating that of some of the races of *P. urinatrix;* bill proportionately wider at the base, and tapering more sharply, than in other Pelecanoididae (width at base equal to three-fifths of exposed culmen); nasal eminence thin-walled, the shape of the oval, closely appressed nostrils in dried skins always more or less altered by shrinking. Mottling of jugulum decidedly variable, becoming very pronounced in some specimens. Natal down gray.

Adults (sexes alike): Upper parts glossy black; scapulars grayish white, with an obscure subterminal band of deep neutral gray, broader and slightly darker on outer web; the scapulars more or less overlaid and concealed by the dark interscapulars, but forming in many specimens a broad, conspicuous diagonal stripe; wings glossy black, more or less tinged with brownish, especially on primaries; secondaries generally edged narrowly with whitish, and primaries becoming pale on edge of inner web; under wing coverts white, sometimes mottled with pale neutral gray, and the shafts sometimes dark terminally; rectrices blackish brown, with a slight gloss, paler on the under surface, and the worn lateral feathers sometimes showing whitish edges; anterior part of forehead and lores suffused with clove-brown; under parts white; cheeks and sides of neck deep neutral gray, the feathers narrowly tipped with white; this gray mottling varying much in intensity and distribution, and in some specimens extending completely across the jugulum; axillaries, sides, and flanks barred more or less strongly with neutral gray, the feathers tipped with white; feathers of tibia

deep mouse-gray; down plumules and aftershafts over entire body varying from deep mouse-gray to dark mouse-gray, with lighter tips. Paraseptal processes situated at the longitudinal center of the septum. Bill black, rami of mandible slaty; iris seal-brown; tarsi and toes flax-flower blue; webs black.

100 males: length (skins), 193–218 (202.6); wing, 104–122 (112.7); tail, 34–42 (37.7); exposed culmen, 14–16 (14.9); width of bill, 8–10 (8.9); depth of bill, 5.5–6 (5.8); tarsus, 22–26 (24.4); middle toe and claw, 27–33 (30.1) mm.

85 females: length (skins), 181–215 (198.2); wing, 104–120 (113.8); tail, 34–43 (38.2); exposed culmen, 14–16 (14.7); width of bill, 8–9.5 (8.8); depth of bill, 5–6 (5.7); tarsus, 21–26 (24.2); middle toe and claw, 26–32 (29.9) mm.

In the nestling young the protoptyle down is light mouse-gray on the upper surface of the body, pallid mouse-gray beneath, where it is also much shorter than above; throat and sides of head nearly bare. Mesoptyle down drab-gray; longer, less dense, and of looser texture above than on the ventral surface. Contour feathers appearing first on the bare parts of head and throat, then on wings, tail, and back. Down lost progressively from head, wings, back, flanks, and breast, clinging longest on the belly, and fading decidedly with age.

Egg: Ovate, short-ovate, or oval; pure white, lustreless; measurements of 4 are 38.5 x 32, 39 x 30, 39 x 31, 41 x 32.3 (average, 39.4 x 31.3) mm. Average volume of the 4, 16.2 cc.

Distribution: A species of the Antarctic Zone of surface water, known only from South Georgia, where it is abundant, and from Macquarie Island, southwest of New Zealand. Only two or three examples have been recorded from Macquarie, but these have all the specific characters of *georgicus*, and are quite distinct from *P. urinatrix* of neighboring islands.

During my expedition to South Georgia, Divers were first observed at sea in latitude 50° 12′ S., longitude 34° 47′ W., on November 20, 1912. This is about 450 kilometers north of the island. None was noted again until February 24, 1913, when many were seen at dusk in the main channel of the Bay of Isles, South Georgia.

On February 27 a breeding colony was discovered in a broad valley which runs eastward from the head of Possession Bay between two high, symmetrical mountain peaks. The floor of the valley is partly of broken stone, partly grassy, with some water-saturated moss and several glacier streams. *Pelecanoides* burrows were distributed from the shore of the bay to the higher slopes more than 3 kilometers inland, not only on banks and knolls, but also on the flat itself, wherever a little bed of clay and sand covered with vegetation was raised above the general stony level. The excavations were hardly larger than field-mouse holes, at least at the entrance (7 centimeters in diameter, according to von den Steinen); but some of them were as much as 2 meters in length. As a general rule, they first led down steeply and then ran horizontally but with sharp lateral turns. Some tunnels were doubled back almost on their own tracks, and often there was a diverticulum just outside of the nest-chamber. Here and there a burrow ran beneath a roof of the tangled roots of a rosaceous herb (*Acaena adscendens*). It frequently happened that the course was changed by stones encountered during the digging; and that the nest-chamber lay under a stone. The chambers were unlined except for a little down and an occasional bit of lichen, perhaps introduced by accident. Most of the nests contained well-grown young, a few of which had all but lost the down. Each of two nests dug open on March 3 held one adult bird, but neither egg nor young.

All the young Divers found were exceedingly fat, except for one or two poor

starvelings which were reduced to a condition of mere feathers and bones, and which had crawled to the mouths of their burrows in vain expectation of their parents, when no doubt the latter had been accounted for by some skua (*Catharacta*) days or perhaps weeks before. Other nests contained emaciated dead young, and told of the consummation of similar tragedies.

During a snowstorm on the evening of March 13, two Diving Petrels, dazzled by a lantern, flew on board our vessel which lay at anchor in Possession Bay. The captain of a Norwegian "floating whaling-factory" informed us that when he had moored his steamer in Possession Bay one January night, the decks had suddenly swarmed with Divers attracted by the lights.

The discovery of a representative of *Pelecanoides georgicus* at Macquarie Island (Murphy and Harper, 1921, 525) is of exceptional interest from several points of view. In the first place, South Georgia and Macquarie Island are situated on almost exactly opposite sides of the South Pole, and are nearly 13,000 kilometers distant from each other across the South Atlantic and Indian Oceans along the parallel of latitude. Though both are situated at the same latitude, South Georgia lies within and Macquarie Island outside the extreme limit of pack-ice. It is not unlikely that additional representatives of *georgicus* may yet be discovered at such high-latitude islands of the Antarctic Zone as the South Sandwich group, Bouvet, and Heard, when these are sufficiently explored. Wilkins (1923, 485) has already observed the species in numbers southeast of Clerke Rocks, and the 'Scotia' expedition encountered Diving Petrels in latitudes 51° to 52° 31′ S., longitude approximately 9° W.

During my stay at South Georgia I collected a series of specimens, which was subsequently added to by Mr. José G. Correia, an account of whose field work has been given in Part I. More than 250 examples of this species were examined by Dr. Harper and me during the preparation of our review of the family.

Divers were observed on the fiords of South Georgia throughout the year by members of the German 'Transit of Venus' expedition. Matthews (1929, 579) also reports that they can be seen during every month, all of which indicates that the entire population never migrates away from the vicinity of the island.

The return to the breeding grounds begins in November, all activity ashore being carried on during the hours of darkness. Such nocturnal habits may be primitive rather than due exclusively to the presence of the skua, but in any event the latter enemy must be an important selective factor in preventing any variation in behavior. Nothing is known of the courtship of this Diving Petrel. The excavation of the long burrows through hard, stony, often frozen soil is a tremendous task, accomplished entirely at night by the employment of both the bill and the strongly clawed feet. Before dawn the birds discontinue their labor and retreat to sea. That numbers of them are nevertheless captured by the skua is indicated by dismembered skeletons on the ground in the neighborhood of the colonies.

New burrows were noted by von den Steinen (1890, 240) on November 24, the more nearly completed among them being occupied by pairs of birds. On December 8 he found the first eggs, each covered by a parent alone in the nest-

chamber. Nesting material is rarely used, and the egg quickly becomes discolored from the bare, usually wet soil. Newly hatched young have been found between January 22 and February 13. After the chick is a few days old, it is left quite alone in the burrow between daylight and dark. The young birds are bundles of down, and they squat with their heads drawn against the back so that bare areas on the throat and face are covered and protected (Matthews, 1929, 579). By March 15 they are mostly well feathered, and by the end of the month they have all grown up, lost their down, and taken to sea. The last chick in a large colony was observed by von den Steinen on March 29.

Growth and moult of the downy coats of young birds are well illustrated by a graded series of chicks collected between February 8 and March 15. The smallest specimen (110 millimeters in total length) is clothed with short, straight protoptyles, varying in color from pallid mouse-gray beneath to a slightly darker gray above. The dorsal down is much longer; the throat and the sides of the head are practically bare. The next specimen is evidently considerably older (185 millimeters in length), and is clad in long, dense, rather curly mesoptyle down, drab-gray in color and of looser texture above than below. The contour plumage is appearing in the form of pin-feathers on the bare throat and cheeks, and the primaries have sprouted to a length approaching 30 millimeters, although the rectrices have scarcely punctured the skin. It is interesting to note that the last tufts of much-bleached mesoptyles cling to the center of the belly, where they serve as a cushion or mattress until the nestling has attained practically its full development.

One of our fledglings, taken from the burrow, had lost the last trace of its down as early as March 15. The juvenal plumage is indistinguishable from that of breeding birds, except that no mottled areas on the jugulum are to be seen among our series of fledglings, and the brownish tinge on forehead and lores is usually fainter and less extensive than in adults. Young birds taken after they have left the nesting grounds are at once determinable, however, because of their weak and slender bills.

I found no food substances within the stomachs of South Georgian Diving Petrels, but only occasional pebbles. A stomach preserved in alcohol contains four fragments of clay-slate, the largest of which measures 10 x 6 millimeters. Matthews lists their food merely as "small planktonic animals." Andersson (1908, 57) found a green paste which he identified as plant tissue, but which was more probably animal food colored by bile.

On March 15, 1913, when my vessel, the brig 'Daisy,' stood to sea from Possession Bay, South Georgia, I fortunately had occasion to make a trip in a whaleboat to a neighboring whaling station for the purpose of posting mail. Shortly after sunset we started on a two-hours' pull to the brig offshore, and as soon as we were well beyond the mouth of the bay our boat was continually in the midst of innumerable small Tubinares flocking over the calm dusky sea. *Oceanites*, *Fregetta*, *Daption*, and Diving Petrels made up the bulk of these birds, which fluttered all about us like bats. Diving Petrels also covered the water in swimming flocks, and often took to flight at the approach of the boat, usually

diving again within a short distance. In spite of the diminutive size of their wings, they seemed to fly at very high speed. Von den Steinen also writes of endless files of Divers and other small petrels which he saw streaming out to sea from Royal Bay during a January evening of 1881. Regarding the speed of these birds in both the air and the water, Matthews says that they literally fly from one into the other as though the two mediums were one.

With reference to the relation between the Diving Petrels and their principal enemy, the skua, enough has been said elsewhere. The advent of man at South Georgia has, however, brought an even more insidious foe, for in the subterranean runways of introduced rats great quantities of cleanly picked *Pelecanoides* bones have been found.

Murphy and Harper have taken advantage of the extraordinarily large series of these nesting petrels from a single island to make a detailed study of variation within the species. As regards color pattern they find a wider amplitude than in most other forms of *Pelecanoides* with respect to the mottled collar crossing the jugulum. Among some specimens of *P. georgicus* this makes a complete and pronounced band, while others have entirely white throats, and still others exemplify intermediate conditions. The variation is purely individual, for no correlation is determinable between it and sex, age, season of capture, or state of plumage.

A statistical study of measurements of birds taken on successive dates between November 29 and February 28 indicates that there is no tendency for the younger or yearling Diving Petrels to reproduce earlier or later than their elders. Such seasonal differences, associated with difference in age, are observable among certain larger Procellariiformes, such as the Wandering Albatross. In the case of *Pelecanoides georgicus*, however, the nesting season, which is definite and closely tied in with the climatic cycle, is evidently uniform for all the breeding members of the population.

Measurements of 100 breeding male Diving Petrels, and of a slightly smaller number of breeding females, indicate that the range of variation in the size of wing, tail, bill, leg, and foot agrees closely with what is known of similar variability among other petrels. As expressed in percentage of the average dimensions, the maximum amplitude among 185 South Georgian Diving Petrels was as follows:

Wing	Tail	Exposed culmen	Width of bill at base	Tarsus	Middle toe and claw
16.0	23.6	13.6	22.5	20.7	20

A comparison of complete skeletons of *Pelecanoides georgicus* and the Dovekie (*Alle alle*) emphasizes more fundamental proportional resemblances than those already referred to in comparing the external likenesses of the Dovekie and the Magellanic Diving Petrel. The similarities apply to the size and proportions of practically all elements of the axial skeleton and the appendages. Furthermore, the expanded wing surface of an adult of *Pelecanoides georgicus* totals 69.7 square centimeters, that of an adult of *Alle alle* 64 square centimeters. These figures emphasize an extraordinary degree of convergence, for the Diving Petrel

is a small-winged extreme within its own order of birds, while the Dovekie is a relatively large-winged member of the auk family. That the differentiation represented by the wing of Diving Petrels lies in difference of feather proportions, rather than of skeletal proportions, is shown by a comparison of the several elements in *Pelecanoides georgicus* and in two species of long-winged petrels.

FALKLAND DIVING PETREL

Pelecanoides urinatrix berard

Procellaria Berard Gaimard, 1823, Bull. Gén. et Univ. Ann. et Nouv. Sci., 3, p. 53 (at sea near the Falkland Islands).

This form is one of three subspecies of the Australasian Diving Petrel which are supposed to occur within the field of this book. I give, therefore, the original reference to the typical form:

Procellaria urinatrix Gmelin, 1789, Syst. Nat. 1, pt. 2, p. 560 (Queen Charlotte Sound, New Zealand).

Names: Diver and Fire-bird in the Falkland Islands. In the literature the Falkland race has been listed under the names *urinatrix*, *berard*, *berardi*, and even *garnotii*.

Characters (of the species *urinatrix*): Size approximately that of *Pelecanoides magellani*. Bill relatively stout and blunt, tapering abruptly near the tip, but almost as wide in the middle as at the base owing to the expansion of the lateral elements of the maxilla and the bowing of the mandibular rami (exposed culmen about equal to twice the width of bill at base). Rami nearly parallel for the greater part of their length, but converging abruptly toward the tip, enclosing an obtusely pointed interramal space. Nasal eminence thin-walled, the shape of the elongate, reniform, closely appressed nostrils in dried skins always more or less altered by shrinking. Natal down silver-gray above, and white on ventral surface.

Adults, of the typical race, *P. urinatrix urinatrix* (sexes alike): Upper parts glossy black; scapulars deep neutral gray, with a whitish terminal bar; wings glossy black, more or less tinged with brownish, especially on primaries; inner webs of primaries clove-brown, lighter on under surface; secondaries sometimes narrowly tipped with whitish; under wing coverts whitish, more or less washed with light mouse-gray, the shafts dark; rectrices glossy black, fading to blackish brown, paler on the under surface; anterior part of forehead and lores suffused with clove-brown; under parts white; feathers of auricular and malar regions, and sides of neck and breast, deep neutral gray, for the most part narrowly tipped with white, giving a somewhat barred appearance; jugulum obscurely mottled with neutral gray, which sometimes forms an indistinct collar; axillaries dark mouse-gray, tipped with whitish; sides and flanks washed with deep neutral gray, the feathers tipped with whitish; feathers of tibia dark mouse-gray; down plumules and aftershafts over entire body deep mouse-gray. Paraseptal processes situated posterior to the longitudinal center of the septum and not prominently developed. "Irides and bill black; legs and feet cobalt, tinged with green, the webs bluish white" (Buller).

Subspecific characters of *P. urinatrix berard:* Size approximating that of *P. u. urinatrix*, but generally with smaller bill, longer tail, and longer middle toe and claw. The mottling across the jugulum is more pronounced than in *P. u. urinatrix*, less pronounced than in *P. u. dacunhae*. Iris brown; bill black; feet blue with blackish webs (R. H. Beck, label).

4 males: length (skins), 195–227 (208.2); wing, 117.5–125.5 (121.1); tail, 39.5–46 (42.7); exposed culmen, 15–16 (15.5); width of bill, 7–8 (7.4); depth of bill, 6–6.5 (6.2); tarsus, 24.5–27 (25.7); middle toe and claw, 32–36.5 (33.4) mm.

3 females: length (skins), 198–201 (199.3); wing, 117–123 (120.5); tail, 40–44 (41.5); exposed culmen, 15.5–16 (15.7); width of bill, 7.5–8 (7.7); depth of bill, 6; tarsus, 25–25.6 (25.2); middle toe and claw, 32–33 (32.5) mm.

Egg: Two collected at Kidney Island, Falklands, in November, 1915, are respectively rounded-ovate, or almost subspherical, and elliptical-ovate; white, lustreless; measurements, 35.2 x 31, 38.8 x 29.5 (average, 37 x 30.3) mm. Average volume of the two, 16.7 cubic centimeters.

Distribution: A sub-antarctic form, which nests at the Falkland Islands and ranges northward to the coast of the Province of Buenos Aires, Argentina.

Pelecanoides urinatrix, the fourth species of Diving Petrel occurring in the American region, is represented by subspecies at the Falklands and at Tristan da Cunha, and apparently by a third among the Magellanic islands of southern Chile.

During the course of the Brewster-Sanford Expedition, Mr. Beck obtained five adult examples and several eggs at the Falklands. I have examined seven other specimens, including two taken off the Argentine coast, between the Gulf of San Matías and Necochea. The latter locality is north of latitude 39° S., and not very far from Mar del Plata. Paessler (1922, 441) reports seeing Diving Petrels during the southern-winter season all the way along the coast of Argentina from latitude 40° S. to the Strait of Magellan. Two specimens he obtained in this part of the Atlantic were identified as of the species *urinatrix*. He observed several at least 160 kilometers from land. It would seem as though the oceanic ranges of *P. magellani* and *P. urinatrix berard* must partly overlap, and it is tempting to speculate as to why the birds of the two species return to mutually exclusive nesting territories. Paessler believes, indeed, that this species may breed on islets along the Atlantic coast of Patagonia, as well as in the Falklands, but of this we have no direct evidence.

The last-named observer kept a number alive on shipboard for several days. The petrels remained very quiet when confined in a dark space, but were at once attracted toward lights, which verifies the statements of Falkland sealers that the Divers will fly like moths into the flames of a fire at night. Paessler's captives proved silent but not particularly shy, and they would swim in a bath-tub in search of bits of fish and mollusks which, however, they did not seem to relish.

Beck saw a single Diving Petrel about 120 kilometers due south of the Falkland Islands on one of the latter days of September, 1915. On November 6, of that year, he visited Cochon Island, East Falkland, and found the first burrow, which contained a male Diver sitting upon a heavily incubated egg. On the same date he also landed at Kidney Island, which is but 6 kilometers from Cochon, and found a second burrow in a patch of tussock grass (*Poa flabellata*) not far from the water. By digging and pulling out the manure-like humus around the nest, he managed to obtain a photograph of the sitting bird. The entrance to the nest was under a slab of rock, but the tunnel twisted about for a meter and ended in an enlarged chamber which was lined with a few dry blades of tussock grass. On November 18 he captured three more Diving Petrels in their nests on Kidney Island. He discovered, moreover, that abandoned *Pelecanoides* burrows are used as nesting sites by the small, dendrocolaptid "tussock-bird" (*Cinclodes*).

On December 16, at Sea Lion Island, he found the foot and leg of a Diving Petrel within the stomach of a Short-eared Owl (*Asio flammeus sanfordi*).

Since information regarding the life history of this and other New World races of *Pelecanoides urinatrix* is so scanty, it will be of interest to summarize an excellent study made by Falla (1934, 246) on islets off northern New Zealand. In this region the annual moult of the Diving Petrels is completed

in March. From April onwards, large flocks of birds in fresh plumage gather at sea near the breeding grounds. For fully three months many of them come ashore at night and clean out last year's burrows. Odd birds, usually males, sometimes remain in the diggings throughout the day during this period. The sex organs begin to enlarge in April, although no eggs are laid before July, from which time they continue to be deposited in the burrows until the end of August. Incubation requires at least five weeks, and the young remain about seven weeks in the nest. (These periods fit in with what little is known of the succession among American species, such as *Pelecanoides georgicus*, although the breeding season of the latter is much closer to southern midsummer.)

Knowledge is slight concerning the pelagic movements of the New Zealand Diving Petrels between January and March, when they are far from the coast. During this period the moult is carried out.

On the breeding grounds the birds come to their nests only after dark, hurtling in without preliminary circling, and landing heavily, each close to its own burrow. Courtship and pairing, according to Falla, take place outside the burrows. At this period the petrels are very noisy, making both mewing and cooing notes. After the egg is laid, the vocal phase subsides more or less.

During courtship the adults probably refrain from eating, for Falla found little or nothing in the stomachs of such birds. When they are feeding young, their alimentary tracts are likely to be filled with a fine paste composed of various oceanic crustaceans. Divers are the only petrels in which Falla has never found remains of cephalopods.

With reference to the depths to which these birds can dive, Layard (1862, 99) states that among the Poor Knights Islands, in September, his steamer passed through large flocks of Diving Petrels, and that some of the birds plunged right beneath the ship, emerged close under the counter on the opposite side, and then rose and flew off like quail.

TRISTAN DIVING PETREL

Pelecanoides urinatrix dacunhae

Pelecanoides dacunhae Nicoll, 1906, Bull. Brit. Orn. Club, 16, p. 103 (shore waters of the island of Tristan da Cunha).

Names: Flying-penguin is the local name of this petrel at Tristan da Cunha. In the literature it has often been listed under the specific names *urinatrix* and *exsul*.

Characters: Apparently most closely allied to *P. u. berard*, but perhaps with generally smaller dimensions. Feathers of cheeks, sides of neck, and jugulum with conspicuous, dark brownish shafts in the two specimens examined.

2 females: length (skins), 202–204 (203); wing, 108–113 (110.5); tail, 36.5–37 (36.7); exposed culmen, 15.5–16.5 (16); width of bill, 7; depth of bill, 5–5.5 (5.2); tarsus, 24; middle toe and claw, 29–31 (30) mm.

Egg: White; 38 x 29, 36.5 x 30 mm. (Mathews, 1932, 38); one from Gough Island measured 40 x 29.5 mm.

Distribution: The Tristan da Cunha group and adjacent waters. A diving petrel, provisionally treated as of the same race, also inhabits Gough Island.

The status of this Diving Petrel, as regards its place in the family, is very uncertain. Beyond the fact that a member of the species *urinatrix* lives at Gough Island and the Tristan group, and that the bird has received the subspecific name *dacunhae*, we know very little. I have been able to find only two specimens, both in the British Museum. Murphy and Harper (1921, 541) give a detailed description of the type but, since the bird has very worn and faded plumage, it is of almost no value for comparison with examples of other races. Satisfactory fixation of the identity of this form will have to await further collecting.

Most of our information concerning this petrel is contained in the following account by Nicoll (1909, 67) of observations made in January, 1906. It should be remembered, however, that he underestimates in his comparison the flight powers of *Pelecanoides magellanicus*.

> The most interesting birds which we saw were some diving petrels, which proved to belong to a species not hitherto recorded from Tristan da Cunha. Superficially these petrels resemble the diving petrel of the Straits of Magellan, but they are somewhat smaller and have a much greater power of flight. On several occasions I saw them rise off the water and fly away out of sight, whereas those found in the Magellan Straits drop into the water after a flight of about fifty to one hundred yards. The Tristan da Cunha diving petrels are constantly exposed to rough weather and breaking waves, and in consequence have to take wing continually to avoid being drowned, and this fact may account for their greater powers of flight.
>
> They were met with soon after we left the yacht, and became more numerous as we approached the land. Half a mile from the shore they were on all sides of us, and appeared continually close to the boat, when instead of diving they at once took to flight, and passed away at a great speed.

A Diving Petrel taken by the 'Scotia' expedition off Gough Island, which is about 400 kilometers south of the Tristan group, was doubtless this form. Wilkins (1923, 503) observed great numbers in the waters around Gough Island between May 28 and June 1, during the 'Quest' expedition. He states that the bird is well known to the Tristan folk, but that they have apparently never found its egg. However, Mathews (1932, 38) lists an egg collected at Nightingale Island in November, 1929, and quotes a somewhat hazy statement that the birds are abundant there.

In books by Mrs. Barrows (1910) and Mrs. Rogers (1928), wives of Tristan missionaries, no mention is made of Diving Petrels among birds observed during long residence at the main island. The fact that Tristan da Cunha is overrun with rats (*cf.* p. 481) suggests the probability that the burrowing *Pelecanoides* have been forced to confine their nesting to neighboring and uninhabited islands of the group.

COPPINGER'S DIVING PETREL

Pelecanoides urinatrix coppingeri

Pelecanoides urinatrix coppingeri Mathews, 1912, Birds Australia, 2, p. 238 (Cockle Cove, Pilot Island, Trinidad Channel, Chile, latitude 50° 05′ S.).

Names: The type of this supposed form was collected in October, 1879, and has several times been referred to in the literature under the name *urinatrix*.

Characters: Status uncertain; apparently nearest to *P. u. berard*, but perhaps averaging smaller; scarcely any trace of mottling across the jugulum.

1 male (?): length (skin), 193; wing, 116; tail, 41; exposed culmen, 16; width of bill, 7; depth of bill, 6; tarsus, 25; middle toe and claw, 31 mm.

2 females: length (skins), 165–206 (185.5); wing, 106–111 (108.5); tail, 36–38 (37); exposed culmen, 15.5–16 (15.7); width of bill, 7; depth of bill, 5.5; tarsus, 25–25.5 (25.2); middle toe and claw, 31 mm.

Distribution: Known only from the coast and inland channels of southern Chile, between latitudes 47° and 50° S.

If the status of the Tristan Diving Petrel is unsatisfactory, that of the form of *urinatrix* known to inhabit waters of the southern Chilean archipelago, to northward of the western entrance of the Strait of Magellan, is much more so. The bird was originally described with an incorrect type locality, and it has never been properly diagnosed. The characters and measurements given above are too deficient to be of much practical use. Nevertheless, I have given the race a separate heading in order to attach at least a provisional handle to the following brief account of what is known.

I have seen but five specimens, of which four are in the British Museum and one in the Berlin Museum. One is from an unrecorded locality in southern Chile; the others are from Trinidad Channel, from Messier Channel which is to northward and inland, east of Wellington Island, and from 30 kilometers at sea, off Tres Montes, in latitude 47° S., longitude 76° W. The last data refer to a single female captured by Paessler during October, and recorded by Stresemann (1922, 130).

Murphy and Harper (1921, 544) quote observations from Beck's notebook on Diving Petrels seen in early July, 1914, between Ancúd and Puerto Montt, Gulf of Chacao, Chile, and later in the Pacific off Guamblin Island and off the Gulf of Peñas. These notes were thought to refer to the present race, but it is now known that all of the localities named lie within the range of *Pelecanoides magellani*.

All that we can positively say is that a representative of the species *urinatrix* is found in southern Chile, in waters also occupied by the Magellanic Diving Petrel. The nest and eggs of the former have not been discovered, and observations certainly referring to it are few. As to what the bird really is, I should say that there are three possibilities, as follows:

1. It may be a resident subspecies of *urinatrix*, the distinguishing characteristics of which are not yet accurately known because of scarcity of specimens.

2. It is possible that the Falkland race of the Diving Petrel nests also on the continental coast, as Paessler (1922, 441) has suggested, and that the bird here called *coppingeri* is nothing else than *berard*, the range of which extends through the Strait of Magellan and northward along the channels of the Pacific coast.

3. It may prove that no race of *urinatrix* nests in southern Chile, and that the few specimens known are nothing else than surviving waifs which have been blown by westerly gales against the continental shores from some remote region in the South Pacific. Buller (1873, 313) and many other observers have testified to similar casualties, on a large scale, in other parts of the world.

THE PELECANIFORMES

The members of this order, unlike their distant (and yet nearest) relatives, the petrels and penguins, include birds of rivers, lakes, and swamps, as well as those of seacoasts and the open ocean. Thus, in a world-wide sense, the snake-birds (*Anhinga*), many cormorants, and certain pelicans belong partly to the interior regions of continents and large islands. With a single exception, however (viz. *Phalacrocorax olivaceus*), all of the South American cormorants and pelicans are at least primarily marine.

Among the forms of the five Pelecaniform families falling within the scope of this book, the pelicans are the most closely "tied to the land." Then follow, in a sequence leading toward pelagic proclivities, cormorants, man-o'-war birds, boobies, and tropic-birds. Cormorants and man-o'-war birds in some instances give a specious appearance of being wide-ranging ocean fowl, the former because they have established themselves at remote islands in high southern latitudes, and the man-o'-war birds because in similar manner they have peopled the pantropical islands and archipelagoes. All forms of both these groups are, nevertheless, extraordinarily sedentary. In the southern hemisphere, cormorants do not even make regular migrations of any considerable length. The man-o'-war birds have found their way fortuitously to innumerable small and isolated oceanic islands, but their high percentage of endemism either as subspecies or as species, and the orderly and logical distribution of such a species as *Fregata magnificens* with reference to the trade-wind belts, show that these supreme masters of flight tend to cling remarkably to the neighborhood of their breeding stations. Furthermore, despite popular opinion to the contrary, man-o'-war birds are rarely seen far from land.

The evolutionary history of the Pelecaniformes is a long one, though reconstructed only from scanty records. Fossils ascribed to the families of tropic-birds and pelicans have been found in Lower Eocene strata. The genus *Pelecanus*, as well as birds closely akin to modern boobies and cormorants, are known as fossils from at least as far back as the Oligocene. In this connection the comments of Wetmore are illuminating. This author is of the opinion that a metatarsus of *Phalacrocorax auritus* from the Pleistocene of Idaho is referable to the identical subspecies (*albociliatus*) that inhabits the inland lakes of the same region at the present day. He then continues:

> While it is commonly recognized that numerous fossils indistinguishable from living species and therefore identified as representing modern birds occur in Pleistocene deposits, it may at first glance seem dubious or even impossible to carry this same procedure back into the Pliocene. The writer has in recent years expressed the belief that our modern avifauna, in so far as its various species are concerned, has had its period of origin and evolution in the Tertiary period, with such changes as have since occurred confined to the minor differences that characterize geographic races or subspecies, these being expressed in color and in slight variations in size. As his work with the avian life of the past proceeds, he has become more and more convinced of these facts. It is therefore only natural to suppose that representation of various modern species will be found in Pliocene deposits as more remains of birds from such horizons are discovered. This may be expected especially among such groups as the cormorants, which appear to be of ancient and long stabilized type (Wetmore, 1933, 7).

The tropic-birds are the most aberrant of the Pelecaniformes in structure and consequently in habits. At the same time the skeletal morphology, particularly of the skull, suggests that they are the most generalized representatives of the order. Their superficial resemblances to terns, which extend even to spotted eggs, will be referred to hereafter.

The other families have much in common with one another, despite wide divergence. Contrasts which seem enormous disappear in some instances when comparisons are made at stages preceding the astonishing effects of differential growth. Thus Maynard (1889, 140) has pointed out the almost incredible change which ontogeny brings about in the relative size of the paired limbs of the man-o'-war bird. In a two-day-old chick the legs and feet are actually larger than the wings! The gular sac, moreover, is at first proportionately capacious, and in this feature as well as other details of head and bill the nestling *Fregata* bears an extraordinarily marked resemblance to a pelican at the same stage of growth. Subtle resemblances of behavior include the fact that fledgling man-o'-war birds tend to hold the tip of the bill close to the breast, in precisely the pelican manner. Such facts go far toward justifying an old popular name of the man-o'-war bird—"frigate pelican." A similar close concordance between the young of boobies and cormorants might readily be cited. Both build and behavior, moreover, point toward a definite, though much more distant, relationship of the Pelecaniformes with the petrel-like birds.

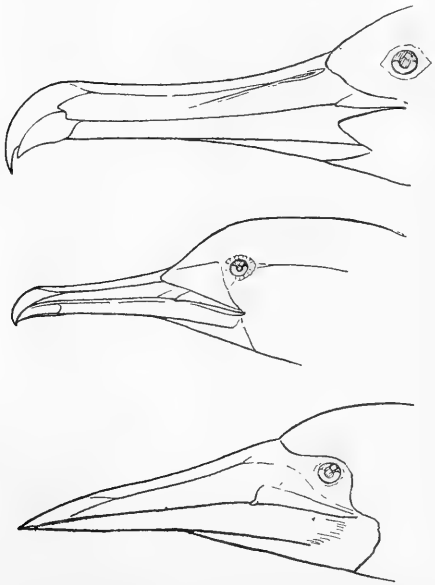


FIG. 67. Bills of Man-o'-war Bird, Cormorant, and Booby.

Upper, *Fregata magnificens* ♀; middle, *Phalacrocorax gaimardi* ♂; lower, *Sula variegata* ♂. All three genera show a "bill-tooth" on the cutting edge of the maxilla near the end of the quadrato-jugal bar. This is obsolescent in man-o'-war bird and cormorant, but is apparently functional in the booby owing to a certain flexibility at the junction of maxilla and cranium. The man-o'-war bird has also an accessory notch at the distal end of the latericorn which, in the booby, is functionally replaced by sharp serrations.

To turn from likenesses within the order to points of discrepancy, we may note how genetic variation has pre-adapted the various types of Pelecaniformes for a wide variety of ecologic niches. Their "adaptive radiation" is, indeed, far more marked than that of petrels except as regards

size range, and infinitely more so than that of the extant penguins. The man-o'-war bird—all wings and practically no feet—has lost the function of swimming or diving. The boobies and salt-water pelicans share the possession of a cellular subcutaneous cushion which admirably fits them for plunging from the air. The cormorants lack this protection, but possess even more efficient swimming feet. They have become grebe-like in their feeding procedure. Furthermore, their powers of flight, as correlated with the length and comparative rounding or attenuation of the outer wing quills, show a greater latitude than we find among other families of the order; one cormorant has, in fact, become wholly flightless.

The Pelecaniformes exhibit curious relations as to the size of the sexes, permitting a classification which seems to harmonize with no other criteria. Thus among the boobies and man-o'-war birds, females are decidedly larger than males. Among the races of the American Brown Pelicans the reverse is true. Males and females within the families of tropic-birds and cormorants are of about the same bodily size, though the bills of male cormorants average longer than those of their mates.

As in the case of petrel-like birds, all kinds of Pelecaniformes appear to abandon their young completely and forever when the latter reach the state of fledglings. Plentiful observation, relating to many species, confirms the general truth of this. I have, however, found certain evidence that under rare circumstances the reaction of pleading for food by young or adult birds may prove a sufficient stimulus to evoke the appropriate response from other adults for a prolonged or indefinite period. While a single instance of such testimony might carry little weight, several to the same purpose acquire a cumulative force. I append two examples of what might be termed successful and permanent infantilism, as practiced by adult but incapacitated Pelecaniformes. They are all the more interesting because Mitchell (1911, 425) has shown that fowl of this order have excellent viability, and potential longevities ranging up to about fifty years.

The first of the following instances refers to a Brown Booby observed in the Pacific during the course of the United States Exploring Expedition. The second is concerned with a man-o'-war bird at one of the Revilla Gigedo Islands. The fact that both accounts are tinged with a too altruistic interpretation does not affect their value.

> While exploring Enderby's Island, which is of coral formation, we found a full-plumaged bird of this species, that is, one having a white breast, which indicated it was several years old; it was at least a quarter of a mile from the shore; and on picking it up, we were surprised to find it had but one wing, the other having been by some accident, taken off close to the body; the wound was perfectly healed, the bird in excellent health, and very fat!—It was fed by its comrades, which were younger birds, as indicated by the brown plumage of their breasts, and they continued while we were near, to display all the careful anxiety of parents (Peale, 1848, 273).

> At a considerable distance from the colony a bird was found that was unable to fly, and thinking that it had been recently injured, and must necessarily starve, where food was not easily obtained by even the best of flyers, I killed the cripple and made an examination of its injuries. One wing was withered and useless,—evidently the bird had never enjoyed its use, though it was fat and its

stomach was well filled with flying fish. Those who know the feeding habits of *Fregata* need not be told that all their food is obtained on the wing, and a bird deprived of the use of its wings would speedily starve if not fed by its fellows. The precipitous sides of San Benedicte also made it impossible for a Man-o'-War Bird to gain the top of the island if deprived of its wings. So it was quite evident that the pensioner had never left the island, but had been dependent on the bounty of its fellows all of its life. From its excellent condition it was evident that even in that busy community of thousands some of them found time to feed the unfortunate (Anthony, 1898, 314).

THE TROPIC-BIRDS

FAMILY PHAËTHONTIDAE

Although there can be no doubt about the place of the tropic-birds in the order Pelecaniformes, they differ much in habitus from all their existing relatives, and share many superficial characters with the terns. These include form and size, the shape of the beak, the silky sheen of the plumage, the voice, and aërial grace. Furthermore, tropic-birds hatch from the egg covered with down, instead of being naked like young boobies, cormorants, and pelicans.

The distribution of the tropic-birds matches very closely the distribution of surface water according to temperature. Since the eastern sides of the continents are washed by poleward-flowing warm currents, while the western sides have cool currents flowing in the direction of the equator, it follows that the tropical oceanic areas tend to be highly restricted on western coasts and spread out widely on eastern coasts. Details of this familiar condition are discussed in Part I of this book. Correlated with it is the fact that the oceanic ranges of tropic-birds within our region are more or less wedge-shaped, with the apex of the area close to Africa in the Atlantic region and to Panama in the Pacific region. In more westerly parts of these respective oceans the tropic-birds extend north and south through much wider belts of latitude. In the western Atlantic, for instance, the breeding range stretches from the neighborhood of the Abrolhos Islets (latitude 18° S.) to Bermuda (latitude 32° N.), and the flight-range still farther northward and southward. It is curious that South Trinidad, which lies much nearer the equator than Bermuda, and only a few degrees farther southward than St. Helena and the Abrolhos Islets, seems to have no resident representatives of the family. Likewise, tropic-birds appear to be unknown along the Brazilian coast to southward of Cape Frio.

The tropic-birds lack the pecten which is so conspicuous on the middle claw of their relatives. A broadened flange, in the position of the pecten, is conspicuous in *P. aethereus*, however, and I believe it to be a homologous structure.

Phaëthon aethereus has been called the most "primitive" member of the family, at least as regards plumage characters, because the adults of this species wear the same barrings which among the others are confined to the first contour plumage. Among all tropic-birds the moult is apparently post-nuptial and complete, and the sexes approximate each other in size.

Worth (1935, 442) has recently made observations leading to the supposition

that the long tail of tropic-birds has a tactile function during the aërial antics of courting birds. He has watched pursuit-flight, at the culmination of which one adult would take a position directly above another, and then bend the tail downward so that the long plumes would touch the bird flying below.

SOUTH ATLANTIC RED-BILLED TROPIC-BIRD

Phaëthon aethereus aethereus

Phaëthon aethereus Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 134 (Ascension Island).

Names: Boatswain-bird, Marlin-spike; "Rabo de Gallo"; "Rabijunco" is both a Spanish and Portuguese name; "Rabo de Palha" is also recorded from Brazil.

Characters: A large tropic-bird with a white tail, and with the dorsal surface thickly marked with dark gray, transverse vermiculations.

Adults (sexes alike): General color glistening white; a black band, proceeding from a crescentic mark above the gape and in front of the eye, passes through the latter and more or less outlines the white crown; the caudad completion of this band depends upon plumage wear, the feathers of the crown being white-tipped but basally black and, as the tips wear away, the black line tends to become continuous; back and sides of neck, mantle, back, rump, upper tail coverts, and most of the proximal wing coverts, transversely barred with neutral gray, these vermiculations tending to increase in width caudad; greater wing coverts blackish gray, broadly fringed with white; the five outermost primaries have the outer web, and the part of the inner web adjoining the shaft, grayish black, only the extreme tips of the feathers being sometimes though not always white; in some instances the third from the outermost quill is partially, and the fourth and fifth are entirely, margined on the outer web with white; the remaining primary quills have a dark gray median stripe, extending within 2 to 3 centimeters of their tips; innermost secondaries and their coverts gray, more or less margined with white, especially externally; long flank feathers mainly gray, with white marginal blotches and terminations; outer tail feathers with dark shafts, except distally, and with a few irregular grayish marks; long central tail quills white, the shafts basally blackish. Iris brown; bill crimson; tarsus and proximal part of foot yellowish flesh color, with the plantar surface gray. In the parti-colored condition of the feet, the tropic-birds resemble certain petrels.

Following are the dimensions of two South Atlantic specimens:

	Wing	Tail	Tail plumes	Exposed culmen	Tarsus	Middle toe and claw
♂, Ascension	326	119		63.3	29	46.1 mm.
Sex ?, St. Helena	317	110	612	62.5	30	46.8

Data on the youthful stages and eggs of this, the typical race of the species, are not available.

Distribution: Known from the islands of Ascension, St. Helena, and, according to Peters (1931, 77), also from Fernando Noronha.

Only since a recent revision by Peters (1930, 261) has it been realized that the resident Red-billed Tropic-bird of the equatorial and sub-tropical South Atlantic islands is a very distinct bird from the more familiar middle Atlantic race, the range of which extends from the Cape Verde Islands on the east to the Galápagos on the west. Doubtless the numerous South Atlantic records, including those from the Abrolhos Islets and other parts of the Brazilian coast, pertain to the subspecies *aethereus*. In view of our present lack of knowledge regarding the geographic boundary between the two races, however, I have elected to discuss them in the succeeding biography, which deals with the species as a whole.

CARIBBEAN RED-BILLED TROPIC-BIRD

Phaëthon aethereus mesonauta

Phaëthon aethereus mesonauta Peters, 1930, Occas. Pap. Boston Soc. Nat. Hist., 5, p. 261 (Swan Key, Almirante Bay, Panama).

Names: The vernacular names and the synonymy are the same as those of the preceding race.

Characters: Differs from *P. a. aethereus* in that all the dark areas, including the transverse bars, tend to be black instead of gray; the deep black greater primary coverts, moreover, are sometimes slightly tipped, but never edged, with white. Furthermore, the subspecies *mesonauta* is apparently of slightly smaller size, particularly in length of wing.

Flesh colors are as in the preceding race. A male captured off Tumbez, northern Peru, on January 16, 1925, has the throat and breast suffused with pink, a characteristic which comes out frequently among the tropic-birds, and which has no taxonomic significance. This specimen agrees in dimensions and markings with Galápagos birds.

Examples in worn plumage have more or less dark crowns and a very densely barred, nearly black dorsal surface, because of the loss of the white terminations of the feathers. The change shows equally among Cape Verde and Galápagos birds.

Measurements of 18 adults of both sexes from the West Indies, Panama, the Pacific coast of Central America, the coast of Ecuador, and the Galápagos Islands are: wing, 293–317 (305); tail, 94–115 (105); central tail plumes, 428–658 (541); exposed culmen, 60–66 (63.2); tarsus, 26–29 (27.8); middle toe and claw, 41–48 (44.5) mm.

Among 15 males and 15 females from the Cape Verde Islands, the dimensions are as follows: wing, 283–319 (298); tail, 94–118 (106.8); central tail plumes, 414–700 (561); exposed culmen, 59–69 (63.7); tarsus, 27–30 (28.8); middle toe and claw, 44–48 (46) mm.

Gifford lists the maximum tail-plume length among 36 Galápagos males as 790 mm., the average being 658 mm. The wing-expanse of a Galápagos male in the American Museum is recorded as 109 cm.

Peters (1930, 261) has described also a third subspecies (*P. a. limatus*), stated to have a longer and more slender bill (maximum 68 mm.) than either of the preceding races. The color of the bill in dried skins is alleged, moreover, to be yellowish horn-color rather than red. Tower Island, Galápagos, is the only known breeding station of this proposed race.

Among a series of American Museum specimens from Hood Island, Galápagos, is a yellow-billed bird with a culmen 67 mm. in length. It seems improbable that two races could thus exist side by side at a single island. Moreover, among 15 males from the Cape Verde Islands are two examples with culmens 69 mm. long. Finally, one Cape Verde male has a central tail plume which exceeds the length of the first lateral rectrix by 584 mm., a character which, by implication, Peters holds to be peculiar to the subspecies *limatus*.

Under the circumstances, I am leaving the status of the Tower Island tropic-bird for future investigation, and am treating all of the Galápagos representatives as identical with those of the Caribbean and the sub-tropical North Atlantic.

The juvenal plumage of *P. a. mesonauta* resembles that of the adult, but the dark transverse bars are broader, and there is more black on the crown, forming an occipital crescent. The central tail quills are barely longer than the adjacent pair, and the bill is yellow. Younger nestlings are clad in down which is short and white ventrally, and long, silky, and gray above. The bill is cream-color and the feet at first entirely light, gradually turning blackish distally.

The single egg exhibits great variation in form as well as in the amount and distribution of the purplish or chocolate pigment (Murphy, 1924, 254, fig. 9). Some examples are very finely mottled, others coarsely blotched. A concentration of pigment at the larger end is common. Six Cape Verde Island eggs, selected for variety, measure: 64 x 43, 62 x 45, 55 x 41, 56 x 43.5, 66 x 44, 59 x 40 mm. Bent (1922, 188) reports that the average of 40 eggs from the American side of the Atlantic was 56.4 x 41.7 mm., the three extremes measuring 63.2 x 46, 50.5 x 39.5, and 51.5 x 36.5 mm.

Distribution: The eastern tropical Pacific from the Galápagos Archipelago to the coasts of Peru and Ecuador and northward to the Gulf of California; the Caribbean Sea, the Antilles, and the tropical and sub-tropical North Atlantic Ocean eastward to the Cape Verde Islands.

After weeks off soundings, in tropical blue waters where birds are scarce, the voyager may sometimes be electrified by hearing the shrill whistle of the Boatswain-bird. Looking aloft, he may see one, or perhaps a pair, of the gleaming, long-tailed creatures passing high in air on steadily and rapidly beating wings. On such occasions, according to my own experience, the visitors are likely to show a certain brief curiosity in the ship, and will turn off their course in order to fly in an oval orbit around it once or twice before streaking away like animate comets. They are well named after Phaëthon, the son of Apollo, who hurtled from the far sky into the sea. I remember the July day long ago when, at a point to eastward of Martinique but out of sight of land, I first saw one of a pair of Red-billed Tropic-birds dive from the height of the 'Daisy's' masthead into the quiet, transparent water. For several seconds it remained below and, after reappearing, shook a shower of pearls from its feathers, rested at the surface with wings spread and raised, and tail plumes cocked up, and finally leaped into the air as lightly as a tern.

Both this species and the White-tailed Tropic-bird are true ocean wanderers, unlike the man-o'-war birds and boobies which as a rule remain within distances of a few hours' flight from their insular headquarters. The tropic-birds, on the other hand, visit the most remote parts of the warmer seas during times of the year between their breeding periods. They even penetrate into the very heart of the barren Sargasso regions, and Bennett (1860, 89) records several during the month of April in latitude 23° 17′ N., longitude 42° 50′ W., which is about as far from the nearest land as it is possible to get in the sub-tropical Atlantic.

We may first consider the distribution of the Red-billed Tropic-bird on the Pacific side of America, where it is confined mostly to the restricted zone of tropical water between Ecuador and Mexico. The outposts in the breeding range appear to be at the Galápagos and the Revilla Gigedo Islands, and it is interesting that these two groups occupy corresponding positions with reference to the analogous Humboldt and California currents. In northern Peru the Red-billed Tropic-bird is one of the species regularly seen at times when the warm countercurrent is advancing southward. The birds were not uncommon, for example, to westward of the Gulf of Guayaquil and Point Pariñas during the extraordinarily active advance of El Niño in the latter part of January, 1925. At other times, when oceanic conditions are normal, the tropic-birds come this far southward only far offshore, beyond the belt of active upwelling and where the surface waters remain permanently warm. It is no doubt by such an outside route that the species has in rare instances wandered in across the Humboldt Current to Callao (Philippi, 1902, 89; Paessler, 1913, 47), Taltal (Hellmayr, 1932, 295), and even to Valparaiso (Albert, 1899, 233). Von Tschudi (1846,314) has published a record of the breeding of the Red-billed Tropic-bird during the month of February on the high island of Fronton, off Callao. He states that two fledgling young were in the nest, and that they flew away when approached. This, however, is evidently the result of a misidentification, not only because of its zoögeographic improbability but more particularly because all tropic-birds rear but one chick.

The southernmost nesting station on the Pacific coast with which I am acquainted is La Plata Island, Ecuador. Near here I have seen examples in September and February, and when I visited the island during the latter month in 1925, the lighthouse keeper informed me that the tropic-birds bred on the cliffs at the northern end. At Daphne Island of the Galápagos, according to Beebe (1924, 264), the breeding season extends at least from April to November. It is probably continuous throughout the year in this archipelago, for Gifford (1913, 105) reports both eggs and young birds during February, April, September, and November. Moreover, at Pacific islands in the northern hemisphere, such as the Revilla Gigedos, eggs and young in every stage of growth have been found in April and May (McLellan, 1926, 287). Gifford states that Red-billed Tropic-birds were logged by members of the expedition of the California Academy of Sciences in the neighborhood of fourteen islands of the Galápagos group throughout the year; they were found nesting at four of the smaller islands but were seen in numbers only at Daphne, Hood, and Tower. At Daphne Island Gifford saw birds wheeling about, without beating their wings, near holes on the hillsides. When they seemed ready to enter their respective niches, they would flutter to check their flight, stand in the air for an instant as though about to alight, but would then usually continue, not entering the nest until the maneuver had been repeated several times. At this island, nests not in natural rock-cavities were in short burrows which covered the surface from close to sea level to a hundred meters above it. In homes without an egg two adults would sometimes be found together, but adults engaged in incubation or brooding were always alone. The long central tail feathers of the birds became broken or badly worn from the cramped quarters of the nest-chamber, and the fact that the quills of females obviously fared worse than those of their mates may indicate that females habitually undertake the larger share of the labor of incubation. Competition for nesting sites was exceedingly keen, and Gifford found that new occupants almost immediately took possession of homes after the first proprietors had been collected. At Hood Island he also took a tropic-bird and its fresh egg from a site which had been occupied by a pair of Swallow-tailed Gulls only five days earlier. At Pacific islands off the coast of Central America the Red-billed Tropic-bird has been known to make secondhand use of burrows of the Wedge-tailed Shearwater (Beck, 1904, 5).

On the Atlantic side of the continent, the species inhabits various islands of the Caribbean and the Lesser Antilles. At Orquilla of the Hermanos group, Venezuela, the birds have been found nesting in unlined holes among the broken rocks of steep slopes during the months of March and April (Cory, 1909, 226). In such places they reveal their presence by loud outcries against the stumbling steps of intruders among their stones (Lowe, 1911, 214). At the same time of year, Taylor (1864, 172) reports them as breeding in great numbers among the cliffs of volcanic ash at Martinique. On Valliceaux, near St. Vincent, Ober (1880, 224) found many nesting on more or less open shelves of the cliff, sitting so quietly when he approached that he mistook them for young birds. Unlike its smaller Atlantic relative, the Red-billed species apparently does not range

to northward of the Antillean Arc, but to eastward in the same latitude it reaches the Cape Verde Islands, where large colonies breed throughout the year at Razo and the Rombos Islets (Correia, in Murphy, 1924, 256). Southward across the equator it ranges to Fernando Noronha, where the Cleveland Museum Expedition recently collected specimens; to Ascension, where it nests in holes burrowed through the accumulated guano of the main island as well as at the outlying rock to which this and the lesser species of the genus *Phaëthon* have given the name Boatswain-bird Islet; to St. Helena, where its habits are similar; and to the Abrolhos Islets, off the coast of Espirito Santo, Brazil (Goeldi, 1894, 598), from where I have examined two specimens collected on December 28, 1887. The Abrolhos seem to represent the southernmost known breeding station in the Atlantic for, curiously, no tropic-birds have yet been recorded from South Trinidad, an island which would seem to be well adapted to their support and which lies within the sub-tropical zonal limits of their breeding area. It is possible that they have been merely overlooked at South Trinidad.

At St. Helena, which is close to the southern border of the range, the Red-billed Tropic-birds are very abundant along the southeasterly coasts, these being the most precipitous and the farthest from the haunts of man. According to Meliss (1875, 97), the birds nest in niches of the cliffs as high as 500 meters above the sea. In launching into flight from such places they simply drop from the ledges, an important consideration with this species, for its terrestrial progression is not at all like that of boobies but rather resembles the gait of weak-legged petrels. Correia states that adults can neither walk nor stand up. They rest with their breasts on the ground, and to cover the short distance between the nest-chamber and the jumping-off place, they merely push along on their bellies, spreading their wings as props and balancers.

At the Cape Verde Islands Correia found that the tropic-birds set forth toward their feeding grounds at daybreak, returning from the first trip about eight o'clock in the morning. They then fly toward their respective clefts or cavities but, instead of alighting, they poise in the air with the feet and tail trailing, and afterwards describe short circles only to swing back and poise again, repeating the performance for an hour or more. This agrees precisely with Gifford's experience at the Galápagos. Meliss writes that at St. Helena a second return from the sea takes place during the latter part of the afternoon.

Gifford describes the vocal expression of this species as a series of short, high, rasping notes given in quick succession. Young birds taken from the nest have a similar cry, and even chicks a day or so in age utter three or four notes of it when handled. Gosse (1847, 430) reports that there are two distinct call-notes, one being like that of a gull, and the other a chattering trill like the rattle of the Belted Kingfisher. The latter note, of course, is the "boatswain's whistle" which has given the species its commonest name among sailors.

The food of the Red-billed Tropic-bird comprises both fish and squids. Remains of either are likely to be disgorged by young or adults when they are disturbed at the nest. Birds coming out of the ocean after a plunge sometimes show the prey held crosswise in the beak during the instant before it is juggled

and swallowed. Food is not carried to young in the bill, but rather in the gullet or crop, petrel-fashion.

The principal enemies of this species seem to be man and the cats he has introduced. According to Correia, hundreds of the birds are annually salted and dried for human consumption by the native fishermen of the Cape Verdes. Gifford states that the tropic-birds are practically immune from the attacks of man-o'-war birds, and that the only mischief he ever saw the latter attempt was unsuccessful. At St. Helena semi-wild cats destroy the young in all nests that they are capable of reaching, besides which tropic-birds were formerly shot here in great numbers for the use of their plumes in the millinery trade. In this connection it is interesting to note that the tail plumes of the West Indian tropic-birds were formerly valued by the Caribs just as those of the Pacific Red-tailed species were by Polynesians. Du Tertre (1662, **2**, 276) writes that the primitive savages of the French West Indies were accustomed to fix the plumes in their hair, or to stick them through a hole in the septum of the nose.

WHITE-TAILED TROPIC-BIRD

Phaethon lepturus

Phaëton lepturus Daudin, 1802, Buffon Hist. Nat., edit. Didot, Quadr. 14, p. 319 (Mauritius).

The species is of wide distribution in the tropical Pacific and Indian oceans, as well as in the Atlantic, but no form occurs in the eastern Pacific, and the races which come within our region comprise only an equatorial Atlantic form, which has thus far been described with complete inadequacy, and the subspecies of the Antillean-Bermuda district. The former of these has been called

Leptophathon lepturus ascensionis Mathews, 1915, Birds Australia, 4, p. 311 (Ascension Island).

Breeds at Ascension, Fernando Noronha, and islands of the Gulf of Guinea.

The second was described as

Phaëthon catesbyi Brandt, 1840, Mém. Acad. Imp. Sci. St. Pétersb. (6), 5, p. 270 (Bermuda).

Breeds in Bermuda, the Bahamas, and locally in the Greater and Lesser Antilles.

Names: Boatswain-bird, Yellow-billed Tropic-bird, Long-tail, Marlin-spike. Spanish-American names include "Caracolera," "Rabi-junco," and "Chirre de Altura." Synonyms of the specific name are *americanus*, *flavirostris*, *candidus*, and *edwardsii*.

Characters: Smallest species of the genus; the adult without crossbarring; black and white or, rarely, black and pinkish or salmon color.

Adults, of the Atlantic equatorial form, *Phaëthon lepturus "ascensionis,"* which has never been satisfactorily distinguished from the typical or Indian Ocean race (sexes alike): General color glossy white, not infrequently with a peach-colored suffusion which, among certain specimens, is heightened to a deep salmon or even orange tint; a broad black stripe, proceeding from a crescentic black mark above the gape and in front of the eye, passes through the latter, more or less outlining the crown; as a result of wear this band sometimes practically meets around the rear of the pileum through exposure of the concealed bases of the feathers on crown and nape, which are black as in *P. aethereus;* a broad black band is formed on the wing by the black distal halves of the median coverts, this stripe being continuous with a large black area formed by the scapulars and innermost secondaries, all of which are at least centrally black, although they may have white margins and white tips; four outermost primaries with the outer web, and the portion of the inner web adjacent to the shaft, black to within 2 to 3 centimeters of their tips; the fifth has the black area confined to the shaft and outer web, while the proximal primary quills have little more than partially black shafts; outer secondaries white; long flank feathers broadly striped axially with grayish black, and somewhat sprinkled with grayish toward their borders; shafts of wing and tail

quills white below, but black on their upper surfaces, except distally; tail composed of 12 feathers. Iris brown; bill bright orange-red, inclining toward vermilion on the culmen (at least during the breeding season); tarsus bluish; toes and webs black.

2 males, Fernando Noronha: wing, 267–274 (271); tail, 97.6–105.5 (101.5); exposed culmen, 49; tarsus, 23; middle toe and claw, 35.3 mm.

7 females, Fernando Noronha: wing, 251–275 (265); tail, 87.4–113 (101.3); central tail plumes, 403–461 (433); exposed culmen, 44–49.7 (46.6); tarsus, 21.5–23 (22.2); middle toe and claw, 36.9–37 (37) mm.

The wing-spreads of the males were 92 cm.; those of the females 86.4–89 (87.8) cm.

Immature birds have yellow bills; those in juvenal plumage have the dorsal surface barred with transverse black vermiculations, similar to the wavy marks of *Phaëthon aethereus*, but coarser. These vermiculations are lost mainly through wear, but it is possible that they are to a slight extent renewed on the plumage which immediately succeeds the post-juvenal moult. Younger chicks are clad in grayish white down, which is nearly pure white on the face, belly, and middle of back.

Birds of the Bermuda-West Indian subspecies, *Phaëthon lepturus catesbyi*, differ from the equatorial and South Atlantic representatives in that the black area on the outermost primary extends close to the tip; on the second and fourth from the outermost it practically reaches the tip; while the third from the outermost quill is entirely black or no more than very narrowly tipped with white. There is also much more black on the fifth from the outermost quill. All of these black markings of the remiges are remarkably conspicuous when the birds are in flight.

The Bermuda race may also be slightly larger than the equatorial race. Figures covering both sexes, and recorded by Gross and by Plath, are: wing-expanse, 885–965; wing, 271–281; bill, 49–54 mm.; weight, 367–465 grams, the average of six birds being 407 grams.

According to Plath, the plumage of full maturity and the bright orange-red bill are not attained until the third year. The roseate tinge on the satiny white plumage of neck and breast of sporadic examples is mentioned by Gross.

The single egg is variable in shape and markings, with a pinkish white ground color more or less thickly concealed by brown, purplish, and chocolate specklings, cloudings, and blotches in endless variety. The shell is extraordinarily tough and somewhat elastic. Eight measured by Gross had extreme lengths of 49–58 and breadths of 36–41 mm. They weighed from 35.2–45 grams, with an average of 40.4 grams. The weight decreases slightly during incubation, as water is lost. Extreme measurements among 40 eggs of this race, as recorded by Bent (1922, 183), were 60 x 40, 56 x 41, 50 x 37.5, and 51 x 36.5 mm.

Distribution: The difference in the flight-ranges of the two races considered above has not been worked out in detail. The range of the American representatives of the species *lepturus*, as a whole, appears to be entirely Atlantic, and to extend from the edge of the Sargasso Sea off eastern North America southward through the Antillean-Caribbean region to Fernando Noronha, and eastward across the tropical Atlantic to Ascension and the Gulf of Guinea. The two races are jointly discussed in the following biography.

Within our region the White-tailed Tropic-bird is confined to the Atlantic, in which ocean it breeds at Bermuda, the Bahamas, many islands of the Antilles, and at Fernando Noronha and Ascension. Throughout the northerly part of this breeding range, the tropic-birds are by no means permanent residents, but they make an annual migration to Bermuda where they appear in February or March to remain until October or, casually, into November. A certain migratory movement seems also to be apparent in the Bahamas and among some of the West Indian islands, but at the Lesser Antilles the species is resident throughout the year.

Neither are the movements at sea confined by any means to migrations for reproduction. After the nesting season has passed, indeed, the White-tailed Tropic-birds wander far and wide, and reach latitudes much nearer the pole

than any part of their breeding range. Until recently, exact pelagic records from points between the equatorial Atlantic and the coast of Nova Scotia were suggestive but rare (Reid, 1884, 262; Lowe, 1911, 215). The work of Jespersen (1930, 28) during the cruise of the 'Dana' has shown, however, that this species on its wanderings is distinctly a denizen of the Sargasso Sea, and that it occurs regularly during the northern-hemisphere autumn as far northward as latitude 40° N. It is in accordance with well-established oceanographic principles, moreover, that the pelagic records of this tropic-bird should be much more numerous and widespread in the warmer western half of the North Atlantic than they are in the eastern half. Jespersen states that it was exceptional in his experience to find this bird anywhere to eastward of longitude 30° W., and that, while encountered everywhere within the Sargasso Sea, it was most numerous in the western part of it.

Jespersen continues that on the high sea the White-tailed Tropic-bird is usually seen alone, and never in large companies. Twice he has encountered three or four together, but this was only within a few hours' flight of Bermuda. During 112 days of observation, at distances of not less than about 100 kilometers from the nearest land, he observed three or four together on only two days, two together on 28 days, and only single birds during the remainder of nearly three-fourths of the days of record. On a very few occasions he saw tropic-birds settle on the water, and this exclusively in fine weather when the sea was smooth. Such swimmers always held their elongated tail feathers at an upward angle, as if to keep them dry. Flying birds, according to Jespersen's experience, show more or less short-lived curiosity regarding a ship, and he once observed one that for some time hovered above the truck at the main masthead and kept pecking at its vane. Again, during a heavy thundersquall in which waterspouts followed a downpour of rain, a tropic-bird attempted to alight upon the vessel.

At one of the South American breeding stations, namely the Brazilian island of Fernando Noronha, I became acquainted with the White-tailed Tropic-birds on October 16, 1912. At this time they were nesting in niches of the cliffs above the beach, as they apparently do here throughout the year. Three birds, frightened from their inaccessible nest-chambers and shot, all proved to be females. Two of them were of the normal satiny white coloration, but the third was of a pale pink or pinkish salmon hue, slightly more orange on the dorsal surface. This condition represents a phase, the meaning of which is not understood, but which crops out among a small proportion of the birds in various parts of the world. A second famous South Atlantic breeding station is at Boatswain-bird Islet, Ascension, where the White-tailed Tropic-bird nests in close proximity with its larger relative, the Red-billed species, as is true also at Fernando Noronha.

The principal biographic studies on this species have been made at Bermuda by Gross (1912, 49) and Plath (1914, 552), from whose valuable reports most of the following data have been drawn.

The sense of orientation of the White-tailed Tropic-bird is shown not only

by its seasonal return to Bermuda, which is more than 1000 kilometers from the nearest land, but also by the fact that the same individual birds come back year after year to the same nesting sites, as has been determined through banding experiments. In 1901 it was estimated that 2000 pairs of the "Long-tails" nested at Bermuda, and it seems probable that this population approximately holds its own year after year. After arriving at the breeding grounds the adults are not shy, nor do they appear to resent close inspection by human beings, except during the period of egg-hatching which transiently conditions them to a state of ferocious antagonism.

The foraging flights of the Long-tails take them a relatively great distance from land, certainly far out of sight of the islands and doubtless regularly as far as 100 kilometers or even more. Reid (1884, 263) reports seeing a pair resting on the water about 150 kilometers to eastward of Bermuda. The adults are most active in early morning, first leaving their cliffs about five o'clock. By half-past eight there is a considerable decrease in activity, which practically ceases by the middle of the forenoon. Shortly before sunset there is another period of movement, though this is less pronounced than that of the morning. The diurnal rhythm is described by Scott (1891, 249) as being exactly similar at Jamaica. At the latter island the White-tailed Tropic-birds are commonest during the winter season, that is from December to March, which may indicate a swelling of the local population through migration from more northerly breeding stations such as Bermuda.

The Long-tails are not strictly gregarious birds, the concentration of their nests being due rather to the scarcity of suitable sites. The fact that they are nearly helpless on a level surface, and there capable of progressing only by crawling and bouncing along on flattened tarsi, makes them of necessity cliff-dwellers. At Bermuda the nests are either on ledges or in small caverns. If the former, they are often at the base of herbage which protects them from the intense heat and light of the sun. Some are situated on ledges so low as to be in danger of being drenched by waves; others are in sites up to 30 or 40 meters higher. Pairing takes place at the nest, and Gross believes that two broods are annually reared by each couple.

The single egg has a strong and somewhat elastic shell, well adapted to resist the rough stone upon which it is laid without benefit of a soft flooring. Batches of fresh eggs appear at Bermuda by April 10, and again at the end of June (Reid, 1884, 263), which supports the hypothesis of successive broods. In the white limestone cliffs of Jamaica, Scott has found adults covering eggs in the honeycombed cells on February 27. In larger caves at the same place eggs were found between boulders on a sandy floor. Here, too, a chick estimated to be more than a week old was found on March 15, which would place the date of egg-laying in early February. It is highly probable that at such sub-equatorial islands as Ascension and Fernando Noronha the nesting season is nearly or quite continuous throughout the year.

Both sexes incubate, but an adult has also been observed feeding its mate while the latter remained on the egg. It is not unlikely that the female is the

more broody of the two. When parents relieve each other at the nest, they indulge in a brief affectionate ceremony and mingle their caresses with sounds which resemble the "flicker" call of the North American woodpecker of that name (*Colaptes*). Gross states that the period of incubation is not less than 28 days, and Plath determined that an egg placed in an incubator took exactly that length of time to hatch. The process of coming out of the shell is evidently a slow one, for within a pipped egg the calls of a chick have been heard for 42 hours before it finally emerged. The weight of a newly hatched chick, which has not yet received food, is little more than half the weight of an egg. The eyes of the nestling are closed for a day or two, but any stimulus excites it to extend its neck and open its beak, in anticipation of a meal.

For the first ten or fifteen days the food supplied the offspring consists of pteropods and other soft-bodied marine animals, but between the fifteenth and thirtieth days more than 90 per cent of the sustenance is made up of squids, the remainder being chiefly fish. Since the young regurgitate upon slight provocation, their food can be readily analyzed. The quantity ejected sometimes equals one-fifth the weight of the bird. Gross infers that most of the squid are captured during the early morning hours, and far out at sea. This is confirmed by the observations of Jespersen, who analyzed the stomach contents of eight adults shot out of sight of land. These included nothing other than remains of cephalopods, the largest of which measured 12 centimeters in length. Most species of such organisms avoid the uppermost layers of the ocean during hours of strong light. They can best be captured early in the day, when the tropic-birds may be seen diving frequently from heights of 15 to 20 meters, the birds first hovering like Kestrels and then falling with wings folded. Usually they twist or spiral on the way down, a characteristic which is also very pronounced in the plunging of the Brown Pelican.

During the early period of the young tropic-bird's life it is fed frequently, but after three weeks or thereabouts the adults carry squids to the nest cavity two or three times shortly after six o'clock in the morning, and then disappear, presumably to take care of their own needs, for a period of 24 hours. The lonely youngsters sleep much of the time but respond attentively to every sound and, of course, come to life vigorously when they hear the characteristic clicking call of a returning parent. In response to this sound the chick utters a series of guttural chirps, and braces itself on legs and tail in anticipation of the breakfast, which is delivered with much gulping and wriggling.

About 62 days are spent in the nest after hatching, making a total of 3 months between the time the egg is laid and the date when the fledgling takes flight. Feathering is completed by the 40th day, though the down still clings to the head and rump. Like young shearwaters the chicks are unable to fly strongly at the time of leaving the nest. They usually leap off the ledges, glide to the water, and then make their way to sea by swimming. They doubtless must depend for some time upon their stored fat, until they have gained strength to fly and to fish for themselves. Gross suggests that possibly the parents feed them on the ocean, but it would be well worth inquiring as to whether they are not

completely abandoned by the adults before they leave the nest, in which case increasing hunger would supply the necessary pulling of the trigger for bringing about this reaction.

Aside from the harsh scream, like an exaggerated tern voice, which the White-tailed Tropic-bird often utters in flight or as a protest while on the nest, it has a number of softer calls. One of them Plath describes as *tik-et, tik-et, tik-et*, a chorus of such notes sounding like a creaking pulley. The Flicker note, heard when adults relieve each other at the nest, has been mentioned above, as has also the clicking sound uttered when parent approaches chick with food.

Aside from the prey already referred to, Gross has noted two species of flying fish, and fragments of sea-urchins and crabs, among material regurgitated by these birds. Penrose (1879, 277) states that crabs of some sort are a staple food at Ascension.

At Bermuda the principal enemy of the White-tailed Tropic-bird is the roof rat (*Rattus rattus*, subspecies).

THE PELICANS

FAMILY PELECANIDAE

The pelicans are a widely distributed family of chiefly continental birds, the Galápagos being the most isolated islands that they have anywhere reached except for the accidental occurrence of one species in New Zealand. Many pelicans are primarily birds of fresh water, but all of those occurring within the field of this book are distinctly sea fowl, although the tropical representative is by no means averse to entering the lower courses of rivers.

The South American pelicans are all "Brown Pelicans," referable to the subgenus *Leptopelicanus* of Reichenbach. They are of two groups, of which one is the Peruvian or Chilean Pelican, formerly given specific rank but now regarded as a subspecies of the typical West Indian form. At any rate, it is a distinctive bird because of its large size and because of its well-defined endemic range.

As regards the forms of the Brown Pelican occurring in North and Central America, the West Indies, and the northerly tropical coasts of South America, I have not yet been able to come to any final taxonomic conclusion. Peters (1931, 81) has recognized three races, of which one (*occidentalis*) is confined to the Antilles, a second (*carolinensis*) nests along the Atlantic and Gulf coasts of the southeastern United States, and a third (*californicus*) is said to range along the Pacific coast from British Columbia southward to Ecuador and the Galápagos Archipelago. This division of the species, particularly with reference to the last race, seems to me quite unsatisfactory both in relation to the specimens I have examined and to geographic likelihood. Since Brown Pelicans constantly cross the Isthmus of Panama *via* natural waterways, as well as through the man-made Canal, it would be hard to believe that the subspecies of the Caribbean and of the Pearl Islands and adjacent parts of the Pacific coast are not one and the same. Swarth (1931, 37) distinguishes between the California and Galá-

pagos pelicans, but he specifically states that Galápagos and Caribbean birds are indistinguishable.

The Brown Pelicans in any population vary to a highly puzzling degree and, until a study based upon more ample material than I have seen has made possible fully demonstrable conclusions, I can only suggest the following probabilities which are based upon the limited data at my disposal.

1. *Pelecanus occidentalis occidentalis* Linnaeus

Type locality, Jamaica; material examined, 6 males and 7 females from Jamaica, Porto Rico, and St. Thomas.

These birds represent a well-marked race, strikingly smaller than the pelicans of the continental coast of North America. The range includes at least part of both the Greater and Lesser Antilles, though Dr. Wetmore informs me by letter that a Cuban specimen he has received belongs to the race of the southeastern United States, not to the smaller West Indian form. Peters includes within the subspecies *occidentalis* the native pelican of St. Vincent, and Rothschild and Hartert (1899, 177) remark significantly that pelicans collected at Aruba Island are smaller than any they have seen from the west coast of America.

From such data it would be natural to conclude that all the pelicans inhabiting the Caribbean islands off the coast of Venezuela, as well as those which range southeastward beyond Trinidad to Guiana, and casually as far as the Amazon, are likewise of the Antillean race. It so happens, however, that a male from Cumaná, Venezuela, agrees definitely with Florida, rather than with Jamaica, birds. This indicates that further collecting and systematic study is required, particularly since the pelicans of Panama, Colombia, and Ecuador are relatively large birds which agree with the pelicans of the southeastern United States, rather than with those of the Antillean Arc. The existence of a small West Indian pelican, the distribution of which remains to be defined, at least emphasizes the strictly littoral nature of the group as a whole.

2. *Pelecanus occidentalis carolinensis* Gmelin

Type locality, Charleston, South Carolina; material examined, 5 males from Florida and Texas, 1 from Venezuela, 7 from Ecuador, and 1 from Talara, Peru; 4 females from Florida and Texas, 1 from western Panama, 1 from Punta Piedra, Costa Rica, 2 from Ecuador, and 2 from Talara, Peru.

All of these are, in so far as I can judge, racially indistinguishable in appearance and measurements, indicating for the subspecies *carolinensis* a distribution along both continental coasts of the Middle American region from the southern United States around the peripheries of the Gulf of Mexico and the Caribbean to northern South America; and on the Pacific coast throughout the zone of warm ocean water from southern Mexico to northern Peru.

3. *Pelecanus occidentalis californicus* Ridgway

Type locality, La Paz, Lower California; material examined, 5 males and 4 females from the coasts of California and Lower California. In conjunction

	Wing			Tail			Exposed culmen			Tarsus			Middle toe with claw		
	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.
P. o. occidentalis															
6 males, West Indies	465	490	479	121	126	124	252	304	287	66	72.5	69.4	100	112.5	107.2 mm.
7 females, West Indies	447	466	459	117	128	123	252	272	262	68	70	68.4	101	107	104
P. o. carolinensis															
5 males, Florida and Texas	508	531	518	130	136	133	301	338	319	78	82	80	111	119	117
8 males, Ecuador and northern Peru	503	513	508	126	136	130	308	335	322	76	80	77.5	112	117	115
4 females, Florida and Texas	488	499	492	125	129	127	279	296	288	74	76	75.2	106	112	110
4 females, Costa Rica, Panama, Ecuador	476	489	485	120	131	125	284	290	287	70	73	71.7	104	106	105.3
P. o. subspecies															
1 male, Galápagos			552			132			365			83			123
1 female, Galápagos			515			132			311			73			112
P. o. californicus															
5 males, California and Lower Calif.	560	570	565	143	149	147	348	373	355	81	86.5	85	126	131	128
4 females, California and Lower Calif.	519	527	523	133	143	140	314	323	318	76	82	79	111.5	119	115
P. o. thagus															
1 male, Lobos de Tierra Island, Peru			596			149			416			108			147
5 females, Peru and Chile	562	609	582	141	149	144	330	360	347	91	101	97	127	142	132

with these I have also made use of the measurements and descriptions of Gifford (1913, 118).

From the data at hand I judge that this race is confined to the semi-arid western coast which is bathed by the relatively cool waters of the California Current, and that it does not extend to southward of southern Mexico. It is, in short, probably an analogue of *Pelecanus occidentalis thagus*, the bird of the corresponding cool-current region of western South America.

4. *Pelecanus occidentalis*, subspecies?

Galápagos Archipelago; material examined, 1 male and 1 female from the Galápagos.

Judging from this inadequate material, and from the published data of the authors already cited, I conclude that the affinities of the Galápagos Pelican are with the tropical continental birds and not with those of the California coast. As indicated by the figures of Gifford, the Galápagos birds are smaller than those from California. At the same time they seem to average distinctly larger than specimens of the race *carolinensis*. Further study may show that the Galápagos Pelican is worthy of subspecific recognition, even though a number of competent systematists have thus far failed in efforts to distinguish it. The very fact that its alleged affinities have been bandied back and forth between the California race and the race of the Atlantic coast, shows that the last word on this subject has not been said.

On page 809 is a summary of measurements based upon the 51 specimens of American Brown Pelicans, representing four or perhaps five races, which I have personally measured.

BROWN PELICAN

Pelecanus occidentalis

Pelecanus occidentalis Linnaeus, 1766, Syst. Nat., edit. 12, 1, p. 215 (Jamaica).
Pelecanus carolinensis Gmelin, 1789, Syst. Nat. 1, pt. 2, p. 571 (Charleston, South Carolina).
Pelecanus occidentalis, subspecies (Galápagos Islands).

In view of the foregoing discussion, and the fact that all the pelicans I have seen from Pacific coast localities between Costa Rica and Point Pariñas, Peru, agree well with examples from Florida and the Gulf of Mexico, I am tentatively listing the Brown Pelican of tropical South America as *Pelecanus occidentalis carolinensis*, and am treating the Galápagos form separately at the end of the following biography.

Names: "Alcatráz" or "Pelícano" in most Spanish countries; "Pelecano" in Brazil; "Grand Gossier" in French Guiana. Synonyms of the specific and subspecific names of the Brown Pelican include *fuscus*, *californicus*, *albicollis*, and *relictus*.

Adults in breeding plumage (sexes alike): Back of head, and feathers bordering the gular pouch, white; remainder of head, including the short occipital crest, straw-yellow; neck rich velvety brown, the hue varying, according to the state of wear and fading, between seal-brown or nearly black and light reddish chestnut; the feathers on the nape show more or less of a mane or crest; dorsal body plumage pale ashy or silvery gray, the feathers of the back, rump, lesser and median wing coverts, and scapulars edged with blackish brown, producing a striped appearance; primaries black, with the proximal three-quarters of the shaft white; secondaries and rectrices mostly ashy, becoming brownish and dingy with wear; ventral surface smoky brown, the flanks and sides of breast with silvery white shaft-stripes. Iris yellowish; naked skin around eye blue; bill grayish,

tinged with brown and spotted irregularly with red, the distal end blackish, more extensively on the lower mandible; pouch dull greenish brown or olive-brown; tarsi and feet black.

The whitish scale which forms on the bill of pelicans, sometimes covering a considerable part of it, seems to be a dermal excretion. It is not calcareous, as I have found by testing it with acid.

In the so-called winter or non-breeding plumage, which is acquired by a post-nuptial moult but which may be found at any time of year, all the feathered parts of the head and neck are white except for a straw-yellow tinge on the head and at the base of the fore neck. Such examples encountered during the breeding season may be immature.

For general measurements, see the foregoing table. The wing-spread of a specimen taken at Point Santa Elena, Ecuador, was 220 cm.

In young birds the head and neck are brownish gray, mottled by paler feather tips; the back and mantle are dull brown, the feathers tipped with pale fulvous; the lower parts are white, tinged laterally and posteriorly with brownish gray. Downy young are white in all stages.

Eggs usually number two or three in a set, the latter number being more common. They are very hard and thick-shelled, with a chalky and granular white surface. Measurements of 46 examples average 73 x 46.5 mm., the four extremes having dimensions of 83 x 49, 81.5 x 54, 68 x 47, and 70.5 x 45 mm. (Bent, 1922, 297).

Distribution: The range of the Brown Pelican of tropical South America, as here interpreted, extends from northernmost Peru to the Pacific coast of Costa Rica, and on the Atlantic side from the southeastern United States along the shores of the Gulf of Mexico, Central and South America, to Trinidad and British Guiana, and casually farther southeastward to the River Amazon. South American breeding stations are chiefly at suitable islands along these coasts. In the Pacific there are colonies on Santa Clara Island in the Gulf of Guayaquil, at the Pearl Islands in the Bay of Panama, etc.; on the Atlantic side there are colonies at a number of the islands off the coast of Venezuela, such as Tortuga, islets off Aruba, etc. The pelicans of the Galápagos, which are at least closely related to the tropical South American birds, are confined to the Archipelago.

In view of the taxonomic uncertainties detailed above, I am here combining the notes on Brown Pelicans from all parts of the tropical South American region, disregarding the possibility that more than one subspecific unit may be involved. For data on behavior, and other biological information, I have drawn upon literature referring to pelican colonies at points more or less distant from any part of the continental coast of South America, such as islands off British Honduras, the West Indies, and Florida.

In Part I of this book I have discussed at length the oceanic conditions which prevent pelicans from extending their normal range much to southeastward of the point at which the southern end of the Antillean Arc approaches the mainland coast. In the northern autumn pelicans sometimes flock by hundreds around Barbados, as though they had come from somewhere on a definite migration (Feilden, 1889, 501). At Trinidad they are present throughout the year, but are apparently not known to breed. Beyond this region, straggling birds cross the Gulf of Paria and enter the mouths of the Orinoco (Beebe, 1909, 79). Furthermore, at least a few pelicans make their way up the increasingly muddy ocean current that sweeps along the coast of Guiana. Schomburgk (1848, **2**, 456) reports them as flying in every evening over the mudbanks of the shore, to spend the night in the trees of the neighboring forest. Chubb (1916, 204) is quite confident that they nest nowhere in British Guiana, beyond which country their numbers give out rapidly toward the southeast. At times a few birds work their way farther along this coast, even into the mouth of the Amazon, and Snethlage (1914, 120) has recorded a specimen taken at Itaituba on the Río

Tapajóz, which is one of the south-side tributaries of the Amazon. Never, however, do such pioneering Brown Pelicans wander as far as Cape São Roque, Brazil, where they might perhaps find themselves once more in waters no less agreeable to them than those of the West Indies.

Near the eastern end of the Caribbean, "around the corner" from Trinidad, the breeding range begins, although the pelican colonies have no doubt become more or less continually reduced in number and restricted in size since the early days of settlement and exploitation among the islands of the Spanish Main. Cory (1909, 220) describes a colony in the mangroves at Tortuga Island, Venezuela, where nests containing young birds of various sizes were found on February 2. The date may or may not have special significance, for pelicans are highly variable with regard to the reproductive season. Even at a single locality this may change from year to year, as shown by the observations of Danforth (1931, 36) in Porto Rico. He found on a small islet off the coast that forty nests in the tops of trees each contained two eggs on April 2, 1927, while on March 22 of the following year the same nests mostly held young birds, including many almost ready to fly. In some tropical localities, egg-laying seems to take place more or less throughout the year. At Pelican Island, Florida, the majority of the birds nest in November, but a few delay until April, which is the usual date for the breeding pelicans of the opposite or Gulf coast of the peninsula (Chapman, 1908, 96).

Along the western Caribbean shores of Venezuela there are doubtless other nesting stations, for pelicans are common throughout the chain of islands on the continental shelf, as well as on the Colombian coast from the Goajira Peninsula to the Ciénaga Grande. Throughout these waters they are quick to assemble wherever fishermen draw their nets. Todd and Carriker (1922, 132) were unacquainted with any Caribbean breeding grounds in Colombia, and Darlington (1931, 361) states that pelicans do not fly inland up the rivers in the Magdalena district, as they are so prone to do in many other parts of their range. Among the numerous small islands in the extreme western part of the Caribbean, there are almost certainly other breeding grounds, such as Salvin (1864, 377) describes at islets off Belize, British Honduras.

On the Pacific side of the continental barrier, which is readily crossed by Brown Pelicans in Panama, breeding grounds are well known at the Pearl Islands. Presumably there are other colonies to southward, at suitable stations along the Pacific coast of Colombia and Ecuador, for the Brown Pelicans are abundant clear down to Point Pariñas, Peru, or slightly beyond. They apparently reach the southernmost outpost of their breeding range at Santa Clara or El Muerto Island, in the Gulf of Guayaquil. Large numbers of pelicans which I saw packed shoulder to shoulder on sandbars within the mouth of the Río Chira, Peru, on January 24, 1925, were presumably of this race, rather than of the west coast race (*thagus*) which breeds in great numbers less than two degrees of latitude to southward, at the island of Lobos de Tierra. I have seen no specimens of *P. o. thagus* collected to northward of Punta Falsa, latitude 6° S., just south of Sechura Bay. Neither have I seen specimens of the smaller

northern pelican collected to southward of Talara (4° 30′ S.). It is no doubt in these waters, close to the westernmost projection of South America, where the Humboldt Current meets and mingles with littoral waters of high average temperature, that the Peruvian and the tropical Brown Pelicans come into contact. Nothing is known about possible intergradation of the subspecies. It is unlikely that it occurs, however, for the nesting predilections of the two forms seem to be rather diverse.

Forbes (1914, 405) has stated that the Peruvian Pelicans not only enter the Gulf of Guayaquil, but also roost among the trees along the course of the Río Guayas. All actual specimens that have been recorded from this region are, however, of the smaller, northern race. Furthermore, I much doubt whether *P. o. thagus*, a bird belonging to an arid coast and to absolutely plantless islands, would under any circumstances perch upon trees or other vegetation. In the Humboldt Current region it is noteworthy that two widely distributed tropical sea birds, namely the Bigüá Cormorant (*Phalacrocorax olivaceus*) and the Blue-footed Booby (*Sula nebouxii*), will alight upon posts, spars, wires, or other man-made structures above the ground, just as readily as they take to limbs and twigs in regions where trees and shrubs grow. The endemic Guanay (*Phalacrocorax bougainvillii*) and the Peruvian Booby (*Sula variegata*), on the other hand, make no use of raised supports of any kind, and never "perch" on anything smaller or less substantial than a point of rock. The same difference is probably characteristic of the respective behavior patterns of the tropical and the Peruvian Pelicans, the latter being an endemic Humboldt Current bird.

Salvin (1864, 377) writes:

> It was a bold Pelican that first perched upon a tree: a bird less adapted to such a resting-place could hardly be imagined. Yet there they sit on the mangrove-boughs for hours, preening their feathers with their long hooked bills, an amusement they seem to take special delight in, all the time keeping their balance with ease, even when a strong wind tries the security of their footing.

While they perch, the hind toe is of course opposed to the others, notwithstanding the continuity of the web. The tight grip is a natural concomitant of a pull on the tendons resulting from the weight of the bird. Gosse (1847, 409) long ago pointed out that when the heel joint of a dead pelican is bent, the flexed toes close like a vise.

The perching ability of Brown Pelicans at least increases their choice of nesting sites, and the birds breed, according to circumstance, either on the ground, in trees, or on the flattish tops of low shrubbery in the manner of the man-o'-war birds. Sometimes all three types of nest occur within a single colony. Chapman (1908, 96) believes that arboreal sites are safer, even at islands unfrequented by predacious mammals. For one thing, it brings the nests above the level of floods, and pelicans have never shown sufficient perspicacity to select the higher areas of land in localities where they nest on the ground. Furthermore, continues Dr. Chapman, the tree-born pelican not only has a cooler, better-ventilated, and cleaner home, but it also avoids competition with its fellows before it is strong enough to care for itself. Ground nestlings, on the other hand, tend to wander away from the home site while they are still young,

and thus get themselves into constant difficulties. Fledgling Brown Pelicans are more or less given to the practice of cannibalism, and many chicks hatched on the ground disappear sooner or later into the maws of their elders.

Nelson (1911, 393) presents a brief for the other side of the argument. He states that the youthful arboreal pelicans begin to crawl out on the adjacent branches as soon as they are slightly steady on their pins but that, like overventuresome small boys, they often find themselves unable to return to the cradle to be fed. When the parents alight on the nest, they may then ignore their roving chick or, if they finally answer its pleadings and try to feed it by flying or hopping to the peripheral twigs, the whole family is liable to get into further trouble. The operation becomes a ludicrous process of balancing for such heavy and clumsy birds. Furthermore, both before and after feeding, young pelicans indulge in demonstrative behavior which has a semi-crazed appearance, and among the twig-walkers this is the cause of much mortality. Some tumble to the ground, while others hang themselves in the crotches. In the case of ground-nesters, continues Nelson, the parents can make easy landings and can call up and feed their young without difficulty. The chicks can wander about and get exercise, and less harm is likely to befall them during their strange pre- and post-prandial antics. In windy weather, moreover, they can easily move into sheltered localities.

At Pacheca and Santelmo, Pearl Islands, Rendahl (1920, 12) found the pelicans occupying tree-nests around the outer border of a thinly wooded plateau, during March. The only breeding station I myself have seen in the Pacific is at the small island of El Muerto, in the Gulf of Guayaquil. Here, during late February, 1925, many pelicans were perching in the bushes, close to nests of a previous year. Because of the phenomenal or practically unprecedented rains of this season, however, neither the pelicans nor such other resident sea fowl as boobies or man-o'-war birds were able to hatch their eggs or, indeed, to prevent them from being washed into the sea practically as soon as laid. I suspect that the Brown Pelicans may also nest in the forest on the neighboring and larger island of Puná, as well as on the ground of the small, bare islet of Pelado in the Bay of Santa Elena, and at the larger, scrub-covered island of La Plata. About all three of these localities I found pelicans abundant during the early months of 1925 but, because of the rains, they seemed unable to negotiate a successful breeding season.

The average number of eggs in the Brown Pelican's set is three, although a limit of two is not uncommon. Since the nesting season is almost everywhere prolonged, it is usual to find fresh eggs and well-grown young at the same time. The period of incubation is said to be about thirty days, during which time the sitting birds can be found in three characteristic positions. In the most common, the head is thrown back between the shoulders, with the bill pointing horizontally forward. The second is the so-called posture of sleep, with the head turned and the bill lying along the full length of the back, partly covered by the scapulars. In very hot weather the pelicans sometimes hold the head straight up in the perching position, with the bill turned downward but not quite

touching the breast, the mandibles parted and the pouch palpitating. The monotony of incubation is relieved by frequent exercise and preening operations. Sometimes the sitting birds turn their pouches inside out by spreading the rami of the mandible and pressing the bottom of the pouch against the convexity of the curved neck. This gesture is followed by an upward jerk of the head (Williams, 1931, 67).

Nest relief among mated pairs is accomplished by a ceremony which Chapman (1908, 96) describes as follows:

> As a rule the bird on the nest is not attended by its mate, who may be feeding, bathing, resting on the shore, or sailing high in the air. The returning bird alights near the nest and, with bill pointed to the zenith advances slowly, waving its head from side to side. At the same time the sitting bird sticks its bill vertically into the nest, twitches its half-spread wings, and utters a low, husky, gasping *chuck*, the only note I have ever heard issue from the throat of an adult wild Brown Pelican. After five or six wand-like passes of its upraised head, the advancing bird pauses, when both birds, with apparent unconcern begin to preen their feathers, and a moment later the bird that has been on duty steps off the nest, and the new comer at once takes its place.

Chapman's observations indicate that such ceremonies are omitted when a sitting male is relieved by the female.

The chicks cry out while they are still imprisoned within the eggshells, and their first squirmings and wrigglings in the free air are accompanied by grunts, to be succeeded by the feeding call, which Chapman describes as a piercing scream. While the young are still small and unfeathered the adults spend much time standing between them and the sun with spread wings, giving their offspring the solace of shade. The impulse behind this is a blind one, however, for if a camera or other strange object distracts the adults they will stand in the same attitude on the side of the nest away from the sun, spreading their wings so as to cast a shadow on the bare ground where the unfortunate chicks can derive no benefit. As soon as the young can walk, they flop over the side of the nest and stagger doggedly about, falling over obstacles and getting tangled up in every vine they encounter. Their peregrinations seem to be aimless within a limited space; the only sound they make is a hiss (Cahn, 1922, 417).

Feeding of the chicks may go on at any hour, although there are usually certain times of day, particularly between seven and eight o'clock in the morning, again shortly before noon, and during about two hours before sunset, in which most of the food is transferred. The feeding periods are, of course, correlated with the natural diurnal movements of pelicans. They are early birds at their fishing, usually leaving the roosts at dawn to forage for a few hours, returning to the nest about eight o'clock to rest until eleven or thereabouts, when they go abroad again and fish, or while the time lazily on the sea or shore, until dusk, at which hour they can be seen flying homeward in long strings (Gosse, 1847, 409). If noise is an indication of the importance of a meal, that delivered during the middle of the day takes first rank, because it is accompanied by a terrific clamor on the part of the young, which are, of course, the noisy members of a pelican population.

Even more than most birds, perhaps, pelicans seem to be hidebound creatures

of the instinctive patterns which determine the course of their lives. Yet the adults at least recognize their own young, possibly by voice. At any rate, Chapman found that they do not recognize dead young as pelicans at all, even though the carcasses lie in their own nests. The chicks, on their part, unquestionably distinguish adults laden with fish from those which have none, even though the difference is beyond the power of a human observer to detect. When an old bird returns from the ocean to the colony, it is immediately mobbed by groups of hungry youngsters, each of which endeavors to be the first into the pouch. The old birds, under such circumstances, beat off most members of the crowd of besiegers by knocking them on their heads with the beak, thus seeming to select deliberately the young to which they are willing to relinquish food. The rejected youngsters stagger off as if dazed by the blows. Cahn has known an adult not only to beat off a too-persistent alien chick, but to kill it, and even to eat it.

The food brought home by parent pelicans is carried not in the pouch but in the gullet, and into this the chicks disappear up to their shoulders. After feeding, and making a good deal of noise about it, the youngsters may lapse into a sort of semi-consciousness, laying their heads on the ground, while the adults leave the vicinity in order to bathe or to soar. Chapman adds that the replete chicks, after recovering from their apparent daze, go through a violent pantomime in which they swing their heads from side to side and bite their wings as if in rage.

Although pelicans are gregarious, they can hardly be called sociable, and the interrelations between families that nest side by side seem to be confined to occasionally bad-humored tilting or fencing with the long beaks, a custom which appears to account for the even spacing of the ground-built nests. Their general psychological responses depend upon the course of events within the environment. Usually they are extremely tame while they have eggs or chicks in the nest, but Job (1905, 7) states that if a flood overwhelms the colony, their conditioned behavior entirely changes with the breaking of the sequence, and the old birds at once relapse into the shyness of the non-breeding season. Fright or any undue disturbance causes both adults and young to disgorge.

The flight of the Brown Pelican is both leisurely and extremely powerful, and their formation of lines or wedges in which the wing-beats make a rhythmic sequence has often been described. The position and spacing of birds in line is doubtless determined by requirements of clear vision ahead for all of them, and perhaps by the nature of the air movements set up by their sweeping wings. All sorts of invisible currents in the atmosphere are, indeed, their servants, and the way in which they take advantage of the lift produced by a wave advancing at an angle against a sandy shore has long been admired. The pelicans appear to glide along a breaker in such a manner that the energy born of lively water, rather than any muscular effort of their own, will carry them for very long distances without a single wing stroke. Bangs (1902, 395) noted that pelicans along the east coast of Florida appeared totally unperturbed during a February gale of extraordinary force and far-reaching effect. At the height of this storm their bands proceeded up and down the lines of breakers, with almost the same calm and measured flight as in the finest weather. Nevertheless, the

West Indian hurricanes sometimes strike them down, as has been reported by Wayne (1894, 85).

The tendency of Brown Pelicans to soar under favorable weather conditions at a height which may reach several hundred meters has often been noted, and yet Bryant (1889, 83) remarks that most birds of a certain Lower Californian colony regularly flew the long way round toward their feeding ground, rather than take a short cut of one-tenth the distance which necessitated crossing a range of hillocks about 30 meters in altitude.

In alighting on the water the behavior of a pelican is much like that of an albatross, for it often lowers its feet and slides for several lengths before it sinks to the floating position. The inelegant but highly effective diving of the bird has been much described. To Captain Delano (1817, 379) this process seemed to partake of

> . . . the manner in which a sailor washes his clothes, by making them fast to the end of a rope and throwing them from the forecastle into the sea; when they strike the water they spread out, with the trousers in one direction, the shirt in another, and the jacket in a third.

In the deep and clear cove just to northward of the Puntilla or elongated tip of Point Santa Elena, Ecuador, I used to watch the Brown Pelicans at close range as they dived among the fishing-boats, taking every advantage of the maneuvers of the local Indian fishermen. Frequently the birds would hurtle from a height as great as 20 meters above the water, usually spiraling or twisting on their downward course so that they struck with their backs rather than their breasts toward the surface. In other words, they would be gliding upside down, with the wings still half spread, at the instant before the plunge. Usually they quite disappear, even to the tips of their long wings. West Indian tradition has it that the pelicans sometimes capture fish a full fathom beneath the surface. The twisting descent is doubtless responsible for the fact that the bird turns some sort of somersault under water, and comes up heading in another direction from that of its diagonal dive. Emergence, in fact, finds the pelican facing the wind and ready for flight, while the plunge is usually, if not always, made with the breeze astern. As soon as pelicans reappear at the surface, they turn down the bill to drain the pouch which, according to Gosse (1847, 409), may hold "17 pints" of water, after which they toss up and open the bill so as to release their victim, only to receive it in the throat and swallow it with a gulp. It is at such times that Laughing Gulls and noddies attempt to steal the prey of the pelican, sometimes standing upon the latter's head.

At their feeding grounds, Brown Pelicans seem to ignore the small and light-winged birds, such as gulls and terns, which hunt among them, more or less at their expense. Perhaps this is because they have learned by experience that they are unable to do anything about it. With larger competitors, such as boobies, or the herons that attempt to keep them company in shallow coves of the Pearl Islands, they are far from amicable, and will pursue them with much saber-rattling, if the snapping of their long bills may be so called.

Little is known about their natural enemies, though Nelson (1913, 393)

states that a plague of mosquitoes at Pelican Island, Florida, during June, 1911, abruptly terminated all the breeding activities of the pelicans, tormenting them so persistently that about 600 nests containing small young were abandoned. If this was the true cause of the departure of these birds, it is probable that mosquitoes are an important factor in the distribution of their breeding stations. The pelicans could hardly nest, for example, at any part of the mosquito-infested mainland shores of Ecuador and Colombia, although at such outlying islands as El Muerto and La Plata they would be completely or relatively free from such insect pests. Brown Pelicans are heavily infested with mallophagan parasites, chiefly of the genus *Menopon*, creatures which live not only among the feathers but also inside the pouch, where they cling in clusters that irritate and sometimes inflame the integument. Nothing is known, however, about the relation of the insects to the actual welfare or illness of pelicans.

At times the pelicans suffer from destructive pandemic maladies, to which many other species of colonial sea birds are likewise subject. Dead examples are often found inland near Point Santa Elena, Ecuador, and at times, when the "peste" is rife in northern Peru, their bodies, together with those of cormorants and boobies, have been found as far inland as the slopes of the Amotape Mountains. Widespread mortality among the Brown Pelicans has been noted for several centuries, for du Tertre (1667, 271) states that during September, 1656, great loss of life occurred among these birds near the southern end of the Lesser Antillean chain, so that along all coasts of St. Vincent and the Grenadines the water was strewn with their dead bodies.

Pelicans have not been recorded from Cocos Island, in the tropical Pacific, which emphasizes the remoteness of the Brown Pelican population inhabiting the Galápagos Archipelago. Because of the isolation of these birds, and the fact that their systematic status is still doubtful, I have kept the notes relating to them separate from those in the foregoing account.

The expedition of the California Academy of Sciences collected pelicans at 18 islands and islets of the Galápagos, and found nests in mangroves and other shrubbery at Albemarle, South Seymour, Indefatigable, and Jervis Islands. Gifford (1913, 107) saw adults mating on April 1 and found eggs or young chicks, or both, during March, April, July, November, and December. Since Scouler (1826, 211) found many young in the nests at Chatham Island during January, it is clear that the breeding season at the Galápagos continues throughout the year. Gifford found a few nests on the ground, as well as others at least 7 meters high in mangroves.

The California Academy naturalists found the Galápagos Pelicans somewhat warier than the boobies and many other native species. When approached closely, the pelicans kept their wings trembling as if nervous. They would, however, decoy readily to wounded birds, and they also proved themselves scavengers ever ready to pick up the bodies of birds as large as hawks tossed overboard from the skinning table on the deck of the schooner 'Academy.' Noddies often accompanied the Galápagos Pelicans on their fishing excursions, and Gifford once saw two of the latter sitting upon a swimming pelican's head.

Rothschild and Hartert (1899, 177) report upon a nest with three eggs, found among the mangroves of Indefatigable on September 3. The eggs measured 78.5 x 51, 78.5 x 50.5, and 72 x 52.5 millimeters.

PERUVIAN PELICAN

Pelecanus occidentalis thagus

Pelecanus Thagus Molina, 1782, Sagg. Stor. Nat. Chili, p. 240 (Chile).

Names: Molina's Pelican, Chilean Pelican. "Alcatráz" on the west coast of South America; "Pelícano"; Chilean fishermen call bands of these birds "Soldatos Peruanos" or Peruvian soldiers; Molina, who wrote in Italian, termed the species "il Thage," which accounts for its specific name. Synonyms of the latter include *molinae*, *nigricollis*, *landbecki*, and *barbieri*, besides which this pelican has been reported upon under the name *fuscus*.

Characters: Similar to the tropical Brown Pelican, but much larger, a distinction no less apparent in the size of the eggs than in that of the birds. Furthermore, the pale straw-colored occipital crest is more prominently developed, and the entire brownish black ventral surface is finely streaked with white, each feather having a narrow shaft-stripe. The bill and pouch, moreover, are more brightly colored, and there is a considerable growth of caruncles between the base of the culmen and the eye.

The text and colored plate of Forbes (1914, 403) reveal the extraordinary variation in the color of head, neck, iris, bill, pouch, and naked skin of the face during the changes incident to age and season. The iris, which is brown in young birds, progresses toward yellow in mature females and gray in males. The naked skin about the eye may be black, blue, or carmine, while the orange of the mandibles and the lavender stripes of the pouch show a wide range in intensity. The legs and feet of adults are lavender-gray, sometimes with a greenish overlay on the tarsus.

Despite the detailed descriptions by Forbes, Coker, and others, the complete plumage sequence of this pelican is not yet fully understood. Coker (1919, 487) writes:

"The following is an account of the color changes as far as I could make them out, by inference from observation of the group, without the opportunity to trace the history of the individual birds. With this qualifying statement, I give them for what they may be worth in suggestion to other observers.

A. The immature bird after leaving the nest is brown with white breast, some buff on the upper side of wings. Head and neck brown without lateral stripe. Bill green at base and top, sides orange. Pouch orange-yellow.

B. Nuptial plumage: The feathers of head and neck stripe are yellow; the 'cravat' or necklace of yellow, is formed, while the rest of the neck is a very dark brown, almost black. The covering of striate feathers on the back and lower side develops, while the mantle of pearly gray completes the nuptial plumage. The pouch becomes black with blue stripes on the sides anteriorly and the characteristic red appears on the generally greenish bill. This phase was observed in birds occupying new-made nests and often in outlying rookeries. No adults of this phase were found on nests where the eggs had hatched out.

C. After the beginning of the laying, the yellow feathers are shed and replaced by white, which, however, do not extend so far into the crest nor are so long as the yellow. A 'cravat' of greater or less size may be retained or may be lost entirely. Many of the birds in the nests had heads partly yellow and partly white. The longer yellow feathers being in patches of greater or less size amid the shorter crop of whites, the changes do not always occur in just the same order. Thus whitehead birds may still show some white feathers in the lower side of body.

D. Another phase may be described, but whether it represents a possible stage between (B) and (C), or an older stage than (C), or is a phase peculiar to one sex, I am unable to say. Birds in this phase were observed to be brooding. The head and neck stripes are light gray, the neck is soft gray, the upperparts are generally brown, but a small region of back and breast around the base of the neck has the typical white and dark brown striate feathers; the breast is generally white mottled with brown feathers having a white median stripe; the bill is red and yellow, the

pouch as in (C) but paler. This phase includes some features of the immature (A), and some of the typical brooder (C), but the gray neck is characteristic."

Measurements of a somewhat inadequate series of adults have been listed on page 809.

The eggs are usually three in a complement, departures from that number being discussed in the text below. They are exceedingly chalky, white over a slightly greenish base, but quickly become soiled with guano. The form is highly variable, some having two ends of almost equal size, and they are much larger than those of the tropical Brown Pelican. Coker found one which measured 97 x 62 mm., and weighed 198.5 grams, but this was exceptional. Average dimensions are 79.9 x 55.6 (Coker) and 83.7 x 55.7 (Forbes). The extremes among 10 from Lobos de Tierra are 86 x 58, 76 x 55, 80 x 53, and 78 x 58 mm. Their weight averaged 149 grams.

Distribution: Coasts of Peru and Chile from northern end of the Humboldt Current southward to Corral, and casually farther; breeding, now or formerly from Lobos de Tierra Island southward to islands off the middle Chilean coast, Mocha marking, perhaps, the southern extreme.

The Peruvian Pelican, or "Alcatráz," is by far the biggest and most conspicuous bird to be encountered in flock formation along the desert coast of western South America. It instantly reveals its identity as far as the eye can reach. It is, indeed, one of the world's largest pelicans, exceeding in size even the White Pelican of North America. A male and female which I shot at Lobos de Tierra on January 10, 1920, weighed respectively 7030 and 5055 grams. The indicated relationship between the sexes is apparently the normal one, for pelicans differ in this respect from their relatives, the boobies and man-o'-war birds, among which females surpass males in size. Young Peruvian Pelicans, according to Coker (1919, 486), are even bulkier than their elders. He records a fledgling which tipped the scales at 16 pounds or 7257 grams.

In habits and appearance the Peruvian Pelican generally resembles the smaller Brown Pelican of the tropical coasts to northward, although its color pattern is subject to perhaps even more extensive variation due to age and other causes. The white or yellow head, with a tuft or topknot, the yellow necklace, dark brown nape, and the blue, green, yellow and orange or reddish hues of the great bill and pouch, are striking marks. Forbes (1914, 405) believed that either three or four years' growth was required for the attainment of fully mature plumage and skin colors.

Forbes and Coker, whose works have just been cited, are the two authors who have set down the most detailed information concerning the Alcatráz in its native waters, and in the present biography I have added many of their field observations to my own.

Along the arid shores of Peru and northern Chile, the Alcatráz is strictly a littoral bird of the Humboldt Current zone. Its range ends, as previously noted, near the westernmost projection of the continent, where cool waters give way to warm. Furthermore, it does not stray out of sight of the coast, and hence has never been recorded from any of the more distant outlying islands, such as San Felix or Juan Fernández, nor even, so far as I can learn, from islets as near the continent as Hormigas de Afuera. In north-south extent the range is practically identical with that of the Guanay (*Phalacrocorax bougainvillii*) and the Piquero (*Sula variegata*), both of which are likewise endemic Humboldt Current forms. In certain years non-breeding pelicans, including particularly great numbers of

immature birds, wander long distances beyond the limits of the breeding range. At the northern end they do not penetrate far into tropical waters, so far as we know, for indubitable records of the race are still lacking from any part of Ecuador, or even from the Peruvian coast between Point Pariñas and the Gulf of Guayaquil. To southward, however, they travel regularly down the Chilean coast, sometimes appearing in vast flocks in the harbors of Antofagasta, Coquimbo, Valparaiso, Talcaguano, and Corral. During the Brewster-Sanford Expedition, Beck even encountered eight pelicans fishing together off Ancúd, Chiloé Island, on May 1, 1914. This seems to be the most southerly record except for a thoroughly lost individual recorded by Dabbene (1902, 396), which was captured at Picton Island, at the eastern end of Beagle Channel, Tierra del Fuego, during the month of February.

In the main, the published records for the southerly Chilean coasts seem to pertain to the winter season or else to be based upon immature birds. Nicoll (1904, 52) states that most of the numerous pelicans he saw in Valparaiso Bay during mid-February were young birds. Such bands seem to be fond of coming ashore to rest and to stand about among the gulls and Limicolae on the sandy beaches of remote and quiet coves. They are also quick to take advantage of artificial sources of food which may supplement their natural diet of fish. Beck found that, like the Cape Pigeons and Giant Fulmars, the pelicans would hang about Chilean whaling stations with the hope of picking up scraps of blubber or other refuse. Hill (1860, 75) states that about the middle of the last century pelicans not uncommonly wandered even into the streets of Arica where, because of their recognized importance as guano birds, a fine was imposed upon any person who harmed them. This did not prevent the direct or indirect destruction of great numbers of pelicans at the guano islands during the same period, but it at least indicated an appreciation of the economic importance of the bird, and represented a forward step from the time when the people of Chile made lanterns and pouches from the gular sacs of pelicans, as reported by Molina, the original describer of the form. Another unjustified economic use to which the pelicans have been put, even within recent times, is related by Coker, who states that many a Peruvian fisherman or guano laborer has gone out to the Lobos Islands with a straw mattress and returned with a feather bed! Still another toll from which the pelicans formerly suffered during a long term of years was due to the use of the albumen of their eggs in clarifying wine. All such destructive practices have, of course, been stopped in Peru since the establishment of the National Guano Administration which now has control of all the islands.

Like most of the other Peruvian guano birds, the pelican carries on the reproduction processes throughout the year, though least prolifically in the winter season, May to September. During March and April, 1907, Coker found thousands of eggs, and young birds in all stages of growth, in the colonies at Lobos de Afuera. In the following December there were again vast numbers of eggs and naked nestlings, while on June 18 of the same year chicks changing from woolly down to contour plumage covered a small islet off the Chinchas.

The Peruvian Pelicans breed, or have bred, at practically all the groups of

islands along the shores of Peru and northern Chile. It is possible, or likely, that they have also occupied many more or less inaccessible headlands of the continental coast, as inferred by Forbes. Little is known about this, beyond the fact that ancient deposits of guano have been found on the mainland as well as on islands. It is worth keeping in mind, however, that on these shores, which are at the brink of the geosyncline, frequent seismic disturbances, or gradual upthrusts, may have changed many recent insular fragments into present peninsular appendages. Alacrán Islet, off Arica, has been the site of the southernmost large insular colony of which I find a record, but Mr. Bullock's manuscript notes report that a few of the birds formerly nested at Isla Muerta, off the island of Mocha (38° 20′ S.). During December the inhabitants gathered their eggs, which were known as "huevos de yegua" or mare's eggs.

From time immemorial the center of pelican population seems to have shifted from year to year or, at any rate, from decade to decade, up and down the Peruvian coast. During recent years the principal headquarters have been at the two Lobos Islands in the north, particularly at Lobos de Afuera, but apparently it has not always been so. Much of the variation has rightly been ascribed to the effects of persecution of the pelicans during guano operations. It is evident, however, that natural causes, especially such as are related to cyclic climatic changes, have also had an important part in the shifting of the populous "pelicaneries."

When I resided at the Chincha Islands late in 1919, for example, most of the birds inhabiting the flat pampa of all three islands were Peruvian Cormorants or Guanays. I was reliably informed, however, that throughout all or most of the years between 1894 and 1911 the pelicans had occupied the greater part of the north island, the Guanays being confined to the outlying farallones. Then, in November, 1911, the "peste" killed off the resident birds in vast numbers. Forbes reports that the surviving adult pelicans abandoned their eggs and chicks, all of which perished. A similar loss of life occurred, in greater or less degree, at other breeding stations along the whole coast line of the Republic. No colonial sea fowl returned to nest at the Chinchas until nearly a year after the catastrophe, and then it proved to be not the pelicans but the cormorants which established the dominant foothold. To this day the latter birds have never lost it at the Chinchas.

A most interesting, and hitherto overlooked, point concerning Forbes's account of the holocaust of the birds in 1911 is that the date was exactly two "seven-year cycles" earlier than the similar but even more marked destruction of Humboldt Current bird life which began in January, 1925. Furthermore, as shown by the summary of Sheppard's observations in Part I, the same phenomena were repeated again in 1932, seven years after the disturbances I had the good fortune to witness in 1925.

There are reasons for believing that in past times the pelican was an extremely important guano-producer, perhaps even the bird of first rank at many islands along the whole length of the Peruvian coast. Certainly the Incas and their

predecessors held it in high regard, as indicated not only by the traditional laws for its protection but also by the preponderant use of the pelican design in pottery, textiles, and other artifacts. Moreover, the mere size of the pelican would give it a competitive advantage over other guano birds under conditions in which the balance of nature had not been upset by man. In November, 1919, for instance, I saw a few hundred pelicans and a much larger number of boobies occupy simultaneously a certain area of flat ground on the south island of the Chinchas. The boobies selected sites and produced eggs first, but within a month most of their nests had been trampled out of existence by their huge, clumsy neighbors. In the end, the pelicans obtained exclusive possession of all the open ground, leaving to the boobies only a fringe of nests containing downy young within a meter or two of the brink of the cliff. The actual jumping-off place was avoided by the pelicans, but was no less acceptable than the ledges beyond to the boobies. Such competition is doubtless one of the agencies which make the Peruvian Boobies almost exclusively birds of the precipices, for I observed that they were quite ready to spread out on to the flat pampa of the islands wherever conditions were favorable.

On the other hand, in competition with the presence of human beings, the timid pelican is invariably the loser, and thick beds of bones in hollows and gulches tell of hordes of young pelicans which have come to an untimely end. Thousands of these, it is said, were driven to slaughter by wanton guano contractors in the old time, purely for the sake of getting them out of the way of the diggers. Even where no harm is intended, the pelicans are not easily reconciled to human disturbance, and Coker found that removal of the guano from a pelican colony was usually the signal for a complete change of location by the birds for the following season. The pelicans invariably give the impression of being the shyest and stupidest of the guano birds, and by all odds the least practical from an industrial point of view. It is difficult to come anywhere near them without having them dash away, bumping into each other on the ground or in the air, and leaving their offspring to the voracious gulls. This is so likely to occur that they should never be approached without the utmost caution. Before taking flight, they usually open their great bills wide and empty themselves of a bellyful of fish. Sometimes even those soaring overhead express their excitement in the same way, sending down a fearful rain of anchovies or anchovy paste!

Between the visits of Coker in 1906 and myself in 1919, the pelican had fallen in rank from the second in importance of the guano-producing birds to a poor third. Considerable bands continued to nest on islands along the central part of the Peruvian coast, such as Santa Rosa, San Gallán, the Ballestas, and the Chinchas, but more and more the headquarters of the species tended to become concentrated at the Lobos Islands near the northern end, where throughout many years no guano extraction was undertaken.

During my own field work there were eight well-distributed pelican colonies at Lobos de Tierra, none of which comprised more than 200 pairs and nests. Lobos de Afuera, however, supported an impressive aggregation, which may

have numbered 50,000 nests or fully 200,000 birds, upon the northern half of the western island. The sight of 10,000 incubating birds in one small valley, or of massed fledglings upon the hills beyond, or of the armies of adults that poured in from sea in stately and deliberate files, is one never to be forgotten. We know from the careful records of Coker how such a colony reacts to guano operations, and it is safe to say that the pelicans of Lobos de Afuera can be saved from serious diminution only if extraction is conducted in such a manner as to leave one of the two main islands always undisturbed. Under such circumstances, it might be supposed that the pelican population and the guano supply would fluctuate only with relation to the one bad year in each seven.

In January, 1920, the pelicans of Lobos de Tierra were nesting in the hollows in large, irregular packs, which were usually considerably longer than wide. Other nests covered the old pier or stretched along the railways built for guano cars. Parts of the track were completely buried under new guano. In the depressions of the island most of the nests contained eggs, or purple, naked young, but on the embankments and hilltops stood droves of awkward, woolly, white youngsters, which looked like sheep rather than birds, and which made the vicinity sound like recess time in the playground of a school. Hundreds of adults alighted among these chicks while I was using a motion-picture camera, and not a few of them revealed their strangely unintelligent temperaments by viciously biting half the young birds within reach.

The Peruvian Pelicans, whether nesting or not, spend a good deal of time on the islands, and are commonly seen standing in solemn groups on some rock or point commanding the ocean. Unlike the cormorants, however, they do not all come ashore to roost. I have sometimes encountered them asleep on the water in the middle of the night when, from the low level of a launch, their great floating bodies loomed up startlingly, like hulks of derelicts.

They like, too, to bathe and splash in quiet coves, especially in the morning. Afloat they seem less timid than while at the nest, and they soon learn to ignore the close proximity of small craft and swimmers. In the smooth water just outside the line of breakers they may often be seen riding sedately, and reaching for bottom life with their long mandibles instead of diving from flight. At times they will also join with other sea birds in hot pursuit of a rapidly moving shoal of anchovies, under which circumstances the pelicans usually swim and scoop instead of plunging. They preen their feathers scrupulously while floating, as well as ashore, and they also yawn, point up and rattle their mandibles, and make the flabby integument of the pouch shake like a loose sail.

But to travellers along the coast, the Peruvian Pelican is most familiar in flight. Long files moving with slow, forward-striking beats give, as Coker remarks, a false appearance of leisureliness, for they are rarely passed by the "swift-winged" birds of smaller size. When atmospheric conditions are favorable, they often soar in circles above their islands, every now and then beating the wings four or five times in order to maintain momentum. They are quite capable of seemingly difficult contortions in the air, such as the feat of scratching the head with a claw without losing a stroke or changing place in the flight

formation. The pecten on the middle nail of most of the birds I examined was clogged with down and fragments of feathers, showing its use in allaying the itching caused by the pelican's notorious horde of bird-lice.

Only on the ground, at the moment of leaving it or descending to it, and during performance of the dive, does the pelican lose its grace and dignity. In quartering the water for prey, its habits and antics are very similar to those of the tropical Brown Pelican. The sighting of fish causes it to apply the brakes, tilt up in front, spread the tail, and tread the air with its feet. The beginning of the plunge may be accelerated by one or two strong wing strokes, after which the bird hurtles headlong, with the wings at least half extended, and strikes the water with a vast, resounding splash. As a rule, the Peruvian Pelicans do not disappear completely beneath the surface, as the tropical pelican so frequently does. Coker, indeed, believed that they never pass altogether out of sight, but this is erroneous, for on November 7, 1919, I saw all the members of a small flock in the bay of Callao fully submerge themselves, not only once but repeatedly. The variation doubtless depends upon the depth-plane of available fish. Forbes writes:

> When it has secured its prey, the Pelican rights itself on the water, but has generally to delay several minutes in properly disposing of the contents of its gular pouch before taking wing again. Its manoeuvres, after a rather successful haul out of a dense shoal of anchovetas, when sometimes it captures enough to weight down its pouch for a foot to a foot and a half, are ungainly. It tosses aloft its huge beak fully agape, shaking its head from side to side to tumble its contents throatwards. To get them properly arranged seems always an awkward and difficult task, and it has often to discharge the whole bagful out on the sea again and re-pick them up.

The height of the pairing period for the Peruvian Pelicans seems to come in October. At this season the birds assemble on their chosen nesting grounds, and claim their sites. Much tilting with the long bills takes place at this time and continues, indeed, throughout the nesting term, four or five adjacent birds sometimes indulging in what looks like mass fencing. The length of the necks and bills thus determines the spacing of the nests, which are, nevertheless, extraordinarily close together. Coker states that they average about two to each square meter of surface, whereas those of the Peruvian Cormorant average three. They are less evenly distributed than those of the cormorants, however, for even in large colonies, such as that of Lobos de Afuera, the pelicans tend to form many separate masses or nuclei of nests, rather than to cover a large surface uniformly.

The beginning of each nest is a hollow scrape in the sand or guano. It seems absurdly small, in comparison with the bulk of its maker, being only about 25 centimeters in diameter. The concavities are more or less lined with feathers, among which the moulted tail quills of the Guanays predominate. Coker states that the pelicans also carry dry guano and sand to the nests in their gular pouches, and build up the outer rims into slight mounds, which grow further through the copious defecation of the sitting birds. At stealing feathers and pebbles from the foundations of neighboring nests, the pelicans are as adept as any of the other guano birds. The colonial habitus is not accompanied by any reactions which might be termed either altruistic or coöperative.

Eggs appear about three weeks after occupation of territory. Three in a set seems to be the commonest number, although I have seen many heavily incubated clutches of two. Among 207 nests examined by Coker, 35 contained one egg, 73 two, 84 three, 10 four, 4 five, and 1 six. Since these counts were made in a group in which incubation was well under way, the number in a nest was probably definitive, except as affected by accident. Coker also discovered two nests containing eight eggs each. He opened the eggs of one of these sets and found that they all contained live embryos at practically the same stage of development. Coker also carried out experiments to show that two or more days intervene between the laying of successive eggs.

The young, which are flesh-colored when hatched, undergo a rapid pigmentation of the skin, which turns dark blue or purple. Forbes states that they remain callow for about two weeks before the white down begins to cover them. They grow to nearly adult size before the first feathering appears on the wings and back.

Coker thus describes some of the extraordinary actions of these birds on their breeding territory:

> The behavior of the pelicans on the nesting grounds in some respects appears stupid and inexplicable. An alcatraz on her nest will sometimes reach over with her long neck and bill, take a fledgling from the uncovered nest of a neighbor and throw it away, perhaps into another nest. Once, within a space of 2 square meters, I saw six little "pichones," almost new born, bandied about in a most merciless way, tossed from one alcatraz to another, each seemingly unwilling to have the little birds in her proximity. Finally three of the fledglings were thrown beyond the margin of the nesting ground and left to die in the sun. I watched a pelican that returned to a nest from which the only fledgling had been transferred by a mischievous neighbor into an adjoining nest. The returning brooder did not appear to notice the loss, but sat composedly on the remaining egg; then, pilfering on her own account, she quietly reached over and stole all of the feathers from the nest in which lay her own offspring (supposedly) among others, to add to the lining of her nest. I questioned if the birds invariably occupied the same nest; on one occasion, at least, a bird was seen to brood on two different nests. The birds near the margin had been frightened away, but most of them returning, all of the nests were soon reoccupied except the ones nearest to me. An alcatraz, after sitting for 15 minutes on one nest, moved slowly over to another nearer to me, while its place on the first nest was at once taken by a bird that was previously covering an empty nest. The young were trampled dangerously by the old birds as they moved awkwardly about. Perhaps these are abnormal actions, attributable to nervousness caused by the presence of an intruder.

The young Peruvian Pelicans develop in due course the wandering propensities already described in the account of the tropical Brown Pelican. While they still look more like woolly lambs than birds, they form flocks on the slopes and ridges above their nests, and keep up a piping which suggests a frog-pond. How, or whether, the returning adults recognize their own offspring is uncertain. In feeding, the chicks practically dive into the gaping mouth of the adult which, as Forbes writes, sometimes has to prostrate itself on its belly to allow free access to the capacious store-chamber. At the slightest alarm, the young eject their repast, a fact of which not only the Indian fishermen in search of bait, but also the Kelp Gulls, take advantage. The latter are ever ready to bully a young pelican into laying a banquet at their feet.

The "anchobeta" (*Engraulis ringens*) makes up a large portion of the Peruvian

Pelican's food, although it also captures much larger fishes as well. Coker saw one regurgitate a mullet more than 30 centimeters in length. An example I shot at Lobos de Tierra contained in its stomach two needlefish (*Tylosurus stolzmanni*), the size of which I unfortunately did not record. Forbes once observed a pelican snatch an eel from the beak of a Bigüá Cormorant. As a rule, however, it is rather a case of other birds robbing the pelican, and Nicoll (1904, 52) saw a Kelp Gull actually alight upon a pelican's head with the object of picking fish from its bill.

Gulls of two species (*Larus dominicanus* and *L. belcheri*) and Turkey Vultures are the pelican's most formidable enemies ashore, for all three of these predacious birds devour its eggs and newly hatched young. So bold and avid are the gulls, and so relatively timid the nesting pelicans, that it is a serious matter for a naturalist to attempt to examine their nests too closely. Feral cats, according to Coker, have also wrought much havoc among pelicans of the Lobos Islands. The place of Mallophaga as enemies is problematical. The plumage of the pelicans, and the ground of the rookeries, swarm with them, and they form clusters inside the pouches of both adults and young. No doubt they are annoying, and many observers have believed that the beating and splashing of the bathing pelicans is in part a delousing effort. However, the Mallophaga are "normal" parasites, and there is thus far no evidence that they carry organisms of disease, or produce any worse effect than local irritation of the skin.

Coker states that the pelicans clearly take cognizance of sharks, and it is known both from his observations and from a photograph published by Chapman (1924, 328) that the birds are occasionally slain by sea-lions. The eviscerated condition of dead pelicans found afloat or on the beaches suggests that the fish-filled belly of the pelican, rather than the flesh of the bird itself, is the lure which occasionally tempts the sea-lions to attack them.

THE BOOBIES

FAMILY SULIDAE

Two comprehensive genera of this family are recognizable, of which the true gannets (*Morus*) are of temperate range in the North Atlantic or belong to somewhat similar, relatively cool-current regions in southern Africa, southern Australia, and New Zealand. The boobies (*Sula*), the common name of which comes from the Spanish "bobo," a dunce, are pan-tropical in all oceans.

The field of this book has representatives of each of the three cosmopolitan species of boobies (*dactylatra*, *sula*, and *leucogaster*), as well as two very distinctive species (*nebouxii* and *variegata*), which are confined, respectively, to warm and cool areas of surface water off the western coasts of Middle and South America. Furthermore, a well-defined race of the Brown Booby (*leucogaster*) has an extraordinarily restricted range in the rainy northwestern bight of the

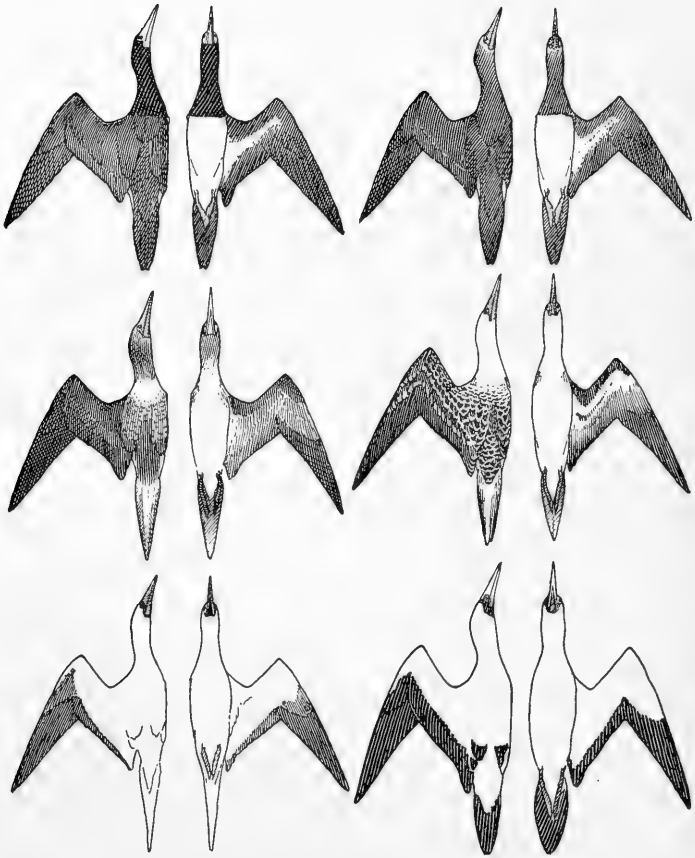


FIG. 68. SOUTH AMERICAN BOOBIES.

Dorsal and ventral aspects of six forms. *Reading from left to right: upper row*, Brown (*Sula leucogaster leucogaster*) and Colombian (*S. leucogaster etesiaca*, male); *second row*, Blue-footed (*S. nebouxii*) and Peruvian (*S. variegata*); *lower row*, Red-footed (*S. sula*, in the white phase) and Masked (*S. dactylatra*).

continent, a district bounded by the Pacific coasts of Panama, Colombia, and Ecuador, and the islands of Cocos and Malpelo (?).

In general, the distribution of certain boobies is clearly to be correlated with that of particular food organisms, such as flying fish. Others, of which the above-mentioned Colombian Booby (*Sula leucogaster etesiaca*) is the best example, are imprisoned, so to speak, within definite climatic and hydrographic regions, and the nature of the bonds is not yet understood. The distribution of one species (*Sula sula*), the only tree-nester in the family, is determined in large part by the vegetation existing on islands throughout its world-wide range.

In degree or extent of speciation the boobies have surpassed the man-o'-war birds and the American Brown Pelicans. Their variety of proportion and plumage-pattern resembles, rather, that of the marine cormorants. They present, nevertheless, a few complex taxonomic and biological problems, the most outstanding of which concerns the status of the several color phases of the Red-footed Booby (*S. sula*), which have been described under numerous subspecific and even specific names. An answer to the many questions involved will, indeed, require more information and a fuller representation of specimens than have thus far been focused upon them. A study of the three or more American races of the Brown Booby, in connection with the differing geographic characteristics of their respective ranges, also promises conclusions of wide significance.

Our most detailed knowledge regarding the life history of the Sulidae has been derived not from the typical boobies, but from observation of the related Northern Gannet (*Morus bassana*). Gurney (1913) reports that in this species the single, notably small-yolked egg is incubated for 42 days, and that the whole cycle of the breeding season lasts 4 months or longer. The fledglings are abandoned by the parents when they are 12 to 13 weeks old, at which time they are considerably heavier than adults. Thereafter, like young petrels, the chicks starve and lose weight for 10 or more days, before finding their own way to the sea, where for a time they lead an exclusively swimming life. Fully adult plumage is not attained until the third year. Gannets, according to Gurney, can neither hear well nor smell well. Despite the fact that they are usually classed as "surface-feeders," they have been captured in nets set as deep as 27 meters, indicating powers of submerged progression comparable with those of cormorants.

BLUE-FOOTED BOOBY

Sula nebouxii

Sula nebouxii Milne-Edwards, 1882, Ann. Sci. Nat. (Zoöl.), (6) 13, Art. 4, p. 37, pl. 14 (Pacific coast of America).

Names: "Camanay"; in Ecuador and northernmost Peru, "Piquero," a name reserved elsewhere for *Sula variegata*. A synonym of the specific name is *gossi*.

Characters: A brown and white booby of somewhat streaked appearance, with a large whitish patch at the junction of neck and back and with bright blue legs and feet.

Adults (sexes alike except as to size, and the appearance of the eye): Head, upper part of neck, and sides of lower neck cinnamon-brown, more or less mottled because each of the narrow, pointed brown feathers has its middle and tip white in fresh plumage; anterior part of forehead, throat

behind the gular sac, base of hind neck, rump, and upper tail coverts mostly white; ventral surface, axillaries, and innermost under wing coverts white; dorsal surface, except as noted, and wings, brown, each feather of the back and scapulars shading into whitish toward the extremity; primary quills blackish brown; secondaries cinnamon-brown; central rectrices mainly whitish, but shading into brown on the distal portions of the outer webs; outer pairs mostly brown, more or less white along the proximal half of the shafts. Iris yellow, that of the female with blotches of black pigment which appear to blend with the pupil; skin of face and gular sac slaty; bill dull greenish blue; legs and feet ultramarine blue, sometimes slightly greenish on the webs.

Coker (1919, 473) states that males of this species have consistently darker heads than females, a distinction not previously reported. Individual variation, as well as the effects of wear, appear to show in the intensity of coloration. Certain examples from the Galápagos and the Gulf of Guayaquil are remarkably white-headed and white-throated. It is possible that Galápagos birds average somewhat larger than any from the continental littoral, but more specimens would be needed to establish this. Very old tail quills sometimes fade almost white.

7 males from the coasts of Panama, Ecuador, and Peru: wing, 387–413 (403); tail, 165–218 (190.3); exposed culmen, 94–106 (99.7); tarsus, 47–54 (50.4); middle toe and claw, 77–88 (81.8) mm.

7 females: wing, 403–426 (416); tail, 165–215 (190); exposed culmen, 106–109.5 (107.5); tarsus, 51–57 (55); middle toe and claw, 83–91 (88.3) mm.

3 males from the Galápagos: wing, 406–433 (422); tail, 171–226 (204.7); exposed culmen, 103.5–107 (105.2); tarsus, 50–53 (51); middle toe and claw, 80.5–84 (82.8) mm.

3 females: wing, 444–448 (446); tail, 212–243 (224); exposed culmen, 114–115 (114.8); tarsus, 51–54.6 (53.2); middle toe and claw, 90–95 (92) mm.

Two males which I collected at Lobos de Tierra Island in January weighed 1340 and 1350 grams; two females from the same island 1660 and 1750 grams.

In immature examples the head and neck are darker brown, the back and wings grayer than in adults. The iris is brown; feet grayish blue. Downy chicks are pure white.

Eggs number from 1 to 3. (At Lobos de Tierra Coker counted, among 39 nests, 12 containing 3 young birds, 19 with 2, and 8 with 1.) The eggs are pale blue, as the result of the thin chalky coating that covers the distinctly blue shell. The form is variable, but inclines toward elongate-ovate. Examples measure 64 x 40, 67 x 39, 65 x 38 (one set); 63 x 41, 60 x 44; 65 x 40 mm. (Coker).

Distribution: Breeds from the Galápagos Archipelago, and the Lobos Islands off northern Peru, northward along the west coast of America to islands in the Gulf of California. Apparently confined as a nesting bird mainly to arid or semi-arid districts, though reported also from such an extremely humid station as Gorgona Island. Wanders casually, and in only small numbers, to southward of the breeding range.

The "Camanay" is the Blue-footed Booby of American ornithological books, and is the only one of the Peruvian guano birds which belongs also to the fauna of North America. Unlike the Guanay, Alcatráz, and Piquero—that is, the cormorant, pelican, and booby of the Humboldt Current, which comprise the great guano-producing triumvirate—it is not a characteristic species of the cool-water belt off western South America. Its range, on the contrary, is confined rather definitely to the Tropical Zone, between the southern waters of the California Current and the northern extremity of the Humboldt Current. Although it is credited in ornithological literature with inhabiting the Pacific "between Lower California and Chile," it is, as a matter of fact, a relatively rare bird south of northern Peru, and it apparently finds its southernmost breeding limit at Lobos de Afuera (6° 58′ S.). A considerable colony occupies a headland on Santa Clara or Amortajada Island, in the Gulf of Guayaquil; other breeding grounds are known at the Galápagos, and thence

northward to the Revilla Gigedos and to arid islands within the Gulf of California.

Despite the long breeding range thus recorded for the Blue-footed Booby, the fact should be emphasized that it is a bird of by no means continuous distribution, for the reason that it seems to avoid, in the main, habitats in the most humid regions, confining its nesting chiefly to bare islands or at least to those with trees and lesser plants of a scrubby and xerophilous type. Thus it finds no available home at Cocos Island, nor in most parts of the wet coastal district of northern Ecuador and Pacific Colombia. Strangely, however, it is reported as a resident of Gorgonilla, the southerly projection of rainy Gorgona Island, and the meaning of this departure from the usual type of environment is still obscure. At the Pearl Islands are stations, such as Pacheca and Galera, capable of supporting a considerable population. The Galápagos Archipelago also furnishes plenty of suitable nesting grounds, and nearer the continental coast these begin as soon as one passes to southward of the zone of more or less perpetual rainfall. At La Plata Island, Ecuador, for example, the perennial vegetation consists largely of cactus and drought-resisting thorn-scrub, while the lush green ground cover is ephemeral, depending chiefly upon heavy rains which come at seven-year intervals. Here the Blue-footed Boobies find, perhaps, their most northerly breeding ground on this coast. When I visited the island in February, 1925, the lighthouse keeper led me to a pampa above the northern shore where there were many of the unmistakable white-ringed ground nests of this species, left over from an earlier season. No birds were in residence at the time, although the White Boobies (*Sula dactylatra*) had fresh eggs in another part of the island. Possibly the phenomenal rains of that year were interfering with the breeding of the Blue-footed species, as they undoubtedly were farther southward at El Muerto in the Gulf of Guayaquil, and at the Lobos Islands in Peru.

During the same month I found many of these birds on the bare islet of Pelado, in Santa Elena Bay, but here any new eggs would certainly have been washed into the sea by the deluges which had cut deep gullies in the guano-covered surface. At El Muerto, a few days later, we found Blue-footed Boobies in abundance, but here the rains were not only preventing them from nesting but were also causing the death of great numbers through landslides. Large sections of the silt-like cutbanks were collapsing every night. Since the Blue-footed Boobies roosted chiefly along the edges, they were carried down by hundreds, and in the heaped-up soil at the base of the cliffs along the northwestern coast of the island, I found many score of the boobies crushed or smothered to death, and a few still alive though hopelessly entrapped.

My observations at El Muerto convince me that this species is much out of place in any region of rainfall and shrubbery. That a booby may become a tree-living creature is demonstrated by the Red-footed species (*Sula sula*), which not only perches well but is also a quick and lively twig-hopper. It has even forsaken the ground entirely in its nesting. The unfortunate Blue-footed Booby, however, is obviously in an awkward stage of its evolution whenever

it encounters vegetation. It aspires, so to speak, to become a perching bird, but its success is negligible when compared with that of the Red-footed Booby or even of its more distant cousin, the Brown Pelican. It seems quite incapable of ever reaching a balance on a small limb, and I saw several come to grief while attempting to alight in the sparse bushes of El Muerto. One became entangled among the branches before our eyes, and hung there for more than an hour. It would surely have died, as several of its fellows had already done, if we had not sent the lighthouse keeper's son to release it. At El Muerto in 1925 the Blue-footed Booby seemed, indeed, to be a personification of ill-adapted misery, suffering alike from the rains, the landslides, and the vegetation, besides which the man-o'-war birds certainly victimized it more than they did any other species. Furthermore, at least one individual was seen to be drawn under the surface of deep water close to the island, while it struggled desperately in the grip of a shark or some other large fish.

For a picture of the Blue-footed Booby under more happy circumstances, it is necessary to go to Peru, where the two Lobos Islands furnish one of the principal headquarters of the species. Here during seasons of normal rainfall (which means no rainfall), they nest by thousands throughout the year, with practically all inimical factors concentrated in a single foe, the Kelp Gull, which feeds largely upon their eggs and newly hatched chicks.

Such a buffoonish sort of bird, possessed of feet of a completely incredible color, could hardly have escaped notice by the literary seafarers of an earlier day. Therefore, while this species was not technically described until 1882, it is not surprising to find that Captain Amasa Delano (1817, 380) has written as follows about the birds as he observed them at the Galápagos Islands during the year 1801.

> They resemble the small kind of booby, and something similar to the kind which is described at the Lobas Islands, called Bonaparte's army, excepting they are of rather a darker colour on the breast and neck, and their beaks and feet are of a Prussian blue.

There are also numerous other early references, such as that of Scouler (1826, 211), who found the Blue-footed Boobies common at Chatham Island, Galápagos, during January.

During the Brewster-Sanford Expedition, Beck collected but a single specimen of this booby, an immature bird shot off Ancón, Peru, among groups of the far more common *S. variegata*. During my own work, I encountered the Blue-foots from the vicinity of the Bay of Ferrol northward, and obtained examples at Lobos de Tierra and in Ecuador. The Museum has additional specimens from the Galápagos, Panama, and from various islands off the west coast of Mexico. It is interesting that while this booby is common on islets close to the Pacific entrance of the Panama Canal, it has never been recorded from the Atlantic side. The Isthmus apparently acts as an effective barrier to every form of booby except *Sula sula*, though it is doubtful whether individuals of even the latter fly across it, as the pelicans and man-o'-war birds regularly do.

Little that is new or noteworthy is indicated by our specimens, beyond the suggestion that the well-isolated Galápagos representatives of the species may

prove to constitute a distinct subspecies from those of the continental coast. They seem, at any rate, slightly larger, though I cannot express a final conclusion with the limited material at hand. Moreover, our specimens indicate that the post-nuptial moult begins while the boobies breed, and that the rectrices are lost in alternation. In a January bird from Lobos de Tierra, the succession of an old quill, a new quill, an old quill, is unbroken across the tail. Primaries and secondaries were being replaced in opposite directions from the wrist.

At the Lobos Islands and elsewhere in northern Peru, as well as in Ecuador, the Blue-footed Booby is known as the "Piquero," a name reserved farther southward for the Peruvian Booby (*Sula variegata*). In the south the Blue-footed Booby is called "Camanay." To southward of Lobos de Afuera, however, the species is relatively scarce and inconspicuous. This part of the coast is, in fact, the boundary between the two species; a little to northward one finds no examples of *variegata* and a little to southward *nebouxii* disappears. A manuscript by Forbes, which I had the pleasure of reading at the headquarters of the Guano Administration in Lima, states that Blue-footed Boobies formerly nested in small numbers at the Guañape Islands, south of Salaverry. They no longer do so, although one may see a casual example among the thousands of *Sula variegata* in the surrounding waters. If it is true that the Blue-footed Booby occasionally reaches the Chilean coast, from where the type specimen is alleged to have come, it probably attains such latitudes by way of the warmer waters outside the zone of active upwelling in the Humboldt Current. Its occurrence in Chile should certainly be regarded as accidental, and Hellmayr (1932) omits it altogether from his recent list of the birds of that country.

Although reckoned the least important of the guano birds, the Blue-foot or Camanay, through years of undisturbed breeding at Lobos de Tierra, has increased enormously in numbers. The World War proved a boon to the species, for the scarcity of suitable cargo vessels, and the high cost and uncertainties of ocean freightage in general, long deterred the Peruvian Corporation, which alone held the right to export guano, from conducting any excavations.

The Camanay is not a colonial bird, strictly speaking, but in many of the flat, detritus-filled valleys of Lobos de Tierra its nests are now so thickly distributed that the total increment of guano is very large. It is hard beset by an extraordinarily abundant enemy, the "Cleo" or Kelp Gull; but since it is the boldest and most pugnacious of all the guano birds, it is well able to defend itself successfully, and I doubt whether its increase is to be limited by any other factors than the supply of food, space for reproduction, and the nature of the consideration it may receive from human beings.

The Camanay is a slightly larger bird than its relative the Piquero or Peruvian Booby, from which it differs also in coloration, the head, throat and upper breast being more or less overlaid with cinnamon-brown. Its large, webbed feet are of an unbelievably bright blue color, which gives it an extremely bizarre, almost grotesque, look. The females weigh about 1700 grams, and exceed the males in size by one-fourth. More striking sexual differences are revealed by the yellow eyes, which, in the female birds only, look as though they had

huge, somewhat star-shaped pupils, an effect probably produced by masses of black pigment in the iris. Still more impressive is the dissimilarity of voice in the two sexes, for while the males express their emotions by mild and plaintive whistles, the utterances of the females are strident, raucous trumpetings. As regards the voice, I found that the male Camanay is equipped with a double sounding-box at the junction of the trachea and bronchial tubes. The throats of the females, and of the young of both sexes, show no such structure, and this observation led to the interesting discovery that the young males, as well as their sisters, have the same resonant, ear-splitting call as the adult females. The change in the voice of the males comes with maturity, when the delicate vibrating membrane of the vocal organ grows out to form a hard, egg-shaped chamber, thus converting a trumpet into a whistle! The same mechanism, or a similar one, appears to be present in most members of the family Sulidae.

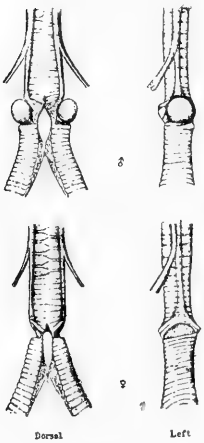


FIG. 69. Trachea and syrinx of *Sula nebouxii*, to illustrate ontogenetic changes correlated with sex. Young birds of both sexes have the structure, and the trumpet-like voice, of the adult female.

Lobos de Tierra supports a varied feathered population, but far and away the dominant guano bird, and one of the two most abundant birds of any kind, is the Camanay. Its only rival in numbers is the Kelp Gull. The Camanays, unlike the other guano birds, are not truly colonial, and yet their nests are often very close together. Sometimes, too, they are situated within a meter, or even a handbreadth, of those of Piqueros or of gulls. Looking in any direction over Lobos de Tierra, from practically any spot on the island, one can hardly fail to see thousands of irregularly distributed Camanays, here in rather dense aggregations, there scattered thinly.

During my stay in January the breeding of the species was in all stages. Fully grown, dark-breasted, brown-eyed fledglings, which had left their nests and parents, were common everywhere, especially near the water's edge where they stood in flocks and exercised their wings by violent flapping. The guano administration warden called these "primeros," or first-brood young, and stated that the eggs from which they had hatched had been laid during October. Then there were sedentary downy chicks of various ages, of which the younger examples were scarcely distinguishable from the nestling Piqueros. Sets of three eggs, more or less incubated, were in many of the Camanay nests, and sets of two or only one egg were no less numerous. Finally, a large proportion of adult Camanays were love-making on their proposed nesting sites, so that a great many eggs were apparently still to be laid.

Beebe has stated that at the Galápagos the Blue-footed Boobies lay no more than one or two eggs, in which peculiarity he sees a possible ecological relation

with the absence of predatory enemies such as vultures and Kelp Gulls. At these islands as in northern Peru, the brooding of the eggs is more a matter of keeping them cool than of keeping them warm. Consequently, the birds stand for hours above their eggs, not touching them but creating a shadow to shut off the fairly coddling rays of the equatorial sun. The incubating adults themselves often pant as if in distress from the heat, and the chicks likewise suffer, particularly when the shafts of their developing quills are weighted down to the hot ground with the abundant blood they contain. Young chicks must be constantly shaded for, even if they were not roasted alive, prolonged exposure would make them unwilling or unable to accept food, as is also true of many passerine birds (Willford, 1925, 293).

Beck (1904, 7) has written of the broiling and insufferable ancient crater at Daphne Island, Galápagos, in which the Blue-footed Booby is the only resident bird. Its walls are so high and steep that the boobies have to circle before they can fly over the rim. Many skeletons tell of the heavy mortality among them. At certain other islands of the Galápagos, however, this species nests on ridges or ledges 300 meters above sea level, which indicates a remarkably wide toleration of nesting conditions.

Because of the character of its nesting, because it is the least susceptible to disturbance of any of the Peruvian guano birds, and because it goes right ahead with all the actions of its normal life in the presence of a human observer, the Camanay is by far the most entertaining of the sea birds inhabiting the Lobos Islands. It is curiously stupid in some ways, for, while it insists upon laying its egg beside your doorstep or in the middle of a frequented path, it never ceases to resent the passage of men or dogs, and will scold just as angrily the twentieth time in a single day as the first. The trail leading from Caleta de Cherra to the lighthouse of Lobos de Tierra, for instance, was traversed many times daily by a considerable number of persons, and yet the Camanays, which had planted their families from one end to the other of the well-trampled ground, threatened with unabated ardor whenever they had to share its use with men.

The courting of the Camanays is extremely diverting and, so long as a beholder does not come unreasonably near them, the birds have no objection to being watched. I have frequently witnessed the performance from a distance of three paces. They begin their advances very early in the morning and continue, judging from vocal indications, well into the darkness of night. Nothing could be more comical than the manner in which the male, with his tail cocked up like a wren's, goose-steps and waddles about, raising his bright blue feet as high as possible and thrusting forth his chest. After strutting round and round in this way for a few moments, he will turn toward the female, who may be several meters away, and, bending forward and raising his wings, he will utter a most beseeching little whistle. This may be repeated several times before he begins to strut again. Then he may pick up a feather, shake it so rapidly that his whole head appears as a blur, and finally lay it gingerly on the ground, which is perhaps his method of suggesting a location for the nest. I often saw several males behaving in this way before one female, especially in early morn-

ing, the lady usually assuming an air of utter indifference. Sometimes the suitors would "mark time" for considerable periods, rhythmically lifting their feet and putting them down again in the same spot.

During later stages of courtship, doubtless after actual pairing, the female becomes more demonstrative, frequently touching the bill or the neck of her spouse, and sometimes even raising her wings in response to his salutation. At all times, however, the males perform much more often than the females. Some time before the first egg is laid, the nest itself becomes visible as a slightly rubbed spot on the soil, and after this both birds stand close by the site until incubation begins.

The Camanays form no high ring of guano around their nests, as the Piqueros do. The accumulation seems to be relatively slow, old nests being encircled only by a broad, flat, whitish frosting. Although the guano contribution of the species is, therefore, not spectacular, it assumes considerable importance when the birds are left undisturbed for long periods of years, as they have been recently. In the presumably optimum environment of the Lobos Islands their mortality appears to be slight, certainly less in proportion to numbers than that of the other species. The dried carcasses of young Camanays were nowhere numerous at the date of my visit, whereas the Lobos pelican colonies of former seasons were strewn with chicks which had failed to survive in the merciless struggle for existence.

I did not learn the length of time that elapses between deposition of the several eggs, but I noted that the chicks in one nest usually showed considerable discrepancy in size and development. Three eggs constitute the maximum set, although, among the families of well-grown chicks, two is a commoner number than three, but this may be due to the loss or sterility of one egg. Both sexes incubate and brood the young, and when one of a pair returns from sea to relieve its mate, the birds usually spend a long period in demonstrations of affection before one steps off the nest and the other promptly covers it. I most frequently saw this change taking place during the middle of the day, and I observed birds of both sexes incubating at all hours.

The arch enemy of the Camanay is the equally abundant Cleo, which is quick to swoop down upon exposed eggs or featherless chicks. Within two steps of me I have seen the gulls pick up Camanay eggs and fly off with them. It should be noted here that the sitting Camanays abandon one egg much more readily than they do two or three, and that they can scarcely be driven from the nests after their chicks have hatched. At least one parent is constantly with the youngsters until the latter have practically passed out of the downy stage. Rarely the adults will attack the Cleos on the ground and boldly defend their offspring, but, while they are individually more than a match for the enemy, they are almost always losers, for Cleos in the rear will steal their nestlings while they are defending them in front. The obvious bewilderment of a pair of Camanays which stand gazing into a robbed and empty nest is altogether pathetic. On the western shore of Lobos de Tierra I once flushed a bird which had been sitting not upon eggs but upon two beach-worn snail shells, and I

wondered whether the parents had pushed such unpromising nest-eggs into their hollow after the breaking up of their home by the gulls.

It is chiefly upon the pretty, innocent-looking, downy chicks of the Cleos that the Camanays wreak revenge for all their wrongs. From the day they hatch, the young gulls are accustomed to leave their seaweed nests at the fancied approach of danger, when, with complete ingenuousness, they will walk directly among the brooding Camanays, and even try to snuggle beneath them. Alas! The Camanays know the foe even in the mottled down of babyhood, and the young Cleos are stabbed through the head or body by rapier bills. While the poor victim cries out in terror, the furious Camanay may thrust a saw-edged beak into its open mouth and out through the back of its skull. More than once I have seen young gulls so impaled by the lower mandible of a Camanay that the latter had to shake its bill violently in order to get rid of the burden. At such tragic times the screaming adult Cleos descend from the swarm above as if to defend the helpless chick, though an exposed egg will even then tempt them into forgetting what they had started about. On at least two occasions I saw Camanays which were not occupying nests go out of their way to attack young gulls that were running over the rocks. The results were lively but very unintelligent fracases, in which many birds of both species took part and in which only the unfortunate eggs and chicks of either suffered serious damage.

The Turkey Vulture is also an enemy of the Camanay, though far less to be feared than the Cleo. That the Camanays recognize it as objectionable is clear, nevertheless. One day I flushed a fledgling vulture so that it launched off from a high ledge upon what may have been its first flight. To my surprise it was at once attacked in the air by Camanays, and knocked down to earth. I never saw the boobies molest an adult vulture.

When a Camanay sitting upon eggs is approached, its "hair stands on end" all over, particularly on the lower part of the back where the feathers turn forward into a retrorse position. At the same time the plumage of the head and neck bristles like porcupine quills. Next, the bird begins to protest by whistles or trumpetings, according to its sex, and by striking out with its formidable bill. If it be a bird with well-grown young it will come between them and the intruder and express intense rage, spreading its wings like a bittern and threatening with its wild eye and darting weapon. When both birds of a pair assume this position the scene is most striking. The powder-puff youngsters, likewise wielding ready and effective beaks, stand as a rear guard, all the while swearing in a raucous voice inherited from their savage mother.

Young Camanays, like the chicks of the other guano birds, are persistent in begging to be fed, and the heads of a whole nestful sometimes disappear down the parent's gullet as they seek their half-digested luncheon. The adults disgorge, when excited, much less freely than their relatives, the Piqueros. One incubating bird, however, was observed to eject from its crop and throat a herring 25 centimeters in length. In general, I believe, it preys upon relatively large fishes, rather than upon anchovies and silversides.

In its feeding habits the Camanay is given much more than the Peruvian Booby to frequenting shallow coves, in which it makes cautious, slanting dives, besides which it swims more or less upon the surface. Farther out at sea, however, I have seen it making long straight plunges with very nearly as much verve as the Piquero. Verrill (1923, 303) reports that at Paita he has seen one dive "from a height of fifty feet into water less than two feet deep." My colleague, Mr. Jaques, was impressed by the smoothness and lack of splash with which this species enters the water, in which feat it excels all other diving birds known to him. The most detailed and circumstantial description of its plunging is that vividly set down by Delano (1817, 380) at the Galápagos:

> . . . These birds collect together in small flocks for the purpose of diving. They fly round in a circle and continue to rise till they get to the height of from sixty to a hundred yards in the air, when one of them makes a pitch to dive, at which motion every one follows, and they fly down with remarkable swiftness, till within four or five yards of the surface, and then suddenly clasp their wings together and go into the water with the greatest velocity that can be conceived of, exceeding any thing of the kind that I ever witnessed. This bird should be contrasted with the pelican. I have often stood upon the ship's taferel rail, and sometimes have gone into one of the tops, to observe the motions of these birds whilst they were diving, especially when they came near the ship. They go into the water with such force as to form a curve of thirty or forty yards in length, before coming to the top again, going to a great depth under water. They glide under water at almost as great a degree of swiftness as when flying in the air. The water was so very transparent where the ship lay, that they could very plainly be seen when near, during all their submarine course.

PIQUERO

Sula variegata

Dysporus variegatus Tschudi, 1845, Fauna Per., Orn., p. 313 (coast of Peru).

Names: Peruvian or Variegated Booby. In the extreme north of Peru it is called "Camanay," the name "Piquero" in this region being reserved for the Blue-footed Booby. No other specific name than *variegata* seems to have been applied to this species, except in error or in accounts of sub-fossil remains. Skulls from northern Chile have been described under the name *antiqua*.

Characters: A white-headed and white-bodied booby, with variegated white and brown wings and back.

Adults (sexes alike): Head, neck, and ventral surface white; quills of wing and their coverts generally brown, but lighter basally, the primaries fuscous black at least on their outer webs, the secondaries, longer scapulars, and primary coverts fuscous, with whitish bases and with slight white terminations or borders on the outer webs; rectrices mainly whitish, the central feathers wholly so, the lateral feathers progressively darker, becoming fuscous black at least on the outer webs of the most lateral pair of quills; feathers of entire mantle, including the lesser coverts of the wings, fuscous, with broad white distal margins which tend to disappear with wear, thus causing the back to become progressively browner; lower back, rump, flanks, upper tail coverts, thighs, and lining of wing similarly mottled with brown white-edged feathers. Iris ruby-red; bill purplish blue, sometimes almost pinkish, with the distal part horn-colored; legs and feet bluish gray, darkening in dried skins almost to blackish. Many museum specimens show bills which are distinctly red. This color does not appear in life and may be due to dried blood in the capillaries.

14 males from the coasts of Peru and Chile, between Lobos de Tierra Island and Chiloé Island: wing, 361–394 (379.5); tail, 146–181 (163.5); exposed culmen, 88–99.6 (92.6); length of gonys, 24–31; tarsus, 45–50 (48); middle toe and claw, 70–82 (78) mm.

9 females: wing, 378–415 (395.4); tail, 161.5–190 (172.5); exposed culmen, 96–101 (98.2); tarsus, 48–53 (50.4); middle toe and claw, 77–86 (81) mm.

The moult of the quills progresses during incubation, the new remiges and rectrices being much

darker than those of worn plumage. Wear and fading likewise produce marked contrasts in the dorsal plumage of birds observed in life, some adults appearing fuscous brown, while others are almost gray. The pecten of the claw on the middle toe is often filled with down and small feathers, showing the use of this organ in scratching and preening.

In immature plumage the white areas throughout have a buffy or dingy appearance, owing to the presence on each feather of a large subterminal brownish gray patch. Furthermore, the white borders of the dorsal plumage are much narrower than in adults, giving young birds a substantially darker cast. The young have a yellowish gray iris, which darkens with age to brown before it turns red; the bill, legs and feet are slightly blue. Primaries, secondaries, tertials, greater and middle coverts, scapulars, and tail feathers appear before the downy nestlings are of full size. Specimens with the breast and belly fully feathered, and the upper tail coverts and back feathers appearing, show adult measurements. The feathers of the breast and belly in such juvenal plumage are of light fuscous or gray, widely margined with white. The feathers of the shoulders are dark fuscous, scarcely tipped with white, and a band of similar feathers extends to the breast around the base of the still down-covered neck. The upper surface of the wings is as in the adult, except that the colors, as everywhere on the body, are duller. A conspicuous feature of the immature bird is the cross of white down on the rump, which persists long after the rest of the body has become fully feathered. The predominant white plumage of the adult bird is not evident until a later stage. The young in the field are, indeed, easily to be confused with those of the somewhat larger species, *Sula nebouxii* (Coker, 1919, 466).

The eggs number from one to four. Out of 25 nests which Coker counted at one view, 9 contained 3 eggs. They are inclined to be somewhat pointed and are generally rather uniform in size. The color is a pale blue, smeared more or less with a white chalky coat. The extremes among a series from Lobos de Afuera and the Chincha Islands measure 53 x 40, 62 x 44, and 59 x 39.5 mm.

Distribution: The cool upwelling zone of the Humboldt Current, along the shores of Peru and northern Chile. Breeding from the neighborhood of Point Pariñas to Arica or southward. The breeding station most distant from the continental coast is at the Hormigas de Afuera Islets, west of Callao. Coastwise, beyond the breeding grounds, birds of this species range sporadically northward as far as the Gulf of Guayaquil, and occasionally, or perhaps regularly, southward as far as Chiloé Island. (Repeatedly, but erroneously, recorded from the Galápagos Archipelago.)

"Piquero" is the Spanish word for lancer, an appropriate appellation for this booby, the spectacular plunges of which are familiar sights throughout the length of the Humboldt Current. It is thrilling to see one bird descend straight from the blue and vanish in a jet of foam which seems to leap to meet it, so swift is the fall. But a Piquero is rarely alone, and the scene of thousands striking the ocean like hissing hailstones is one that beggars description.

Perhaps the most vivid of my memories concerned with the Piquero dates from December 7, 1924, when, as the setting sun illumined the weathered flanks of the Cerro de Guañape, south of Salaverry, a vast flock followed its prey to a point abreast of the steamer upon which my family and I were voyaging. The long-drawn-out horde of birds was moving southward at a pace which kept its middle just abeam. The white bodies caught the late rays so that each bird looked like a glowing spark. A continual shower fell from the array to the water, some of the Piqueros coming down aslant while others tilted up their tails and dropped like stones. The whole darkening sea became a field of small explosions.

This white-bodied booby, with its speckled back, will offer no difficulty of identification, for it is far and away the most abundant bird of its region, which means the strictly littoral waters along the desert coasts of Peru and Chile.

To northward and southward there are never more than a few strays. I saw a lone bird off the south end of Puná Island, Ecuador, on February 26, 1925, and Paessler (1914, 277) records one as far north as Manta in November. At times of the pest that follows an exceptional southward flow of El Niño, sick Piqueros may enter the Gulf of Guayaquil in moderate numbers, and wash ashore, dead or dying, along the beaches of Chanduy.

To southward of the desert shores, Piqueros likewise wander casually, and during the Brewster-Sanford Expedition Beck saw a few off Ancúd, Chiloé Island, fishing outside the mouth of the river or perching on small islets with the native shags. This was in April, May, and June, and Bullock's notes state that the species is a common visitor to the waters about Mocha Island at the same time of year. From more northerly parts of Chile, the Piqueros are reported everywhere, sometimes in abundance equal to that along the Peruvian coast, but I have been unable to run down a single satisfactory breeding record from any point to southward of the frontier between Peru and Chile. Offshore the species finds its most distant nesting station at the islets of Hormigas de Afuera, which puts it in the same category of Humboldt Current endemics as the Guanay, the Inca Tern, and Belcher's Gull.

The northernmost breeding station of which I know is on cliffs outside the sea caves at Capullana Point, near Talara. A few Piqueros nest in similar situations close to the mouth of the Quebrada Pariñas, at the westernmost tip of the continent, although the greater part of the booby population in the neighboring waters is made up, of course, of the Blue-footed species (*Sula nebouxii*). The most southerly nests of the Piquero encountered during my own field work were observed at San Gallán Island in November, 1919, but Mr. Jaques reports a few at Santa Rosa Island, Independencia Bay. It is highly probable that other breeding stations will ultimately be discovered southward to such islands as Alacrán, off northern Chile.

Numerous references in the literature include the Peruvian Booby within the avifauna of the Galápagos Islands. These all prove to be erroneous, however, and to be based upon misidentification of the Masked Booby (*Sula dactylatra*).

As soon as a southbound ship on the west coast of South America leaves Lobos de Afuera astern, it will be forced upon the attention of even a casual observer that one booby over the ocean roundabout becomes rapidly replaced by another—in other words, the warm-water realm of the Blue-foot or Camanay is succeeded by the cool-water realm of the snowy Piquero. The latter is a swifter, more active flyer, and appears to be a more powerful diver, than its northern relative. In these facts, perhaps, lies at least a partial explanation of the distributional limits, for it may well be that the Camanays cannot successfully compete as fishermen with the wonderfully specialized and multitudinous Piqueros, which form an inseparable element of bird life of the Humboldt Current.

The Piquero is the most abundant of the guano birds, and, as a producer of available fertilizer, it has undoubtedly won the place of closest rival of the

Peruvian Cormorant or Guanay. It is in all ways a less sensitive and more adaptable bird than the native pelican, and in future the relative standing of the two is likely to swing more and more in favor of the booby. A single Piquero produces as much as 150 grams of guano a day. If 30 grams of this (a low estimate) were deposited on an island, a thousand Piqueros would produce more than ten available metric tons a year, or a million birds 10,000 tons, which might be close to a million dollars' worth.

The Piqueros are the noisiest as well as the most numerous of the guano birds at the Peruvian islands, and on a quiet morning their voices come as a loud chorus, a medley of whistles, gabblings, and trumpet-like calls ringing out from each community. The birds nest mostly upon the cliffs and pinnacles of the islands but, with the recent reduction in the pelican population, they have taken to spreading over the flat surfaces or pampas. Curiously enough, early observers have recorded that formerly these boobies nested habitually in the central parts of the islands, whereas modern visitors have found them to be typically, or almost exclusively, cliff-dwelling birds, and their reinvasion of the insular table-lands is certainly a very recent development. Coker (1935, 11) discusses this matter as follows:

> That careful student of natural history, Dr. J. J. von Tschudi, who spent four years in Peru *just before* the modern commercial extraction of guano began, said that the variegated gannet, *Sula variegata* Tschudi, was the chief guano-producing bird, that it nested only on the barren islands and not on the mainland and that it made nests in the sand, implying that it had extensive rookeries on the level parts of the islands. Not one of these statements was applicable in 1907 and 1908. The gannets of this species nested almost exclusively on the faces of steep cliffs, its nesting areas only rarely overflowing to a very slight extent onto ground on which a man could find a fair foothold. The geographer, Raimondi, in 1856, *a few years after* guano extraction had begun, confirmed Tschudi by stating that the Sulas "keep themselves in the interior of the islands" (translation). Some years later he uses a more qualified expression—they cover *at times* a part of the islands ("cubren a veces la parte de las islas"). Could von Tschudi and Raimondi have been mistaken, or had this bird changed its nesting habit with the development of the guano industry during the latter half of the nineteenth century?
>
> Now it happened that *about ten years after the new plan* of conservation had come into effect, Dr. Murphy visited some of the same islands on which my observations were made and took photographs showing great rookeries of this species on the level or gently sloping ground—just the condition that von Tschudi and Raimondi had encountered on the islands. Such a photograph as Murphy shows opposite page 304 could not possibly have been taken in 1908. The statement is not lightly made. I saw hundreds of rookeries of this species on islands and mainland over some 700 miles of the coastal region during a period of a year and a half and made many inquiries with the particular aim of checking the statements of von Tschudi and Raimondi. The conclusion seems inescapable that *Sula variegata* did originally nest extensively on level ground (and doubtless also on the cliffs), that some time during the period of unregulated extraction of guano, it gave up practically entirely the level areas, and, seemingly, found previously unfrequented cliffs on the mainland, and that it subsequently reclaimed the level areas when conditions made it feasible to do so.

I noticed the interesting fact that Piqueros nesting upon level ground are shyer and more susceptible to fright than those occupying the usual environment of the cliffs. Birds in the latter situation will permit observation at very close range, while those on flat ground are liable to abandon their nests at the approach of an intruder. Piqueros on the pampa are also more or less at the

mercy of the pelicans, which clumsily trample their eggs and young, as I have already described. It may therefore prove to be true that cyclic fluctuations in the relative abundance of pelicans and boobies have something to do with the nesting habits of the latter, and that in times of their ascendancy the Piqueros simply "overflow" from the filled precipices to the partly empty tops of the islands.

In 1919-1920 I found Piqueros breeding upon nearly all the Peruvian islands visited, though in very small numbers to the southward of the Ballestas group. Eggs and young in every stage of development were observed at each island, and on many mainland cliffs, between Talara and San Gallán. Coker (1919, 467) found the breeding season to be continuous throughout the year, but in most colonies a large proportion of the eggs are laid between September and February, indicating a certain heightening of reproductive activity during the southern-hemisphere spring.

At Lobos de Tierra, in January, 1920, the Piquero was far less numerous than its rival, *Sula nebouxii*. I found, nevertheless, seven Piquero colonies, all located on flat ground. The appearance of these, as viewed from adjacent hilltops, was strangely unlike the precipitous eyries with which I had already learned to associate the species. A little to southward, at Lobos de Afuera, the two boobies had struck an approximately even balance in numbers. Furthermore, the behavior of the Piqueros seemed more "normal" for, in the absence of extensive cliffs, they were occupying chinks in the piles of sand and rubble which had passed through the guano screens during earlier exploitation.

South of the Lobos Islands, the Camanay was out of the picture, and the Piquero ruled alone. At the Guañape group it was more numerous than anywhere else, the south island being occupied all but exclusively by this single species. The leeward slope of North Guañape, from which 7640 tons of guano had just been taken, was bereft of birds of any sort. The entire windward side, however, with the exception of a few sandy banks, was packed with breeding Piqueros and Guanays. The former covered not only the steepest hillsides, but nearly all of the peaks as well. From a distance, the territory of the Guanays looked black, that of the Piqueros gray. These mutually exclusive areas dovetailed with one another, so that the distribution of the two species was revealed clearly from afar. On the heights of South Guañape not one Guanay was living and, except for the narrow domain of Inca Terns and Red-footed Cormorants around the weedy rocks at sea level, it was inhabited only by the Piquero. The breeding ground spread from the magnificent western scarp, 125 meters high, over to the pampa of the eastern slope, where the nests filled extensive spaces, presenting one of the most beautiful scenes that could be imagined. Evidently the higher sites were the preferred ones, for on New Year's Day fresh eggs were to be found only on the lower slopes, as if they had been laid by late-comers. The thickly peopled summit, on the other hand, had countless thousands of well-grown chicks. The older fledglings among these were winnowing the air with their long wings and thus getting the exercise which is a necessary preliminary to flight.

Still older chicks, which had left the vicinity of their nests, were encountered all over the island, resting or sleeping, striving to scramble uphill, or launching out into space. Sometimes they would hover or wabble in the air for a minute or two at a time. One could never tell when such a youngster might come hurtling down from aloft, to alight with a thud close by. These fledglings were all extraordinarily tame; almost any of them could be touched or picked up. During the greater part of the afternoon five of the guano workers fished from a rock upon which two of the young Piqueros were standing. The surface was not more than three paces square and the fishermen, who were continually moving about while cutting bait or landing their catches, would stoop now and then to give the entirely undisturbed "Piqueritos" a pat on the head or a playful chuck under the chin.

I have seen the penguin regiments of the far south, the courtship antics of the Wandering Albatross, a file of eighteen condors which passed me within a stone's toss, and other marvelous sights in which birds held the center of the stage, but nothing more exquisite than the pantomime of adult Piqueros hanging on the wind above the cliff of Guañape. The innumerable white birds would come sailing up over the nests on the plateau and, when they had reached the brink, the updraft would lift them like kites. Then for minutes they would poise, hardly changing their positions, but twisting their necks to look toward me or to glance at their hopeful chicks below. Some of the graceful, living seaplanes were hardly more than arm's reach from me, and beyond they stretched away until the distant birds seemed like a flurry of snowflakes.

At Mazorca Island, of the Huaura group, Beck found plenty of young and a few eggs of the Piquero on June 14, 1913. My visit, on December 29, 1919, came at a higher peak of the breeding season, for the great majority of the many thousands of nests contained eggs or callow chicks. The latter are pinkish when they hatch, but rapidly turn livid or purplish, presumably under the oxidizing action of light. At Mazorca the main headquarters of the boobies were on cliffs at either end of the island, but from here they swelled over on to the pampa, and interdigitated with a great colony of cormorants. A few of the Piqueros even had nests on top of boulders in the heart of Guanay territory.

Love-making was very active at Mazorca. Although the sexes are of different size, it is somewhat difficult to distinguish them by appearance alone. The voices, however, are revealing and, although I neglected to examine the syrinx of this species, it probably shows the same structure and peculiarities as those described in the life histories of the Blue-footed and Masked Boobies. At any rate, one of each pair of Piqueros has a high-pitched whistling note, while the other (presumably the female) gives utterance to a harsh chatter, with an occasional single trumpet-call. Since the members of a family converse almost uninterruptedly, the difference is very marked. They shake their heads violently and half spread their wings before each other. Their throats tremble in the characteristic steganopode manner. Both sexes incubate and, at the time I was watching them at Mazorca, as many males as females were sitting on eggs. A long-range hail usually foretold the return of a mate for nest relief. As soon

as the newcomer arrived, there would be a crossing of necks and other demonstrations of affection, often accompanied by an incidental territorial quarrel between one of the happy birds and a disgruntled neighbor.

At the Pescadores, Asia, and Chincha Islands, the Piqueros were only moderately common during the time of my visits, and they were confined entirely to the cliffs and ledges, or to the very edge of the plateaus where there is always a narrow ribbon of territory avoided alike by cormorants and pelicans. At Asia it was evident that the Piqueros react favorably to sunlight, for they had kept out of the perpetually shadowed parts of a great chasm, their nests forming a sort of sundial line along a stretch of the wall reached daily by late afternoon rays.

At the Chinchas, where I remained for a month, there was opportunity to watch selected families throughout a good part of the breeding cycle. In mid-November some nests held one new egg, some chicks about to fly, while others represented every intermediate stage of family development. Three eggs in a set seemed to be as common as two and, unlike the rule in the life history of the Brown and Masked Boobies, no lethal penalty was necessarily paid by the second or even the third offspring. Three fledgling chicks, in fact, were not uncommon in a nest, and two were exceedingly numerous. Is it not likely that a correlation exists between this condition and the ready availability of plenteous food in Humboldt Current waters? The tropical "blue-water" boobies which produce two or three eggs are living, so to speak, beyond their means, for they find their food in relatively poor pastures, and must fly far in their daily foraging. The penalty for this has been the development of a "Malthusian" mechanism leading to the suppression of all but one chick in each generation. The prolific Piqueros, on the contrary, have the richest and least variable of food resources at their front doors through all the year.

That the eggs in a set are deposited at intervals of several days is indicated by the sequence of sizes in a nestful of chicks. Not infrequently one may be twice as large as its nestmate, yet both such usually survive. They seem to be rather chummy companions, often stroking or nibbling each other, while making soft grunting sounds. When the parents return, well laden, a considerable stimulation of coaxing seems to be necessary before food is relinquished. The heads of the youngsters then disappear down the gullet of the old bird. Replete chicks are likely to sleep for a while on their sides, curled up like kittens, with the bill tucked under the wing. The return to consciousness and renewed appetite is accompanied by prolonged yawning. The older chicks are well able to defend themselves by biting, although they seem less ferocious than the fledgling Camanays and boobies of certain other species. Excitement always sets their pouches atrembling, which reminds one of their ordinal relationship with cormorants and pelicans, both of which exhibit the same trait.

The last thought recalls a curious custom of the adult Piqueros, namely, the persistence with which they associate with groups of other Pelecaniform birds in flight. Wedges of Guanays and files of pelicans in the Humboldt Current are generally, if not invariably, accompanied by, or even led by, a lone Piquero.

Large formations often have a Piquero here and there along the outskirts, as though a self-appointed booby lieutenant were an essential part of any successful foray against the fish!

When feeding, the Piqueros generally begin by circling over the water where they see, or suspect the presence of, their prey. Then they suddenly tip up and fall, sometimes with almost complete synchrony. Between the Guañape Islands I once watched them dropping like plummets all over the strait, closing their wings the instant before striking the water. So rapidly did they descend that they were visible only as white streaks followed by splashes. Guanays, "Chuitas" or Red-footed Cormorants, and penguins were fishing among them, and I marveled that some of the surface-feeding birds were not transfixed by the winged arrows which fell all about them. They may remain under water at least as long as a minute, after which they reappear at the surface to swallow their catch before rising to repeat the performance. As Coker (1919, 466) remarks, they may dive from a height that seems to be 30 meters, with wings held slightly open to direct the headlong course, or from a tenth of that altitude, or from a position barely above the surface from which they have just risen. The technique depends, no doubt, upon the depth of the schooling fish. Coker thus describes a scene he witnessed in the Bay of Pisco:

> We saw an actual cloud of thousands of piqueros flying over a school of anchobetas, when suddenly they began to fall, hundreds at a time until practically the whole cloud was precipitated into the sea before the first birds had risen from their brief rest after emerging from beneath the surface. Scarcely a bird was seen in the air. The first to fall were soon up, however, and from that time on the plunges were uninterrupted. Changing the course of our boat a little we soon rowed directly through this downpour of birds. Hundreds of birds seemed to strike the water at every instant, and even within a few feet of our boat. The bewildering effect is to be imagined rather than described; the atmosphere "cloudy" with birds; the surface of the sea broken and spattering from falls of animate drops and speckled with reappearing birds; the confused sounds of whirring wings and unremitting splashes.

In the Humboldt Current are various kinds of small fishes that travel in enormous shoals. These include silversides (Atherinidae) and several sorts of herrings, all of which are doubtless acceptable to the Piquero. Coker states that the birds also regale themselves at times upon *Munida* and other small crustaceans. The only food I actually identified in Piquero stomachs, however, was the native anchovy (*Engraulis ringens*), and this creature is probably the mainstay of the booby's existence. In three stomachs sent to the United States Biological Survey, two were more or less filled with anchovies, while the third contained a dozen of their eye-lenses.

The hazards of the Piquero's life are related chiefly to the nature of its preferred nesting sites. Chicks fall out of the precariously perched nests or, more likely, a certain proportion of the nests themselves give way and crash to rock or water. At any rate, the foamy drift lines that stretch to leeward—*i. e.* usually northward—of the Peruvian islands are likely to be well punctuated with the corpses of nestling Piqueros of all ages. The adults have for the most part to encounter only the never-ending but unconscious competition with other kinds of guano birds along the border lines of terrains suitable for one or

the other. A more direct and active enemy is the Chilean Skua which, according to Beck's field notes, victimizes the Piqueros to a certain extent by forcing them to disgorge in flight.

MASKED BOOBY

Sula dactylatra

Sula dactylatra Lesson, 1831, Traité d'Orn., livr. 8, p. 601 (Ascension Island).

Within the field of this book there are two well-marked subspecies of the Masked Booby, one belonging to the tropical Atlantic, the other to the eastern tropical and sub-tropical Pacific. The differences between them pertain to size, rather than to alleged distinctions in the skin-color of face, beak, and legs. The Atlantic form should be known as *Sula dactylatra dactylatra* Lesson.

To birds of the eastern Pacific at least two names have been applied, as follows:

Sula granti Rothschild, 1902, Bull. Brit. Orn. Club, 13, p. 7 (Culpepper Island, Galápagos).
Sula dactylatra californica Rothschild, 1915, Bull. Brit. Orn. Club, 35, p. 43 (San Benedicto Island, Revilla Gigedo group).

So far as I can determine from the material at hand, the Masked Boobies of the Revilla Gigedos, the Galápagos, the coasts of Ecuador and northern Peru, and the Chilean islands of San Felix and San Ambrosio all represent one race, which should therefore be known as *Sula dactylatra granti* Rothschild.

Names: Blue-faced Booby, White Booby, "Piquero Blanco." The commonest synonym of the specific name is *cyanops*. Other synonyms include *personata*, *nigrodactyla*, *elegans*, and *melanops*, while a considerable number of subspecific names have been given to representatives throughout the world.

Characters: Largest of the boobies. The adult plumage is white except for the dark brown of the wing quills and some of their coverts, the tips of the long scapular feathers, and the tail.

Adults (sexes alike except as regards size and flesh colors): Pure white except the quills of the wing and upper coverts, and the tail quills, which are blackish brown, becoming fuscous or almost chocolate-brown on the exposed outer webs of the wing coverts; the inner webs of the primaries tend to become somewhat grayish, while those of the secondaries are basally white; the concealed bases and middle parts of the rectrices likewise tend to become grayish or whitish, while the shafts and bases of the central pair are conspicuously white. Iris yellow; skin of face black; bill distally horn-color, bright orange-yellow at the base in males, and pink or light red in females; feet and legs olive-drab in males, plumbeous in females.

Measurements of *Sula dactylatra dactylatra:*

9 males from Ascension and Fernando Noronha: wing, 406–433 (424); tail, 153–173.2 (166); exposed culmen, 92.6–97.2 (95.6); tarsus, 53–56.2 (54); middle toe and claw, 84.6–88.6 (86.4) mm.

7 females from Ascension, Fernando Noronha, and Rocas Reef: wing, 417–440 (429); tail, 151.3–180 (164.6); exposed culmen, 91.6–99 (95.7); tarsus, 52–54.6 (53.4); middle toe and claw, 82.6–89.7 (87.3) mm.

Length, males, 80–82 cm.; females, 76–84 cm. Wing-spread, males, 155–167 cm.; females, 157–168 cm.

Measurements of *Sula dactylatra granti:*

5 males from the Galápagos: wing, 413–443 (429); tail, 172–181 (177.6); exposed culmen, 102–104.4 (102.7); tarsus, 52.3–58 (55); middle toe and claw, 90–93.5 (90.8) mm.

6 females: wing, 427–468 (450); tail, 176–189 (183); exposed culmen, 102–114.5 (106.5); tarsus, 54–59 (57); middle toe and claw, 92–103 (96.1) mm.

The above were taken at sea off the Galápagos, and at the islands of Culpepper, Hood, Wenman, and Daphne.

3 males from La Plata Island, Ecuador, and off Talara, Peru: wing, 439–457 (451); tail, 180–196 (186.3); exposed culmen, 101–103 (102); tarsus, 54; middle toe and claw, 93–95 (94.3) mm.

2 females from La Plata Island: wing, 465–474 (469.5); tail, 188–193 (190.5); exposed culmen, 109–111 (110); tarsus, 55–56 (55.5); middle toe and claw, 99–103 (101) mm.

A male collected off Talara, Peru, January 20, 1925, weighed 2155 grams, and had a total wingspread of 168 cm.

4 females from San Felix Island: wing, 453–486 (471); tail, 188–196 (192); exposed culmen, 100.5–108.4 (104.1); tarsus, 57.4–60.6 (58.7); middle toe and claw, 92.4–103.5 (98.6) mm.

The size distinction between the Atlantic and Pacific races is brought out well by the following average dimensions of females, the larger sex:

	Wing	Tail	Exposed culmen	Tarsus	Middle toe and claw
S. d. dactylatra					
7 ♀ from Ascension, Fernando Noronha, and Rocas Reef	429	164.6	95.7	53.4	87.3 mm.
S. d. granti					
12 ♀ from the Galápagos, La Plata Island, and San Felix Island . . .	464	189	107	57.1	98.6

Immature birds have the head, neck, and upper parts smoky brown, somewhat mixed with white feathers. Between the base of the neck and upper back is a large spot of whitish feathers resembling that in the adult of *Sula nebouxii*. A further resemblance to the latter species shows in the color of the legs and feet of immature *dactylatra*, which are said to be lavender-blue. The iris is recorded as pale green, but is probably at first brown. After loss of the wholly white down, the quills of wing and tail are as in the adult, and the ventral surface and a ring around the base of the neck are white. The head and upper neck, back, and proximal parts of wings are mottled grayish brown and white. The feathers of this juvenal plumage undergo considerable wear, which tends at first to darken the areas referred to. At the time of post-juvenal moult the dark feathers are replaced by white, so that the birds have successively a mottled and spotted white neck, with darker areas on the crown and back; after a length of time not yet determined they moult into a plumage entirely white except for the tail and the distal parts of the wings.

A fledgling with down still clinging to the top of the head is nearly uniform grayish brown dorsally, the feathers of neck, back, rump, and lesser coverts being edged with whitish. The entire neck is of the same color as the back, the remainder of the under parts being white.

The eggs are two in number, although more than one chick is rarely or never reared. Bryant (1859, 125) reports that the chalky coating is much thicker on the egg of this species than is true of other boobies. Bent (1922, 195) records the average dimensions of 67 eggs, chiefly from Pacific localities, as 67 x 46 mm., the extremes measuring 77 x 47, 65.2 x 48.5, and 60 x 40 mm. Lister (1891, 294) records the weight of single eggs as ranging from 119–144 grams.

Distribution: Pan-tropical oceans, nesting localities being invariably close to flying-fish waters, which apparently determine in part the distribution of the species. Breeding stations in the Atlantic include Ascension, Fernando Noronha, Rocas Reef, South Trinidad, the Bahamas, and the Abrolhos Islands off the coast of Brazil. In the Middle American region the species is found at suitable islands of the Caribbean Sea and on cays in the Gulf of Mexico. Pacific nesting stations within the South American region include the Galápagos Islands, La Plata off the coast of Ecuador, and the twin islets of San Felix and San Ambrosio.

Peters (1931, 83) recognizes six subspecies of *Sula dactylatra*, although the ranges he records are insufficient to cover the distribution of the species even in the American region. At least three of these alleged forms concern us in the present study, namely, *dactylatra*, which is regarded as the bird of the South Atlantic and of the West Indies; *californica*, which breeds on islands off the western coast of Mexico; and *granti*, described from the Galápagos and tacitly accepted as peculiar to that group.

The subspecific distinctions among eastern Pacific birds are those assigned

by Rothschild (1915, 43) and are based, in the main, upon allegedly different colors of the bills, the naked face and pouch, and the legs and feet. Mathews and Iredale (1921, 75) have elaborated Rothschild's classification to cover six subspecies. They do not state, however, whether the differences apply to male birds or females. Yet this is a fair question, for in all parts of the world the two sexes of adult White Boobies are utterly unlike in the colors of their fleshy parts. My own observation of living birds in the field, supplemented by comparison of a large number of museum specimens, has led me to the conclusion that both Rothschild and Mathews have overlooked an important admonition of caution written by Ogilvie-Grant (1898, 431) in a footnote to a description of this booby in the "Catalogue of Birds of the British Museum." Referring to the colors of the soft parts, the latter author states:

> Too much importance must not, however, be attached to these differences, for after making allowance for the changes of colour caused by age, season, and sex, it must be borne in mind that some of the records are probably taken from birds some hours after death, when the colours of the gular pouch and legs are entirely altered, while some descriptions are taken from dry skins.

The soundness of Ogilvie-Grant's remarks was impressed upon me at La Plata Island, Ecuador, when, on February 17, 1925, I made a scrupulous examination—within arm's reach, or at least as close as I dared stoop beside the nests—of more than 20 pairs of White Boobies which were either still courting or had just produced an egg or two. The females, as among most species of boobies, were distinguishable from the males by their larger size and different voices. An added distinction, namely that of the flesh colors, was uniformly as follows: both sexes had bills which were horn-colored distally, but those of males were bright orange-yellow at the base, while in females the same region was pink or light red. The legs of males were olive-drab or khaki color, while those of females were plumbeous. The differences in both bills and feet were visible at long range, and were invariable among all these breeding adults. Both sexes had bright yellow eyes and the skin of the face was black, so that "Blue-faced Booby" is a misnomer so far as the birds of La Plata Island are concerned.

Such observations are at least sufficient to indicate that subspecific division within the limits of this species in the Pacific has thus far been very imperfectly worked out, for which reason I shall treat the Masked Booby as a whole in this biography, although recognizing well-marked Atlantic and eastern Pacific races.

In a number of important ornithological contributions, such as those of Rothschild and Hartert (1899, 178), Snodgrass and Heller (1904, 244), Gifford (1913, 89), and Fisher and Wetmore (1931, 32), the Galápagos form of this booby has been erroneously identified and recorded as *Sula variegata*, which is the endemic booby of the Peruvian coastal islands. The mistake has been corrected by both Rothschild and Wetmore.

In the South American region the great White Booby is a bird of the Tropical and Sub-Tropical Zones of surface water, its distribution apparently being the same as that of flying fishes, which make up the principal component of its

diet. Most of its known breeding grounds are at oceanic islands, such as Ascension, Fernando Noronha, Rocas Reef, South Trinidad, numerous stations in the West Indies, and San Felix, the Galápagos, and more northerly islands in the eastern Pacific. Its coastal range belongs to belts of warm, blue, and clear water in northern South America, between breeding outposts at the Abrolhos Islands, Brazil, on the east coast, and La Plata Island, Ecuador, on the west. The species avoids, of course, the littoral of muddy waters between northeastern Brazil and Trinidad, but it occurs as a breeding bird at Los Hermanos Islands in the Caribbean, and from here westward to Alacrán and other low sandy reefs in the Gulf of Mexico.

On the Pacific coast of South America, this White Booby is one of the species which serves as an index of the advancing water of the countercurrent from the north. It is unknown in the zone of normal upwelling along the shores of Peru, but, during influxes of El Niño between December and April, examples frequently fly southward past Point Pariñas, so that the oceanic range of the species comes to overlap that of the normal bird life of the Humboldt Current. Such vagaries are not to be wondered at, because the distribution of flying fishes undergoes this same extension during the same periods.

It is evident that in the zone of relatively warm waters which lie to westward of the Humboldt Current, the White Booby regularly reaches much higher latitudes. I have seen a specimen from latitude 11° S., longitude 88° W., taken on Christmas Day, 1912, and the late Dr. Frederic A. Lucas, former director of the American Museum of Natural History, once shot an example equally far out over the high sea off the coast of southern Peru or northern Chile. The source of these was no doubt at San Ambrosio or San Felix, where my colleague, Dr. James P. Chapin, found these boobies in residence during February, 1935. He collected four females at San Felix, and one male a day's sail to eastward of that island. His birds are all adults in non-breeding condition, but two of the females possess on the ventral surface a few dark fleckings which are the remains of the immature plumage. He describes the iris of the male as bright lemon-chrome, the bill as dull ochreous lemon-yellow, with the bare skin of face and chin blackish, and the feet "olive-green." The females had yellow eyes and blackish faces, with the bill dull yellow, basally pinkish, and the feet "olive."

The stomach contents of these birds included small squids and their mandibles together with remains of fishes. The example mentioned above as being shot by Dr. Lucas contained a flying fish 28 centimeters in length.

At Ascension, which is the type locality of this species, the White Booby breeds among the Brown or Common Boobies on the flat top of Boatswain-bird Islet. Perhaps its most populous present colony in the South Atlantic is at Rocas Reef, directly northeast of Cape São Roque, Brazil, where the leader of the Cleveland Museum South Atlantic Expedition estimated that there were 1500 nests on New Moon Cay during the month of April. This species, in fact, here far outnumbered the Brown Booby. At Orquilla in the Caribbean, Lowe (1911, 207) found the birds breeding in January, making no attempt at actual nest-building but occasionally toying with small sticks. I judge from many

records in the literature that this booby may breed at any time of year within the tropics, but that at many localities the nesting season is rhythmic, for the population as a whole, with relation to the local rainy season.

During my work along the coasts of northern Peru and Ecuador, I found the White Booby common off the Gulf of Guayaquil and in Santa Elena Bay during January and February, and collected one specimen as far southward as Talara. Apparently the birds avoid islands close to the shore, or those lying in bights such as the Gulf. They were unknown, for example, to the observant lighthouse keeper at El Muerto. At La Plata Island, however, we found them breeding in the lush rain vegetation above the cliffs of the southerly end, on February 17. So far as I can learn, this colony, previously unreported, is the closest one to the Pacific coast of South America. Hitherto the species had been known as a breeding bird in this general region only at the Galápagos Archipelago.

The great white birds, with black-tipped wings and gleaming yellow eyes, were at this season completing their courtship or already sitting upon one or two eggs in a field of enormous white, yellow-hearted spider lilies or "amancaes" (*Hymenocallis*). The birds and the flowers harmonized completely. The boobies notified us of their presence before we saw them in the knee-deep vegetation, for the males piped up their rather pathetic whistles and the females blew their clamorous trumpets. Reithmüller (1931, 142) states that the male of this booby has a quacking call, the female a loud hissing whistle, but this is exactly the reverse of the truth, as I found by a dissection made on the spot. The sexual differences in voice correspond, in fact, with those of the Blue-footed Booby, and are correlated with an identical structural difference in the syrinx. In the case of the White Booby, however, the eyes of adult males and females are alike, whereas in the Blue-footed Booby they differ as markedly as the voices.

All of the nesting White Boobies at La Plata had curious blackish blue, cloudy spots on the outer white feathers of their throats, just below the pouch. Sometimes there were half a dozen of these, and while I was examining them on living birds I found, to my astonishment, that the spots changed their position and shape. Closer inspection showed that the marks were made by hippoboscid flies, buried just under the surface of the snowy feathers so that they were only half veiled. They were present at all times among the feathers of every one of a large number of nesting birds, and always confined to the throat. Possibly they selected this part of the booby plumage as a retreat because it was the only accessible area which afforded shade from the full glare of the equatorial sun.

Most of the nesting boobies were altogether fearless, although some of those having only one egg took flight at our too close approach. Those with a full set of two eggs were invariably ready to take the offensive as soon as we had come within reach, demonstrating once again the conditioning which is a concomitant of egg-laying. The birds trumpeted or whistled, according to their sex, and one of them succeeded in biting the finger of a member of our party sufficiently to draw blood. Frequently they revealed their troubled state merely by disgorging. One of them ejected a pile of seven flying fish, each 15 to 20

centimeters in length, which were practically as good as new and were immediately appropriated as bait by the lighthouse keeper of La Plata. This individual informed me that he and his son obtained all their bait for fishing by tickling the throats of these boobies with a switch and, furthermore, that flying fish made up the only recognizable part of their diet he had ever seen them disgorge. Since adult flying fish tend to avoid continental coasts, and even those of islands, the feeding habits of the White Booby would suffice to account for its predilections regarding nesting stations. Snodgrass and Heller (1902, 512) call attention to the relatively great distances from shore to which this large booby extends its foraging, and they conclude that its daily excursions may sometimes carry it from 150 to 175 kilometers away from its home island.

Major Chapman Grant has sent me an observation from the Caribbean relating to the capture of prey by this species, and indicating that flying fishes are taken chiefly by being dived after, rather than by being caught in the air. On September 24, 1930, only a half day along the route between Cristobal and Porto Rico, Major Grant watched two White Boobies for about an hour as they accompanied the steamship 'San Mihiel.' The birds soared with only occasional wing-beats, apparently taking advantage of wind deflected from the bow. Numerous small flying fish were being scared up by the advancing vessel, and the birds gave every evidence of making the same use of a ship that an ani does of a horse in its insect-hunting. The sea was rough, making exact observation difficult, but every little while one or another of the boobies would spy a fish and dart downward with the wings partly closed, yet still in such complete control that it might turn up again when only a meter or so from the surface. Whenever a dive was completed, the wings seemed to be about three-fourths folded at the instant of submergence. The birds appeared to penetrate the clear Caribbean water to an extraordinary depth, perhaps from 2 to 3 meters, and a burst of bubbles indicated the large amount of air released from their lungs or carried down in the plumage. Within six seconds, or thereabouts, they would pop up to the surface and, if the dive had been successful, would float for a moment with the bill and face held beneath the water while preparing to swallow their catch.

In the prevailingly birdless stretch of the Sargasso Sea, between the Azores and the Lesser Antilles, Nicholson (1931, 274) observed a Masked Booby following his ship for half an hour on a day in the middle of October, and diving repeatedly from a height of 12 meters above the water. During the plunges, its conspicuous black tail was fanned out as a rudder. The same author mentions an example shot not far off the coast of British Guiana in August, 1929, and now preserved in the Georgetown Museum.

Interesting details regarding the life history of this species have been published by many observers in various parts of the world. Some of the notes, such as those of Reithmüller, refer to Australasian birds of the large-billed race which has been called by the subspecific name *personata*. The behavior, however, undoubtedly applies to the species as a whole, a supposition of which we may be all the more confident because much of it is entirely in harmony with that of

certain other species of boobies. One point that immediately becomes evident from the common discoveries is that the White Booby requires a more or less bare and open terrain for its nesting sites. It would, therefore, be barred from forested islands such as Cocos. At La Plata, as I have noted, the birds were nesting in a tangled bed of greenery, but this was no more than transient ground vegetation, and the boobies could readily walk to the edge of the cliff close by, whence, indeed, they customarily took flight. Beck (1904, 8) has noted that at the Galápagos this booby usually nests in similar situations, near the edges of high cliffs above the ocean, although to some extent it also occupies sandy islands which rise barely above sea level. Lowe (1911, 207) states that it always seems "more at home" where higher nesting ground is available. At some islands, such as Clarion of the Revilla Gigedo group, birds of this species nest at all levels, from the beach to the summit. Anthony (1898, 4) states that at San Benedicto Island, of the same group, they seemed to nest later than the two other resident boobies. At the end of April he found them guarding the nesting territories they had appropriated, even though eggs had not yet appeared.

Reithmüller reports that the first indication of an approaching breeding season is shown by the curious courtship antics of pairs of these boobies on the beaches. One of a couple will walk away, pick up a small stone, and return to place it on the ground in front of the other bird which will, as a rule, accept it and then slowly and deliberately place it on the ground again. This procedure may continue for an hour or two, during which any other bird that comes near is warned away by pugnacious posturing and bluffing on the part of the courting pair. Reithmüller believed that such behavior is peculiar to this species but, as a matter of fact, it agrees entirely with that of the Blue-footed Booby (*Sula nebouxii*), showing how fundamental such reactions may be.

Two eggs make up the normal clutch of the White Booby, and the birds incubate by folding the webs of their broad feet around the shells, the dense plumage of the breast then covering the feet as well as the eggs. Boobies apparently do not develop bare brood-patches such as characterize so many other waterfowl, including both petrels and penguins. The advantage of the warm web membrane, with its rapid circulation of blood, as an incubating surface is therefore particularly apparent. The blindness of the instinctive brooding impulse is shown by these and other boobies in their willingness to accept "nest eggs" of the crudest sort, such as water-worn beach shells. Anthony (1898, 4) found that they seemed quite content when snails of the proper size were substituted for eggs taken from beneath them. Still more strange and suggestive is his observation that a bird, which had been incubating a single egg, accepted two shells, tucking them under its breast with its bill, but within a short time discarded one of them, as though unpleasantly stimulated by the change from a single object to two. Other birds which had been covering two eggs accepted permanently a pair of shells, continuing to guard and warm them for ten days or longer.

The two eggs are laid several days apart, one chick consequently hatching well before the other. All observers seem to agree that rarely or never is more

than one youngster reared. Reithmüller says that two young are not found in the nest together for more than three days after the second egg has hatched, and he, as well as Snodgrass and Heller (1902, 512), believes that the elimination of the second and weaker offspring is due to the voracity of the first-born, which causes the parents to react so as to give it all of the food, thus allowing the weaker chick to starve. Fisher (1904, 91) makes the same interpretation, remarking that the smaller nestling, trampled to death, may remain in the nest for a long time. It is probable, however, that this result cannot fairly be ascribed wholly to the behavior of the first chick. Doubtless, the adults of this species are ill-conditioned to the presence of more than one young bird in the nest. An interesting experiment would consist of apportioning two young of equal age and strength among each of a number of nests. Under such circumstances I believe that the end would be the same, namely that the parent birds would, for one reason or another, concentrate upon one of their two charges, neglecting the other with fatal effect.

The young White Boobies, as long as they are brooded, keep their heads tucked under the parent, even though the body remains exposed to the sun. This might be interpreted as an escape from light instead of heat, but it is noteworthy that the chick also climbs on top of the large feet of its parent at every opportunity instead of sitting upon the hard and often blisteringly hot ground. Possibly the fact that there is room for but one of the youngsters to obtain insulation of this sort is one of the reasons why two chicks cannot survive. If nestlings are moved a few meters away from the nest site the parents fail completely to recognize them and continue to center their interest for a time upon the slight scrape, encircled by a whitewashed ring, which is a poor apology for a nest.

The parent returning with food swoops in swiftly from sea, applies the brakes very abruptly by turning upward and beating its wings, and then drops beside the home site. The chick thereupon vigorously attacks, not only picking at its parent's beak, but also striking with its wings. In the feeding process its head is inserted far into the throat of the adult, where it remains for a long time, picking and jabbing and pumping in what looks like a most uncomfortable manner, until all of the available flying fish have been extracted. The inordinate length of time devoted to the feeding of a chick, which has been especially mentioned by Fisher, may be still another reason why no food ever remains in the gullet to profit the second offspring. When an intruder enters the territory of a White Booby family, the youngster joins its parent or parents in hissing or barking defiance. The adults appear extremely formidable with their feathers on end, their bills half open, and the pupils of the eyes contracted to a speck in the middle of the bright yellow iris (Lister, 1891, 294). The chicks have brown eyes.

The size and strength of this species, which is the largest of the boobies, is still not sufficient to protect it from the persecution of the man-o'-war bird. Dill (1912, 19) reports that one of the latter pirates was seen to pursue a White Booby, seize it by the tail, and completely overturn it in the air.

BROWN BOOBY

Sula leucogaster leucogaster

Pelecanus Leucogaster Boddaert, 1783, Table Planche Enlum., p. 57, No. 973 (Cayenne).

Names: Common Booby, "Pájaro Bobo," "Alcatráz." In Brazil, both the latter name and "Murgulhão" are applied to this booby. Synonyms of the specific name include *fiber*, *sula*, *parva*, *brasiliensis* and *australis*.

Characters: A brown booby with white ventral surface, the hue of head and neck being somewhat darker than that of back and wings.

Adults (sexes alike except as to size): Head, neck, and chest clove-brown; remainder of dorsal surface, including the readily visible parts of wings and tail, of distinctly paler brown (close to mummy brown or bister), the primaries somewhat blackish on their outer webs; secondaries basally whitish, especially on the inner vanes; shafts of wing quills blackish above, paler below, those of the rectrices basally whitish; ventral and lateral surfaces, caudad from the chest, white; axillaries and median under wing coverts white, the remainder of under-wing brownish. Iris pale gray or whitish; eyelids bright blue, with gray skin above, below, and in the loral region; remainder of face, gular pouch, and base of bill yellow, shading into bluish horn-color toward tip of bill; legs and feet chrome-yellow (often appearing green in dried skins).

13 males from Fernando Noronha, Ascension, St. Thomas, and Dry Tortugas: wing, 372–391 (381); tail, 169–198 (186); exposed culmen, 87.8–101 (92.7); tarsus, 42–48.4 (44.3); middle toe and claw, 72.5–81 (76) mm.

10 females from Brazil, Fernando Noronha, Ascension, St. Thomas, and the Bahamas: wing, 384–415 (400); tail, 162–198 (180.5); exposed culmen, 91.8–102 (96.3); tarsus, 45–48 (46.8); middle toe and claw, 79–86.6 (82.8) mm.

Length, males, 71–76 cm.; females, 76 cm. Wing-spread, males, 135–144 cm.; females, 145–147 cm.

The figures agree substantially with those from a series of breeding Cape Verde Island birds (Murphy, 1924, 253).

In juvenal plumage boobies of this species are almost uniformly grayish brown above, only slightly lighter on the belly, and darker on the breast. Even in such immature examples the feathering of the neck is distinctly darker than that of the back, supplying a character differentiating such birds from similar stages of the eastern tropical Pacific race (*etesiaca*). The primaries of such young birds are distinctly blackish. The ventral surface, over the entire area which is white in the adult, is composed of pale gray feathers, with broad subterminal ashy brown bars succeeded by a narrow whitish band. The general effect is, therefore, brownish gray instead of white. The bills are evidently darker than those of adults. The down of young nestlings is pure white.

Sets of eggs usually number two, but one and three are also not uncommon. They are bluish white, with the usual calcareous coating, and are exceedingly variable in form (Murphy, 1924, 254, fig. 10). Two sets obtained by Beck at Cockroach Islet, off St. Thomas, August 10, 1916, measure 64.3 x 41.6, 60.8 x 41.2; and 57.5 x 40.4 mm. The extremes of a large series recorded by Bent (1922, 204) are 65.5 x 41, 62 x 42.5, 52.5 x 40, and 56.5 x 34.5 mm.

Distribution: Pan-tropical Atlantic, breeding at Ascension, Fernando Noronha, Rocas Reef, St. Paul Rocks, the Cape Verde Islands, many islets off the coast of eastern South America, and at numerous localities in the Caribbean and the Gulf of Mexico, northward to the Bahamas. The species occurs in tropical and sub-tropical seas throughout the world, but distinct races inhabit islands off the west coast of America.

Opinions may differ regarding the relationships of the Red-footed Boobies (*Sula sula*) on the two sides of the Isthmus of Panama, but there can be no question about the fact that the Brown Booby finds in this strip of land an effective barrier against natural distribution from either oceanic region to the other. The birds of the Caribbean side are of the typical race, which appears to have spread over the entire tropical Atlantic—northward to the Bahamas, eastward

to the African coast, and southward beyond the tropic of Capricorn along the shores of Brazil. The Brown Booby of the Pacific coast of America is, on the other hand, a very distinct bird, in which the male is characterized by a hoary gray head and throat. There are, in fact, two different subspecies of Brown Boobies of this type along the west coast of America. The northern race (*Sula leucogaster brewsteri*) ranges from Lower California southward to Clipperton Island, and thus belongs to a prevailingly arid zone. The other (*Sula leucogaster etesiaca*), the only Pacific form of the Brown Booby falling within the scope of this book, is a race belonging to a highly humid zone, the range of which extends from western Panama and Cocos Island southward along the rainy coast of Colombia to northern Ecuador. It will be considered further in the next biography.

In the Atlantic the Brown Booby scarcely ranges outside the zone of distinctly tropical water. It breeds at oceanic islands not far from the equator, such as the Cape Verdes, St. Paul Rocks, Fernando Noronha, and Ascension, as well as along the Antillean Arc, but it apparently does not reach either St. Helena or South Trinidad, both of which lie in sub-tropical water. Gulf Stream influences carry it northward to the Bahamas; and along the South American coast, where the warm Brazil Current sweeps southward, it inhabits many coastal islands as far as Santos or even Santa Catharina. According to Goeldi (1894, 594), the bird is familiar to all inhabitants of the Brazilian coast, and is not uncommon in the bay of Rio de Janeiro. Burmeister (1856, 458) remarks, however, that it does not habitually come as close to the continental shore as do the man-o'-war birds. The trait implied, which I believe to be characteristic of boobies in general, goes far to explain why the two sides of Middle America are occupied by distinct races, whereas one and the same man-o'-war bird flies back and forth across the Isthmus with complete freedom.

To southward of southern Brazil the Brown Booby is known only as a casual or accidental wanderer. It has been more or less doubtfully reported, for example, from the Falkland Islands (Bennett, 1926, 329). A record from "Punta Arenas" has also been much repeated in the literature, but it appears that the original specimen responsible for this was captured in Costa Rica and not in the Strait of Magellan.

In more northerly South America the Brown Booby inhabits even the muddy coast of Guiana from where, in fact, the species was originally described. While I find no record of its breeding in Guiana, it is very likely that there are nesting stations on some of the islets off the French colony. Along the coasts of Trinidad it is particularly common, according to Léotaud (1866, 560), during the season of winter rains. From here it is but a step to its headquarters on the Caribbean coast of Venezuela, where the Brown Booby is one of the commonest of sea birds, to be seen at times by thousands in the channel between Margarita Island and the mainland. From this point westward and northward it breeds wherever there are islets well offshore and not yet overrun with predatory animals, such as the Islas de Aves, Los Hermanos, and the Testigos of the leeward chain, and many localities among the Antilles and Bahamas.

In its style of flight this species is perhaps the least spectacular and inspiring of the boobies. As Cory (1880, 191) puts it, its maneuvers appear to be decidedly for work rather than for pleasure. However, such remarks are merely comparative, for even the least of boobies is a master of the air. Bangs (1902, 395), who saw large numbers of mingled Brown and Red-footed Boobies during a violent gale on the peninsula outside Indian River, Florida, on February 16, 1895, describes how the birds assembled in bands in the raging wind in order to plunge for fish just outside the line of breakers. The boobies appeared not to be in the least incommoded by the gale and the driving rain, and acted, indeed, as though experience had taught them that such weather meant good fishing. Bryant (1859, 193) tells us that the Brown Boobies are capable of diving repeatedly, in very rapid succession, from a height above the water scarcely equal to the spread of their wings; he once saw a bird catch a dozen fish within the space of a minute by making such short plunges. In calm weather the Brown Boobies beat their wings, of course, much more than during a high wind, and progress with slow and steady strokes, which Friedmann (1927, 146) describes as gull-like rather than duck-like. Parties of birds often travel in single file.

The force of the breeze also has much to do with their ability to take off, either from the water or from the ground. At times they appear unable, or at least very unwilling, to undertake the effort of rising from a level surface. They will rather stand their ground and snap and hiss at invaders of their domain or, if they are driven to taking wing, they will strike the soil or the vegetation for the first ten to twelve strokes. The advantage offered by resting places well above the ground induces them at times to perch in trees, from where they can spring forth regardless of the presence or absence of wind and, by means of a downward glide, gain sufficient momentum to send them safely on their way, after which they soon rise with strong wing-beats. Peters (1929, 134) observed a score of these birds that came nightly to roost in coconut palms overhanging the water at Great Corn Island in the western Caribbean. While by no means as apt a tree fowl as the Red-footed species, the Brown Booby handles itself rather better on slender and precarious perches than do most members of the family. In the equatorial South Atlantic I saw one alight on the tip of the main boom of the brig 'Daisy' before dark of a quiet evening. At five o'clock next morning the bird was still asleep on the same gently swaying and pitching spar. At Porto Rico, Wetmore (1918, 337) found evidence of the boobies' continual contact with vegetation in the form of thorns, or even small lobes of cactus, clinging to their feet and feathers and demonstrating, incidentally, how such prickly plants might become widely distributed through the migratory or irregular wandering of the birds.

Observations made at various seasons on the plateau of Boatswain-bird Islet, Ascension (Moseley, 1879, 563; Penrose, 1879, 281), at St. Paul Rocks (McCormick, 1884, 20; Nicoll, 1904, 37; Wilkins, 1923, 478), and at Fernando Noronha (Simmons, 1927, 69) show that the tropical breeding season of the Brown Booby is continuous, so far as concerns the population as a whole. Farther from the equator, as in the West Indies, the birds appear to be somewhat more

seasonally rhythmic in their nesting activity, though even here there are great irregularities. Cory (1880, 191) states that there is a definite migration to the Bahamas, beginning about February 1. During April at the same islands Bryant (1859, 123) found, however, not only full-fledged young already flying, but also newly hatched birds and many eggs. At Desecheo Island, Porto Rico, Wetmore visited a colony of 8000 to 10,000 Brown Boobies in June, when the young were full grown, and yet Beck, during the course of the Brewster-Sanford Expedition, found eggs still in some of the nests at Cockroach and Cricket Islets, off St. Thomas, on August 10, 1916.

As a nest-builder, the Brown Booby seems to be somewhat intermediate between such species as the Blue-footed and Masked Boobies, which produce nothing more than a scrape, and the tree-nesting Red-footed species, which often makes use of a great quantity of twigs and leaves. In certain localities the Brown Booby can hardly be said to build a nest at all, but in places where twigs, stones, or seaweed are readily available it usually gathers together, perhaps as part of the courtship procedure, a slight accumulation upon which the eggs are laid. The nature of the ground appears to be of relatively little importance to the birds, although a bit of altitude, a slope, or proximity to some sort of jumping-off place confer sufficient advantage so that they appear to be more or less consciously selected. Vegetation is no detriment, provided it is neither dense nor high enough to interfere with take-off and landing. The breeding grounds therefore vary between terrains which are little more than bare, damp stone, as at St. Paul Rocks, or sun-baked guano, as at Boatswainbird Islet, and the sandy stretches of Bahaman cays which are covered more or less thickly with wire-grass, prickly-pear, and sea-grape (*Coccolobis uvifera*).

In such a situation as the last named, a colony of about 1500 pairs of Brown Boobies was studied by Chapman (1908, 141). The birds here occupied comparatively level ground and the nests, most of which were scantily lined, were placed 2 to 3 meters apart, the included circle of territory being violently defended against interlopers of their own species. In the main, the boobies were silent, but when aroused they uttered raucous screeches. The eggs, which usually numbered two, began to appear in February. About a week intervened between the laying of successive eggs in each nest and, since incubation began as soon as the first appeared, the doom of the junior chick would have been sealed far in advance even if there had not been an apparently high percentage of infertility among the eggs. McCormick, too, found that at St. Paul Rocks, in December, 1839, all but one of the two or three eggs in Brown Booby nests proved as a rule to be addled. In the Bahama colony, according to Chapman, two chicks in a nest were so unusual that such families totaled only a fraction of one per cent of the population.

The young Brown Boobies are, of course, hatched without a feather on their livid skins, and they are constantly brooded by one of the parents until the white down clothes them. After the chicks have grown too large to be covered, they lie for considerable periods flat on the ground, with eyes closed, giving every appearance of being dead. Aside from the high prenatal mortality men-

tioned above, however, the great majority of the chicks seems to survive the nesting period. About three months elapse between the time the egg is laid and the date when the chick takes flight. The young are fed upon squids and fish which they obtain by thrusting their heads into the parents' gullets. Cory (1880, 191) states that even flying progeny still depend upon the adults for food. This matter deserves further investigating, however, because there is evidence that young boobies, like young petrels and albatrosses, are permanently abandoned soon after they begin to deserve the name of fledgling.

Chapman continues as follows with a description of a typical day in the Bahaman Brown Booby colony. Activity began on March 9, for example, at 5.15 A.M., and for some minutes a subdued quacking was heard throughout the colony. Within a quarter of an hour there was a general movement toward the sea, but one parent of each couple remained with its egg or young chick. Throughout the day exchanges at the nests were taking place sporadically, but not until dusk did the birds begin to return *en masse* from the ocean. Before this time the frigate-birds had already retired for the night, a circumstance which may have had more or less to do with the later hours of the booby. Both parents spent the night at the nest, one squatting and brooding, the other standing beside it. Young and adults kept the tip of the bill tucked into the down or feathering of the shoulders. Wetmore's observations in Porto Rico led him to conclude that the Brown Boobies show much activity at night as well as by day, and that they sometimes do part of their fishing during the hours of darkness.

Half-grown chicks often react much more savagely toward an intruder than the adults do (Nicoll, 1904, 37). So long as the young remain covered with down, and are confined to the nest site, they are, in fact, exceedingly noisy and aggressive in the presence of potential danger. They will reach forth as far as possible to lunge with their bills, all the while keeping up the utmost possible clamor. When, as fledglings, they have once left the nest, however, they tend to become timid, and are quick to scurry out of the way of an intruder or to take flight. A selective advantage is to be seen in these responses correlated with age. The only effective defense of an altricial chick, tied by its own weakness to one spot on the ground, would be to intimidate a natural enemy by its savage outcry and apparent ability to take care of itself. On the other hand, the safest of all measures for a fledgling would be to fly away from danger.

By most observers the voice of the Brown Booby has been described as a quack, a series of grunts, or as strident screeches, without an attempt to distinguish between the notes of the two sexes. Reithmüller (1931, 143) is more specific in stating that the male quacks and the female hisses, except that I believe he has here reversed the facts. Among at least two other boobies (*nebouxii* and *dactylatra*), as I have shown elsewhere, the female is the possessor of the sonorous voice, that of the male being a sibilant whistle, and these differences are correlated with a structure of the syrinx which constitutes a definite secondary sexual character.

Bryant (1859, 123) states that at the Bahamas the Brown Boobies always

seek their food in blue water, never in the shallows of the banks. Here again we have a clue as to why the Isthmus of Panama presents a barrier to boobies, notwithstanding that it is crossed so readily by pelicans and man-o'-war birds which show no aversion to shores and estuaries.

Food taken from Brown Booby stomachs at the Bahamas included principally flying fish and halfbeaks, but also flat-fish, parrot fishes, and large prawns. Clark (1903, 285) writes that just off Carupano Point, on the Caribbean coast of Venezuela, he noted a certain spot where hundreds of sea birds, including Brown Boobies, pelicans, frigate-birds, gulls, and terns congregated to fish. Every few moments the diving members of this large flock would plunge within a single small area. Investigations showed that at this point sea catfish and other marine animals were being incapacitated by sulphurous fumes from the ocean bottom, and that the birds had assembled to take advantage of this.

Little is known regarding the natural enemies of the Brown Booby, except for the customary depredations of the man-o'-war birds. At St. Paul Rocks great numbers of crabs move about among the nesting birds and, while they appear not to be a serious hazard to chicks, McCormick saw them carry off boobies' eggs in their claws after the sitting birds had been disturbed. At the same islets Nicoll observed how quick the crabs were to take advantage of the flying fish disgorged by the adult boobies. Reithmüller states that the nesting boobies are sometimes much troubled by ticks.

COLOMBIAN BOOBY

Sula leucogaster etesiaca

Sula etesiaca Thayer and Bangs, 1905, Bull. Mus. Comp. Zoöl., 46, No. 5, p. 92 (Gorgona Island, Colombia).

Names: This booby has been reported upon in the literature under the names *leucogaster* and *brewsteri* as well as under its own subspecific name.

Characters: Differing from the Brown Booby (*Sula leucogaster leucogaster*) in that the sexes are of dissimilar plumage, the male being gray-headed. In the female of *etesiaca* the back and wings are concolor with the head and neck, without trace of the demarcation so strongly evident in the subspecies *leucogaster*.

The male, in which subspecific characters are still more striking, is thus described from a Cocos Island specimen by Snodgrass and Heller (1902, 513):

Feathers of head just back of bare space very pale, nearly pure white above, almost immediately, however, darkening into grayish and then into brownish gray, passing from this through grayish brown on the hind neck, sides of head and throat into dark sooty brown on the back, upper surface of wings, tail and upper breast, the brown darkest on under surface of the primaries. Lower breast and belly pure white. Median lower tail coverts white, the lateral ones brown.

Snodgrass and Heller add that in the adult female the gular sac and the base of the bill are pea-green, with a slate-blue spot in front of the eye, the legs and feet light yellowish. The feet of a male are described as light pea-green.

3 males from the Pearl Islands and Cocos Island: wing, 365–382 (374.3); tail, 170–182 (178); exposed culmen, 87–95 (90.3); tarsus, 43–50 (44.2); middle toe and claw, 74–76 (75) mm.

8 females from Gorgona, the Pearl Islands, and Cocos: wing, 360–412 (390); tail, 174–191 (186); exposed culmen, 93–102 (97.8); tarsus, 44–48.5 (41); middle toe and claw, 79–83.5 (81.6) mm.

Birds in youthful plumage can be distinguished from Atlantic Brown Boobies of the same stages by the uniform coloration of their necks and backs.

Gifford (1913, 99) shows that there is a wide though by no means unusual variation in the shape

and size of the eggs, which range in form between ovate and elliptical-ovate. In a series of 24 the extremes and averages of length and breadth were as follows: 50.3–63.1 (58.7); 37.5–42.5 (39.8) mm. Four sets of two eggs each measured as follows: 53.6 x 40, 54.5 x 40; 63 x 41.6, 58.9 x 39.5; 62.5 x 39, 59.7 x 37.5; and 58.3 x 40, 55.5 x 38.2 mm.

Distribution: The humid Pacific coast of tropical America, from southern Costa Rica southward to northern Ecuador, and offshore to Cocos Island. Breeding at Gorgona Island, the Pearl Islands and elsewhere in the Gulf of Panama, as well as at Cocos.

I have noted in the account of the Atlantic Brown Booby that its close relative, the Colombian Booby, belongs exclusively to a small and humid area of the eastern tropical Pacific. The known range of this subspecies is, in fact, restricted to the oceanic bight at the northwestern corner of the South American continent. Cape San Francisco, Ecuador, probably marks the southern bounds of its distribution, while Cocos Island is the outpost farthest from the mainland shore. Just where the range of this booby terminates to northward, on the coast of Middle America, is not yet certain, but its limits will doubtless prove to be well south of the semi-arid zone of western Mexico. Specimens have thus far been taken northward and westward to a point near the delta of the Río Grande de Terraba, Costa Rica. Peters (1931, 85) states that the range of *etesiaca* probably includes the Galápagos Islands, but I believe this to be highly unlikely on zoögeographic grounds, because of the prevailing aridity of that archipelago. It is much more probable that Gifford (1913, 97) was correct in inferring that the examples of "*Sula brewsteri*" (meaning *etesiaca*) reported from the Galápagos were actually the young of *dactylatra* or of *nebouxii*. Formerly the two Brown Boobies of the western coast of America, which are today known by the subspecific names *brewsteri* and *etesiaca*, were regarded as a single form. They prove to be readily distinguishable, however, and it is exceedingly interesting to find that the birds from the dry island of Clipperton are of the former race, while those from humid Cocos are *etesiaca*.

In the climatic proclivities mentioned, there is every suggestion of a genetic difference between the boobies concerned, however closely related they may appear on ordinary taxonomic grounds. *Sula leucogaster etesiaca* everywhere lays and hatches its eggs in nests that are perpetually drenched with rain-water, and it is entirely possible—and doubtless open to experimental test—that such humid conditions are in some way necessary to its existence.

A little north of Tumaco, Colombia, and far enough at sea to be out of sight of the coast, I passed a male booby of this form, as it stood on a floating tree trunk, on the afternoon of March 13, 1925. Its white forehead was sufficient to distinguish it at long range. Females resemble more closely those of the typical race of *leucogaster*, but differ in that the neck and mantle of *etesiaca* are of a single shade of brown.

Gifford, during the California Academy Expedition, first saw this booby 50 to 60 kilometers from Cocos Island on September 1. Subsequently it was discovered that the birds flew regularly offshore in the morning, and returned to headquarters at evening. The principal colony was on a small islet at some distance from Cocos, and situated between the outliers known as Nuez and

Cascara. Only two or three of the boobies were observed on the shores of the main island.

At the Cocos colony the boobies were nesting in mid-September, one or two eggs and both naked and well-grown downy young being found at the same time in slight hollows amid grass and rocks on the steep, dripping slopes of the islet. Among the sets of eggs collected here, eight were composed of singletons and 16 of pairs. All were stained a dirty brown on account of the sodden character of the nests in a region where deluges of rain descend every day.

Thayer and Bangs (1905, 92, 141) report upon this booby at Gorgona Island, Colombia, from where it was first described, and at the Pearl Islands in the Gulf of Panama. Rendahl (1920, 10) and Sturgis (1928, 113) have added further notes from the Pearl Islands. The boobies are abundant at Pacheca and Saboga, at the northern end of this group, and also at the isolated islet of Galera, to southeastward of San Miguel. At an unstated date, Sturgis found the birds nesting on the ground among gaunt and leafless trees of Galera. The nests, which were untidy heaps of twigs, contained either two eggs or a solitary downy chick. Male and female adults were observed brooding over adjacent nests.

At Taboguilla Island, within sight of the Pacific entrance of the Panama Canal, Hallinan (1924, 306) found the Colombian Boobies breeding on December 5, 1915. The nests were constructed of sticks, fallen leaves, and a few feathers, and were placed on a rocky shelf among shrubbery and cactus. Each contained two eggs at this date. Hallinan observed a female booby in a tree with the tail of a large fish projecting from its mouth. The prey, when recovered and measured, proved to be 35 centimeters in length and about 5 in diameter.

RED-FOOTED BOOBY

Sula sula

Pelecanus Sula Linnaeus, 1766, Syst. Nat., edit. 12, 1, p. 218 (Barbados).

Names: Tree Booby, Red-faced Booby. Synonyms of the specific name include *piscator*, *rubripeda*, *erythrorhyncha*, *brasiliensis*, *candida*, *hernandezi*, *coryi*, *websteri*, *autumnalis*, and *nicolli*. A large number of subspecific names have also been applied to birds of this species.

Characters: A booby of many puzzling phases, some of which have been given taxonomic status. Adults in the white phase have an entirely white plumage except for the quills and coverts of the wings. Certain others are white with brown tails. Many of those in the brown or gray phase have white tails. The species has relatively the longest tail of any booby, and it is also the smallest member of the family occurring within the South American region.

Adults in the white phase (sexes alike except as to size and the colors of the naked face): Plumage generally white, with a somewhat variable, terminal, yellowish or "golden" tint on the feathers of the head, neck, back, and tail; primaries and their coverts, alula, greater upper wing coverts, outer webs and distal portions of secondaries blackish brown, with a hoary gray or silvery gloss on the outer webs of all; inner webs of most of these feathers paler, becoming white toward the base of the secondaries; under wing coverts white with the exception of the median and greater series, which are mostly grayish brown. Flesh colors are somewhat variable, and the sexual distinctions have not yet been fully correlated. Males have gray or whitish irides, females sometimes, or perhaps always, brown or dark yellow irides. In males the bill is bluish, red at the base, with green skin around the eyes and in the lores, but the eyelid blue; the gular sac is velvety black.

In females the center of the gular sac is gray or pinkish gray. The legs and feet of both sexes are red, variously described as "blood-red," "coral," "vermilion," "salmon-red," etc.

The so-called immature plumages, or the phases which have been given subspecific or specific names, are discussed in the text below. In many parts of the world two or more of these phases appear to be persistent throughout life. The situation is not consistent, however, for everywhere at least a small proportion of the white birds seem to be present.

Measurements of white specimens:

9 males from Navassa, Little Cayman, Fernando Noronha, and South Trinidad: wing, 362–385 (372.1); tail, 206–231 (217); exposed culmen, 76.3–85 (81.2); tarsus, 32.7–36.9 (33.7); middle toe and claw, 66.2–74.5 (69) mm.

Length, 69–76 cm.; wing-spread, 147–150 cm.

7 females from the same localities: wing, 378–405 (389); tail, 198–215 (207.4); exposed culmen, 80.5–86 (83.7); tarsus, 35–40.3 (37.3); middle toe and claw, 70–75.5 (72) mm.

Length, 72–79 cm.; wing-spread, 146–158 cm.

From the island of Fernando Noronha and other South Atlantic localities the Museum has eight examples representing the brown, white-tailed "*coryi*," "*autumnalis*," or "*nicolli*" phases. Some of these were mature enough to be nesting. Their dimensions and flesh colors agree completely with those of white birds among which they were living. In five of these specimens the tail and rump, as well as the lower belly, are entirely white. In a sixth there is a mixture of gray feathers among the rectrices, while the seventh has a tail largely gray, and with only a few whitish feathers on either side of the vent. One of them seems to be acquiring on the crown of its head a yellowish white plumage, similar to the same part in the white birds, and also white feathers among the scapulars and wing coverts.

The brown-tailed or "*websteri*" type of Red-footed Boobies, from the Galápagos and other Pacific localities, appear to differ very slightly, if at all, in size from Atlantic birds. Furthermore, fully white adults crop out at least sporadically among their populations. I have not examined a sufficient number of specimens to discuss their taxonomic status. Measurements of four are as follows:

2 males, Galápagos and Revilla Gigedo Islands: wing, 382–404 (393); tail, 189–221 (205); exposed culmen, 86–87 (86.5); tarsus, 36–37 (36.5); middle toe and claw, 75–78 (76.5) mm.

2 females, Galápagos: wing, 384–402 (392); tail, 197–211 (204); exposed culmen, 88–92 (90); tarsus, 38–40 (39); middle toe and claw, 80 mm.

In immature plumage the Red-footed Booby is wholly brownish, lighter ventrally. Examples can be readily distinguished from the somewhat similar young of the Brown Booby (*leucogaster*) by the shape of the rectrices, which are slender in the former and notably broad in the latter. The rectrices of juvenal examples of *Sula sula* are, nevertheless, broader than those of adults, whereas the primaries of the young birds, on the contrary, are narrower than those of adults. The gular sac is pinkish; the legs and feet dull yellowish.

The down is white, and the naked skin of newly hatched chicks plumbeous.

Unlike most other boobies, this species lays, as a rule, only one egg. The bluish shell is covered with a rough, lumpy, and usually much scratched chalky deposit. The form is highly variable. Bent (1922, 212) records the extreme measurements among 38 examples from various sources as 72 x 48.5, 59 x 40.5, and 69 x 35 mm. The average of the series was 62.7 x 41.4 mm.

Distribution: Breeds chiefly at islands far from continental coasts throughout the pan-tropical oceans. Within our region one or more forms of the Red-footed Booby nest at South Trinidad, Fernando Noronha, numerous Caribbean and West Indian localities, and at Cocos and the Galápagos Islands. Formerly the species inhabited also the island of Ascension, but apparently it does not at the present day.

Both the technical name and the type locality of the Red-footed Booby, a bird of wide distribution in the pan-tropical seas of the world, have been subjects of much disagreement and uncertainty. In 1915 Mathews designated Ascension Island in the Atlantic as the *terra typica* of the *Pelecanus sula* of Linnaeus, a most unfortunate choice for reasons discussed in Part I of this book

(p. 154). The decision has, however, been accepted by Peters (1931, 84) and other recent writers. Fortunately, Grant and Mackworth-Praed (1933, 185) have now shown that the correct type locality for the bird of Linnaeus is the island of Barbados, British West Indies, a district in which this booby finds an abundance of tree- and shrub-covered islands suitable for its nesting, and in which it has always remained an abundant sea fowl.

Of the three subspecies of this booby listed by Peters, only two pertain to our region, namely the typical form which is the bird of the South Atlantic and of the Caribbean-Gulf bight, and the subspecies known as *Sula sula websteri*, which is presumed to be the eastern tropical Pacific race, occupying islands from the Galápagos northward to the Revilla Gigedos.

There is more logic in the case of boobies than in that of most other Pelecaniform birds for assuming that taxonomic differences exist between examples occurring on opposite sides of the Isthmus of Panama. The reason for this is that boobies in general shy off continental coasts and, so far as I can learn, they rarely, if ever, cross extensive bodies of land. Pelicans and man-o'-war birds are familiar creatures throughout the length of the Panama Canal and the passage back and forth is so simple for them, and of such frequent occurrence, that it would be zoölogically unreasonable to expect a distinct race of either on opposite coasts of this region. The boobies, however, have achieved a measure of definite isolation by the emergence of the Isthmus of Panama as a wall which has not always existed between the Atlantic and the Pacific. In the case of at least three species of boobies, we know that this barrier has been an effective one. For example, *Sula nebouxii*, a common bird of Pacific waters in the tropical American region, is unknown from the Caribbean side. *Sula dactylatra* is represented by distinct Atlantic and Pacific subspecies. Furthermore, the Atlantic Brown Booby, which ranges from the Cape Verde Islands and Ascension westward into the Caribbean and the Gulf of Mexico, is replaced on the Pacific side of the narrow continental connectant by a peculiarly well-marked subspecies (*Sula leucogaster etesiaca*).

Under such circumstances, the simplest taxonomic treatment would doubtless be to recognize the eastern Pacific race of the Red-footed Booby as distinct from that of the Atlantic, and to treat them in two separate accounts. Nevertheless, I cannot bring myself to do this because the differences which have been so often pointed out seem to me to be ill-defined and even contradictory, and to be, in fact, of the same nature as the still unexplained individual variations to be noted among single colonies of the Red-footed Booby in practically all parts of the world.

The puzzling point about the Red-footed Booby is that birds not only exist, but apparently breed, in three distinct color phases, which may be broadly termed the white, the gray, and the brown, although such comprehensive distinctions as are implied by these names are further complicated by the variable color of the tail, which is sometimes white in gray and brown birds, etc. Age alone does not appear to offer a satisfactory explanation of these differences, for in certain localities the great bulk of the population is always gray, while at

other places the majority of the individuals are white. All attempts to base taxonomic distinctions upon these differences appear to lead to absurdities.

Grant and Mackworth-Praed (1933, 118) have sought to escape the dilemma by boldly cutting the Gordian knot. They have described as a wholly new species the "White-tailed Red-footed Booby" (*Sula nicolli*), said to differ from *Sula sula* "in having the head, neck, mantle, wings, breast, and abdomen ash-brown, with a slight gloss or sheen; the head and neck have a golden tinge and the mantle and upper side of the wings are rather darker than the rest of the plumage; . . . rump, tail, vent, and thigh-feathers white." The distribution assigned includes Madagascar, Mauritius, Raine's Island, Samoa, Navigator and Henderson Islands, and the West Indies!

In other words, these authors hold that there are *two species* of Red-footed Boobies, each distributed pretty much all over the tropical oceans and each breaking up into several subspecies. While they may be right, I can only hold that they have by no means made their case. Specimens to support my doubts are numerous, and I can refer the reader to excellent photographic portraits of both these "species" nesting at the small island of Fernando Noronha (Simmons, 1927, 69, 70), as well as to observations summarized below.

At South Trinidad, Wilson (1904, 211) observed four birds in the completely white plumage and one in brownish plumage breeding on September 13, and Ribeiro (1919, 186) has since described from this same island, under the subspecific name *autumnalis*, a breeding phase in which the head, neck, back, breast, and wings are chestnut-brown, the lower back, rump, belly, and tail yellowish white. The author states that he describes this race "for want of better solution of certain plumage problems." If the proposal of Grant and Mackworth-Praed should prove to have substantial merit, their new species would become a synonym of *Sula autumnalis* Ribeiro, unless one of the still earlier names applied to the brown, white-tailed birds should prove available.

Lowe (1912, 205) found white adults much scarcer than breeding examples in the brownish plumage at Orquilla Island in the Caribbean. Nicoll (1904, 588) collected 11 white examples and 23 dark ones from a colony at Little Cayman. At the Galápagos, according to Ridgway (1897, 598), examples of this booby with deep red feet and other evidences of maturity are all in gray plumage, including even the tails, but Beck (1904, 8), whose experience at the Galápagos is practically unparalleled, states that while the first 19 of the nesting birds may, indeed, be of this grayish type, the twentieth will be white. Beebe (1924, 313) likewise writes that at Tower Island there were both brown and white Red-footed Boobies, the pure white birds numbering only about one among forty. Other notes by Beck, still in manuscript and made during the Whitney South Sea Expedition and on certain of his earlier voyages, state that the same discrepancies and uncertainties are to be encountered throughout all of the central and western Pacific archipelagoes. Between Ducie Island and Matahiva, in the vast cluster of the Tuamotus, gray birds are prevalent, with here and there a white tail and, somewhat less frequently, a bird in pure black and white plumage. At the Revilla Gigedo group, Beck found by actual count

that 29 of the first 100 Red-footed Boobies seen were white, the others being darker in various combinations. Flesh colors of this species have been noted in the head matter, but I quote below Beebe's (1924, 320) rainbow-tinted description of the grayish or brownish birds, as he found them nesting among the trees of Tower Island, Galápagos:

> The boobies were of a beautiful gull brown with much made-up bill and face. When one of them looked down its long beak at me it reminded me more than anything else of a circus clown in full regalia. The bill was greenish-yellow shading into blue at the tip, the base of the bill and narrow forehead pink, set off by jet black pigment behind. The skin around the eye was bright blue grey, the eye itself cadmium-yellow, framed by eyelids of clear forget-me-not blue. When the bright red feet were added to this, the harlequin effect was most striking. And with it all, the bird wore an air of anxious sobriety which heightened the bizarreness of the colour scheme.

As noted in Part I, this species is the only tree- and shrub-nesting booby and, indeed, the only member of its family which has become a thoroughgoing perching bird, entirely at home even among twigs and limbs swayed by a gale of wind. Its distribution as a breeder is, therefore, determined not only by the character of the ocean surface, and the presence of flying fish which make up the bulk of its food, but also by the vegetation growing upon islands within its possible nesting range. Ascension may once have furnished it a home, but it can hardly have done so to any extent during recent centuries because of the absence of trees and bushes. Moseley's (1879, 563) record is clearly in error, for he speaks of the nests as hollows in the guano. They doubtless pertained to *Sula dactylatra*. Meliss (1875, 97) infers that it once inhabited St. Helena, which is quite likely, though the destruction of the forest cover by goats within historic times has been sufficient to banish it completely. At South Trinidad we see such a process of change actually under way, for the Red-footed Boobies still cling tenaciously to the fallen boles and broken stumps in the dead groves of *Caesalpinia*. When the last of these has finally crumbled into dust, the bird will perhaps become confined to the scrubby vegetation growing toward the crest of this high island, and its numbers will undergo progressive reduction, as they have no doubt for many decades past, owing to the dwindling number of nesting sites. At any rate, a bird which has become so well adapted during long ages for nesting in vegetation will hardly be likely to change its tastes and build its nest upon bare rock.

Throughout the West Indies, and in the eastern tropical Pacific, we can see further how environment becomes a factor in selective distribution. Bare islands are of no avail to the Red-footed Boobies, even though the waters about them teem with flying fish. The forests of Cocos and the scrub of the Revilla Gigedos and the Galápagos are alike sufficient to attract and hold breeding colonies; Clipperton Island, on the other hand, is avoided because of the absence of suitable vegetation. At certain islands a single surviving tree may serve as the last tenuous tie which keeps the Red-footed Booby among the local residents. Such an instance has been pointed out by Wetmore (1925, 100) at Laysan.

A detailed search of the literature has yielded only a single report of boobies of this species nesting anywhere other than in woody vegetation. The excep-

tion, which seems to me of particular interest, is that of Hanna (1926, 65), and refers to birds of San Benedicto Island, Revilla Gigedo group. He writes: "The Webster's [Boobies] nested chiefly in the grassy areas and built a platform one to two feet high of grass stems. . . . There were numerous birds of this species on the cliffs, but they seemed to be only resting."

Such towers of grass culms must furnish the essential jumping-off place, for Maynard (1889, 55) states that Red-footed Boobies cannot take flight from the ground, and that they usually scramble along with the aid of wings and feet until they can climb a bush and launch forth.

At nest-building time in most localities, according to the notes of Mr. Beck, the Red-footed Boobies fly about looking for sticks and twigs, frequently alighting in low bushes and on the ground to break off small branches which are carried back and passed to a bird presumed to be the female, which remains at the nest site and builds up the structure. Youthful boobies, continues Beck, frequently make very small nests, through which the egg can be seen by anyone looking up from below. Many twigs are dropped during the process of construction, and piles of such material on the ground beneath, more or less cemented together by the excrement of generations, indicate that sites are used year after year for long periods. Frequently the nests of the Red-footed Booby are built close to those of man-o'-war birds, with which it seems to live in perfect harmony at home, even though this booby is a common victim of the pirate over the surrounding sea. The trees or shrubbery furnishing the nesting site vary, of course, in different localities; mangroves, sea-grape, West Indian birch (*Claphrium simarubra*), palms, chenopodium bushes, and many other kinds of vegetation are reported to be utilized.

As a rule only one egg is laid or, if there are two, one of the chicks comes to an early—usually prenatal—end, as in the case of the Masked Booby. Fisher (1906, 797) states that at Laysan Island the slightly hollowed platform of twigs is lined with green leaves, which dry and shrivel up as incubation proceeds. He found that he could judge rather accurately of the age of an egg merely by observing the condition of these leaves. After the appearance of the egg the boobies stand their ground tightly, and will ruffle up their feathers, utter harsh cries, and lunge savagely with their bills, rather than be driven away. Peale (1848, 274) states that nesting birds definitely aim their blows at the eyes of intruders. Salvin (1864, 379) reports upon a colony on a cay off Belize, British Honduras, where in April he found four or five nests in every tree. Because of the clear sky, the lack of a sea breeze, and the thinness of foliage, the heat was here intense, and the young boobies sat panting all day with their beaks open. Some of them, apparently still more overcome, were resting with their heads hanging straight down and their eyes shut. Such chicks looked dead, but when stirred up they opened their eyes somewhat listlessly, and remained in the same posture. To emphasize the normality of such odd behavior, I quote below a similar observation by Maynard. Young birds in the Honduras colony were in every stage of growth, and abundant data show that the breeding season is either continuous or fitful, except perhaps toward the northern limit of the range.

Reithmüller (1931, 144) writes that only newly hatched chicks of this species are brooded by the parents. As soon as they become well covered with down they are left entirely alone except at feeding time. Even during the night he never observed an old bird guarding a downy chick at the nest. Maynard (1889, 52), however, reports observations at variance with this, and states that even when the young are as large as their parents it is usual to find one of the latter during the day, and both at night, sitting beside them.

Maynard's excellent observations were made at Little Cayman, between Cuba and Jamaica. Here, in March, he found the Red-footed Boobies nesting on large flat-topped sea-grape trees. The colony extended along the shore to the edge of a mangrove swamp into which, however, it penetrated for only a short distance.

> The nests were very numerous, five or six being placed on every tree; as this locality had been occupied for many years, a large number of the trees had been killed by the droppings from the birds, and on the long, naked branches, were perched thousands of Gannets, sitting side by side in rows, a motley array, consisting of all stages of plumage, from the newly fledged, wholly dark brown young, to the creamy dress of the perfect adult. Almost every nest was tenanted by a young bird, usually well grown, clad in a beautiful garment of long, pure white down, from which protruded the dark brown wings and tail, while the air was filled with hundreds of birds, departing and returning from fishing excursions, giving utterance, as they came and went, to harsh cries that were answered by those perching. . . .
>
> The most remarkable thing about this gannetry, was its situation in such close proximity, not only to the houses, but to the cocoa-nut grove in which the inhabitants were constantly at work, for the birds could have retreated to the fastnesses of the mangrove swamp, where they would have been perfectly secure from intrusion. The people, however, never disturbed the birds much, at most only taking a few eggs at the beginning of the nesting season, for cooking. . . . The presence of the Gannets was regarded favorably, as they not only killed the trees, thereby opening spaces in which cocoa-nuts could be planted, but also greatly enriched the soil.

Maynard states that the nests are ill-constructed fabrics, resembling those of the night heron (*Nycticorax*). Egg-laying at Little Cayman begins about New Year and continues at least until March. The newly hatched bare chicks are killed very quickly if they become exposed to the direct rays of the sun. Within ten days, however, they are well covered with down. Young of all sizes cling to their boughs and twigs tenaciously and the older nestlings climb about freely, aiding themselves with the bill but apparently not employing the wings for this purpose. The nestlings

> . . . are fed at first by true regurgitation, that is the fish eaten by the parents is converted into a peculiar glairy fluid which is given to the young. The old birds introduce the terminal portion of the bill into the mouths of their offspring and the liquid is literally poured down their throats. Later the fish is given to the young in half digested fragments and in the same manner, then the size of pieces is gradually increased, until finally whole fish are disgorged for them. In all cases the fish are swallowed by the adults and so carried to the gannetry.
>
> The young remain in the nests until two-thirds grown, then leave them and perch on the branches near. Here they remain until wholly fledged, and evidently for some time later. In fact, they appear to fly with considerable reluctance, sitting on the branches long after they are capable of using their wings. I have often taken such birds in my hands and by tossing them gently into air, induced them to take wing, and in all cases, when once launched, they would fly readily, frequently keeping in air for some time. On several occasions, I have seen the adult Gannets trying to compel their young to take wing, by flying against them in order to push them from the branch,

the young remonstrating by struggling and screaming lustily, but the parent would invariably accomplish its object after a trial or two.

The cry of the young to the parents, when they desire food, is a kind of chatter, much like that emitted by young herons, under similar circumstances. When annoyed they will give a harsh squak and at the same time will launch out the bill at the intruder. As in all birds, there is a large amount of individual variation in respect to disposition; some being very irritable, and these would even attempt to reach me with their bills when I was walking along the ground; others were good natured from the beginning. Such would even permit me to stroke and pet them as they sat in the trees or on the nests. The one that I kept at my house and that I afterwards carried to Kingston in company with a young Man-of-war, was very tame and soon learned to recognize me, evincing his enjoyment upon being petted by a tremulous motion of the head.

With reference to behavior of adults Maynard writes:

I could climb a tree on which a number of nests were placed, some of which contained birds that were incubating, without them taking flight; even when I was within arm's length of them they would not move, but would sit perfectly quiet, regarding me with attention. When I stretched out my hand toward them they would not even attempt to escape, but would merely bow the head downward, nearly touching the breast. They uttered no sound at this time, neither did they evince any sign of hostility. I was so completely deceived by the amiable and dove-like behavior exhibited by the first bird that I encountered, that I unhesitatingly reached out my hand to feel beneath her in order to ascertain upon what she was sitting. She maintained her state of composure until my fingers were within a foot of her, when without a moment's warning, she launched out her bill fiercely, seizing my hand with a vice-like grip. Then she almost instantly jerked back her head without opening her bill, thus cutting my hand badly above and below, with the sharp, serrated edges of the mandibles.

I did not fail to profit by this hint, and ever after carried a short stick, then when I wished to find out what a Gannet had in its nest, would push the occupant off with this weapon, at which, however, the birds were too sensible to strike. When thus forced to vacate the nest, they would seldom fly, even when there was only an egg, and never, if there were a newly hatched young. They would, in these latter named cases, simply retreat a few feet along the limb on which their domicile was placed, then would return as soon as I removed my stick and bending down, would touch their helpless offspring with the tip of their bill, repeating this several times in succession. . . .

The adult Gannets give harsh cries when annoyed, and upon returning from a fishing excursion, just before alighting, they give a series of nearly continuous croaks. Both young and adults sleep by lying down upon whatever they may be perching, often with the head hanging directly downward, the neck stretched at full length. So singular is this attitude, that the first time I saw an adult in this position, I was so sure that it was dying, that I went to it and caught hold of the head, before it was aware of my presence; the result was a surprise for both of us, the Gannet recovering with such marvelous celerity, as to astonish me, and it, in turn, retreated screaming, badly frightened at this unceremonious awakening.

Maynard found that the Red-footed Boobies would return to their colony in files or irregular wedges, made up of from three or four to a score of birds, and that they invariably came to their nests directly from the sea. In other words, they would never cross any part of the island either when setting forth empty or coming back well laden with fish. Their invariable custom was to skirt the shore at a considerable distance, and then turn at a right angle when they came abreast of their particular nests. This curious predilection gave every advantage to their enemies, the man-o'-war birds, which regularly lay in wait for the boobies between their colony and the open sea. A victim was usually singled out and harassed by from two to eight or ten man-o'-war birds, which frequently seized it by the tail or wings in the effort to make it disgorge.

Maynard believed that if the boobies could only overcome their disinclination to fly across the island they would circumvent their principal enemy, because he noticed that no man-o'-war bird ever pursued a booby which had once gained a position above the land.

At Tower Island in the Galápagos, Beebe (1924, 313) observed that these boobies flew steadily and rapidly, usually close to the water and chiefly in flocks of from eight to forty. Their flight, like that of the pelicans, was a rhythmic flap-flap-flap-flap-soarrrrrrrrrrr, flap-flap-flap-flap soarrrrrrrrrrr. Gifford (1913, 88) writes:

> The flight of the Red-footed Booby is more graceful than that of the Blue-faced, . . . , and somewhat resembles that of a large shearwater. When in the vicinity of Cocos Island and of Clarion Island, flocks of Red-footed Boobies were seen flying away from the islands in the morning and towards them in the evening. The flocks contained from six to fifteen birds. The birds fly with the same gentle, wave-like rise and fall that characterizes the flight of other members of this genus. The wing-strokes occur on the rise; on the downward swing the bird sails, in calm weather often going several yards very close to the surface of the water. The members of a flock are practically synchronous in every action.

According to Gifford, the Red-footed Booby dives in the same manner as the Blue-footed, plunging from heights up to 10 meters or thereabouts, and entering the water with wings half closed and held rigidly. On one occasion at the Galápagos he saw these birds catch flying fish on the wing by swooping into schools that were skimming along above the water. Flying fish are the best known food of the species, and Wilson (1904, 211) refers to a 15-centimeter example in the throat of a bird. Fisher, however, found many cephalopods in stomachs examined at the island of Laysan, and Beck's notes likewise report that flying fish and squids were present in equal quantity in the stomachs of Pacific specimens inspected by him. Beck confirms Gifford's observations that flying fish are sometimes captured in the air, but he adds that the greater part of them are taken by diving at times when the unfortunate fishes are being harried and driven to the surface by larger predal fish below. Beck writes, furthermore, that these boobies regularly fly to distances of more than 50 kilometers from their nests on their daily excursions. All observers appear to agree that they are not given to plunging into the coastal breakers of their home islands, as the Brown Boobies frequently do, but that they head at once for "blue waters."

Squids come to the upper layers of the ocean chiefly at night, and their presence in the stomachs of surface or aërial animals is usually an indication that such captors are more or less nocturnal or crepuscular in habit. This applies to the Red-footed Booby, for at whatever island it lives it is notorious as the last of the resident sea birds to calm down in the evening. The members of a colony also come and go during moonlit nights, and at the same time they appear to spend more of the daylight hours asleep than do any of the other species. Lowe and Kinnear (1930, 184) quote the following paragraph from entries made at South Trinidad, during July, 1910, by Dr. E. A. Wilson:

> These Gannets were by no means difficult to capture by hand. They evidently have no enemies at all on the Island for they go to sleep with their heads under their wings, either alone on a dead

tree trunk or branch, or in small colonies of half a dozen together on the evergreen bushes high up on the hillside. Here and there one found them sleeping in the hot sun in broad daylight—it was very easy to crawl quietly up to one and seize it by the neck as it awoke.

In correlation with such partially nocturnal habits, the Red-footed Booby apparently has the largest eye of any member of its family. This character has perhaps not previously been pointed out, but it shows well in all good photographs of the species, in comparison with those of other boobies, and is determinable even in the size of the ocular orifice of dried skins. The colors of the iris in relation to age, sex, phase, race, range, and individual peculiarity have a significance not yet fully worked out. They have been variously recorded as white, blue, gray, brown, and yellow.

THE CORMORANTS

FAMILY PHALACROCORACIDAE

The cormorants or shags are of almost cosmopolitan distribution but, except toward the northern and southern extremities of the world oceans where distance lessens with the converging of the meridians, they have not generally established themselves at islands remote from the continents. In other words, they are all littoral rather than pelagic sea fowl and even the southern circumpolar forms, which inhabit many of the pan-antarctic islands from South America across the Atlantic and Indian Oceans to the outliers of New Zealand, are highly sedentary. It would be reasonable to suppose that the meteorology of the west-wind zone explains the present distribution of the latter group, and that the direction of dispersal has been from west to east.

The only other cormorant which has attained notable oceanic isolation is the peculiar flightless species of the Galápagos.

In the northern hemisphere there are many cormorants of a common type which have taken to the interiors of the great continents and have thus become inland no less than coastal birds. Some of these have also penetrated southward into Africa and Australasia. South America, however, has but one species of this stamp, namely, *Phalacrocorax olivaceus*, which is doubtless an immigrant from North America and which, like its closest of kin, is equally at home in either salt water or fresh. The Flightless Cormorant, despite the profound structural gap which separates it from any other member of the family, also has many earmarks of the widespread northern-hemisphere birds which, for want of a better term, may be called the *carbo* assemblage. In the Hesperidian environment of the Galápagos Archipelago, where for long ages the climate has been bland and uniform, food abundant, competitors limited, and predacious enemies wanting, *Nannopterum* has suffered no phylogenetic inhibition against the trends which have led toward increase of size, loss of flight, and the development of a curious hair-like plumage. As an evolutionary product it may be fairly compared with the Great Auk among the Alcidae, although its degree of relative morphological departure is greater.

The remaining cormorants of the South American region are of totally different heritage from either *Nannopterum* or *Phalacrocorax olivaceus*. Leaving out of consideration the question of the ultimate origin of this ancient family, we may feel reasonably sure that the species mentioned below have no near relationship with any cormorants of the northern hemisphere. They are of a different aspect as regards plumage-pattern and minor details of structure. They are almost exclusively marine, and the historic path of their invasion of South American coasts has undoubtedly led from south to north.

First is the Red-footed Cormorant (*Phalacrocorax gaimardi*), a gray and peculiarly marked species which stands alone. Its closest relative is apparently *Phalacrocorax punctatus* of the New Zealand region, and nothing is known about its primordial introduction into South America. It is possible, of course, that both the New Zealand and South American species are peripheral relics of some form of cormorant that long ago worked its way southward along Pacific seacoasts from the holarctic region. Of at least equal weight is the fact that the present range of *gaimardi* is directly to leeward of that of *punctatus* in the west-wind belt. Even the breadth of the South Pacific might not form an insuperable barrier to direct accidental transportation from west to east in high latitudes. In any event, the present distribution of the Red-footed Cormorant extends from Atlantic Patagonia northward along the west coast through part of the Humboldt Current zone.

The other South American cormorants are all obviously of pan-antarctic origin. They are white-breasted birds, with caruncles at the base of the bill, and they comprise the two species of "blue-eyed shags" of the southern tip of the continent and adjacent antarctic coasts, a Falkland-Fuegian species (*magellanicus*), and an endemic Humboldt Current species (*bougainvillii*).

Because of the geographic relationships and consanguinity indicated, I have departed in the biographies from the systematic order of Peters (1931, 90), who separates the southern-hemisphere cormorants by unnatural lines of cleavage. The following arrangement of South American cormorants throws the species into taxonomic groups, and indicates the probable affinities of *Nannopterum* with birds of the northern hemisphere.

1. *Phalacrocorax gaimardi*
2. *Phalacrocorax atriceps*
   Phalacrocorax albiventer
   Phalacrocorax magellanicus
   Phalacrocorax bougainvillii
3. *Phalacrocorax olivaceus*
   Nannopterum harrisi

The cormorants exhibit a certain fundamental sameness in their behavior-patterns, thus demonstrating the deep-seated genetic composition in the ancestry of all. Portielje (1927, 107) has made observations on captive Common Cormorants at Amsterdam, pointing out fixed responses that mostly apply

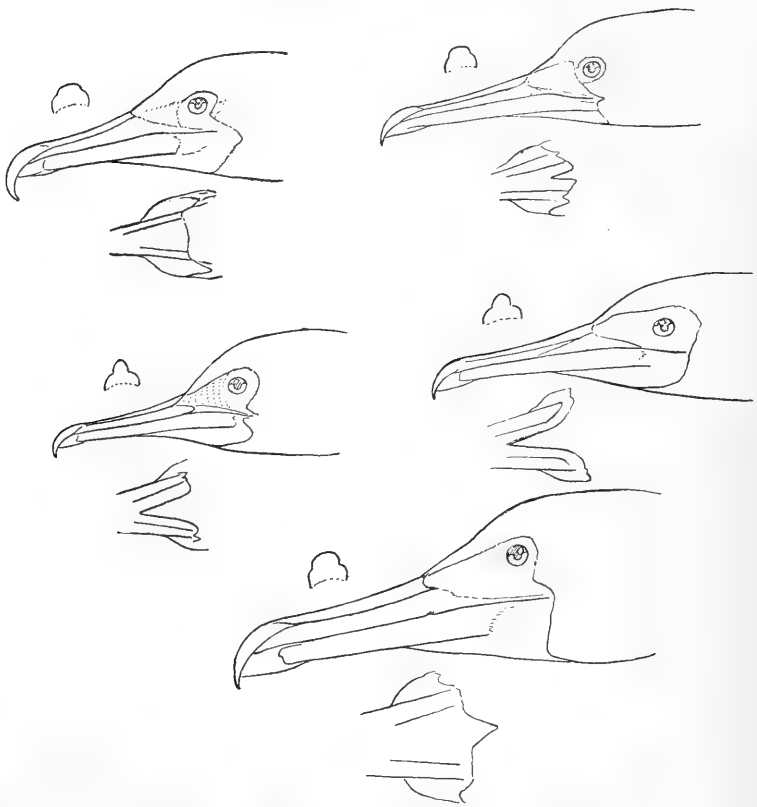


FIG. 70. Feathering of face and gular sac, and cross-section of the maxilla, in five species of South American cormorants. The sketch beneath each head shows the base of the sac of the respective species in ventral aspect.

Reading from left to right: upper two, *Phalacrocorax olivaceus olivaceus* and *P. gaimardi;* middle two, *P. magellanicus* and *P. bougainvillii;* lower drawing, *Nannopterum harrisi*. All represent males. The affinity between *magellanicus* and *bougainvillii* is clear; that between *olivaceus* and *N. harrisi* is suggestive; *gaimardi* is highly distinctive.

equally to such South American species as have been closely watched in the field. The birds are particularly lively, for example, at the beginning and end of the day. They dive and plunge in zigzag lines. In early spring the female seems to take the initiative in expression of courtship mannerisms about the time that both sexes assume the details of pre-nuptial plumage. Simultaneously they develop a new vocal repertory. The male is the first to begin to toy with

nest material, which it passes to the female, and the latter utters the mating call while arranging it. In the reaction of invitation to her mate, the female spreads the tail like a fan, bends it upward and forward, extends the head upside down along the back, at the same time swinging it from side to side, and shuffles the wings. The male puffs out the plumage of the head and neck, and distends or inflates the gular sac. Both sexes hold the beak widely open during much of their display. As noted elsewhere, many of these gestures are strikingly similar to those of petrels and their kin.

Lewis (1929) has published an exhaustive study of the Double-crested Cormorant (*Phalacrocorax auritus auritus*), which is a suggestive guide to observers of any other species. Both he (76) and Crisp (1860, 259) describe the use of the uropygial gland in the preening process, the latter author stating that the crown of the head, as well as the beak, is frequently applied to the nipples of the gland.

During long flights cormorants commonly hold their bills agape, as though increased activity of respiration were thus aided. The external nostril is, of course, almost obliterated among these birds. The osseous canal is also of very slight diameter, but the narial chamber is in free communication with the mouth (Ewart, 1881, 455).

Numerous authors have alleged that cormorants do not employ their wings for swimming beneath the surface, and F. H. Salvin (1891, 150) has shown that a captive which had had an injured wing amputated continued to catch fish as readily as its fellows. Be that as it may, we now know from abundant evidence that many if not all cormorants literally "fly" beneath the surface in the course of their longer plunges. Clay (1911, 138) has taken several Brandt's Cormorants, of western North America, from fish traps set at depths of 40 meters, and relates testimony concerning even deeper dives.

Cormorants have notoriously enormous appetites and rapid digestive powers, both traits of fish-eaters in general. Mattingley (1927, 182) has found that examples of several Australian species ingest an average of slightly more than half their weight per day. The body temperatures of various Australian cormorants were found by White (1918, 214) to range between 40.7° and 43.1° C.

RED-FOOTED SHAG

Phalacrocorax gaimardi

Pelecanus Gaimardi "Garnot" Lesson, 1828, Man. d'Orn., 2, June, p. 373 (Callao Bay, Peru).

Names: Gray, or Scarlet-footed Cormorant. The South American names are numerous and include "Chuita," "Chiquitoy," "Patillo," "Pato de Mar," and "Lile" or "Pájaro Lile." A synonym of the specific name is *cirriger*.

Characters: A gray-plumaged cormorant with an elongate white patch on each side of the neck, the naked skin of the face orange-red, and the feet coral-red.

Adults (sexes alike): Head, neck, lower back, rump, upper tail coverts, and quills of wing and tail dark neutral gray; ventral surface, caudad from throat, somewhat paler (deep neutral gray); an elongate white patch on each side of the neck, placed somewhat toward the mid-line; a few short white hackles in the post-ocular region of the head; upper back, wing coverts, and scapular feathers bearing conspicuous sagittate subterminal markings of silvery gray, distal to which each

feather is broadly bordered with blackish; the size of the gray areas increases caudad, and on the longer coverts occupies the greater part of each feather. Iris green, surrounded on the lid by 16 pale blue, jewel-like spots, 10 above and 6 below the eye; bill distally horn-yellow, blending into orange toward the base; gular sac orange-red; legs and feet coral-red.

The horny mandible of this cormorant extends caudad quite to the angle of the mouth. Among other South American species a soft integument covers the mandible at least as far forward as the position of the eye. The arrangement of feathering about the eye, lores, and gular pouch is likewise peculiar, although approached to a certain extent in *P. magellanicus*.

10 males from Peru and Chile: wing, 240–254 (248); tail, 92–101 (97.2); exposed culmen, 55–62 (58.2); tarsus, 50–54 (52.2); outer toe and claw, 91–98 (94) mm.

8 females: wing, 232–245 (239); tail, 92–103 (97.5); exposed culmen, 55.5–62 (58.8); tarsus, 50–54 (51.4); outer toe and claw, 89–96.5 (91.6) mm.

Specimens of this cormorant in the flesh weighed between 1304 and 1417 grams (Coker, 1919, 480).

In immature examples the plumage is generally brown, the wing coverts and under parts being mottled with brownish white; the white patches on the neck are always at least faintly indicated. Birds in juvenal plumage are paler, and have whitish throats and a conspicuous sprinkling of white plumules on the center of the throat and the sides of the neck. The down of nestlings is largely brownish drab.

Eggs number 2, 3, or 4, and are usually of somewhat elongate form. The color of the shell is pale blue, more or less concealed by an unevenly distributed white chalky coating. Two examples recorded by Coker measured 63 x 38 and 64 x 39 mm.

Distribution: Coasts of southern and western South America, from the Macabí and Guañape Islands, Peru, southward to the Strait of Magellan, and northward along the Atlantic coast to the vicinity of Puerto Deseado, Argentina. The species seems to be rare in the Strait of Magellan, although it was described from there (as *Phalacrocorax cirriger* King) in 1829. Its breeding sites include both islands and cliffy parts of the continental coast.

The Red-footed Cormorant or "Chuita" is recognizable from its scarlet feet and face, its gray plumage, the elongate white markings on the sides of its neck, and its high-pitched chirping voice which seems very "unseabird-like." It is peculiar to southern and western South America, but its blood relationship seems to be closer with a New Zealand cormorant (*Phalacrocorax punctatus*) than with any species of the New World.

The "Strait of Magellan" or "Chile" are often cited as the type locality of this cormorant, but Garnot's account leaves no doubt that the birds upon which the original description and plate were based came from central Peru. He states, "Ce beau cormoran habite les bords de la rade Callao," and that it is particularly common on the rocks of San Lorenzo Island. Its distribution appears not to carry it as far as the northern end of the Humboldt Current. There are thus no records for the Lobos Islands, though on February 2, 1920, I saw two examples off Macabí Island (7° 50′ S.). Only slightly to southward, at Guañape (8° 36′ S.), it is an abundant resident. From here it remains a common bird down the west coast at least as far as Chiloé Island. Mr. Bullock found it abundant and nesting at Mocha Island, its homes being built on ledges of promontories or rocky islets against the bases of which the sea pounded. On November 20, 1932, he took five sets of three eggs each on a headland known as Punta Cuervos.

Throughout the Magellanic waterways the Red-footed Shag is relatively scarce, but it appears again in numbers along the Atlantic coast of Patagonia.

On May 11, 1915, Beck found the species plentiful at the mouth of the Río Santa Cruz, noting in his journal that he had last seen it at Ancúd, Chile. To northward these cormorants have been recorded from Port San Julián (Hellmayr, 1932, 296), and as breeding on the Isla del Cañadon in the estuary of the Río Deseado (Renard, 1931, 412; Doello-Jurado, 1917, 11). The last-named authority found about 250 nests containing eggs and fledglings during February, 1916. Renard reports that the breeding season was still in full swing here at the opposite season of the year, in July.

Two facts are noteworthy: first, that the Chuita is a strictly continental cormorant, unknown from the Falklands, the outlying Fuegian islets, and the oceanic islands off the Pacific coast; and second, that it is a distinctly sub-antarctic intrusion into the Humboldt Current zone, which it does not occupy in full.

During my own field work and that of Mr. Beck, nesting Chuitas were encountered at more than a score of cliffy insular and mainland localities between North Guañape Island and the rocks off Ancúd. It is safe to assume that not one of the Peruvian guano islands lacks a few pairs engaged in some part of the reproductive process during every month of the year. South Guañape, the Huaura group, the Pescadores, San Lorenzo and its outliers, the Chinchas and Ballestas, San Gallán, Vieja, and Santa Rosa were all centers of abundance. At South Guañape this species shared the whole periphery of the island with Inca Terns, leaving the crown exclusively to the Peruvian Boobies. In a cave on Guaca, of the Pescadores, and in the gorge of a neighboring split islet known as San Pedro, the Chuitas were nesting so thickly during December, 1919, that they formed practically a colony, which is exceptional on the part of this "hermit" species. Furthermore, in the largest of the sea caves at North Chincha I found several nests only a few meters apart.

The notes of Paessler (1909, 102), in conjunction with numerous specimens in the American Museum Collection, indicate that the status of the Chuita along the desert coast of Chile is similar to that in Peru.

Coker (1919, 480), whose important studies of the guano birds I have constantly drawn upon, has given an interesting ecological comparison between the three species of cormorants inhabiting the Peruvian littoral. These are the Guanay (*Phalacrocorax bougainvillii*), the Cuervo or Bigüá (*P. olivaceus*), and the present species, which he calls the "Patillo." He writes:

> The three species of cormorants above described offer a striking illustration of the adaptability of nature. Three birds closely related, within the same genus in fact, dwelling in the same localities and not differing greatly in size, afford such striking contrasts in habits and appearance, as may be expressed in the following analysis.
>
> *Social habit.*—The one herds in enormous flocks, another forms small groups, while the third is never seen except singly or in pairs. Of the two extremes, the patillo is always thought of as an individual, even though chance might bring several birds together, but the individuality of the guanay is always lost in the multitude.
>
> *Breeding habit.*—The one nests crudely on the broad expanses of the island tops, another on the rough outlying rocks, while the third finds isolated homes on the cliffs or in the caverns where it constructs strong and secure nests of variously collected materials.
>
> *Feeding habit.*—The one flies out in great flocks to swim on the surface and dive for prey in the schools of surface fishes; another watches from its low perches or dives down to capture the fishes

of the bottoms near shore; while the third often makes long single flights before diving in search of eels or other fish or for nest-building materials.

Voice.—The one utters a distinctive croak, the second makes a harsh guttural grunt, while the third has a high-pitched voice of the timbre of a song bird.

Color.—The guanay has a shiny black back and glossy white breast, the cuervo is dark and of almost uniform coloring, and the patillo is of generally variegated color with white stripes and scarlet feet.

The patillo (*P. gaimardi*) is rather remarkable among cormorants for the entire absence of any disposition to gregariousness, and it is the most specialized of the three in its well-developed habit of nest construction and its instinct of protection of young, shown in the choice of location for the home.

Without wishing to gainsay Coker's correct understanding as to the essentially solitary predilections of the Chuita, I must report that it does, on occasion, form bands or small flocks. Several such are mentioned in the literature, as by Cunningham (1871, 365). Mr. Jaques observed "strings of as many as twenty" in the bay of Callao, and Beck saw larger aggregations at Corral, Chile. On January 24, 1920, between Salaverry and the Guañape Islands, I noted many groups of from 6 to 20 on the ocean, and two compact flocks of 16 and 30 birds, respectively, in flight.

The Chuita is a familiar feature of the seascape, found equally along the coastal steamship lanes offshore and on every buoy and lighter in the west coast roadsteads, but never entering fresh water.

One meets them floating lazily yet watchfully on the water, occasionally flapping wings or ducking beneath the surface as enjoying a bath, or making a sudden dive for prey to come up with a fish or a wriggling eel, which is swallowed only after a little struggle. They seem to be peculiarly successful eel catchers, as I have many times seen them with such prey. . . .

Their flight is characteristic—low and straight. The appearance of intentness in flight is accentuated by the series of three conspicuous streaks in series; the orange and red bill, the white neck stripe, and the scarlet legs and feet lying straight back beneath the tail. The whole manner is that of one with predetermined course eagerly seeking a certain destination. I never saw one turn its head aside, as the swift gannet will do to investigate an observer. A very slight bend of the neck is sufficient for reconnoissance or for determining a change of course. Their short wings make flight a more strenuous and absorbing affair than for the gannet. Thus, as I have counted them, the wing strokes of the patillo, a minute, are from 250 to 300, as against 160 to 170 for the gannet, 150 to 190 for gulls of different species, and 140 to 150 for the pelican.

The home of the patillo is on the bold cliffs and in the caverns, and the body color would give effective concealment against the rocky walls except for the brighter markings of the legs and the neck of the adults. As one approaches an apparently bare rocky wall rising above the surf, small bright red spots in pairs with three or four rays may be distinguished against the gray background of the rocks. If low down, they may easily be mistaken for starfishes or the red-legged crabs left by the tide, but these are the legs and feet of the patillo. When one is a little closer a white spot is made out some distance above the red. The eye and the imagination may then fill out the form of the bird between the white neck stripes and the scarlet feet. The young birds against a rocky wall are almost indistinguishable even when one knows the exact location of the nest. When in flight, the bright skin colors and the neck stripe, together with the characteristic manner of flight, makes this bird most easily recognized even at a great distance.

A surprising characteristic of the patillo is its cry, which is entirely unlike that of the ordinary cormorants that utter a coarse grunt or croak. When flying from the nest it often gives a high-pitched repeated chirp, somewhat like the note of the sparrow. This undoubtedly accounts for the common name sometimes used, "chuita," a name entirely more suggestive of a peewee than of a cormorant (Coker, 1919, 480).

The nest, built on some small bracket or ledge of a cliff, is composed of a variety of seaweeds, of many leathery worm tubes, of straw, feathers, string, or any other accessible and suitable material. The worm tubes are especially important because they bind together the looser materials, giving the nest strength and stability in its precarious position. Coker writes:

> One nest was weighed, although, unfortunately more than a third of the material had been lost in removing it from the side of the cliff. The amount saved was found to weigh 8 pounds, and the complete nest must have weighed over 12 pounds. It was composed of *Ulva* and of various brown and red seaweeds, but the bulk of the total material was a chocolate brown weed with white tips, probably *Corallina chilensis*. The worm tubes, however, formed a very considerable portion, constituting 2¾ pounds or one third of the material saved.

From the rocks of Central Chincha in October, 1919, I could watch individual Chuitas diving for both food and nesting materials. When gathering the latter they would plunge repeatedly to the bottom in depths of from 8 to 10 meters, emerging each time with a larger bunch of seaweed and tubes of marine worms in their bills. How they kept a grasp on the accumulated spoils is a mystery, but they would not fly to the chosen home-site until they had garnered a generous billful.

All observers who have sometimes found more than two eggs in a nest agree with me that only two black downy young are reared. The nestlings seem more alert than those of most cormorants, soon learning to stand up on straight legs on their trampled mattress, and moving their heads with rapid, nervous, peering gestures.

The breeding season seems to be absolutely continuous. At the Pescadores Islands, in December, I saw fledglings in flight while many adults were still collecting nest lumber and whizzing across the water with their bills full. At the same place in April Beck found the same medley of behavior, as Pickering also did at San Lorenzo Island (Cassin, 1858, 376).

Since the Chuita is of no value as a producer of guano, because of its habit of nesting on the cliffs and in the caverns, neither law nor sentiment protects it, and it therefore suffers the plight of a preferred "game bird" of the maritime Indians. I was once served with boiled nestlings, but the dish left me with no taste for more. Two destructive pieces of apparatus seem to be part of the habiliments of all the guano island guardians—men who would go to almost any length to see that no harm came to the commercially valuable birds under their special charge. One of these is a pole of bamboo or sugar cane, with a fishhook lashed to the end; the other is the long surcingle of webbing which supports their trousers. With the hook they yank the unfortunate young Chuitas from their ledges, and with the strap they make a noose for hauling penguins out of their holes. Singly or in combination, indeed, the pole and strap are put to a variety of nefarious purposes, but the average inaccessibility of Chuita nests is sufficient to save the species from serious depletion.

Other than men, the Chuitas have no apparent enemies. Possibly their ectoparasites may at times bring about a natural reduction in numbers, for of these cormorants in Chile, Gay (1847, 489) has quaintly written, "Se empiojan

y mueren muchísimos por agosto"—in August they get lousy and perish mightily!

Regarding their food, I have quoted above the observations of Coker. It appears, however, that the famous "anchoveta" (*Engraulis ringens*) is a staple of this as of so many other sea birds along the coast of Peru. Four Chuita stomachs that I sent to the United States Biological Survey contained only this fish—one of them 28 examples—together with a few parasitic isopods (*Anilocra plebia*).

The Blue-Eyed Shags

The blue-eyed shags—more exactly blue-eyelidded, for the iris is brown—comprise a circumpolar group of rather sedentary cormorants, the interrelationships of which are still very imperfectly understood. In the Pan-Antarctic Zone there are about a dozen distinct forms, which have been variously listed as species and subspecies. A conservative taxonomic arrangement would admit perhaps four or five species, but future research may revise such a figure downward. Outside the limits of sub-antarctic surface waters are certain related or derived cormorants, of which the famous Guanay (*Phalacrocorax bougainvillii*) of the Humboldt Current is presumably one.

The typical pan-antarctic representatives, to which we shall here confine our attention, have been distinguished by the subgeneric name *Leucocarbo* of Bonaparte. Of them Falla (1932, 144) has recently written:

> The cormorants inhabiting high southern latitudes and grouped in three areas, namely, South America and its sub-antarctic quadrant, the South Indian Ocean, and the sub-antarctic coasts and islands of New Zealand, are generally regarded as distinguishable from other cormorants by well-marked external characters shared by most of them. These characters are the fleshy ring of blue skin surrounding the eye, the frequent presence of dorsal and alar patches of white feathers, the brightly metallic plumage of the upper parts, and flesh-coloured feet. This last point, the colouration of the feet, has been a source of much confusion in descriptions, and most published coloured plates are unreliable in this respect. It would now appear that the feet of blue-eyed shags are all some shade of pink in life. It has recently been accurately reproduced by L. H. Matthews (1929, pl. XLVII) in the case of *P. georgianus*. In dried skins the feet of all the species I have examined dry to a rich orange brown, which is perhaps responsible for the frequent occurrence of "feet orange" in descriptions. Literature of this group by various writers during the nineteenth century is not always reliable, on account of inaccurate determination and lack of comparative material, a disadvantage that still persists to some extent.

The first known of the blue-eyed shags was *Phalacrocorax carunculatus*, described by Gmelin in 1789. It is supposed to be confined to New Zealand and its outlying sub-antarctic islands. In its general plan of color and pattern, however, it closely resembles the South American members of the group, and it is noteworthy that the old-time sealers applied one name, "King Shag," to both Old- and New-World representatives.

In the American quadrant blue-eyed shags are of antarctic as well as sub-antarctic range. Indeed, in the Antarctic Archipelago they nest as far southward as any birds except, perhaps, the Emperor and Adélie Penguins and the South Polar Skua. The shag of this antarctic district is *Phalacrocorax atriceps*,

which also reaches South Georgia and continental South America and which, according to Peters (1931, 92), is practically circumpolar, with a subspecies at Macquarie Island, southwest of New Zealand. This allegation at least tends to cast suspicion upon the specific distinctness of the shags inhabiting the Crozet Islands and Kerguelen, which are stations of similar latitude along the west-wind route of avian distribution.

A second American species of the assemblage is *Phalacrocorax albiventer*, of Tierra del Fuego, the Atlantic coast of Patagonia, and the Falkland Islands. No subspecies of this cormorant have been described, but it has been much confused with one or more of the races of *P. atriceps*, particularly with the form inhabiting the Fuegian islands, where the ranges of *albiventer* and *atriceps* overlap. Very recently, Reynolds (1935, 81) has written as follows:

> I cannot distinguish between [the birds of] such colonies as that breeding in the centre of Tierra del Fuego (Lake Yewin) and the colony north of Hermite Island. I, therefore, do not see that *P. albiventer* is segregated in breeding colonies anywhere on Tierra del Fuego. . . . The only Cormorants which I am inclined to recognize for Tierra del Fuego are the three species listed above [*olivaceus*, *magellanicus*, *atriceps*], with the possible inclusion of *P. a. albiventer* of the Falklands as either a rare vagrant or as a poorly segregated race, which, if it breeds at Tierra del Fuego, mixes with the typical form. The records of *P. a. albiventer* from Tierra del Fuego should, I suspect, be regarded as variations of *P. a. atriceps* (age and season?).

Reynolds states, furthermore, that among examples of *P. atriceps* in all the Fuegian breeding colonies there is much variation in the proportionate areas covered by the dark dorsal and the white ventral plumage on the side of the neck. The condition, as will appear below, is concerned with characters supposed to distinguish *atriceps* from *albiventer*.

Now, while the remarks of Reynolds, who has had extraordinarily great field experience, serve to point out the difficulties of the problem, I cannot believe that there is but one species of blue-eyed shag in the Fuegian region. Typical examples of what I consider to be two species were, for example, shot on the same date by Beck at Magallanes in the Strait of Magellan. To be sure, the species *atriceps* and *albiventer* are exceedingly similar birds. Their differences are of the grade ordinarily marking subspecies, but the fact that the two apparently share a common breeding ground in southernmost South America makes it necessary to regard them as more distinct than they superficially appear. The real differences between closely related species doubtless lie more particularly in physiological composition, in metabolism, in tolerances and other reactions to environment, than they do in the color and pattern of their plumages. It is altogether likely that *atriceps* and *albiventer* have a strongly marked divergence in behavior which has not yet been adequately pointed out.

The two species, as represented by topotypical birds in the Brewster-Sanford Collection (viz., *albiventer* from the Falkland Islands, *atriceps* from the Strait of Magellan) show no detectable differences in average dimensions. The principal visible distinctions between them are reduced to two: (1) the line dividing dark from light plumage on the side of the head is high in *atriceps*, while in *albiventer* it cuts across the cheeks; (2) *atriceps* acquires after the breeding season

a squarish patch of white feathers on the back, while in *albiventer* this mark never appears. In the light of present probabilities, I am therefore treating the South American blue-eyed shags as representing two species, realizing at the same time that it may never be possible properly to allocate some of the earlier published observations between them.

The typical race of *Phalacrocorax atriceps* is continental and sub-antarctic, but it seems highly probable that there are also two or more American antarctic subspecies. The shag of South Georgia, for instance, is somewhat intermediate between *atriceps* and *albiventer* with respect to the line separating black dorsal from white ventral plumage. In the acquisition of a white patch on the back it agrees wholly with *atriceps*, but it has a much shorter bill and larger caruncles than the South American form. It was originally described as *Phalacrocorax atriceps georgianus*, a subspecific status which is probably as close to the truth as it is possible to come at present, for the characters by which I once thought to link it more closely with *albiventer* (Murphy, 1916, 32) prove not to be valid.

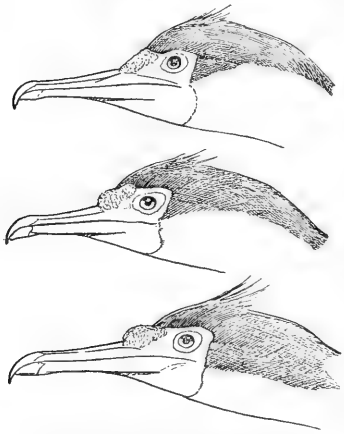


FIG. 71. Heads of three forms of "blue-eyed shags," to show the line of demarcation between dark and light plumage and the characteristic size of the excrescence at the base of the maxilla. Upper, *Phalacrocorax atriceps atriceps* (Chiloé Island); middle, *P. a. georgianus* (South Georgia); lower, *P. albiventer* (Caroline Island, Tierra del Fuego).

Of the blue-eyed shag inhabiting the Antarctic Archipelago, and islands of the Scotia Arc to southward of South Georgia, I have seen only a few specimens collected by Mr. A. G. Bennett and Mr. Lincoln Ellsworth. This somewhat inadequate material, in conjunction with the measurements published by Valette (1906, 58), Clarke (1913, 247) and Gain (1914, 74), indicate that the antarctic race is characterized by a much longer bill than the South Georgia representative and a longer tail than any other race. It is even possible that the South Orkneys and South Shetlands may each prove to harbor an endemic race, which would not be surprising in view of the sedentary behavior of cormorants of this group.

Among all the American blue-eyed shags, males average slightly but consistently larger than females, although the sexes are alike in appearance. The largest series among our American Museum specimens chance to be made up of females, and the following table, which includes certain figures taken from Gain, shows the relative sizes and proportions of several forms. Since Gain's measurements of tarsus and foot were evidently taken in a manner differing from my own, I have omitted these dimensions in the case of the birds from the Antarctic Archipelago.

	Wing	Tail	Culmen	Bill from gape	Depth of maxilla	Tarsus	Outer toe and claw
P. atriceps atriceps 10 females, continental South America . . .	271.4	121.4	57.8	87	8.6	60	100.3 mm.
P. atriceps georgianus 5 females, South Georgia	275	118.6	48.4	71.6	7.9	59	102
P. atriceps, subspecies 2 females, South Shetlands	302	132	56.2	86.1		65.2	100.3
P. atriceps, subspecies 7 females, Antarctic Archipelago (Gain) . .	311	185	56				
P. albiventer 12 females, Falkland Is., and the Fuegian region	276	121	58.1	85.3	8.6	61.1	102.5

In closing these general remarks upon a poorly understood group, I must hark back to a suspicion hinted at above, namely, that perhaps no more than two species of blue-eyed shags, divided along latitudinal convergences, and each with subspecies at numerous islands, may ultimately prove to encircle the southern oceans and to include all the New Zealand as well as the American forms.

MAGELLANIC BLUE-EYED SHAG

Phalacrocorax atriceps atriceps

Phalacrocorax atriceps King, 1828, Zoöl. Journ., 4, p. 102 (Strait of Magellan).

Names: Crested or White-necked Shag or Cormorant; Imperial Shag; "Lile Imperial," "Yeco." Synonyms of the specific name include *imperialis*, *cirrhatus*, *elegans*, and *caruncula tus*.

Characters: A blue-backed, white-breasted, crested cormorant, with a long white alar bar over the bones of the mid-wing during the breeding season, a white dorsal patch in post-nuptial plumage, and brightly colored caruncles at the base of the bill. Among South American examples the caruncles are of lesser size than in *P. albiventer*, but adult specimens of *atriceps* from the Antarctic Zone have large caruncles and represent a distinct race. From *albiventer* the typical form of this species may be distinguished by the course of the demarcation between black and white plumage on the side of the head (as figured), the ear opening being covered by white feathers.

Adults (sexes alike): Dorsal surface black, with metallic green, blue, and violet sheen; the luster is dull violet on occiput and neck, green-blue on forehead and crest, dusky blue on back, rump and flanks, rich dark bottle-green on scapulars and wings; the scapulars, interscapulars, and lesser coverts have a scaled appearance, each green feather bearing a narrow glossy bluish border; quills of wing and tail blackish brown, with a greenish tinge when new; shafts of rectrices basally white; a white alar bar, composed of lesser coverts, extends for from 8 to 12 cm., along the radial border of the wing during the nesting period; under wing coverts and thighs dusky, with a slight metallic gloss; entire ventral surface white, the plumage of the throat projecting in a point on to the gular pouch to a position about under the eye. Iris brown; naked skin around eye blue (variously described as cobalt, French blue, ultramarine, etc.); nasal caruncles yellow (sometimes gamboge or orange), and never developing as conspicuous wattles; bill olive or horny brownish; gular pouch sooty, with a sprinkling of fine yellow warty spots which give it a yellowish or greenish cast; legs and feet pinkish or salmon, brownish on the joints and soles and with blackish claws.

3 males (Chiloé Island and Magallanes); wing, 282–287 (284); tail, 117–131 (124); exposed culmen, 59–64 (61.8); bill from gape, 85–96 (92); depth of maxilla, 9–10 (9.5); tarsus, 64–66 (64.7); outer toe and claw, 107–109 (108) mm.

10 females (Corral, Mocha Island, and Chiloé Island): wing, 258–282 (271.4); tail, 112–132 (121.4); exposed culmen, 55–60 (57.8); bill from gape, 83–90 (87); depth of maxilla, 8–9.5 (8.6); tarsus, 57–63 (60); outer toe and claw, 97–103 (100.3) mm.

The crest attains a length of 60 mm. or more.

The juvenal plumage is sufficiently indicated by descriptions of the same stage under one of the following subspecies, which apparently do not differ. The caruncles of youthful birds are not tumid, and are mingled with feathers. Nestlings are clad in blackish down, and the naked young have black wrinkled skin.

The eggs are greenish white and resemble those of related forms. Beck collected none, and I find no published record of dimensions.

Distribution: Breeding from the southernmost of the Fuegian islets, near Cape Horn, northward along the Pacific coast to Mocha Island, and to Santa María Island in the Bay of Arauco (latitude 37° S.); on the Atlantic coast northward to the Río Santa Cruz or beyond. Related races occur at certain islands of the Scotia Arc and in the West Antarctic Archipelago.

Observers agree that the Magellanic Blue-eyed Shag is the most abundant cormorant throughout the labyrinthine channels of southernmost South America, from which region its northerly extension is chiefly along the physiographically similar Pacific coast. Reynolds (1935, 80) writes that during December he found some of the basaltic rocks north of Grévy Island, of the Wollaston group, packed with incredible hordes of these birds. He adds that the species

> . . . was probably breeding on two of the higher pinnacles of rock jutting out of the sea about the Barnevelt Islands. The only place, however, where nests were definitely investigated was at a rock in the channel north of Hermite Island. Numbers of a red shrimp were found disgorged about the nests. The colony was a small one, with only thirty or forty nests, many of which were deserted. There were perhaps ten nests with eggs and about a dozen young birds, some almost as large as the adults and nearly fledged. The smaller chicks were, of course, naked and helpless, but the elder youngsters left the nests, struggling to climb into other structures higher up by hooking their bills over the edge and scratching helplessly with their feet. On giving up the attempt some hid in the rocks, while others simply stood by awaiting developments. The young are covered with thick black down, including the breast, the ends of the growing rectrices in some cases abraded brownish, and the basal two-thirds of the bill bluish-grey, especially pale, and sometimes pinkish, on the lower mandible.
>
> Immature birds in comparatively dull plumage, with the black extending far down on the side of the face and less white on the neck, were equally plentiful with adults in breeding dress.

The final comment in this quotation is doubtless made with reference to the opinion of Reynolds that *P. atriceps* and *P. albiventer* are doubtfully distinct.

In an earlier paper Reynolds (1934, 349) has reported that many of these shags nest likewise on a low and stony islet in Lake Yewin, which is north of Lake Cami in the heart of southern Tierra del Fuego. Here, in early January, 1932, he found adults with and without the white dorsal patch, well-grown chicks, and nests with eggs, all of which is indicative of the somewhat prolonged breeding season of the species.

Mr. Bullock found the Magellanic Blue-eyed Shag nesting abundantly on the flattish tops of islets and promontories at Mocha Island, Chile, during November, 1932. Sets of three eggs were just being completed about the middle

of the month. The inhabitants of Mocha called the species "Guanay," a name applied elsewhere along the west coast of South America to the Peruvian Cormorant, which the Mocha folk know as the "Cholo." Bullock's observations comprise the northernmost positive breeding record for *atriceps*, although he believes that he also saw birds of this species nesting at Santa María Island, in the Bay of Arauco, during December.

During the Brewster-Sanford Expedition, Beck's collections of specimens of the Blue-eyed Shag were made at Corral, near Ancúd on Chiloé Island, and at Magallanes in the Strait of Magellan. His observations were, however, far more extensive, and are worthy of brief summation.

1914

April 23. Common at the mouth of the river near Ancúd, mingling with black shags (*P. olivaceus*).

July 4. Numbers in the Gulf of Peñas.

November 30 to December 9. Present or plentiful at London, Timbales, Thomas, and Caroline Islands along the southwestern coast of Tierra del Fuego.

December 17. Hundreds on their nests along ledges of inaccessible cliffs at Black Point, Hoste Island, with tufts of tussock grass hanging from each nest. The rows of nests were chiefly in undercuts, where softer rock had eroded away more rapidly than overlying layers of basalt.

December 20 and 24. Fishing in numbers along the coast of Hermite Island, and in Lort Bay, False Cape Horn.

December 29. Large numbers nesting on the precipices and pinnacles at Cloven Cliff, the southwestern point of Horn Island.

1915

January 18. Flocks flying in from rookeries on the windward coast to feed in the sheltered waters around Smoke Island, south of the Brecknock Peninsula.

February 27. Magallanes. Blue-eyed shags fishing for "sardines," with black-browed albatrosses and other ocean fowl, in the Strait of Magellan.

April 7–11. Fledgling shags now common in Lort Bay, False Cape Horn, fishing for "shrimps" all about the schooner at anchor. They are worried by a few young kelp gulls, which seek to snatch food from their beaks as they emerge. High winds, however, put the gulls to rout, while the young shags merely float, shaking the water out of their eyes after the chops have broken over them. If they attempt to rise, they are swept rapidly to leeward.

May 1. Hundreds on the rocks together at Almirante Brown Bay, Gable Island, Beagle Channel.

May 11. Flocks flying from sea at evening toward the estuary of the Río Santa Cruz, Argentina.

July 23–29. Observed at Navarino Island, near Ushuaia in Beagle Channel, and along all neighboring waterways.

August 2. Thousands off Harberton Harbor, Beagle Channel.

August 4–6. Many fishing in the Strait of Le Maire, and off the Atlantic Fuegian coast to northward. They swim low in the water, with the tail practically submerged, and leap upward when diving. The reappearance of a bird is usually in an unexpected or unpredictable place.

In view of the uncertainties regarding the status of *Phalacrocorax albiventer* in the Magellanic district, one can hardly be sure that all of the field references actually apply to *atriceps*. However, it was in all probability the latter species which Cunningham (1871, 271) encountered at Santa Magdalena Island, which lies in the middle of the Strait of Magellan, just south of the Second Narrows, and not far from Elizabeth or Isabel Island. This author wrote:

. . . Pursuing our way over the island, we ere long reached some large hollows, which cormorants (*Phalacrocorax carunculatus*) had adopted as breeding-places. The birds were there congregated in their nests literally in thousands, forming a dense black mass covering a space of many yards; and, on being disturbed, rose into the air in a cloud, winnowing it with their wings so as to produce a sound resembling that of a strong breeze blowing, and almost concealing the heavens from view; while a number of skua gulls, associated with them, gave vent to a tumult of discordant cries. Their nests were regularly shaped flattened mounds, slightly excavated on the upper surface, and ranged in almost mathematical series, exactly a foot of space intervening between each nest. They were formed of dried grass and other herbage baked into a solid mass with earth and guano; and the generality contained from one to three greenish-white eggs about the size of that of a domestic fowl, and with a rough chalky surface.

At Quartermaster Island, which lies on the Fuegian side of the Strait, in the entrance of Jente Grande Bay, Cunningham found a roosting or resting place of these cormorants, where there were no nests, but where upwards of a thousand of the birds stood erect, in regular ranks. On the plateau above the cliffs, the grass had been worn off by their tramplings and the smell of decaying fish was insupportable.

The South American examples of *P. atriceps* are not devoid of nasal caruncles, as has been stated in some of the literature, though these are apparently never as prominently developed as among the antarctic race or races of the same species. Neither do they attain the size of the caruncles in *P. albiventer*. Furthermore, the continental form of *atriceps* exhibits during the courtship season as luxuriant a crest as any other race of blue-eyed shag. The usual condition of the three purely seasonal plumage characteristics of adult birds, allowing for a certain amount of lag and individual variation, is illustrated by the following table:

Season	Crest	Alar bar	Dorsal patch
Pre-nuptial	maximum	absent	absent
Egg-laying	abraded	present	incipient
Rearing of young	lost	maximum	maximum

Moulting begins early during the nesting period, as with most other cormorants. The quills are first dropped and replaced, followed by the loss of the worn body plumage, and the quick growth of the patch of white feathers on the back. The latter is a short-lived post-nuptial mark. Quite possibly, in a species which has such a relatively long breeding season, it serves the cormorants as an effective signal that wearers of the patch have passed the point of being receptive toward amatory advances. The last traces of the patch may linger until May, or thereabouts.

The most active part of the moult occurs in the late southern summer, that is, between March and June. By the end of the latter month the birds are in splendid new plumage, with highly iridescent backs, very long crests (reaching 58 millimeters in a female collected at Ancúd on June 15), and no trace of either the white patch on the back or *the white alar bar*. Both the back of the neck and the white sides of the neck become flecked with decomposed white feathers,

some of which may attain a length of 30 millimeters, but which are soon lost. A similar patch of feathers sometimes appears above and behind the eye. At the same season (June–July) the gonads begin to enlarge, showing that, in *P. atriceps* and related species, the height of plumage should not be called a "breeding" garb, but rather a pre-nuptial plumage, at its best during the early part of the rather lengthy courtship which precedes the nesting season. With the approach of actual mating, the white alar bar, which is a true breeding mark, develops. This is demonstrated by September and October birds, which show considerable traces of wear, and which had already shed or worn off the longer plumes of their crests. The replacement of the tail quills and remiges is usually not completed until the end of the breeding season. Some specimens show the new feathers still growing in April.

Young birds do not put on fully mature plumage, *i. e.* without trace of brown, until the second year. It is probable from the appearance of nesting colonies that they do not breed as yearlings. Nevertheless, a more or less definite trace of the white dorsal patch appears after the moult of the second summer.

SOUTH GEORGIAN BLUE-EYED SHAG

Phalacrocorax atriceps georgianus

Phalacrocorax atriceps georgianus Lönnberg 1906, Kungl. Svensk. Vetens. Akad. Handl., 40, No. 5, p. 69 (South Georgia).

Characters: Differing from *P. a. atriceps* of the Magellanic district in its markedly shorter bill, extremely well-developed caruncles, and in the fact that the demarcation between dark and white plumage on the side of the head is more ventrad, crossing the ear opening.

Iris hair brown, lightening to gray at its periphery; cornea chocolate; skin surrounding eye cyanine blue; bare skin of lores and throat blackish brown; caruncles deep chrome; legs and feet salmon, the under side of toes clove-brown.

I have measured no adult males, which are presumably somewhat larger than females.

5 females: wing, 270–278 (275); tail, 116–122 (118.6); exposed culmen, 44–51 (48.4); bill from gape, 70–75 (71.6); tarsus, 58–60 (59); outer toe and claw, 100–104 (102) mm.

The maximum length of the crest among the five females is 46 mm. Lönnberg records a length of 60 mm. in a male.

Newly hatched, naked chicks have livid skin, which turns nearly black within an hour or so, through oxidation of the pigment. The gular pouch is pinkish, the mandibles slaty blue, the feet and legs plumbeous. Within five days tufts of fuscous down appear, covering first the back and neck. Simultaneously the quills of wing and tail sprout as bristly plumules. Finally, tufts of white down grow out amid the darker down of the belly, throat, and pileum. The mesoptyle envelopment is prevailingly fuscous, the face alone remaining bare.

After five weeks, moult of the down exposes the dull greenish feathers of the back. At an age of seven weeks little down remains except on the neck. A line of pale-edged feathers then indicates the position of the alar bar; the breast is white save for a few dark flecks; the head and neck are sprinkled with white filoplumes, especially above and behind the eye; the rectrices have grown to a length of 12 cm., despite active wear, but the primaries are still short and fresh. The caruncles are not developed in young birds, but are represented by a brownish, papillate area.

Eggs number either two or three. They are pale dull glaucous blue, with the usual chalky incrustation. Our only specimens have been broken so that they cannot be measured.

Distribution: South Georgia, and Shag Rocks (?).

At the date of the discovery of South Georgia, in January, 1775, Captain James Cook wrote, "The shags and soundings were our best pilots." As soon

as he had passed off soundings in the fog, he saw no more shags. Elsewhere the great explorer recorded that these birds rarely go "more than half a mile from their rocks." All of this is indicative of the sedentary habits of the shags, the resulting isolation of the colonies, and the evolution of two or more races in the American quadrant of Antarctica. I myself never saw shags on the whaling banks off the northeastern coast of South Georgia, where most of the other resident sea fowl abound.

When a vessel first draws close to the island, however, the shags are likely to be the first creatures from the land to welcome it (von den Steinen, 1890, 267). Matthews (1929, 584) notes that they have a habit of flying toward the modern South Georgian whaling steamers, and then of progressing slowly, close to the crow's nest at the masthead. At such times they are knocked down to the deck by the man on watch and are subsequently served in the whalemen's mess.

All naturalists who have visited South Georgia since the time of the German Expedition of 1882 have found that the Blue-eyed Shags breed chiefly in small colonies of from ten to twenty pairs, building nests on grassy ledges of the sea cliffs both of the main island and the islets offshore. Often the nests are more or less screened by drooping tussock, but white blotches of guano below them are likely to indicate their position. The nests, which are bulky, are constructed of seaweed, grass, mud, and droppings. The first eggs are laid after the middle of November, and the period of incubation appears to be in the neighborhood of five weeks. In the fiords the shags are seen in groups numbering up to about thirty birds, particularly after the end of the nesting season, when the white blazoning on their backs—like an athlete's "number"—makes the adults conspicuous.

Nothing is known about the taxonomic status of the cormorants which form a great colony on the Shag Rocks, far to westward of South Georgia, for the Swedish Antarctic Expedition, which reported its presence, failed to obtain a specimen (Andersson, 1908, 38).

On my own visit to South Georgia, I saw the first Blue-eyed Shags along the northerly coast on November 24, 1912. The morning was exceptionally clear and calm, and most of the cormorants were swimming about among small bergs and areas of floe-ice. When rising into flight, they kicked heavily along the surface for considerable distances, seeming to strike with both feet at once. They flew in string formation, a dozen or more together, and often spread their broad webs to serve as an adjunct to the tail, especially when stopping headway. Their flight seemed to be more or less aimless, for they were inclined to travel in circles.

In mid-December I found the breeding grounds of the shags on a precipitous islet lying near the south shore of the Bay of Isles. Here I landed on one of the first calm days, December 29, and clambered to the top, where the rock was covered with thick black humus and a luxuriant growth of tussock grass. A pair of pipits inhabited the small plateau, and also a few burrowing whalebirds (*Pachyptila*), to judge by the dismembered skeletons that had been scattered about by skuas; but the principal residents were shags, the nests of which

lined the rocky and grassy ledges all over the northerly or sunny face of the declivity.

The nests were steep-sided, truncated cones, with a small but deep depression. In height they measured from 20 to 25 centimeters, the outside diameter at the rim being about 40. Some were balanced on the tops of dead tussock hummocks; others rested more stably on the shelves of lichen-covered rock, with long and dripping icicles overhanging them. The area around each nest was whitened to a distance of 2 meters by the birds' ejecta.

Many nests contained sets of two or three eggs, others young birds just hatched or a few days old, and yet another three practically full-grown fledglings which had lost nearly all their down. Two or three pairs of adults had apparently not yet laid eggs, and stood upon their empty homes engaged in courtship antics.

Both parents were together at most of the nests. I lifted off one female which had been brooding with her wings spread, and discovered a blind, bare shaglet, the eggshell from which it had just crawled, and another egg not yet broken open. It was impossible to keep either parent away from the nest, although the male was less fearless and persistent than his mate. Both adults were gentle, not attempting to defend themselves against handling; they merely watched me sharply with their close-set, blue-rimmed eyes, bringing both to bear in common focus for a few moments at a time, and then turning the head to gaze with a single eye. The only note they uttered was a soft croak. They kept their bills parted, however, the mandible and throat trembling rapidly in the familiar cormorant reaction. Whenever I tossed a parent aside in order to see the nestling, it would fly back immediately, and the female would always settle down upon the nest. The male, less broody, once brought up a billful of fresh peaty soil, which it worked into the edge of the nest at my very feet.

The ugly chick, which was the center of all this solicitude, behaved as though it were in a tantrum. It jerked and snapped about the nest bowl, rolling belly upward, and squeaked loudly all the while.

The courtship or connubial behavior of the shags continued while the nests were building. Pairs stood side by side, curtseying. The birds would put their cheeks close together, bow down their heads and necks, then, twisting their necks, put the other cheeks together in the same way, and curtsey again. After this graceful minuet had continued for several minutes, the male would launch off on a short exuberant flight, from which it would return to resume the love-making.

A few days later I visited the islet again. The shags were still together in pairs, twisting and curving their necks without cessation. Most of the eggs had now hatched. It was again evident that females had more pronounced inhibitions than males against leaving the young in the face of the stimulus of my approach. A territorial response was noted when one pair attacked and bit the neck of a neighbor which had alighted upon their particular crag.

On January 11, 1913, I made a third visit to the colony. Two young which had hatched, respectively, on December 29 and a day or two later were now

well covered with blackish tufts of down, but they still showed a slight size difference correlated with age. I found one set of three wholly fresh eggs; another nest contained two chicks just hatched and an addled egg. The parents seemed conditioned to stronger broodiness than ever, though in each case it was the female which tolerated prolonged stroking, while the male retreated to the far side of his mate, yet still remaining within arm's reach. Undisturbed birds were bowing, caressing, and circling as usual, besides which they sometimes stretched up and beat their wings rapidly, without producing any drumming sound.

My last landing at the islet was on February 16, when most of the youngsters had begun to acquire greenish quills and white breasts, and were wandering away from their nests among the high hummocks. These chicks had a low, mellow whistle which they repeated over and over, swelling out their throats. The breeding ledges had by this time become foul with decayed fish remains and excreta. The parent birds were rather less confident than when the young had been helpless, but the females still exhibited far less timidity than the males.

My last view of a shag colony was on the face of a cliff at Possession Bay, where the adults were still caressing and curtseying as late as March 2.

The only observed food of the South Georgian Blue-eyed Shag was fish of the genus *Notothenia*, which the birds obtained by diving among the beds of kelp. One taken from the throat and mouth of a shag shot at the surface measured 27 centimeters in length.

Many of the nesting shags proved to be infested with a species of tick (*Ceratixodes putus*), the bags of which were about 6 millimeters long. Five such were taken from the blue feathering on the neck of one incubating female.

ANTARCTIC BLUE-EYED SHAG

Phalacrocorax atriceps, subspecies

Characters: Resembling *P. a. atriceps* and *P. a. georgianus*, but with a longer bill than the latter, larger caruncles than the former, and a longer tail than either. The line of demarcation between dark and white plumage on the side of the head resembles the condition in the South American, rather than the South Georgian, birds. Flesh colors of South Shetland adults are described as: iris pale brown; bill olive to sooty; caruncles yellow; gular pouch sooty, with fine yellowish specks; eyelids cobalt-blue; feet flesh color, with an olive wash.

2 males, South Shetlands: wing, 312–314; tail, 127.8–138.5; exposed culmen, 56.2–59; bill from gape, 87.1–89; tarsus, 66.4–68; outer toe and claw, 106 mm.

2 females, South Shetlands: wing, 293–311; tail, 131.5; exposed culmen, 55–57.5; bill from gape, 82.3–90; tarsus, 64.6–65.8; outer toe and claw, 100.3 mm.

The total length of these four in the flesh ranged between 730 and 826 mm.

Gain's (1914, 74) published measurements of shags from the Antarctic Archipelago are notable for the tail-lengths. His figures are:

6 males: wing, 305–322 (312.5); tail, 179–208 (191); exposed culmen, 55–61 (58) mm.

7 females: wing, 302–330 (311); tail, 162–208 (185); exposed culmen, 51–62 (56.5) mm.

The total length among these 13 specimens ranged between 725 and 842, and the wing-spread between 1170 and 1320 mm.

Among South Orkney specimens, Clarke (1913, 247) records a weight of 2948 grams for males, a maximum bill-length of 63.6, and a maximum crest-length of about 45 mm.

Young stages do not differ materially from those of South Georgian shags.

Eggs from the South Orkneys are described by Clarke as measuring from 51 to 67 mm. in length

by 41 in breadth. Four collected by the French Expedition at Port Lockroy, at the southern end of De Gerlache Strait, measured 64 x 39, 68.5 x 42.5, 60 x 42, and 64.5 x 42 mm., and weighed from 57 to 63 grams.

Distribution (one or more subspecies ?): The southerly islands of the Scotia Arc, including the South Sandwich, South Orkney, and South Shetland groups; and the islands of the Antarctic Archipelago southward to latitude 65° S., or beyond.

From Mr. A. G. Bennett and Mr. Lincoln Ellsworth the American Museum has received several examples of Antarctic Shags from the South Shetlands and neighboring regions. Five from Wilhemina Bay (latitude 64° 30′ S., longitude 62° W.), collected during January, 1922, comprise four adults and a half-grown downy chick. The male in best plumage had passed its breeding period and has a white dorsal patch 10 centimeters wide and seven in anteroposterior diameter, partly concealed by the overlapping wings. The three other adults are moulting, and show clearly the bleaching effect of the antarctic light. Some of the old quills of wing and tail have become practically white, the result resembling that produced by the same agency in the plumage of skuas. The chick is a counterpart of young birds from South Georgia.

Mr. Bennett has labeled these specimens with a doubtless deserved subspecific name, *bransfieldensis*, which seems, however, never to have been published. In view of the systematic work that remains to be done with the shags from various parts of West Antarctica, I prefer to attempt no further discrimination at present.

At the South Orkneys the members of the 'Scotia' expedition found large numbers of Blue-eyed Shags in 1903, as reported by Clarke and by Brown, Mossman, and Pirie (1906, 120, 172). Birds were seen throughout the year, although an autumn emigration took the bulk of them just far enough to northward or westward to keep them in touch with open water. Whenever leads opened around the South Orkneys or in the pack-ice to southward, well-ordered lines and wedges of several score shags could promptly be seen passing high in air toward the new feeding grounds.

During the summer season the shags avoided the main islands, but nested by hundreds on rocks and pinnacles off Laurie and Saddle Islands. Clarke (1913, 246) writes:

On August 2nd a flock containing several thousands, probably early immigrants, was seen from the *Scotia* as she lay in her winter-quarters.

The first eggs were obtained on November 8th, on a small islet some forty feet high situated off the north coast of Laurie Island, where a few Ringed Penguins were also nesting. The nests were well-built structures composed of seaweed, moss, lichens, and feathers. Some of the birds were still engaged in nest-building, and were diving and bringing up masses of seaweed in their bills, while others were busily engaged in picking mosses and lichens off the rocks. They were great thieves, even worse than the penguins, for when the more timid of the nest-builders retreated on the approach of the explorers, the bolder birds immediately carried off the momentarily deserted materials for their own use. A few only of the nests contained eggs, mostly one apiece, though some had two; and the conclusion was arrived at that the birds had only just commenced laying. Many of the nests were on rocks, some of them in the sites of previous years; while others were on pinnacles of ice, having been built on snow which had gradually thawed away all round the nest, but not at its base. The sitting birds were very confiding, and allowed themselves to be

stroked on their nests. On the following day, November 9th, another nesting colony was found on a small bare islet. Here many of the nests contained three eggs, and the rock between them was in a terribly unsavoury condition. The usual number of eggs was two, but three were not unfrequent.

Clarke also well describes the seasonal sequence of peculiar nuptial and non-breeding characters, the crest and nasal caruncles being best developed in September, a duller aspect and a white dorsal emblem becoming current by late December or January.

In the Antarctic Archipelago the shags have been studied by numerous observers, including the naturalists of the Swedish and of two French Expeditions. Important among the accounts are those of Menegaux (1907, 26), Andersson (1908, 38), and particularly the informing and meticulous record of Gain (1914, 74).

The distribution of the cormorant throughout this region is very similar to that of the Gentoo Penguin. It inhabits both coasts of the long peninsuloid chain of islands and, in common with other organisms, extends farther southward along the westerly or milder shore line. It is never seen far from land, or from the heavy pack-ice which in winter becomes the ecological and meteorological equivalent of land. Consequently the migratory movements of the cormorants have a lesser oscillation than those of penguins, and they have been observed in flocks during midwinter near such localities as Booth-Wandel Island (beyond 65° S.), and Snow Hill Island on the Weddell Sea side. Gain states that lone birds or small groups, which seemed to have the function of "scouts," were all winter to be seen flying hither and thither, high overhead, as if in search of new open water.

At their breeding grounds the cormorants are intimates of the *Pygoscelis* penguins, the nests often being close together or intermingled. Steep slopes are the preferred sites of the shags, the crater-like nests, which are built about half a meter apart, therefore forming series of terraces. Andersson reports communities of as many as a thousand adult birds on rocks near Trinity and Cockburn Islands.

The reproductive season begins somewhat earlier than in the less severe environment of South Georgia. The Swedish naturalists observed apparent mass interest in the old nesting grounds on July 12, when the thermometer stood at −22° C. In August the shags at Paulet Island became sufficiently stimulated to snuggle down in their weathered nests, but subsequent cold, dark, and stormy weather made such behavior prove abortive. Definite courtship is usually under way about the first of September, and by the middle of the month the building or rebuilding of the nests commences. Combat is rare, in sharp contrast with the custom of penguins, and it seems likely that old sites are to a great extent reappropriated by their former owners, and even that many individuals retain or reacquire the same mates year after year.

While one member of a pair stands guard, the other hies to ice-free water to gather reddish algae. Thievery of nest material is universal, and observers agree that the shags are even more adept kleptomaniacs than their notorious neighbors, the penguins. Bones, feathers, soil when available, and pebbles are mixed with the seaweed in building.

Menegaux writes that at Booth-Wandel nest-construction ceased about three o'clock each afternoon, after which the mated couples, which probably abstain largely or wholly from feeding throughout this period, stood together on their foundations and engaged in a reciprocal pantomime such as I have described for the South Georgian Shags. The indication of a definite diurnal rhythm in the patterns of reproductive behavior is highly interesting and merits further study. Among these shags, by the way, it harmonizes with what is known about their daily feeding and resting rhythms.

The first eggs appear about the end of October, two or three constituting the usual set, though more have occasionally been found in one nest. The chicks conspicuously outgrow the penguins that hatch along with them, so that by the last days of the calendar year the young shags have an almost adult look, while many of the penguins are still downy babies. Nevertheless, the shaglets remain long on their trampled nests, and not until March do they appear to undertake any fishing for themselves. Thereafter old and young depart together toward Bransfield Strait, or other bodies of open water, setting forth about eight o'clock in the morning and returning *en masse* not later than four in the afternoon. Rough water may bring them in much earlier, or cause them to remain at home. When approaching the nesting ground these shags characteristically swoop toward the ground, which they barely skim until the final rise, circling, and descent which ends at the nest.

The naturalists of Dr. Charcot's party banded various young and old shags at several of the West Antarctic breeding grounds. On November 26, 1909, as related by Gain, nine of ten adults that had been banded during the same season of the previous year were discovered again at the Wiencke Island colony, a most remarkable instance of both homing and survival. Banded yearlings proved too shy for satisfactory observation, whereas the adults could be handled at will as soon as the magnetic pull of the nest had taken possession of them. However, Gain saw indications that broods of the preceding season's young, which had attained an age of 11 months or more, still showed a tendency to follow and associate with their own parents after the latter had begun a new courtship and had long since passed out of the annual "mothering" cycle.

The principal enemy of the Antarctic Shags is the sea-leopard. The skuas also victimize them, sometimes snatching fish from their beaks the instant after they have risen to the surface. Fish naturally make up the bulk of the shags' food, but euphausians and other crustaceans have been found in their stomachs, which also often contain pebbles and nematode parasites.

KING SHAG

Phalacrocorax albiventer

Carbo albiventer Lesson, 1831, Traité d'Orn., livr. 8, p. 604 (Falkland Islands).

Names: White-necked Shag; Falkland Blue-eyed Shag. Synonyms of the specific name include *carunculatus*, *verrucosus*, *cirrhatus*, and *purpurascens*.

Characters: Similar to *Phalacrocorax atriceps*, but the purple-black plumage on the side of the head extends ventrad to a line on a level with the commissure of the bill, besides which no white

dorsal patch develops at any time of year. The white alar bar in this species is less extensive than in *atriceps*, and the caruncles at the base of the maxilla are more prominently developed than in the typical or South American race of *atriceps*. The plumage sequences, including the seasonal appearance and disappearance of the crest and the alar bar, are similar to those of *atriceps*.

Iris brown (not "green," as has been sometimes recorded); bill horny brown; "skin round the eyes campanula-blue; cockles at the base of the upper mandible, saffron mixed with gamboge-yellow; marks between the eye and the corner of the mouth, orpiment orange" (Darwin); feet flesh color, with brownish webs and soles.

11 males from the Falkland Islands, the coast of Patagonia, and Tierra del Fuego: wing, 273–293 (284); tail, 112–140 (125); exposed culmen, 56–64 (60.4); bill from gape, 83–94 (87.5); depth of maxilla, 8–9 (8.5); tarsus, 60–64 (61.6); outer toe and claw, 100–109 (104.3) mm.

12 females: wing, 266–285 (276); tail, 99–133 (121); exposed culmen, 54–60 (58.1); bill from gape, 77–92 (85.3); depth of maxilla, 8.6; tarsus, 58.5–64 (61.1); outer toe and claw, 99–106 (102.5) mm.

Downy young are of an almost uniform clove-brown color, only the head and neck being slightly darker than the remainder of the body. By the time the contour feathers of wings and back appear, there is a sprinkling of white filoplumes on the crown and belly. From this stage the nestlings moult into a plumage which is white speckled with grayish brown on the under surface, and dull brown, with faint suggestions of green, above. The down clings longest on the neck. The new feathers of the wings and lower back are edged with grayish white, and they are more pointed than the corresponding feathers of adult plumage. This, the true juvenal plumage, is followed by a partial post-juvenal moult, which includes the tail feathers and which clothes the bird in its first winter plumage, similar to that of the adult, but far less rich. The breast still retains a few streaks and spots of grayish brown. This new feathering, which is the first winter plumage, is worn a year. No long crest or large caruncles develop until the second year.

Sets of two and three fresh eggs collected by Beck at Bleaker Island, Falklands, on December 23, 1915, are pale Nile-green, moderately plastered over with a smooth white chalky incrustation. They are prevailingly very elongate, though several are ovate but with sharp smaller ends. Five sets measure: 66.8 x 37.8, 64.3 x 38.9; 63.4 x 38.5, 63.6 x 37.4, 65 x 37.2; 61.2 x 41, 62.8 x 38.8, 62 x 40.5; 60.9 x 38.9, 59.3 x 38.8, 59.2 x 39.1; and 62.8 x 38.5, 65.2 x 40, 65.1 x 40.9 mm. These figures agree well with those of Vallentin (1924, 329) for Falkland eggs, and with those of eggs from Staten Island ascribed to this species of shag (Hartert and Venturi, 1909, 241).

Distribution: Breeding at the Falkland Islands, and along the Atlantic coast of Patagonia from Puerto San Julián southward. The breeding status in the Fuegian region is uncertain, but the species occurs throughout at least the easterly and southerly parts, from the Strait of Magellan to Cape Horn, and also at Staten Island. It wanders regularly or casually northward along the Atlantic coast of the continent, reaching the Province of Buenos Aires every winter (Daguerre, 1922, 265). Examples have been taken at the mouth of the Río Negro (Wetmore, 1926, 412), in the Gulf of la Plata, and on the coast of Uruguay (Devincenzi, 1929, 6).

As a resident of the Falkland Islands, the King Shag presents no taxonomic or distributional difficulties other than those concerned with the relationships among the whole group of circumpolar, blue-eyed cormorants, which is badly in need of a general revision. The species is the only cormorant of its kind at the Falklands, where birds which have white cheeks and which develop white dorsal patches (*i. e.*, *atriceps*) have apparently never been found.

On the continent and in Tierra del Fuego, the problem becomes complicated, as pointed out above in the words of Reynolds, because there are apparently two kinds of blue-eyed shags which, in certain stages of plumage, can perhaps not be distinguished. It is even possible that hybridization takes place, but the question can hardly be solved until more facts come to light.

At any rate, during the Brewster-Sanford Expedition Beck collected abso-

lutely typical examples of *Phalacrocorax albiventer* in the Strait of Magellan, in the Beagle Channel, at Caroline, London, and Bertrand Islands, and at Cape Horn itself, in addition to the series he obtained at Bleaker and Kidney Islands of the Falklands. Furthermore, the few specimens of fully adult shags that I have seen from Coy Inlet, Puerto San Julián, and other localities along the Patagonian coast, are definitely *albiventer* and not *atriceps*. There are likewise many older records of *albiventer* from eastern Tierra del Fuego and Staten Island, such as those of Oustalet (1891, 144) and Salvadori (1900, 627).

Mr. Beck collected two specimens at sea east of Puerto San Julián on September 15, 1915, and recorded others off the Río Gallegos during the same month. On September 28, 1914, while working off Mar del Plata, Argentina, he saw several small flocks pass in the distance. His other notes on the species were all made at the Falkland Islands.

The height of the King Shag's pre-nuptial plumage comes with the beginning of enlargement of the gonads, in July, August, and September, when adults have swollen and brilliant caruncles, recurved crests composed of 40 or more plumes and measuring up to 60 millimeters in length, and little if any trace of the white alar bar. The latter develops rapidly as nesting begins, and at the same time the crest is reduced through a combination of moulting and disintegration of the feathers. Substantial traces of a crest are, however, more common among birds with young than is true in the case of *Phalacrocorax atriceps*. Among some King Shags the total extent of plumage wear during the breeding season is very marked, while others come through only lightly scathed. At this period the quills are replaced, and the new primaries do not ordinarily reach their maximum length until well into the following winter season (July or August). Young birds in first winter plumage, that is, after the post-juvenal moult which replaces the abraded and bedraggled tail quills worn in the nest, often have longer rectrices than they will ever put forth again. The wing in this species, as among its relatives, is very rounded, the three primaries succeeding the outermost being of subequal length, and the fifth not greatly shorter than the outermost.

When Mr. Beck approached the Falkland Islands from the Strait of Magellan, in July, 1914, the first King Shags were encountered about 30 kilometers offshore. At later dates he found the birds common in Falkland Sound, and visited colonies at Cochon and Kidney Islands (November, 1915), East and Bleaker Islands (December), and West Point Island (January, 1916). The following notes on the life history of the species are taken in part from Beck's journal and in part from the published text of Vallentin (1924, 329) and Cobb (1910, 67; 1934, 71).

The shags sometimes nest indiscriminately among Rockhopper Penguins and Black-browed Albatrosses. Again, they form huge colonies of "pure culture," on flattish, terraced rock, or on ground once covered with tussock grass. At the north end of Bleaker Island Beck found such an aggregation of fully a thousand pairs on December 13, 1915. The dense flocks moving along the water as they fished offshore reminded him of masses of shearwaters.

When the shags are courting, according to Cobb's sprightly account, the male will hold the female's head gently in his large open bill, and the two will sway from side to side. The birds will then bow, kiss, and nibble each other about the head, and utter sundry grunts and coos, and a blowing sort of whistle.

The sound of a large colony during nest-building time in October is responsible for the Falkland simile "to make a noise like a shag rookery." At close range it is a deafening din. The pungent smell, moreover, advertises the location of the colony a long way to leeward. The time is one of incessant coming and going of birds with bunches of seaweed in their bills, and in wet weather the mud, slush, and filth are appalling. Cobb writes that many spotless shirt-fronts become sadly soiled with splashes from dirty seaweed "pinched" from some nest when the owner's head is turned. Smart tails are dragged through puddles, like long skirts by careless ladies.

Tussock bog fiber is much used for nest material, and an army of male shags works at rooting it up with the bills. The males bring it to their mates, which snatch it and tuck it carefully about them, all the while making a murmuring *o-o-o-o-o*. Grass, mud, and algae also enter into the construction of the well-built homes. Streamers of kelp may be seen festooned around some of the nests, which are raised high above the ground, so that the brooding shags usually keep clean despite the Augean surroundings. The small bowls seem ample enough for the three eggs, but hopelessly outgrown by the time the downy nestlings begin to expand over their edges.

Why one shag—usually if not always the female—remains at the site during nest-construction is shown by the alacrity with which an abandoned nest is pillaged and razed by the surrounding workers. All of this is likely to go on under the nose of a human observer, for the behavior of nesting King Shags is almost as nonchalant as that of barnyard fowls.

Egg-laying begins at the Falklands during the last few days of October, but the height of the season is not reached until late November or December. The eggs are less heavily incrusted with chalk than those of the Rock Shag (*P. magellanicus*). Fanning (1924, reprint, 56) states that they have blood-red yolks and are too fishy to eat. Incubation begins when the first egg appears, with the usual result that the chicks are of assorted sizes, being hatched two or three days apart. They begin to fly, according to Cobb, about three months after the date of egg-laying.

The exodus of population from a shag rookery is reminiscent of the movements of sheep, for when one shag flies off to sea others are likely to follow by hundreds within a few moments, streaming low over the water. On the rocks these shags occasionally stand with their wings spread to the sun and the wind, in the manner of so many other kinds of cormorants. When sleeping, they sometimes lay the head on the back. They spend much time at their toilet, bathing in pools of rainwater, scratching their heads with their nails while afloat, preening and oiling their feathers, making marvelous contortions of their long necks in the process, and sometimes smoothing off with their large feet. The

nibbling which they give to each other's heads and necks seems also to be a part of the preening régime (Cobb).

At Bleaker Island, where Beck visited the large King Shag rookery in mid-December, he found thirty or more Sheath-bills (*Chionis alba*) hanging about the margins, now and then making forays among the nests in search of all sorts of scraps and droppings. The shags paid little attention to such small neighbors but, on the other hand, they were keenly aware of the dozen or so skuas which were patiently watching for uncovered eggs. The shags always faced front toward the skuas, in consequence of which groups of the former presented a uniform attitude at such a time, and showed as black, white, or piebald, according to the standpoint from which they were viewed. In the absence of such a focal stimulus as a skua, the ordinary direction of brooding shags was that of weathercocks, facing the wind.

During the winter season, Cobb reports, many King Shags are found dead or dying along Falkland beaches. The same is true of *Phalacrocorax magellanicus* in Tierra del Fuego, as related in the biography of that species. It is all suggestive of the pandemic types of disease which periodically affect other sorts of colonial cormorants, such as the Peruvian Guanay.

Fish of various unidentified sorts, and small crustaceans of both free-swimming and bottom types, have been found in the stomachs of King Shags.

ROCK SHAG

Phalacrocorax magellanicus

Pelecanus magellanicus Gmelin, 1789, Syst. Nat., 1, pt. 2, p. 576 (Tierra del Fuego and Staten Island).

Names: Magellanic Shag. "Nigaud" or "Ninny" is the sailors' name, according to Oustalet (1891, 151). "Lile del Sur" appears in some of the Chilean literature. Synonyms of the specific name include *sarmientonus*, *erythrops*, *leucotis*, *mentalis*, *penicillatus*, *ater*, and perhaps *eumegethes*.

Characters: This species has the weakest bill, with the smallest dertrum, of all South American cormorants. Head, neck, and dorsal surface greenish black in breeding plumage, but chin, throat, and fore neck white during the winter. A small but conspicuous auricular tuft of white feathers. The wing is exceptionally rounded.

Adults (sexes alike): Head and neck black, with steel-blue gloss, which becomes purple with wear, and with a scattering of white filoplumes; a pre-nuptial crest upon the head, of which the longest feathers are lighter and more brilliant, verging toward green, and attaining a length of about 50 mm.; a conspicuous patch of white feathers on the ear coverts; interscapular region and wings bottle-green, each feather narrowly margined with a darker hue; lower back, rump, upper and under tail coverts, flanks, and thighs black, with more or less steel-blue gloss, all of these parts interspersed with long white filamentous feathers and tufts; remainder of ventral surface, including the chest, white; quills of wing and tail brownish black, with a slight gloss on the outer webs, all of them, particularly the rectrices, fading and fraying greatly with wear. Iris red (at least while the adults are breeding); bill blackish; gular pouch and lores brick-red, flecked with yellow scale-like excrescences, which give the face an orange cast; legs and feet flesh color, the toes darker.

In post-nuptial plumage the throat becomes white, and the crest and white fleckings are lost. The sequences are discussed further in the text.

10 males from the Magellanic region (Caroline, London, Navarino, and Bertrand Islands; Beagle Channel; Chiloé Island): wing, 245–258 (252.6); tail, 128–155 (141); exposed culmen, 48.5–54.5 (52.6); bill from gape, 68.5–79; tarsus, 52.5–54 (53.5); outer toe and claw, 88–95 (91.4) mm.

20 females: wing, 237–255 (244); tail, 123–146 (134.4); exposed culmen, 48–55 (52); bill from gape, 70–78; tarsus, 49–53 (51.2); outer toe and claw, 85–91 (88.2) mm.

5 males from the Falklands: wing, 233–263 (251.4); tail, 127–142 (134); exposed culmen, 51.5–54 (53); bill from gape, 72–76; tarsus, 51.5–54 (52); outer toe and claw, 89–95 (91) mm.

9 females: wing, 236–255 (246.4); tail, 129–134 (130); exposed culmen, 46–51.5 (49); bill from gape, 69–73; tarsus, 49–53 (51); outer toe and claw, 86–89 (87.4) mm.

Young birds have the iris brown; subsequent changes may be due not entirely to age but also to the incipience of the breeding period, or to other causes, for very full notes on the labels of specimens collected by Beck indicate that there is the following sequence or variation in the color of the iris among birds from any one locality: brown, dull orange, yellowish, whitish, white, pink, red.

The legs and feet of young birds are blackish, changing to flesh color, with dark toes, as they mature. The transformation is very gradual, and in the examination of specimens it can apparently be used as a criterion of age. The plumage sequences of the young have apparently never been described and are reserved for the text below.

The eggs number from 2 to 5, 3 being perhaps commonest. The form varies between cylindrical ovate and elongate-ovate, and the color of the shell is a faint greenish or bluish white, with the usual chalky and blistered surface. At East Island of the Falklands Beck collected one set of 2, two of 3, and one of 5, on December 10, 1915. The average measurements of these 13 eggs are 62.4 x 37.9 mm. The longest and widest eggs, respectively, measure 69.1 x 37.8 and 59.5 x 39.8 and the two smallest, 55.8 x 37.2 and 65.2 x 36.5 mm.

Distribution: Falkland Islands and the southerly coasts of South America, from the Río Santa Cruz, Argentina, to the vicinity of Corral, Chile. According to Hellmayr (1932, 300) the breeding range on the west coast is on islands from Llanquihue southward. The species has been casually recorded from near Talcaguano (Paessler, 1914, 272), and at least once from Valparaiso (Schalow, 1898, 681).

The Rock Shag is a relatively sluggish and sedentary cormorant which inhabits the winding coast lines and hidden channels of southern South America. It is particularly common throughout the Strait of Magellan and connecting waterways, southward quite to islands behind Cape Horn. The structure of its wing seems to be correlated with its habits and habitat, for this organ is much more rounded than that of cormorants which brave the winds of the open ocean around the antarctic islands or along the coast of Peru. In the wing of the Rock Shag, the second, third, and fourth primaries from the outermost are sub-equal in length, while the fifth is nearly or quite as long as the first. It would be rash to say that such physical equipment makes the bird particularly likely to be beaten down and exhausted by the gales of its tempestuous homeland. Nevertheless, in connection with numerous observations in the record, it is suggestive of weak flying powers. Crawshay (1907, 150) speaks of the particular frequency with which he found carcasses of this shag along the beaches of Useless Bay, Tierra del Fuego, without being able to assign any reason as to why such examples had come to grief. Furthermore, Cobb (1934, 57) states that birds of this species always fly very low over the water, and that even when taking flight from a cliff they swoop down close to the surface before getting up speed, a custom which is responsible for the Falkland saying that the Rock Shag cannot fly until it has wetted its tail. Reynolds (1934, 349) also states that the flight is never high, and that the birds neither sail nor soar, but rather beat along steadily with the head stretched straight forward and held a little lower than the neck.

During Mr. Beck's travels on the Brewster-Sanford Expedition he collected his first examples of the Rock Shag as far north as Corral, and thereafter found the species common all the way from Chiloé to Cape Horn. Among his specimens are birds from Caroline, London, Navarino, and Bertrand Islands, various parts of Beagle Channel, and the Falkland Islands. He also obtained evidence that the Rock Shags nest throughout these regions, although he collected eggs only in the Falklands. In the latter colony the eggs of this species, like those of the King Shag, are regularly gathered for eating, though Cobb (1910, 67) says that both sorts are inclined to be decidedly "tasty." The Rock Shags themselves have also long furnished a source of food to the indigenous Magellanic Indians, and I fancy that this is the species indicated in the following quotation from Byron (1748, 140), which refers to a locality not far north of the western entrance of the Strait of Magellan:

> A night or two after they sent out some of their young men, who procured us a quantity of a very delicate kind of birds, called shags and cormorants. Their manner of taking these birds resembles something a sport called bat-fowling. They find out their haunts among the rocks and cliffs in the night, when taking with them torches made of the bark of the birch tree, which is common here, and grows to a very large size (this bark has a very unctuous quality, and emits a bright and clear light; and in the northern parts of America is used frequently instead of a candle) they bring the boat's side as near as possible to the rocks, under the roosting-places of these birds; then waving their lights backwards and forwards, the birds are dazzled and confounded so as to fall into the canoe, where they are instantly knocked on the head with a short stick the Indians take with them for that purpose.

In the neighborhood of the Gulf of Ancúd, the northern limit of the breeding range of this species on the Pacific coast, the shags collect in flocks before the nesting season, which lasts from November until April or later. They choose for sites the tops of straight-sided blocks of rock on the islets, and build their homes of a variety of seaweeds, laying from two to four, or sometimes five, eggs (Germain, 1863, 315; Hellmayr, 1932, 300). In this region Beck saw many nests with large young during April, 1914. Half a year later, he found the Rock Shags nesting on the ledges of cliffs along the leeward sides of Londonderry and Caroline Islands, off Tierra del Fuego. In addition, a number were occupying a cave on a small islet close to Caroline Island. Some of the nests were here placed fully 50 meters back from the entrance, so that only the white breasts of the birds were visible through the dim light. Such a choice of nesting site is reminiscent of the habits of the Red-footed Cormorant (*Phalacrocorax gaimardi*) in grottoes of the Peruvian coast. Reynolds (1935, 73) states that one of the species of tussock bird (*Cinclodes*) shows a strong predilection for the vicinity of Rock Shag colonies.

Elsewhere in Tierra del Fuego, as well as at the Falklands, the Rock Shags are reported as nesting in similar situations, sometimes on the fronts of deep gulches below which the sea boils. Only rarely do they seem to take to flat open spaces, such as are favored by the King Shag (*Phalacrocorax albiventer*). Rookeries are numerous along the shores of West Falkland, and Beck saw many also on East Island and at the small islets of Bleaker, Sea Lion, and others. In places where long, straight, perpendicular cliffs have been cut by wave

action, the shag nests are sometimes arranged with great regularity along the ledges for considerable distances. Many are apparently used year after year, being refurbished during the month of October. They are tricked out, in fact, very gayly and picturesquely, bits of bright color being supplied by green or red seaweed, intermingled with tussock grass, stones, and leaves and twigs of diddle-dee or other shrubs. Sometimes mud is also used, and the entire mass soon becomes thoroughly plastered by the droppings of the birds. The first eggs at the Falklands are laid in November, the season agreeing substantially with that in other parts of the range. Beck collected a number of sets on December 10, 1915.

As soon as the nesting season is under way, pairs of skuas invariably attach themselves to a shag colony in order to profit by opportunities to steal eggs and newly hatched chicks. The skuas seem to fly in regular beats up and down the rows of incubating cormorants, although, when they come too close, the sitters thrust out their necks and protest ineffectually. Despite the fact that the parent shags change places quickly at relief periods, the skuas always succeed in a certain amount of decimation. Nor does the maltreatment of the eggs end here, for they are not infrequently broken by the hurried departure from the nest of the shags themselves. This damage appears to be due to the pumping action of the feet as the birds spring off. The feet strike downward together with the same movement when the shags leave the surface of the water. The shells of the eggs are relatively thin and weak, as among all cormorants; Abbott (1861, 167) has suggested that their limy excrescences and nodules may serve somewhat to strengthen them.

The Rock Shags are, of course, hatched without feathers, wearing only what looks like a black rubber suit. Their subsequent stages of down and plumage have never been fully described, and the sequence presents certain peculiarities which warrant an account based upon 25 males of all ages in the Brewster-Sanford Collection.

The first down is clove-brown, which soon becomes mixed on the belly with white down. The relative amounts of white and brown down vary individually, but the white is always confined to the belly alone, except for a few sprinklings on the head and neck. The moult of the down exposes the juvenal or first contour plumage, which is brown tinged with dull bottle-green on the back, and white on breast and belly. This white juvenal belly feathering has not previously been described. It is mixed with a few partly brownish feathers, but is nevertheless sharply white from the brown neck and upper breast to the base of the tail. Birds in this plumage from Ancúd, Chiloé, were taken in April; juvenals in the same plumage from the Falkland Islands are dated January, doubtless indicating earlier hatchings.

With the growth of the young shags, the white belly feathers are replaced by brown feathers, so that when the birds are nine to ten months old they are entirely dark. The brown belly is, however, composed of white feathers which are brown only at their tips, and by a process of wear and growth the belly becomes white for the second time, a condition which is thereafter retained

throughout life. The seasons of the successive steps in these plumage changes vary in different parts of the range of the bird, as might be expected. Among the Magellanic Shags of Nassau Bay, near Cape Horn, the date of breeding is doubtless more definitely fixed by climatic conditions than it is at the Falkland Islands or in Central Chile.

Simultaneously with the appearance of the permanent white breast of juvenals, the white throat also develops, but the latter is not acquired by wear, like the breast, but entirely by moult and a growth of new white feathers. Sometimes, however, the white throat does not develop until after the first nuptial plumage has appeared.

At the end of a year, or thereabouts, a complete moult of both quills and body feathers leads to the first nuptial plumage. At this time the colors have their maximum richness. A crest is developed, the white ear-patches appear, the head, neck, and flanks become glossed with steel-blue, and the back with oil-green, while the breast is immaculate. The nesting season is scarcely under way, however, as is shown both by breeding specimens and by Mr. Beck's photographs from life, before white feathers again appear on the throat, subsequently spreading to the sides and base of the neck, and sometimes even on to the crown. The crest, moreover, is soon dropped, and the bird has assumed its so-called winter plumage. It should be borne in mind, however, that the latter plumage is characteristic of many birds that are still nesting. Nuptial, post-nuptial, pre-nuptial, etc., would be more accurate designations for the stages of adult birds.

A series of Falkland Island females likewise shows well the continuous changes from nuptial to post-nuptial plumages. While the birds are nesting, in November, the ear-patch rapidly enlarges, white feathers appear in the throat and cross over the head, and in some specimens the remains of the crest itself become white because of the growth of a band of white across the forehead.

According to Cobb, the Rock Shags start on their fishing expeditions soon after the coming of daylight, when they can be seen setting out by the hundreds. They feed chiefly in kelp fields close to the coast, diving for fish among the submarine tangles of this seaweed. Usually they leap almost out of water before plunging beneath the surface, where they make use of their wings as well as their feet while foraging about. The various sorts of small fish that they catch must be brought to the surface before they can swallow them, which sometimes results in the prey being filched literally out of their mouths by the ever-watchful skua.

GUANAY

Phalacrocorax bougainvillii

Carbo bougainvillii Lesson, 1837, Voy. 'Thétis' et de 'l'Espérance,' 2, p. 331 (Valparaiso, Chile).

Names: Peruvian Cormorant. Local Spanish names in one part or another of the west coast of South America include "Pato Yeco," "Lile," and "Cholo." The only common synonym of the specific name is *albigula*.

Characters: A long-billed, long-winged, bicolored, crested cormorant, with a white throat-patch and green circumorbital skin.

Adults (sexes alike): Top of head and crest dark oil-green; remainder of head and neck black, glossed with steel-blue; interscapular region, lower back, rump, upper tail coverts, and thighs glossed with dark bluish green; sides of upper back, wing coverts, and scapulars dull bronze-green, each feather with a narrow margin of darker greenish blue; a median white elongate patch on the fore neck extends from the anterior pointed feather-tip on the pouch caudad for 7 cm. or thereabouts; ventral surface white from the base of the fore neck to the under tail coverts, which are dark; a slight patch of white filoplumes above the eye, with others scattered here and there on the neck; quills of wing and tail greenish black, the rectrices tending to fade rapidly with wear. Iris dark brown, surrounded by a clear white ring of cornea, which is more or less visible posteriorly in life; surrounding bare skin olive-green, succeeded beneath by a crescent of dull brown skin which loops slightly around the cephalad and caudad extremities of the green area; outside this, in turn, the bare skin of the face is red, somewhat orange above the eye and somewhat brownish behind it; bill horny or brownish black, with scaly accretions like those of pelicans, and with faint pinkish and bluish tones at the base of the mandible; gular sac brownish; legs and feet flesh color, sometimes almost pink, the toes and the back of the tarsus brownish.

5 males from Lobos de Tierra Island and Ancón, Peru, Tofo and Corral, Chile: wing, 281–303 (296.4); tail, 96–104 (100); exposed culmen, 65–78 (71.4); bill from gape, 91–107 (99.2); tarsus, 66–71 (68.8); outer toe and claw, 91.2–105 (98) mm.

4 females from Peru: wing, 270–287 (281); tail, 96.6–108.5 (103.3); exposed culmen, 65–73 (69.1); bill from gape, 86–99 (93); tarsus, 66–67 (66.6); outer toe and claw, 90–97 (93.4) mm.

Young birds moult from the down into a plumage resembling that of adults, but more brownish and less richly colored throughout. They very closely resemble certain stages of the young in *P. magellanicus*, which is doubtless a near relative. The down is an even mixture of black and white, producing a pepper-and-salt effect peculiar to this species.

The eggs closely resemble those of *P. atriceps* and *P. albiventer*, being of the usual, somewhat elongate cormorant shape. A set of three collected at Pescadores Island, Peru, December 13, 1919, shows heavy but patchy limy coating, large areas of finely granular, Nile-blue shell being exposed. The specimens measure 64 x 40.7, 65.7 x 41.6, and (broken) x 40 mm.

Distribution: Breeds on islands along the west coast of South America from Lobos de Tierra, Peru, southward to Mocha Island, Chile; ranges from Point Pariñas southward to Corral, and casually farther to northward and southward.

The Guanay, first in importance among the famous guano birds of Peru, has been called the most valuable bird in the world. Coker (1919, 484), after a conservative calculation regarding the quantity of guano normally deposited on an islet by a cormorant of this species, continues,

> Fowl which produce $1.43 worth of guano a pair annually, without expense for care and feeding except the minimal cost of protection, may well be appraised at $15.00 a pair. The fowl which dwelt on the South Chincha Island alone, when it was visited in 1907, might well be regarded as an asset representing a value of several millions of dollars.

The Guanay is a relative of the pan-antarctic "blue-eyed" shags. The ring of bare skin surrounding its eye is green rather than blue, but in its general structure and plumage-pattern, its carunculated bill and nuptial crest, it resembles not only the Rock Shag (*Phalacrocorax magellanicus*) but also the more southerly species, *atriceps*. The cross-section of the long, deeply incised bill, the feathering of the gular pouch, and the number of tail quills are further suggestive of relationship with the southern circumpolar shags. Like the Peruvian Penguin and Diving Petrel, and so many other endemic creatures of the Humboldt Current, the Guanay is descended from ancestors which long ago invaded this peculiar littoral region from the south.

In the course of its evolution the Guanay has, however, undergone a number of remarkable specializations. It is a long-winged cormorant, capable of flying strongly for hours against the brisk southerly breezes that blow every afternoon throughout the greater part of its range. No other cormorant in the world, perhaps, is so distinctly aërial. Furthermore, it feeds exclusively upon surface organisms, rather than upon animals of the sea-floor or of the kelp fields, and its method of flock-fishing involves the discovery of its prey from the air, rather than by means of a submerged search. It is likely that only one other kind of cormorant, namely, *Phalacrocorax capensis* of the west coast of South Africa, has developed similar ways as regards flock-fishing upon an extensive scale. The Cape Cormorant, at any rate, is described as flying out to sea from African bays in formations numbering a hundred thousand birds (Spiess, 1928, 223). This species and the Guanay are not closely related, but they inhabit homologous cool-current regions, and both illustrate the interaction between organism and environment which has resulted in the evolution of a common habitus.

Together with the Piquero, the Peruvian Pelican, and several other voracious surface-feeders of the Humboldt Current, the Guanay is in effect a machine for converting fish into guano. A relatively small proportion of this is deposited upon the islets, where it becomes available for human use; the remainder returns to the sea where, however, it is not "lost," for it restores to the water the fertilizer of the marine pasturage and thus finds its place in the closed circuit that runs from chemicals through various stages of life, and back again to chemicals. Single colonies of Guanays dwelling on Peruvian islands take out of the surrounding ocean waters more than a thousand tons of fish a day (Murphy, 1925, 81). Man's utilization of the resources of the ocean along this coast is, indeed, as nothing compared with that of the birds. Schweigger, as quoted by Schott (1935, 395), has computed that, whereas the people of Peru capture and market annually about 4000 metric tons of fish, the sea birds of the country devour 5,500,000 tons!

Thus, presumably, since the uplift of the Andes and the beginning of the meteorological and hydrological conditions as they exist today, has the process been going on. We know little about the age of the Guanay as a species but, as I have already noted, it has been described under at least one other name as a fossil or subfossil cormorant from northern Chile (Philippi, 1895, 14). Furthermore, it seems to be the sea fowl, erroneously listed as a penguin ("*Aptenodytes*"), from the bottom of a 30-meter layer of guano at Huanillos, Chile (Ribera, 1904, 339). Lambrecht (1933, 239) estimates that if the substance had here accumulated at the moderate rate of 5 centimeters a year, not allowing for surface wastage, the mummy had been buried for at least eight to nine thousand years.

Coker has pointed out the ease with which a Guanay population may be counted at the breeding ground, because of the even distribution of the nests and the complete coverage of all practicable terrain. The birds turn around and squabble with their neighbors as they prepare the breeding sites for the reception of eggs, for which reason the distance from the center of one nest to the

center of adjacent nests is exactly the "sparring space," or about 60 centimeters. Coker found 39 nests in 12 measured square meters of ground, and 52 nests in another 18 square meters; 3 per square meter is a fair average. The census of adults is therefore 6 per square meter; that of adults and young not less than 12, for the Guanay lays 3 eggs and rears an average of more than 2 young. The nesting territory covers all relatively smooth level or gently sloping ground, and the borders of a colony, no less than the interior, are usually densely populated and sharply defined. The nests begin as mere scrapes lined with feathers (mostly tail quills), but they soon become small craters in a continuous carpet of guano, each having an outside diameter of about 40 centimeters, of which the bowl comprises half. More than a million such nests, occupied by between four and five million birds, have been counted or measured on the central Chincha Island.

Since the bulk of my personal observations concerning the Guanay are quoted below from an earlier publication, I wish to write in further detail of only two matters, namely, the normal range of the species, and the periodical wanderings which are generally, if not always, related to the rhythmic Niño phenomena or similar aberrations of climate and hydrography.

The most populous breeding colonies of recent times have been characteristic of islands between central and northern Peru, or from Independencia Bay to Lobos de Tierra. Shifts in the centers of abundance may be due in part to the temporary disturbances of guano exploitation, but they are also in large measure unpredictable. However, it would be a rare year in which most of the following islets or groups were not occupied by impressive colonies of Guanays: Santa Rosa, Ballestas, Chinchas, Asia, Pachacamác, Pescadores, Mazorca, North Guañape, and Macabí. Lobos de Tierra is also often the home of large numbers, though in relatively small aggregations. The high islands, such as Vieja, San Gallán, Fronton, and San Lorenzo, are avoided. The most distant breeding station from the mainland coast is at Hormigas de Afuera, where a few Guanays were on their nests at the date of the visit of the yacht 'Zaca,' in February, 1935.

In southern Peru and in Chile there have been few reports of densely occupied communities within recent decades. The islet of Alacrán, off Arica, is occasionally "black with Guanays," and no doubt the birds have bred there now and again from time immemorial. Many islets to southward along the coast probably harbor small colonies, for in December, 1932, Mr. D. S. Bullock found these cormorants abundant all around Mocha Island, and nesting by hundreds on a small outlier known as Isla Muerta. He preserved one skin, and the head of another adult, and reports that on December 8 the inhabitants of Mocha visited the colony of the "Cholos" and gathered hundreds of eggs for food. This is the southernmost breeding record of the Guanay, so far as known.

Delano (1817, 315) and Morrell (1832, 105) both refer to the southern headland of Santa María Island, in the Bay of Arauco, as headquarters of an enormous colony of shags, which put forth to sea in order to fish at a distance from the island, and darkened the sky when they returned. "One hundred barrels of their eggs . . . may be collected in a very short time," writes Morrell.

Despite the well-known gift for exaggeration possessed by the latter captain, the testimony of Delano is reliable, and both descriptions fit no other cormorant than the Guanay. Delano's observations were made in the year 1800, when the ground of the colony was white with the ordure of the cormorants. Might it be possible that the shags recently seen by Mr. Bullock at this same island were *Phalacrocorax bougainvillii* and not, as he thought, *P. atriceps*?

In Part I, I have made several references to the disasters which overtake the Guanays, and other sea fowl of the Humboldt Current, at times when the warm countercurrent from the north causes a cessation of upwelling along the coast of Peru. The effects are in proportion to the strength of the cause. They are, therefore, most marked at intervals of about seven years, and are particularly pronounced during seasons of extraordinary disturbance, such as those of 1891 and 1925. Various reasons, such as starvation due to the death of food fishes, avian tuberculosis, aspergillosis (a fungous disease), and an abnormal multiplication of endoparasites have been assigned as the intermediary agency which destroys the birds. Doubtless each has its part, and all are covered in Peru by the general term "peste," meaning a pandemic malady. In any event, its source lies in change of the physical environment and a resultant malnutrition. The whole cycle is doubtless to be correlated with the periods of excessive increase, climactic competition, mass emigration, and destruction, which have been studied with relation to many species of organisms, both of the land and of the sea.

In the case of the Guanays, the birds in an affected area of the littoral ocean first become "loco" or queer. The flocks move in unusual directions, and beyond the limits of the normal range. Many birds die and drift ashore, and the survivors behave in an unwonted manner, of which two or three instances are given below. For example, on March 4, 1925, after the Niño Current had been in full swing for several weeks, an immature Guanay came aboard my launch not far south of Tumbez, Peru, sat on a coiled hawser while it preened its feathers, and subsequently allowed itself to be played with and passed from hand to hand. It seemed to enjoy being stroked and tickled and, while perching upon my knee, it even bit my fingers tenderly, just as a puppy bites in fun!

During the same memorable season, I observed small flocks of doomed Guanays out of their normal districts, as in various parts of the Gulf of Guayaquil and even far up the Río Guayas. At the same period, the birds were dying by hundreds of thousands in the unduly warm water along the greater part of the Peruvian coast.

In 1932, the phenomena were in part repeated, as recorded heretofore in the words of Sheppard (1933, 210). Mr. A. Hyatt Verill (*in litteris*) states that after the strong countercurrent and heavy rains of that southern-hemisphere summer, Guanays again invaded the Guayas, and died in droves at Guayaquil. Others, however, penetrated the Ecuadorian rivers still farther toward the interior, while at sea they wandered along the tropical coast at least as far as the latitude of Buenaventura, Colombia. It is unlikely that any such cormorants survived to find their way back to the guano islands.

Less familiar, but of peculiar interest, is the fact that strange emigrations of ill or "unbalanced" Guanays take place from the southerly limits of the specific range, as well as in the north. This subject has been discussed by Moore (1926, 176), who writes of a mass emigration from the Peruvian coast into central and southern Chilean waters, after the disastrous summer of 1925. At Coquimbo, even before the beginning of the rains at the northern end of the Humboldt Current, the Guanays came ashore in hordes, apparently seeking food among the cattle, or in the troughs of swine! Large numbers were killed with sticks by the inhabitants. At San Antonio, at least 20,000 were observed dead or dying, and others pushed on southward into Magellanic waters. A single specimen examined proved to have the liver heavily infested with roundworms. Millions of hungry Guanays, concludes Moore, ranged along the coast of northern Chile, seeking food, and at least a few of them apparently survived to return northward.

Below is my own record of the life history of the Guanay as I was able to work it out in the course of all-too-rapid travel, and amid the press of many other duties, during the Peruvian spring and summer of 1919–1920. In this account the plural form of the word is spelled in the Spanish manner—Guanayes.

Picture to yourself the shining, rainless coast of Peru, washed by ocean waters to which storms are unknown, where the swells surge northward, from month to month and year to year, before winds that blow regularly from a southerly quarter. On such an ocean dark flocks of guanayes form rafts which can be spied miles away. Slowly the dense masses of birds press along the sea, gobbling up fish in their path, the hinder margins of the rafts continually rising into the air and pouring over the van in some such manner as the great flocks of passenger pigeons are said to have once rolled through open North American forests in which oak or beech mast lay thick upon the leafy floor.

At other times, when the guanayes are moving toward distant feeding grounds, they travel not in broad flocks but rather as a solid river of birds, which streams in a sharply marked, unbroken column, close above the waves, until an amazed observer is actually wearied as a single formation takes four or five hours to pass a given point.

Equally impressive are the homeward flights of these cormorants, after a day of gorging upon anchovies, when in late afternoon slender ribbons, wedges, and whiplashes of guanayes in single file twist and flutter, high in air, toward the rounded plateaus of white islands which gradually turn black as the packed areas of birds swell out from clustered nuclei toward the borders of the available standing room. . . .

Given . . . a belt of cool ocean waters replete with small organisms . . . , together with nesting sites upon islands which for climatic reasons could never become encumbered with vegetation, and the geographic stage was set for the northward emigration of the ancestors of the guanay. Furthermore, because of the normal superabundance of food, conditions seem to have been prearranged for the increase of the birds to numbers limited only by competition with other animals and by the amount of safe, insular space for reproduction. Although suitable islets are very numerous, the enormous food supply in the Humboldt Current is still out of all proportion to the area of the breeding places. This doubtless explains the excessively colonial nesting habit of the guanay, in which it surpasses all other birds, even the penguins, for in the middle of a bounteous sea there would be a constant tendency for the cormorant population to become more and more congested upon the islets. The doctrine of Malthus applies to birds as well as to men.

These facts suggest that the geographic background does not tell the whole story. Evolution is, at least in part, the result of interaction between a living being and its surroundings. The guanay itself has had to undergo considerable modification in order to fit into a new environment, especially as regards the particular character of its food in the Humboldt Current. Several such adaptive

changes are apparent, changes which have progressed so far that they now strongly differentiate the Peruvian species from its antarctic cousins and from every other kind of cormorant in the world.

For instance, the guanay, unlike any other cormorant, "hawks" its food, that is, it hunts exclusively by sight and from the air, locating the fishes which it seeks before descending to the water to catch them. Most cormorants search for their prey individually, swimming alone or in loose groups at the surface, then plunging in what seem to be favorable places and conducting the hunt as well as the capture while they are submerged. For the most part, moreover, they subsist upon bottom-living species of fish, often diving down many fathoms in pursuit of single victims. But the guanay feeds altogether upon surface-swimming fishes, such as anchovies, young herrings, and the toothsome silversides which the Peruvians call *pejerreyes* ("kingfish"). Such forms travel in tremendous schools which are assailed *en masse* by proportionately large flocks of birds.

The correlation between the numbers of the fishes and the extreme gregariousness of the cormorants results among the latter in a system of efficient coöperation which almost suggests certain customs of ants or other social insects. The vast flocks of guanayes which spend their nights upon the islands do not start hunting in a body when morning breaks. On the contrary, the birds first sally forth only in small scouting parties, which can be seen flying erratically above the ocean, usually keeping well in air, and frequently "back pedaling" or hovering when they see the silvery glint of schooling fish or the ruffled appearance of the sea which indicates the presence of fish below. The dropping of the scouts to the surface, and the shallow dives which mark the beginning of an orgy, are the signals that cause the approach of such rivers of birds as have been described above. The cohort of guanayes then spreads out as a great fan over the unfortunate anchovies, which are likely to be no less harried from beneath by bonitos and sea-lions. Small wonder that the Peruvian fishermen, who are familiar with such sights, believe that the guanayes and the seals have a working understanding! However this may be, the gorging proceeds until both sea-lions and birds must cease long enough to allow their rapid digestions to fit them for another meal. From the crop and gullet of a dead guanay the remains of no less than seventy-six anchovies, four to five inches in length, have been taken.

Sometimes the guanayes pursue the fishes to the very beaches, so that a rare view of a one-sided fray may be enjoyed by a landsman. One morning during my sojourn at Independencia Bay shoals of silversides were packed in deep, glittering ranks close to the quiet shore, when a raft of guanayes, accompanied by a few pelicans and a horde of screaming gulls, drove the fishes before them against the shelving sand. Soon the water gleamed like flashing quicksilver, and in wild rioting the birds jammed and crowded each other until hundreds of them were pushed clear beyond the tideline by the scrambling mob behind.

The guanay stands and walks erect, somewhat after the manner of a penguin. Its height is in the neighborhood of twenty inches and the weight of a full-grown bird about four and a half pounds. It has a glossy green and blue-black neck and back, a white throat-patch which is a conspicuous mark in flight, a white under surface, and pinkish feet. During the courtship season a crest of plumes develops at the back of the head. The guanay's iris is brown, but an area of green, naked skin surrounding the orbit makes it look at close range like a veritable personification of envy. A second ring of turgid red skin, outside the staring "green eye," heightens its extraordinary expression. . . .

The breeding season, like that of many tropical ocean birds, is practically continuous, but it reaches a climax during the southern summer months of December and January. In its adaptation to an all-the-year nesting habit, the species has, of course, diverged widely from the ways of its antarctic relatives, the reproductive season of the latter being rigidly fixed by the climatic cycle. Individual pairs of guanayes are believed commonly to rear two broods during a single year. The flight of the last families of the young of one season, in May or June, is at any rate followed hard by the courting and love-making of adults in preparation for the breeding season of the second spring.

In early October, 1919, when I arrived at the Chincha Islands, the resident guanayes were in the early stages of mating. From this place and date, as investigations were carried northward from island to island, successive manifestations of the birds' life history were revealed, until at Lobos de Tierra in January, 1920, full-fledged young were observed taking to the ocean, quite independent of parental care.

At South Chincha Island in mid-October the breeding grounds were covered with just one year's accumulation of sun-baked guano, and the cormorants were getting ready to nest again. They stood in compact bodies, each comprising thousands of birds, on the flat top of the island, and, when a human being approached, all those on the nearer side began to stir—not *en bloc*, nor yet individually but in groups of a few hundred, each of which for the time constituted a unit. One group would move rapidly away, the birds carrying themselves bolt upright. Another group would advance toward the observer, so that this section of the army would gleam with white breasts instead of shiny, dark backs. Still another unit would rush to the right or to the left, so that both the dark backs and the white breasts showed at once, and the long bills and red nasal warts became conspicuous. Such closely huddled companies soon collided with others moving in different directions, producing much confusion about the margins. A few of the birds showed no fear at all, stolidly permitting a man to approach within a few feet. The greater proportion, however, frantically took to flight, rushing helter-skelter down a slope, and raising a cloud of dust with their whistling wings. The air became bewilderingly thick with birds as they circled overhead, but within a few moments the number returning to earth once more exceeded the number taking wing.

When an observer makes his way slowly and very quietly into the heart of a colony in which nesting has definitely begun, the guanayes gradually retreat, and one may sit down in a clear circle which is at first fifty or more feet in diameter. But almost imperceptibly the birds will edge in again, until the bare circle narrows to but three or four paces. From such a point of view it seems as though the ground were covered with as many pairs of sprawling webbed feet as there is room for, and yet new arrivals plump down by scores or hundreds every minute. Over the ocean, moreover, to the north, south, east, and west, one may commonly see endless black files still pouring in toward the island. The hum of wings is like the effect of an overdose of quinine upon the ears, and the combined voices seem like mutterings of the twelve tribes of Israel. It reminds one of all sorts of strange, oppressive roarings, such as the noise of railroad trains in river tunnels. The near-by voices, which can be distinguished individually, are merely sonorous bass grunts and screepy calls. It is the multiplication of such sounds by numbers almost too large to imagine that makes the outlandish and never-to-be-forgotten babel.

Toward evening of such October days, most of the guanayes would be courting, after strenuous hours at sea during which all their energies had doubtless been devoted to winning the sustenance of life. Privacy does not enter into their notion of fitness, and while six or seven birds occupy each square yard of ground, the love-making antics are often in full progress. These are in general not unlike the courtship habits of the closely related antarctic cormorants. Two guanayes stand side by side, or breast to breast, and ludicrously wave their heads back and forth or gently caress each other's necks. The crests upon their crowns are frequently erected, and the feathers of the nape puff out so that the velvety necks appear twice their normal thickness. Cheeks and chin-pouches continually tremble, and chattering bills are held wide open. Now and again one will bend its body forward and at the same time extend the head upside down along the spine and toward the tail, holding this curious, paralyzed attitude for several seconds. Sometimes the birds of a pair snap so much at one another that it is hard to judge whether they are making love or quarreling.

Indubitable quarrels between birds of different pairs also go on without cessation, and occasionally many join together in a mêlée. Every now and then, for example, some unfortunate guanay, which seems to be the butt of all bystanders, will go dashing through the throng, holding its head as high as possible in order to avoid the jabs and bites which all others direct at it. If the victim would but stop fleeing, perhaps the blows would cease, but it keeps more and more desperately running the gantlet, flapping its wings, bumping into innumerable neighbors, until eventually it bursts from the vicious crowd into a clear space, shakes itself with an abused air, and opens and shuts its mouth many times with an expression of having just swallowed an unpleasant dose.

In the early stages of courtship it often happens that several cocks select the same female for their addresses. In one instance, five assiduous suitors, all with necks expanded, were observed bowing around a single hen which crouched in their midst. But by no means all the birds are engaged in love-making at every moment, for they spend much time preening their feathers,

frequently raising the coverts of the tail and thrusting the bill toward the oil-gland. Then, after combing their heads and necks thoroughly with their claws—a real feat in balancing—they promenade in small troupes along the outer edge of the colony.

Visible actions, rather than unusual sounds, alarm the courting birds. A quick motion of the hand will start sudden pandemonium. Even when an observer rises to leave them as slowly, silently, and unostentatiously as possible, a small panic inevitably results, many of the nearer birds beginning to scamper about or to take flight. On the other hand, the firing of a gun straight into the air produces scarcely a stir provided the weapon is not brandished. The effect of human conversation is, however, most amusing. Whenever a man, sitting perfectly still, begins to talk to the guanayes in a loud voice, a silence falls over all the audience within hearing. Their mumbles and grunts die away, and they listen for awhile as if in amazement.

During the course of a few hours' resting on any island, the birds get much befouled with fresh guano, which hardens upon their plumage. They periodically rid themselves of this by flying some distance off the lee side of the island where they plunge and violently beat the water with their wings. Sometimes most of the inhabitants of a colony will make their toilet in this way at one time, producing a thunderous roar which can be heard from afar. It is often audible during morning fogs, when the flocks are invisible, and as a boat draws near such a gathering it is easy to mistake the sound for the dreaded crashing of waves upon unseen rocky shores.

Inhabitants of the Peruvian coast are agreed that the guanayes never spend the night upon the ocean, as the native pelicans often do, but that they return to their island roosting places even when the journey involves a flight which must continue long after dark. I have sometimes watched from two o'clock in the afternoon until nightfall, or for about five hours, while they streamed uninterruptedly homeward. A few piqueros often accompany them, as if filling honorary positions in the line, but fully 999 in every 1000 birds are guanayes.

The grandest sight of the day, when the homeward flight is at its maximum, usually comes during the hour before sunset. From some point far away the birds make a beeline for the center of their island, but, as they near their destination, they invariably skirt the shores so as to come down across the wind. The instinct of following a leader is evidently strong; if, for any reason, a file is broken, and the rear birds turn toward the left coast instead of the right, those behind will obey the signal and all swing into the new course. Close over gulches and ridges of their home island the oncoming streams of birds flow, the separate "rivulets" cutting across each other like the blades of scissors. At the same time these files also rise and fall in beautiful undulations which can best be seen from the crest of a hill above them. Sometimes three or more such lines will flow along for a while 10 to 15 yards apart, but sooner or later one of them will make leeway until two files interweave. Then the soft, humming swish of wings is interjected with sharp clicks as the quills of two guanayes strike together in air. When one beholds the endless mingling, the crossing and recrossing and tangling of the lines, it seems incredible that more birds do not clash.

It goes without saying that such gregarious creatures as the guanayes must have natural enemies to prey upon their abundance. The sea-lions of the coast have been accused of devouring the fledglings when they first take to water, but, so far as my observations go, there is little evidence to support the charge. The naked, black-skinned, and very ugly chicks, which hatched from rather small greenish eggs, are apt to be thickly infested with feather-eating lice (Mallophaga) transferred from the plumage of their parents, and yet, so long as the sensitive nestlings are shielded from the hot sun, they seem to suffer no ill effects from these parasites. Other birds, in fact, appear to be their only serious enemies.

When I landed upon Asia Island, off central Peru, on December 4, 1919, great destruction of guanay eggs had been wrought by gulls, turkey vultures, and condors. Although a colony containing countless eggs and young still covered about half of the western slope, extending from the summit almost to the water, and filling a deep ravine as well as the rounded hillside, the other half had become a waste of empty nests and broken egg-shells, and had been deserted for the season by the parent birds. Early in the morning of this day, guanays were leaving their breeding ground to pour out over the Pacific in an unbroken column which was following a school of fish in a tremendous sigmoid curve toward the north. The colony was, however, still densely peopled with homekeepers, *i. e.*, the birds of each pair which had remained to cover the eggs or the newly

hatched, squeaking chicks. The nests were luxuriantly feathered with molted quills, which, by the way, the brooding birds were forever stealing from each other's foundations. Many walked about carrying bunches of feathers, or flew elsewhere with a bill full. In the heart of the colony stood a condor, with a small circle of abandoned and rifled nests roundabout. When this pilferer had been shot and picked up by the feet, the albumen and mostly *unbroken* yolks of a round dozen of fresh eggs slid out of its gullet. Scarcely any pieces of shell were visible in this rich meal, the supposition being that the condors must suck the contents of the eggs through their trough-shaped tongues.

Later in the month of December, the guanayes were observed in more advanced stages of the nesting period at the Pescadores and Huaura Islands, to the northward of Callao. Here their robber-enemies were less in evidence, perhaps because the government guardians had been using their guns freely, and few empty nests or broken eggs were noted. Although a certain proportion of the adults were incubating new sets, the latter probably represented second broods, for the nests were exceedingly large, and the quills which had once formed a lining were now buried deeply under the craters of guano which constituted the rim of each nest chamber. Moreover, nearly full-grown young, in pepper-and-salt plumage, were abundant everywhere. These chicks were inclined to be indiscreet in wandering away from their own headquarters, whereupon they would presently be chastised by old birds and would have to scurry ignominiously back to their respective home sites. Among the larger chicks the approved method of obtaining food was to shiver and plead before their elders until the latter acted as though they were frantic from the teasing. As long, indeed, as the adults were at the nests, the youngsters never let up trying to ram their heads down the parental throats, and it was nothing unusual to see two or even three dive together into a capacious and well-stocked crop. At this season the sound coming from a colony bore some resemblance to an April frog-chorus, for the high-pitched voices of the chicks tended to drown out the mumbling of the old birds.

Still older fledglings had gone down in droves to the quiet rock pools around the shores, where they flapped their wings and dived until they had become proficient in the ways of maturity. Late every afternoon thousands of these apprentices could be seen scrambling up the steep hillsides from their training grounds, striving to get back with the crowd before dark. Such was their strange indifference to the presence of man, that they made no protest when we picked them up by their pinions and helped them on their way. This lack of fear is not necessarily innate. It may be due rather to the familiarity of the birds with guardians who never harm them, an idea suggested during a later visit to an isolated colony of guanayes on the large island of Lobos de Tierra, where both old and young were unwontedly timid, and where all the chicks that were big enough to walk left their nests pell-mell at the approach of a human being.

At Mazorca Island, of the Huaura group, a splendid colony of guanayes occupied practically all of the southern or windward slope, from the very brink of low precipices, over which the spray flew, to the crest of the island. Breeding gannets mingled to a certain extent with the cormorants along the lower border of the nesting ground. A few birds of both kinds had established themselves also on the northern slope, out of the wind, but here their enemies had been active and had succeeded in devouring many eggs. It seems to be characteristic of the vultures and gulls to attack at the edges rather than in the midst of a colony, and thus tend to annihilate projecting portions and small outlying groups. Perhaps this is one of the evolutionary factors which have caused the guanayes to breed in such compact hordes.

The birds at Mazorca were most tenacious in clinging to their nests, even when a man stepped over them. In late afternoon many of the broods were covered by both parents, which were so huddled together that they looked like single birds with two heads. One usually had a wing, for instance, over the back of its mate. When approached, they bristled all over until their plumage resembled that of Japanese bronze eagles. They would then wave their heads threateningly, and hiss with widely opened bills.

In the forenoon the colony usually appeared thin and gray when viewed from the lofty balcony of the lighthouse; but by three o'clock in the afternoon it would be black, owing to the return of tens of thousands of additional birds. Before alighting, most of the homecomers soared back and forth considerably in the fresh breeze. Whenever one came to earth in the wrong place, it would

immediately disclose its mistake by what can only be called a "lost" expression. Other guanayes in the vicinity would grasp the situation at once, and would then assault the newcomer, forcing it to take wing again at much sacrifice of dignity. It was a genuine misfortune for birds to alight where they were not welcome, for they seldom got off without being thoroughly pecked and jabbed. Such extraordinary reactions answer the question, so often asked, as to whether colonial birds always find their individual homes among myriads of seemingly identical nest-hollows distributed over acres of undifferentiated surface. Above all else, Nature jealously guards the unity of the family; each mated pair must fulfil its own obligation of rearing offspring to maturity, and every unconscious tendency to depart from this responsibility is nipped in the bud (Murphy, 1925, 74).

BIGÜÁ CORMORANT

Phalacrocorax olivaceus olivaceus

Pelecanus olivaceus Humboldt, 1805, in Humboldt and Bonpland, Rec. d'Observ. Zoöl. et d'Anat. Comp., p. 6 (Magdalena River, latitude 8° 55′ N., Colombia).

Names: "Cuervo de mar," meaning sea-crow, is perhaps the commonest name in most parts of Hispanic South America, but "Bigüá" or "Mbigüá," in imitation of the grunt of the bird, and probably of Indian origin, is also widely used; in northernmost Peru, this cormorant is called both "Patillo" and "Guanay Negro," but farther southward these two nouns are reserved for other species of the genus; "Yeku," according to Bullock's notes, is the Araucanian name, from which we have "Pato Yeco," which has spread up and down the west coast of South America; Beck also records in his notes "Pato del Diablo," the latter being a sort of equivalent of the North American hell-diver, as applied to grebes; reported also are "Pato Cuervo" and "Pato Pescador"; Die-dapper is the name among English-speaking inhabitants of the Corn Islands; "Corúa" is a native name in Venezuela, and "Pareka," an Indian one in Guiana; "Corvo Marinho" is used in Brazil, as the equivalent of the Spanish "Cuervo de Mar," and sometimes this cormorant is listed there as Mergulhão, a term ordinarily applied to boobies. Azara's work on Paraguayan birds refers to this species as "Zaramagullón Negro," a noun which is usually reserved for grebes. The commonest specific name in the literature is *vigua*, because Humboldt's prior name *olivaceus* was disinterred only as recently as 1926; other synonyms include *brasilianus*, *brasiliensis*, *niger*, *gracilis*, *ventralis*, and probably *promaucanus* and *eumegethes*.

Characters: The only South American cormorant in which the adult is clad in a wholly dark plumage, resembling the majority of cormorants of the northern hemisphere.

Adults in breeding plumage (sexes alike): Head, neck, lower back, rump, upper tail coverts, and ventral surface glossy black, the feathers at the base of the neck being somewhat elongate and fluffy and forming a crest or mane; naked skin of throat and gape outlined almost from eye to eye by a narrow white band of feathers; a tuft of long white filoplumes in post-auricular position and others, mostly of smaller size, showing over the greater part of the neck, as well as in the lores and above and behind the eye; plumage of the upper back, wing coverts, and scapulars lanceolate, of a color close to dark olive-gray, each feather with a black shaft and bordered with blackish; primaries and rectrices glossy black, tending to fade rapidly with wear. Iris green (called "lustrous myrtle green" by Lane, but sometimes recorded as blue); bill bluish horn-color, usually rugose and in some instances covered toward the base with overlapping horny "shingles"; gular sac and bare parts of face yellow or yellowish; legs and feet black.

28 males from Panama, Venezuela, Colombia, Peru, Bolivia, Argentina, and Chile: wing, 271–305 (283.3); tail, 144–181 (166.6); exposed culmen, 54–61 (57); bill from gape, 79–90; tarsus, 51–59 (55.1); outer toe and claw, 82–93 (87.3) mm.

18 females: wing, 250–282 (270); tail, 139–175 (154); exposed culmen, 49–58 (54); bill from gape, 75–88; tarsus, 50–57 (53.6); outer toe and claw, 76.5–90 (84.3) mm.

A series from the mouth of the Amazon and elsewhere, measured in the Berlin Museum, show dimensions agreeing with the above. Five adults taken at the Chincha Islands, Peru, October 27, 1919, had an average weight of 1680 grams.

The immature plumage is dull brownish, with only slight suggestions of gloss. In juvenal stage the breast is more or less white. The down of nestlings is blackish.

Eggs number usually three or four, though full sets of from two to six have been recorded. No specimens appear to exist in the American Museum Collection. Oates (1902, 203) records measurements of eggs from Chile as ranging from 52.3 to 62.5 mm. in length, and from 36.3 to 39.4 in breadth.

Distribution: Coasts, rivers, lakes, and marshy regions of Central and South America, from Nicaragua to southern Argentina and Chile, and from sea level to high Andean lakes such as Lago Junín, Peru (altitude 3932 meters). A distinct race is found in southern Tierra del Fuego, the geographic boundaries between the two forms being still undetermined.

The "Bigüá" or "Cuervo de Mar," which has been mentioned so often in my account of a hypothetical circumnavigation of South America, is found in every country on the continent, ignoring altitude no less than latitude. Not only does it occur along the seacoasts, but also up the courses of almost every river to its headwaters. It breeds on arid islands that lie in front of desert shores, among the trees of steaming tropical swamps and lagoons, on cold beaches soaked by the nearly perpetual rains of the west-wind zone, and on the banks of lofty mountain lakes such as Titicaca and Junín. In short, it exhibits a diversity of habitat and a climatic toleration which are perhaps without parallel.

In Central America the range of the typical subspecies gives way to that of a more northerly race (*mexicanus*), which extends into the United States. In the extreme southern tip of South America is a third race, to be described hereafter, which is found close to Cape Horn, the northern limit of its distribution remaining to be determined.

A large series of this cormorant was collected by Beck and myself, besides which specimens from many other sources give the American Museum a representation of the species from practically every section of South America. From Panama to the Río Gallegos in southern Patagonia, a single race seems to hold sway. The measurements of about forty specimens show considerable variation which is, however, quite within the range of normal individual differences, and which exhibits no consistent association with geographic source. Thus, two specimens from Lake Titicaca have unusually short bills, whereas others from the not distant Lake Junín have bills of average length for the series. A number of birds from the coast of central Peru have definitely longer tarsi than most others, but the difference is at best slight and inconstant. Neither does geographic variation, as it has been pointed out in the literature, seem to hold. It is stated in the "Catalogue of Birds of the British Museum" that examples from the southerly parts of South America have shorter tails than those from tropical regions. I find, on the contrary, that the longest rectrices among all the birds I have studied belong to a specimen from the south of Chile. It is further stated in the "Catalogue" that this cormorant has but twelve tail quills, but no less than four specimens, among the thirty I have examined with reference to this character, have fourteen rectrices, and a number of others show thirteen. Wetmore (1926, 412), too, records a female from the Río Negro with thirteen rectrices. From all such data, I conclude that *Phalacrocorax olivaceus olivaceus* is a highly variable race in all parts of its range. It is not unlikely that more exhaustive work may yet show further geographic correlations. Certainly

the members of the species inhabiting southern Tierra del Fuego and the adjacent islets seem to represent a well-marked short-billed subspecies, which is to be considered in the next biography.

In the style of its throat-feathering, the Bigüá differs from all the other South American cormorants, for the line at which plumage and naked skin meet usually runs squarely across the base of the gular pouch. Occasionally one finds a specimen in which there is a slight point at the mid-line; this is especially true among immature birds, indicating perhaps an ancestral condition in which the feathering once projected forward, as it still does to a much greater extent in *Phalacrocorax gaimardi* and in all of the white-breasted cormorants of supposed sub-antarctic origin. The type of throat-feathering in the Bigüá is, indeed, doubtless one of a number of signs showing its affinity with the dark-colored, northern-hemisphere members of the family. The bird bears a close resemblance in general morphology, color, the feathering of the face, and the rugose character of the bill integument, to the holarctic group of cormorants, and it is presumably of northern derivation. In fact, the chief pronounced difference between *olivaceus* and the North American species *auritus* is that the former has lanceolate instead of broad plumes on its back and scapulars, as well as a border of white nuptial feathers extending from eye to eye behind the gular sac.

The height of feathering in the Bigüá, when the head and neck become decorated with long white rudimentary or obsolescent plumes, apparently does not coincide with the actual nesting season. It appears, rather, to be a courtship plumage which reaches perfection somewhat before nesting time. It is probable that in certain tropical districts, such as the coast of northern Peru, this cormorant has no fixed breeding season, which may account for the mixture of plumage stages and physiological conditions to be noted among examples of such origin. In short, the potential variability of this cormorant with reference to seasonal rhythm may be no less marked than that concerned with altitude, latitude, and climate. Among tropical examples, moulting birds are represented practically throughout the year. In the succession of the quills, the middle rectrices and the inner remiges are replaced first. In full-plumaged condition, the second and third from the outermost primaries are the longest, and are sub-equal. The lateral rectrices of certain specimens show distinct traces of the diagonal crinkling or crossbarring, which is usually or always characteristic of the Snake-bird (*Anhinga*). A noteworthy feature of the plumage of this cormorant is also the "mane" of long soft feathers situated on the back, just at the base of the neck.

Since the Bigüá is found in all parts of South America, it has been the subject of a relatively enormous literature, of which neither space nor time will here permit more than a few important references to coastal distribution. The species is common in the western Caribbean Sea, although specimens obtained by Peters (1929, 134) at Corn Island show signs of intergradation between the races *olivaceus* and *mexicanus*. It is found in vast numbers near Ciénaga, in the Santa Marta district of Colombia, and also along the courses of the great streams to westward (Todd and Carriker, 1922, 132). The cormorants are abun-

dant on most or all the islands off the coast of Venezuela and, according to Clark (1902, 258), they do not as a rule mingle with the other species of sea birds offshore. Beebe (1909, 78) reports a flock in one of the mouths of the Orinoco, a short distance above the Gulf of Paria. The bird abounds in boggy districts along the Corentyne coast of British Guiana, where the sea often floods the shore and where there are miniature islands covered with marsh plants. Here the cormorants may be seen resting on oozy mounds, with wings half-open, in the attitude which is so characteristic of a number of northern-hemisphere cormorants (Young, 1929, 3). Schomburgk reports that in Guiana the species is still more commonly found on the rivers, especially near waterfalls (Chubb, 1916, 198).

In the Berlin Museum I have examined specimens taken at Marajó, at the mouth of the Amazon. Friedmann (1927, 147) observed examples in the harbor of Rio de Janeiro, and in marshes about the border of the city, as well as from here down the coast to the roadsteads of Montevideo and Buenos Aires, and to adjacent inland regions. Subfossil bones of this species are known from the great limestone caverns near Lagoa Santa, in the province of Minas Geraes, Brazil (Winge, 1888, 5 and 11). At Carrasco in Uruguay, Beck saw many on February 14, 1916, and Aplin (1894, 197) has seen a thousand or more feeding together in early morning off Uruguayan beaches. Wetmore (1926, 53) has found the birds common in channels traversing the marshes and tidal flats of eastern Argentina. Gibson (1919, 517) also states that they are abundant in the Cape San Antonio district wherever there is water, either salt or fresh, and that on the coast they are distinctly birds of mud flats rather than of sandy strands. They are always present in the muddy crabberies or "cangrejales" of this low coast. Salvadori (1900, 627) and Crawshay (1907, 149) report them from the central and southern Patagonian seashore. Off the mouth of the Río Chubút large flocks remain at sea throughout the day, and fly up the river to fish in fresh water at night.

The distribution of the species in Tierra del Fuego will be discussed in the next biography. Typical examples of the present race are, however, well represented from the central and southern provinces of Chile, where the "Pato Yeco" is everywhere familiar. Lane (1897, 186) says, in fact, that it is the most numerous of all Chilean coastal sea fowl, increasing toward the south and penetrating streams as far as the base of the Andes. The birds are usually seen singly along these rivers, flying up and allowing themselves to drift down with the current while fishing. Hellmayr (1932, 298) attributes to Albert the assertion that the Bigüá breeds on lagoons of the Cordillera, up to an elevation of 2000 meters or more, which does not seem improbable in view of its habits in the northern Andes. Beck's journal states that he saw it nearly everywhere among the islets of southern Chile during the Brewster-Sanford Expedition. On a bar of the river at Ancúd, Chiloé, he often noted flocks of fifty or more, at the time of his visit in April, 1914. Bullock observed a few pairs at Mocha Island. Lane found the birds on the coast of Arauco, where they were accustomed to fly up the rivers to roost in the trees of the forest some 15 kilometers

inland. Beck observed as many as 200 massed together in the harbor of Corral, and in the Berlin Museum I have examined specimens collected by Plate during the month of October on the Isla de Pájaros, off Coquimbo. Reed (1896, 206) and Paessler (1909, 102) report the species as common along the arid coast of northern Chile. From here northward, throughout the length of the Peruvian coast, it has been observed by every member of American Museum expeditions in the region. I encountered it everywhere during my own Peruvian field work, perhaps in greatest or most concentrated numbers among the protected straits and channels along the islet-dotted eastern side of Asia Island. Von Tschudi (1844, 314) persistently recorded this species from the coast of Peru under the name *Plotus anhinga*. His misidentification has led in turn to endless repetition of error. As a matter of fact, the Snake-bird does not occur anywhere along the desert stretch of western South America.

In Ecuador I found the Cuervo in many localities, particularly in the Gulf of Guayaquil, where, on the evening of February 24, 1925, there were many thousands on a bar off the southern tip of Puná Island. A few were noted at El Muerto Island, as well. Flights of the birds at morning and evening in the Gulf indicated that they were going to and returning from more or less definite feeding grounds every day. Between this vicinity and Panama the Cuervo appears to be everywhere present, nesting in numbers at the Pearl Islands, and being common about the Pacific entrance of the Panama Canal (Hallinan, 1924, 307).

Apparently this species does not willingly go out of sight of shore, but hugs the coast closely, not venturing to islands that lie more than a few kilometers out at sea. This is highly significant in view of the fact that it never has reached such islands as the Galápagos, Juan Fernández, or even the Falklands. On the other hand, it is understandable why it frequents many of the Caribbean and West India Islands, as well as others which are either close to the continent or are members of a continuous chain.

On piers, lighters, and all kinds of wreckage along the coast of Peru, the Cuervos perch and grunt. Passengers landing from steamers often look over the edges of the piers in search of the droves of pigs which they assume must be confined somewhere below their feet. It was in such a situation that I first saw a large aggregation of these cormorants at Pisco, on November 8, 1919. When I looked over the railing of the long dock, I could see the projecting tails of hundreds of birds that had come there to roost. They were spaced evenly in tiers, like fowls on the perches of a chicken-house. Many of the brownish younger birds were mingled with the glossy adults. Even as one looked through the chinks between the planks under foot, the upturned green eyes, and the white hackles on the heads, were conspicuous. Other cormorants were still coming in to join the roosting throng, and, as they approached the pier, they would set their wings and soar, a style of flight more characteristic of them than of most species of cormorants. Just before swooping upward to alight, they would invariably stretch down the naked skin of their throats in a way that reminded me of the dew-lapped lizards (*Tropidurus*) that one sees every-

where on the bare rocks of the Peruvian coast. The ability of a seemingly clumsy web-footed bird, such as this cormorant, to perch upon the slender steel rods which serve as struts of a pier, is astonishing. They are, however, even capable of sleeping all night on the wire topmast stay of a ship, which stretches from point to point at an angle of forty-five degrees.

In this part of its range along the Pacific coast, the Cuervo seems to have become almost a domesticated bird. At wild and remote islands, such as San Gallán and Vieja, where there are no fishermen's shacks or other structures built by man, it is relatively rare. But on all the smaller guano islets which have docks and buildings, and in every port where there are ships, small craft, buoys, water-pipes, wrecks, or aërial trolleys with cordage, it is invariably abundant. Toward evening of every day during the last two months of 1919, the sunken hulk of the square-rigger 'Leonidas,' off the coast of North Chincha Island, was usually well covered with Cuervos, from the highest spars to the bulwarks. I counted seventy-six of the birds roosting on this vessel at sunset of November 23.

Along the beach of Talara, in northern Peru, I have seen Cuervos working at the very edge of the water, engaged in catching small fish thrown against the shore by the waves, and paying little attention to Indian boys swimming near or even among them. In the same manner I have seen them feeding in the company of Indian fishermen at the mouth of the Río Chira. In January, 1920, I found them plentiful at the Lobos Islands, mingling on rocky sections of coast with the Blue-footed Boobies, and on sandy beaches with the Kelp Gulls. Sometimes on the higher points they were close even to Turkey Vultures, which they resembled curiously when both species stood with their wings half open, their backs to the sun. At Lobos de Afuera, on January 5, I found the nests of the cormorants on little pinnacles of a gulch, more or less surrounded by incubating Peruvian Boobies (*Sula variegata*). The cormorant nests were composed of seaweed, and were balanced upon the tops of small blocks of rock 20 to 30 meters above the water. Families of fledgling young, numbering two or three, continued to return to these platforms to rest even after they had taken flight and had begun to undertake more or less fishing for themselves.

At Estorbo Islet, off Puerto Deseado, Patagonia, Doello-Jurado (1917, 11) found the nests of Cuervos on the tops of low stiff shrubs of a species of *Atriplex*. Here the nests were constructed of twigs. In February they contained young in various stages of growth, only one unhatched egg being observed. The adult cormorants ejected fishes when they were approached. Along the coast of Chiloé Island, according to Germain (1860, 315), these cormorants nest either on rocks or in trees bordering lakes. Their bulky nests are often made of aquatic plants and give off the offensive odor characteristic of the birds themselves (Lane, 1897, 186). Near Corral they are said to nest exclusively in trees, sometimes in such huge arboreal colonies that the droppings kill all the vegetation. Hellmayr speaks of a colony of thousands on the summits of the loftiest trees near a place called Los Guauros, south of Mansera Island in the Bay of Valdivia.

At Pacheca, of the Pearl Islands in the Gulf of Panama, the inner plateau is thinly wooded, and here Rendahl (1920, 11) found these cormorants nesting in leafless trees at the end of March. Nearly every tree had several nests. The cormorants made up a sort of central colony in the general sea bird population, with pelicans and boobies nesting in separate areas roundabout them. The cormorants promptly drove out any boobies that attempted to alight within their territory, but they submitted meekly to similar invasions made by pelicans. Rendahl found the species common also at Santelmo Island, and Thayer and Bangs (1905, 141) report them from San Miguel of the same group. The last authors also speak of a nest in a tree at Saboga which contained six well-incubated eggs on April 14. This is the largest set of which I find any record.

Stomachs of Cuervos I collected along the coast of Peru contained the following species of fishes: *Scorpaena histrio*, *Chromis crusma*, *Epinephalus labriformis*. One had five or more small examples of the last-named species, together with a hippa (*Emerita analoga*), which may have come from the viscera of one of the fishes. Another contained an unidentified fish 20 centimeters in length, and also barnacles (*Balanus tintinnabulum*), crabs, a chiton, other mollusks, and algae, all of which may likewise have come from the alimentary tract of the fish, which was partly digested.

A manuscript note by the late Dr. H. C. Forbes states that he saw one of these cormorants on the coast of Peru capture 22 eels within ten minutes. Since there are no catadromous eels in this part of the world, the fishes were doubtless shore-eels (*Ophichthus* or *Gymnothorax*), of which I have collected specimens in Peru. According to Coker (1919, 479), the Cuervo prefers shallow-water bottom fish which it can capture close to shore, especially such forms as blennies, which one may see from the rocks in suitable places. He has found in the stomachs and gullets of the birds fish of this sort, ranging in length between 6 and 25 centimeters. Lane (1897, 186) states that the cormorants sometimes remain from three to four minutes beneath the surface while hunting food. Like certain other cormorants, as well as grebes, they can swim at the surface with only the head exposed. Mr. George K. Cherrie states in manuscript that in the Río Paraguay he has frequently seen the Cuervos bring up from the depths a kind of catfish about 15 centimeters long and armed with strong and sharp pectoral and dorsal spines. They never attempted to swallow such victims until they had been tossed and caught again so as to go down head foremost. Verrill (1923, 303) states that at Paita, Peru, he noted that the Cuervos remained beneath the surface for from 30 seconds to nearly a minute.

FUEGIAN CORMORANT

Phalacrocorax olivaceus hornensis, new subspecies

Subspecific Characters: Similar to *Phalacrocorax olivaceus olivaceus*, but with a much shorter bill, and averaging smaller in all other dimensions except length of tail.

Type.—No. 3609, Brewster-Sanford Coll.; Amer. Mus. Nat. Hist.; ♂ ad.; Bertrand Island (south of Navarino Island), Chile, April 22, 1915; R. H. Beck.

Measurements, and other data, covering 4 adults are as follows:

	Wing	Tail	Exposed culmen	Bill from gape	Tarsus	Outer toe and claw
♂, Bertrand Island, Apr. 22, 1915 . .	281	165	49	79	54	89 mm.
♂, Beagle Channel, July 29, 1915 . .	281	176	50.5	79	54	92
♀, Bertrand Island, Apr. 22, 1915 . .	265	133	46	70	50	86
♀, Beagle Channel, Jan. 11, 1915 . .	269	148	46	70	51	81

Distribution: Islands and waters in southern Tierra del Fuego and the neighborhood of Cape Horn; known specifically from Bertrand Island in the Gulf of Nassau and from Beagle Channel; northern limit of the range not determined.

This well-marked race, which has not previously been distinguished, has been reported upon from the Magellanic region by many naturalists under the specific names *vigua*, *brasilianus* or *brasiliensis*. It is presumably the form taken or observed in various parts of Tierra del Fuego by King (1828, 101), Oustalet (1891, 142), Dabbene (1902, 395), and Crawshay (1907, 149).

Beck found these cormorants common along all the southerly Fuegian coasts between July and December, 1914, and collected examples in Beagle Channel and at Bertrand Island during January, April, and July of the following year. A female shot on January 11 was practically ready to lay eggs, while the April and July birds of both sexes had gonads in the resting stage. Notes on the label state that all the birds had green irides, the bill being black above and yellowish or brownish on the mandible, the legs and feet black, in all of which respects they agree with the typical subspecies.

The relatively slight evidence from the sex organs of four adult individuals indicates exactly what might be expected, namely, that the native Bigüá Cormorant of the inclement region close to Cape Horn has a definitely fixed breeding period, which comes at the beginning of the summer, as opposed to the extended or continuous breeding season characteristic of the tropical representatives of the species.

The range of this form remains to be worked out through further collecting. Practically all of the birds from more northerly parts of South America are, as previously noted, typical of the subspecies *olivaceus*. A female from the Río Gallegos, Patagonia, which is just north of the Strait of Magellan, has, however, a very short bill (50 millimeters) and may be somewhat intermediate between the two geographic races. It is worth noting that the Central and North American race *mexicanus*, which is even smaller than *hornensis*, has a very much longer bill.

FLIGHTLESS CORMORANT

Nannopterum harrisi

Phalacrocorax harrisi Rothschild, 1898, Bull. Brit. Orn. Club, 7, p. 52 (Narborough Island, Galápagos Archipelago).

Names: Galápagos Cormorant. There are no synonyms of the specific name.

Characters: A gigantic brown cormorant, with diminutive, rounded wings, in which the fifth from the outermost primary is the longest.

Adults (sexes alike): Entire plumage soft, loose, and hair-like, generally blackish brown,

lighter ventrally; a faint greenish gloss on the scapulars and other parts of the dorsal surface; the ventral surface varies among several specimens from tawny to seal brown; sides of head and neck sprinkled with white filoplumes, each of which has a brush-like termination of many loose barbs. Iris emerald ("clear glittering Italian blue," according to Beebe), the pupil somewhat elliptical, with the horizontal diameter longer than the vertical (Snodgrass and Heller, 1904, 249); maxilla blackish or slaty, with the tip and tomia horny brown; mandible horny brown, with darker tomia; gular sac brownish purple, with whitish dots; lores dusky, with parallel rows of pale dots; legs and feet black.

Dimensions (based upon two American Museum specimens and published figures of Gifford and of Snodgrass and Heller):

Males: Length, 905; wing, 186–188; tail, 154–165; exposed culmen, 65–77; bill from gape, 120; tarsus, 72–79.6; outer toe and claw, 124 mm.

Females: Length, 885; wing, 177.5–193; tail, 149-165; exposed culmen, 59–76.5; bill from gape, 112; tarsus, 59–66; outer toe and claw, 99–110 mm.

I find no descriptions of the young.

The eggs number 2 or 3. They are described as elongate-oval or narrowly elliptical in form, with a bluish green shell, much concealed by a limy deposit. The extremes among two sets of 3 measure 71 x 42.5, 59 x 41, 68 x 45, and 64 x 39 mm.

Distribution: The Galápagos Archipelago; thus far recorded only from Albemarle and Narborough Islands.

The Flightless Cormorant of the Galápagos is one of the most striking examples of genetic loss of function made possible by the safety of isolation. We need to know nothing about the ultimate place of origin of the species to realize that at the lonely archipelago where it is still found it has enjoyed for ages—in the absence of predacious reptiles and mammals—an immunity which has put no check upon diminishing wing-area and increasing body-weight. As Beebe (1924, 115) has pointed out, the degeneration of its wings has gone even further than that of the Great Auk, for those of the cormorant measure not more than 20 per cent of the total length of the bird. The weight of the largest cormorant collected by Beebe was 3.85 kilograms; that of a captive example in good health, 2.5 kilograms (Townsend, 1929, 211).

The fact that this species was unknown to science until just before the beginning of the present century is somewhat astonishing. Townsend explains it by inferring that in the water the bird looks much like any other cormorant, for which reason it would be less likely to attract the attention of a visiting naturalist than many of the supposedly more extraordinary birds of the Galápagos. On the other hand, it is possible that the range of the cormorant was highly restricted even during times before dogs were introduced. At present it is by far the most local in distribution of all the sea birds of the archipelago, its range being confined to Narborough Island and the adjacent parts of the coast of Albemarle. Snodgrass and Heller (1904, 249), who were in the field soon after the date of first description of this cormorant, never saw more than a dozen of the birds at one time, and wrote: "Their small numbers and their much restricted habitat would seem to indicate that they are on the verge of extinction."

The Flightless Cormorants seem to nest altogether on the shores of main islands of the Galápagos, instead of on outlying rocks as so many of the other sea fowl do. Nesting groups are small, rarely more than a half dozen pairs,

and the birds are not wary enough to retreat to the water when safety demands it. One of the nesting localities is in Tagus Cove, where most scientific visitors have anchored. Here Beebe found two nests situated 5 meters apart on projections of lava on a steep slope from the water. In each of these a bird was covering a single egg. The nests were well-formed masses of débris from the cove, chiefly dried seaweed, starfish, and fish bones. At Banks Bay the nests are described as depressions in the sand, lined around the edges with a few sticks and seaweed. The birds here protected them savagely, opening their mouths menacingly and uttering harsh guttural croaks (Gifford, 1913, 80). In the northeastern part of Narborough, Gifford found two "colonies" in April. In one there were three pairs, in the other four or five, the nests lying on black lava about 3 meters above the water, and each containing either two or three eggs. Snodgrass and Heller (1904, 249) describe the nests as made of brown algae heaped into cone-shaped masses about 30 centimeters high, with a hollow at the top for the eggs. These authors give the following dimensions: external diameter 75 centimeters; internal diameter 40; depth of cavity 10. They usually saw the adults in pairs, and observed that the females were particularly stubborn in defense, thrusting with their beaks and hissing loudly.

In the water the Flightless Cormorants are both efficient and graceful, carrying the neck in very swan-like fashion while they remain at the surface. The body floats as low as that of an otter, sometimes only the head and part of the neck being exposed. In sounding, these birds do not merely sink, like a Galápagos Penguin or a seal; rather, they make a rapid upward and forward leap, then curving under head-first.

Ashore, the large bodies and short legs of the Flightless Cormorants put them at a great disadvantage. On a level surface they waddle, changing their method of progression on a rough terrain to a series of springy jumps. They can leap to the top of a rock 15 to 20 centimeters high, though in this respect they are far less agile than their little neighbor, the penguin. They are fond of working their way to some high point on the coast near the nesting sites, there to sit and sun, with the wings half spread, as vultures do. At such times they can be all too easily approached, and even killed with a stick.

In captivity at the New York Aquarium, Galápagos Cormorants eagerly drank seawater. They were extremely quarrelsome, and threatened to kill a Galápagos Penguin in the same pool. They resented handling or any other intimacy, and squawked loudly when seized or picked up. While pursuing food under water, they held the wings close against the body, progression depending entirely upon the widely webbed feet. After swimming and feeding in the Aquarium pool, the birds would stand upright and spread their abbreviated wings to dry, in the familiar cormorant fashion. They slept standing on one foot, with head laid diagonally across the back and the beak tucked under the wing coverts. They jumped well from the height of a table to the floor. The birds were much interested in their own image in a mirror, or even in the dim reflection in a bookcase door (Townsend, 1929, 211).

The croaking and hissing of these cormorants has been referred to above.

Bronson (1931, 62) likens their notes to "static on the radio." Gifford states that the young are capable of making "loud cries" when they pursue their parents in the water to demand food.

A stomach examined in the field by Beebe contained eels, smaller fish, and a good-sized octopus. The last creature evidently enters heavily into the menu. Bronson states that a Flightless Cormorant can swallow in rapid succession two dozen "seven-inch herring," and Gifford saw one come to the surface and swallow a "14-inch eel."

THE MAN-O'-WAR BIRDS

FAMILY FREGATIDAE

In many groups of birds the various related species differ more in the details of their life history than they do in structure and appearance. Among the man-o'-war birds the opposite is true. Occupying one part or another of the warmer oceans of the world are no less than five species, which appear to exhibit well-marked differences of size and of color pattern, whereas in habits and ecological position all forms seem to be extremely similar. At a few breeding stations, such as the island of South Trinidad, two species—one large, one small—live side by side, and a more exhaustive knowledge of the life history of each is, of course, likely to bring to light yet undiscovered divergence as to their respective places in the local web of life.

In view of the extraordinary powers of flight possessed by man-o'-war birds, it is remarkable that several of the species have developed a number of subspecies of highly restricted range. Such a condition presumably means that the breeding stocks have been isolated during long periods of time, which brings us back to the thesis discussed in an earlier section (p. 91), namely, the essentially sedentary nature of these birds. Stragglers among the man-o'-war birds have no doubt at rare intervals wandered far and wide, or have been transported great distances by storms. Only in this manner could remote oceanic islands have become populated by representatives of the group. With such exceptions, however, man-o'-war birds cling rather closely to continental or insular coasts and, indeed, seldom fly out of sight of land. Finsch (1900, 446) has devoted particular attention to this subject, and the most remote pelagic record he could find was of a single individual noted during the month of August some 600 to 700 kilometers to southwestward of the Hawaiian group. It should be remarked, however, that this position is a much lesser distance from Johnston or Cornwallis Island. Mr. J. T. Nichols has reported to me by letter on a man-o'-war bird observed during April in a position "some 800 sea miles west of the island of San Felix." Even this point is less distant from the Sala y Gomez Rocks where, as I have reported earlier, man-o'-war birds nest. In any event, the great scarcity of pelagic records shows that the man-o'-war birds, like all of their near relatives except the tropic-birds, are distinctly not "ocean wanderers." While not as exclusively littoral as the pelicans and cormorants, they

at least cling closely to their island homes, and are even less likely to be seen off soundings than are some of the boobies.

Man-o'-war birds are of pan-tropical distribution. Finsch notes but one record to southward of the tropic of Capricorn in the central Pacific, and this was only in latitude 26° 50′ S. The breeding station at Sala y Gomez, considerably farther eastward, is about at the same parallel, but the bird does not appear to be a resident of Easter Island. The northward bend of the Sub-Tropical Convergence, as the South American coast is approached, bars it, of course, from San Felix and San Ambrosio. In the western South Pacific no man-o'-war birds inhabit the Kermadecs, Norfolk or Lord Howe Island, and the few New Zealand records are evidently based upon accidental occurrences. In order to pass from the South Atlantic to the Indian Ocean, or *vice versa*, it would be necessary for man-o'-war birds to cross the 35th parallel of south latitude, but it is of zoögeographical interest to note that they might do so without crossing or even closely approaching the Sub-Tropical Convergence, which loops sharply southward off the southern tip of Africa (Fig. 6). Between the Atlantic and the Pacific the only direct route available within recent epochs of earth history would be across the Isthmus of Panama. This, however, imposes no effective barrier, for man-o'-war birds constantly fly back and forth from one ocean to another as, indeed, they do over lands much higher and twice as wide, such as the island of Cuba.

In the light of present knowledge, the following species and races of man-o'-war birds occur within the South American region, or at the more or less remote islands of the South Atlantic which I have included within my geographical discussions.

1. *Fregata aquila* Linnaeus.

Type locality, Ascension Island.

This species is confined entirely to Ascension, and has not been recorded from anywhere near the South American coast. Formerly, however, the specific name *aquila* was applied to frigate-birds from all parts of the world, so that it appears much in the synonymy of other forms of the genus.

2. *Fregata magnificens magnificens* Mathews.

Type locality, Barrington Island, Galápagos Archipelago; also recorded from Indefatigable, Albemarle, Duncan, and Hood Islands.

Peters (1931, 95) states that this race breeds also at the Pearl Islands in the Gulf of Panama. In view of the fact that the Caribbean Man-o'-war Bird is regarded as a distinct race, and that individuals and bands regularly and constantly pass back and forth between the Pacific and the Caribbean, it would be biologically inconceivable that separate races exist on the Atlantic and Pacific coasts of the Isthmus. It is much more likely that this large Pacific race is confined exclusively to the Galápagos Islands, from which it never wanders as far as the coast of the continent. I have no knowledge as to whether it is this form or another which inhabits Cocos Island.

3. *Fregata magnificens rothschildi* Mathews.

Type locality, Aruba Island. Distribution, southern Florida, the Bahamas, West Indies, all coasts of the Gulf of Mexico, the Caribbean Sea, and the South Atlantic Ocean southward to Fernando Noronha and islands along the eastern coast of Brazil; also along the Pacific coast of America from Mexico to northern Peru.

I judge that *Fregata minor januaria*, described by Ribeiro from the littoral of Brazil between Rio de Janeiro and Santos, is identical with this form, and not with the larger of the two frigate-birds inhabiting South Trinidad Island. At any rate, all the specimens I have seen from the coast of Brazil prove to be *magnificens* rather than *minor*.

4. *Fregata minor ridgwayi* Mathews.

Type locality, Culpepper Island, Galápagos Archipelago; recorded also from Wenman and Hood Islands.

Swarth (1931, 39) has shown that the two breeding species of man-o'-war birds in the Galápagos are at the same time closely associated and readily distinguishable, and that there is probably a general segregation of breeding grounds between the two, even though both apparently occur throughout the archipelago. It is almost certain that *magnificens* is an Atlantic derivative dating, like the Red-billed Tropic-bird, Brown Pelican, Yellow-crowned Night Heron, Flamingo, etc., from the time when the Galápagos were in an oceanographic sense an outpost of the West Indies. *Fregata minor*, on the other hand, probably reached the Galápagos from the west or southwest, for it is a circumpolar species throughout a pan-tropical belt of the southern hemisphere.

Although the two species of man-o'-war birds at the Galápagos present no difficulties when it comes to distinguishing one from the other, it cannot be said that the peculiar characters of the resident subspecies of *minor* have been very clearly pointed out. *Fregata minor ridgwayi*, as shown by Swarth, has been collected once to northward of Clipperton Island but, according to the "A. O. U. Check-List of North American Birds" (1931, 25), all available Lower Californian specimens prove to belong to the species *magnificens*.

5. *Fregata minor nicolli* Mathews.

Type locality, South Trinidad.

Known only from South Trinidad and the neighboring Martin Vas Islets. As noted above, this form apparently does not wander to the Brazilian coast.

6. *Fregata ariel trinitatis* Ribeiro.

Type locality, South Trinidad.

Restricted to South Trinidad and Martin Vas. This race of the Lesser Frigatebird is the only Atlantic representative of a species of world-wide distribution in warmer waters of the southern hemisphere, and it also crosses the equator in the western part of the Pacific.

? Doubtful forms.

It should be pointed out here that the island of St. Helena, in the eastern sub-tropical Atlantic, was formerly inhabited by some form of man-o'-war bird,

which seems to have become extinct before any specimens were preserved. With the ranges of no less than four species approaching this island from the directions of South Trinidad, Ascension, and Gambia, it would be unprofitable to speculate as to what the affinities of the St. Helena bird may have been.

Finally, I have had no opportunity to examine any man-o'-war birds from Cocos Island, and am therefore uncertain as to whether the resident form is a representative of *magnificens* or of *minor*. Gifford (1913, 103), working in the field at a date when the two were not distinguished, found them common during September in the tall forest trees of Cocos. They were persecuting not only the boobies but also the smaller noddies. No specimens were collected.

The man-o'-war birds exhibit specific differences which should be the delight of a geneticist, for every one of them represents a combination of characters of a sort which has appeared many times in breeding stocks of laboratory animals. Among these birds, for example, one sees evidence of mutations which have produced "cock-feathered hens" and also "hen-feathered cocks." Every adult man-o'-war bird, in fact, wears a plumage representative of a stage in the ontogeny of some other man-o'-war bird. No ornithologist has ever attempted to split the group into two or more genera, and it seems probable that all the forms in the world are very closely related, and that they have become differentiated through simple and comprehensible types of genetic mutation, which have affected the size, proportions, and plumage-pattern of each.

In using the adjective "simple," I mean merely that the results are extraordinarily understandable by analogy with those of controlled breeding experiments in other animals. The mutations involved may well be very numerous, for in the domestic fowl at least a dozen genes which modify the pigmentation of feathers have been discovered. Such a phenomenon as cock-feathering in a female bird, moreover, may occur in two or more ways. In the mallard duck, for example, a secretion of the ovaries inhibits development of the basic plumage-pattern which is similar to that of the male. Ovariectomy removes this check and the female will then become drake-feathered after the next moult. Among other species, cock-feathering in the female is due to a gene which affects the chromosomal content of the skin cells, and the gonads are not concerned with the visible results. A brief analysis of plumage-patterns in the five species of the genus *Fregata* is as follows:

In juvenal plumage all of them look much alike, except as regards size, each having a white head, neck, and breast, and a pronounced light-colored alar bar, regardless of sex. The males of two species, namely, *magnificens* and *aquila*, change from the last-named plumage to a completely black garb, relieved only by iridescence which is mainly violet in the former species and mainly green in the latter.

The female of *magnificens*, however, retains the alar bar and white breast of juvenal plumage, whereas the female of *aquila* becomes a cock-feathered bird although in the distinctly paler brown of its breast and hind neck, and in a vague brownish tinge along the ulnar coverts, it retains what might be called a palimpsest of the juvenal pattern.

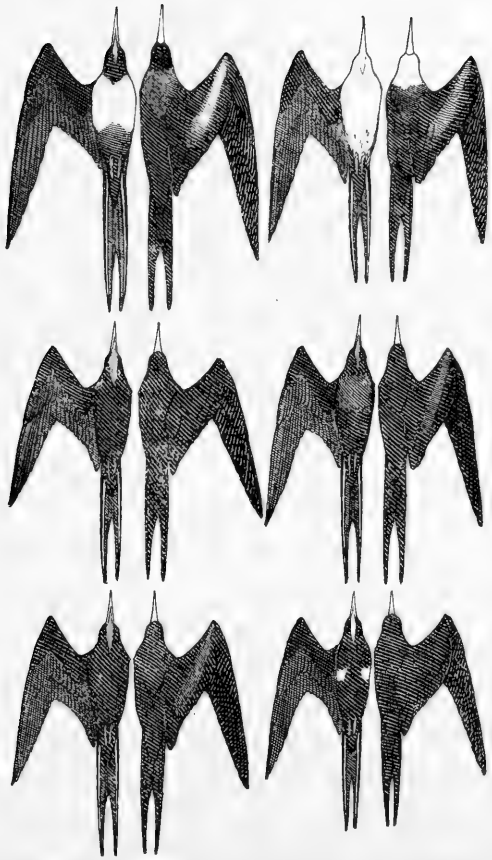


FIG. 72. Plumage-patterns, in ventral and dorsal aspect, among several ages and species of Man-o'-war Birds.

Reading from left to right: upper two, *Fregata magnificens magnificens*, adult ♀, and *F. magnificens rothschildi*, young ♀; middle two, *F. aquila*, adult ♂ and ♀; lower two, *F. minor*, adult ♂, and *F. ariel*, adult ♂.

The adult male of *minor*, on the other hand, retains the brown wing band which is universally characteristic of immaturity and generally of femininity, while its mate is only slightly differentiated from the female of *magnificens*.

In still another species, which does not come within the scope of this book, namely, *Fregata andrewsi* of the Indian Ocean, adults of both sexes have taken the opposite genetic trend from that of *aquila*. In other words, not only does the female of this species retain the feminine type of plumage, but the adult male is also hen-feathered, keeping both a wing-bar and a white abdomen.

Finally, the female of the species *ariel* has the usual pattern of its sex, while the male has made a new departure in plumage experimentation, and has developed conspicuous white spots on either side of its black ventral plumage.

Throughout the family, of course, the principal secondary sexual character, which is the brightly colored, inflatable gular sac, is restricted to males. Vigors (1833) reports upon a dissection by Collie, surgeon of H. M. S. 'Blossom,' which purports to show that the pouch of the man-o'-war bird is inflated from the lungs through an opening anterior to the humeral articulation of the scapula. From here, in the cellular substance beneath the skin, a passage of some length leads from the bony orifice to the pouch. A modern reëxamination of this mechanism is much needed.

As a flying-machine, the man-o'-war bird is unparalleled in nature. Among all birds it has the greatest plane area in proportion to weight. Furthermore, its plumage and pectoral muscles together make up at least 47 per cent of the total body-weight.

ASCENSION MAN-O'-WAR BIRD

Fregata aquila

Pelecanus Aquilus Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 133 (Ascension Island).

Names: Ascension Frigate-bird.

Characters: A relatively small-billed man-o'-war bird, and the only species in which the adult female is entirely dark.

Adult male: Black, with glossy metallic sheen on much of the plumage, this being mainly bluish green on the lanceolate feathers of the head, and bottle-green, with only a slight admixture of bronzy or purplish, on those of the back; breast and belly duller, with a suggestion of brownish, but still never without slight bronze, purplish, or dark bluish reflections; shafts of wing quills dark, but those of the tail ivory-white in ventral aspect. Iris brown; gular sac red; feet apparently black. Alexander (1928, 264) states that the feet of the male are red. Among our dried specimens, however, they look black, whereas those of the female are red, as in *F. magnificens*.

Adult female: Similar to male, and only slightly less glossy green on the back where, however, the feathers are less distinctly lanceolate; the breast, furthermore, is distinctly brown, without trace of metallic iridescence, and an extension of this area forms an indistinct brownish collar around the hind neck; a faint suggestion of a brownish alar bar is also usually perceptible. Feet red.

5 males: wing, 552–581 (562); tail, 357–402 (384); exposed culmen, 87.3–95.5 (91.7); width of maxilla at base (average), 29; middle toe and claw, 65; length in the flesh, 891; wing-expanse, 1957 mm.

4 females: wing, 587–607 (598); tail, 393–411 (405); exposed culmen, 99–105.9 (103); width of maxilla at base, 34; length in the flesh, 960; wing-expanse, 2055 mm.

The juvenal plumage is at first nearly indistinguishable from that of *magnificens*, the resemblance extending even to the pronounced grayish alar bar. An incomplete brownish collar, however, terminates in large patches at the side of the breast, which ultimately turns entirely dark.

Nestlings and eggs not seen.

Distribution: Known only from Ascension and the adjacent waters. The principal breeding center is at Boatswain-bird Islet.

The name of the typical species of the man-o'-war bird is the Latin adjective signifying dark-colored, and not the noun meaning eagle. Possibly Linnaeus knew that both sexes of the Ascension bird are black, but for much more than a century after the original description his specific name, *Pelecanus aquilus*, was made to cover practically all forms of man-o'-war birds the world over.

The Ascension bird has always been rather little known, and very rare in collections, but the American Museum now fortunately possesses nine specimens collected in November, 1925, during the South Atlantic Expedition of the Cleveland Museum of Natural History. The species proves to have a curious diagnostic character in its slender and remarkably depressed bill, the culminicorn plate of which is extraordinarily flat, rising little if any above the plane of the latericorn plates on either side. The depth of the closed bill at its midpoint averages 14 millimeters among 5 females; among 21 females of *Fregata magnificens rothschildi* this same measurement averages 17.6 millimeters. The cock-feathered plumage of the female of the species *aquila*, which is unique in the genus, has been sufficiently referred to in the introductory section.

More than a century ago, Burton (1822, 1) collected several man-o'-war birds at Ascension where, he states, they were breeding in vast numbers during the month of September, and made some interesting comments upon the morphology and life history of the species. Not unnaturally, he mistook the adult females for males, which they so much resemble, and assumed that the immature birds, collected over the surrounding ocean, were females.

Average measurements in centimeters of five mature examples, presumably including both sexes, Burton found to be as follows: length of body (tip of beak to tip of tail), 91; wing-expanse, 208; length of extended wing, 98; length of longest primary quill, 43. The weight was 1247 grams, of which the pectoral muscles alone made up "nearly one-fourth." The weight of the plumage of an example, derived by weighing the body before and after plucking, amounted to 283.5 grams. Regarding the extraordinary disproportion between the pectoral and pelvic members of these birds, to which Burton devotes considerable discussion, he records the following interesting data:

Humerus: length, 184 millimeters; weight, 11.34 grams.
Ulna and radius: length, 241 millimeters.
Femur: length, 51 millimeters; weight, 0.713 grams.
Tibia: length, 57 millimeters.

Burton calls attention to the fact that the preen gland, which is no larger than a "garden pea," is in this species totally insufficient for its usual office among sea fowl and that, in correlation with this, the plumage of man-o'-war birds immediately became water-soaked when they were placed upon the ocean. Uninjured birds, moreover, could make no progress whatsoever by swimming. The tail, he writes, is the most important organ in the aërial gyrations required

by the habits of man-o'-war birds, such as the "flattening out" by means of which they suddenly check their breathless descent when darting straight down from a great height toward the water. The tail is regulated by seven distinct pairs of muscles leading to the caudal vertebrae, and the enormous rectrices are inserted in an exceedingly massive cushion of tissue on either side of the huge pygostyle.

A downy chick examined in the nest by Burton disgorged seven flying fish.

Moseley (1879, 563), Penrose (1879, 276), and Simmons (1927, 51) have described the nesting of the Ascension Man-o'-war Bird at Boatswain-bird Islet. The plateau is fairly flat, with an area of roughly 8000 square meters (2 acres), and here the birds apparently breed throughout the year, for the 'Challenger' party found them on the nests in March and April, and the 'Blossom' party in November. So far as can be judged from the literature, no nest-structure is built up, the egg being deposited in a hollow of the islet's guano-crust. Penrose states that the birds have considerable difficulty in rising from the ground, but the remarkable point is that they are able to take wing at all from such a flat surface, for other species of man-o'-war birds are generally credited with being helpless under similar circumstances. Photographs accompanying the text of Simmons show the nature of the terrain, which has few projections or irregularities.

It is likely that this species inhabited the main island of Ascension during the remote time when it was wooded, and that the birds now occupy the small outlier because they can always take wing by floundering to the readily accessible brink of the cliff.

Schlegel (1863, 2) tells of an Ascension Frigate-bird which attempted obstinately to tear the pennant from the masthead of his ship, a trait which has also been reported of other species. Ascension is a famous breeding ground for sea turtles, and the man-o'-war birds are said to devour many of the newly hatched young. I have no satisfactory testimony, however, as to whether the baby reptiles are picked up from the beaches or only from the surface of the water. The question is referred to again in the biography of the next species.

GALÁPAGOS MAN-O'-WAR BIRD

Fregata magnificens magnificens

Fregata minor magnificens Mathews, 1914, Austr. Avian. Rec., 2, p. 120 (Barrington Island, Galápagos Archipelago).

Names: The commonest synonym in the literature of this, as of most other forms of man-o'-war birds, is *aquila*.

Characters: A sexually dimorphic species, the adult male with wholly black plumage, the female white-breasted. This is also the largest race of the largest species of man-o'-war bird.

Adult male: Entirely black except on the unfeathered parts, the lanceolate feathers of the pileum glossed with metallic bottle-green, those of the scapulars and interscapulars with both green and reddish purple, but with the latter predominating; the coverts of the wing also have a similar gloss, with green predominating, while the duskier plumage of the ventral surface has a less pronounced purplish gloss. Iris brown; bill blackish horn-color or leaden blue, usually with more or less of a flaky crust similar to that on a pelican's bill; gular sac bright red, with small,

warty, orange excrescences, during the courtship season, subsequently shrinking so that the surface is prevailingly orange; legs and feet black.

Adult female: Head, neck, and dorsal surface, lower belly and crissum, brownish black, darkest on the crown and the quills; lanceolate feathers of the crown only slightly glossed with green; feathers of scapular region not lanceolate and very slightly glossed; breast, base of neck laterally, and flanks, white, with an indistinct grayish collar passing around neck from the white area; central lesser wing coverts grayish brown, forming a broad and somewhat ill-defined bar along the anterior edge of the mid-wing; quills of wing and tail faintly glossed with blue and purple hues. Bill horn-color; bare throat dusky purplish; orbital skin dark blue; legs and feet red, pink, or magenta.

One male, Indefatigable Island: wing, 651; tail, 465; exposed culmen, 111.2; width of maxilla at base, 32.1; middle toe and claw, 69 mm.

One female, Indefatigable Island: wing, 703; tail, 543; culmen, 125.7; width of maxilla at base, 35; middle toe and claw, 75 mm.

Young: Head, neck, breast, and belly white, usually with a brownish extension from the flanks more or less meeting across the breast; remainder of plumage much as in the adult female; gular sac lavender-blue; feet flesh color.

Nestling: Covered with fluffy, booby-like white down, from which it moults directly into the juvenal plumage described above, the first contour plumage to appear being the clove-brown feathers of the back and scapulars. The first white feathers on the head are usually tinged with a rusty hue. The quills are glossy black. The ashy lesser coverts of the wing form the broad band which is characteristic of juvenal and adult female plumages.

I have not seen eggs of Galápagos Man-o'-war Birds, and the descriptions and measurements published by Gifford include those of two distinct species.

Distribution: The Galápagos Archipelago, probably throughout the group, but specifically recorded from Barrington, Indefatigable, Albemarle, Duncan, and Hood Islands.

At the Galápagos Islands, the Atlantic-Caribbean species of man-o'-war bird reaches its westernmost outpost. The local birds seem to comprise an exceptionally large subspecies, which is presumably endemic. No specimens from the west coast of South America, or from Panama, at any rate, appear to equal them in size. The large dimensions are illustrated by the two specimens in the American Museum Collection, the female of this random pair being the largest man-o'-war bird among the more than 70 examples I have measured. Gifford (1913, 104) has recorded the measurements of many other specimens but, as pointed out by Swarth (1931, 39), he has confused representatives of this species with those of the Galápagos race of *Fregata minor*, so that the measurements of these dissimilar birds are combined.

Notes on the life history of the Galápagos race of *Fregata magnificens* are included in the next biography, which deals with the very closely related continental and Antillean subspecies.

CARIBBEAN MAN-O'-WAR BIRD

Fregata magnificens rothschildi

Fregata minor rothschildi Mathews, 1915, Birds Austral., 4, p. 280 (Aruba Island, Caribbean Sea).

Names: Frigate-bird, Man-o'-war Hawk. Spanish-American names include "Tijera," "Tijereta," "Tijerilla," "Rabijunco," "Rabihorcado," and "Anunciador." In Brazil the names "Grapirá," "Tesoura," "Tesoureira," and "João Grande" are used. The specific names *aquila* and *minor* have both been applied to this form.

Subspecific characters: Similar in all respects to the typical subspecies, but smaller.

21 males from Florida, the Bahamas, the Lesser Antilles, Santo Domingo, Porto Rico, Texas, Vera Cruz, Honduras, Panama, Ecuador, northern Peru, Fernando Noronha Island, and Rio de Janeiro: wing, 611–661 (633); tail, 339–472 (431); exposed culmen, 105.2–118.5 (112.1); width of maxilla at base, 30.2–32.5 (31.4); tarsus, 21–25 (22.4); middle toe and claw, 69–74 (71) mm.

The length in the flesh of 5 males was 93–104 (99.5) cm.; wing-spread of the same birds, 217–229 (224) cm.

21 females from the same regions as the males and also from Lower California and Sinaloa, Mexico: wing, 628–674 (650); tail, 504–506 (431); exposed culmen, 109.2–130 (121); width of maxilla at base, 32–35 (33); tarsus, 21–25 (22.9); middle toe and claw, 71–80 (75.6) mm.

The length in the flesh of 3 females was 94–112 (103) cm.; wing-spread of the same birds, 224–236 (231) cm.

A female which I shot at Talara, Peru, on January 20, 1925, had a wing-spread of 230 cm. and a weight of 1587 grams. The dried skeleton of another female weighs 103 grams.

The single egg is approximately elliptical-ovate, and dead white, with a very thin shell. Measurements of 50 average 68.4 x 46.5 mm., those exhibiting the extremes measuring 74 x 48.5, 72.5 x 50, 64.5 x 46, and 66.5 x 43.5 mm. (Bent, 1922, 309).

Distribution: Atlantic and Pacific coasts of America throughout the extent of tropical littoral; breeding on the Pacific side from the Gulf of Guayaquil, Ecuador, to Central America (southern Mexico ?), and on the Atlantic side from the vicinity of Rio de Janeiro, Brazil, to Florida and the Bahamas; breeding also at Fernando Noronha and throughout the West Indies and the islands of the Caribbean Sea.

The man-o'-war bird described under the specific name *magnificens* is chiefly of tropical American range, although it also crosses the Atlantic to the west coast of Africa. Lowe has referred to it as a species of the "American Mediterranean," by which he evidently means the Caribbean-Gulf of Mexico region, together with a section of the Atlantic to eastward and another of the Pacific to westward. Its distribution in a north-south direction is widest along the Atlantic littoral of America, where the limits are approximately in latitudes 25° N. and 25° S.

A number of subspecies have been described, of which three are likely to stand the test of further taxonomic research, namely, *Fregata magnificens magnificens* of the Galápagos Archipelago, *F. m. rothschildi* of the Antilles and both the Atlantic and the Pacific coasts of America, and *F. m. lowei* of the Cape Verde Islands and adjacent parts of the African coast. Only the first two of these need here concern us, and I am combining the accounts of their life histories.

In much of the literature, man-o'-war birds of the species *minor* are listed from the Pacific coast of America. A form of *minor* does, indeed, inhabit the Galápagos Islands, but there is thus far no evidence that its range approaches nearer toward the continental shores. At any rate, the man-o'-war birds I have examined from Lower California, Sinaloa, the Gulf of Panama, Ecuador, and northern Peru are all representatives of *magnificens* and are indistinguishable from specimens of West Indian origin.

In the headings I have called the two American races of *Fregata magnificens* the Galápagos Man-o'-war Bird and the Caribbean Man-o'-war Bird. Unfortunately, there are no really vernacular names for either of these, unless one might select one of the South American Spanish or Portuguese terms connoting "scissors" and referring to the manner in which these great sea fowl open and shut the long blades of their tails. For the species as a whole I am reluctantly

driven to adopting the name "Magnificent Man-o'-war Bird," which has already been used by Alexander (1928, 263).

The Magnificent Man-o'-war Bird is, then, a species of South American tropical coasts and certain outlying islands. However, the most distant and isolated islands within the range, such as the Galápagos and the Cape Verdes, have segregated populations which comprise endemic subspecies. In the coastal region the species ranges from the neighborhood of Paita, Peru (5° S.), northward and eastward around the continent, and southward on the east coast well beyond Santos, Brazil. It exemplifies diagrammatically the effect of cool and warm currents upon zoölogical distribution. The Humboldt Current, for example, holds it back on the western side of the continent; the Brazil Current, on the eastern side, carries it southward across the tropic of Capricorn into higher latitudes than man-o'-war birds customarily inhabit in other parts of the world. The most distant point from the continental coast that it reaches to southward of the equator is the island of Fernando Noronha. I have given above sufficient information regarding its distribution to northward of our region where, for example, Gulf Stream influences carry it slightly farther from the equator than any point attained in the southern hemisphere. It is interesting to note that in South America the distribution of the Magnificent Man-o'-war Birds exactly supplements that of such a species as *Sterna hirundinacea* (Fig. 23). The ranges of these two sea birds begin and end at about the same points on the Atlantic and Pacific coasts of the continent, but that of the tern symbolizes the cool-water route by way of Cape Horn, while that of the man-o'-war bird stands equally for the littoral zone of the tropics.

On the voyage from the Río de la Plata toward Rio de Janeiro, Mr. Beck first encountered Man-o'-war Birds near Santos, on February 18, 1916. Other records from the southerly Brazilian coast include those of Burmeister (1856, 459), Bryce (1912, 371), and Friedmann (1927, 148). Cassin (1858, 358) reports the species as common in the harbor of Rio de Janeiro, and Burmeister notes that it nests on uninhabited islets outside. Fitz Roy (1839, 65) found it to be a resident of the Abrolhos Islets in March, and from this same locality I have examined two specimens collected during December. Goeldi (1894, 596), who found the birds nesting at many places along Brazilian shores, also states that he had only once seen an example more than about 30 kilometers out at sea.

In British Guiana, according to Schomburgk (1848, 763), the Man-o'-war Bird is seen periodically along the muddy coast and in the estuaries of the rivers. Breeding stations, if they exist at all, are probably on islands off the French colony. Farther northwestward, Schomburgk adds, hundreds of the birds may sometimes be seen passing inland at dusk in order to roost among the mangroves or in the taller forest behind them. Beebe (1909, 79) found them common for a short distance up the estuaries of the Orinoco, and yet Chubb (1916, 202) assures us that there is no nesting colony in British Guiana.

Throughout the length of the Caribbean, from Trinidad to the Isthmus, Man-o'-war Birds are everywhere in evidence, not only over the ocean but sometimes soaring with Black Vultures at great heights over the hot plains

and cactus thickets of the mainland (Robinson and Richmond, 1895, 653). They breed at many islands, such as Orquilla of the Hermanos group and Little Swan, nesting according to circumstances either in shrubbery, the tops of tall trees, or on hummocks of grass barely above the ground (Lowe, 1911, 213).

On the Pacific side, the closest colonies to Panama are perhaps those of the Pearl Islands. Rendahl (1920, 11) found that Cangrejo Island of this group was the breeding ground of several hundred, and Sturgis (1928, pl. 8) publishes a photograph showing large numbers of nesting Man-o'-war Birds on Pacheca Island. From this vicinity southward along the Colombian and Ecuadorian coasts as far as El Muerto Island in the Gulf of Guayaquil, the Man-o'-war Birds doubtless find abundant nesting sites, for the birds themselves are everywhere. At La Plata Island, Ecuador, during February, 1925, the lighthouse keeper informed me that their nests with eggs had covered the shrubbery at the southeast point of the island during the preceding October. At El Muerto I found them plentiful, roosting in dense groups on the bushy tops and slopes of the islet, but not a pair was nesting in the early months of 1925, doubtless because of the deluges of that year, which thoroughly interfered with the breeding of many of the local sea birds. At the bare islet of Pelado, in Santa Elena Bay, I saw for the first time many Man-o'-war Birds actually on the ground. They were perching, in fact, all around the edges of the cliffs of this island on February 14, 1925. Indian fishermen informed me that Pelado was a breeding station, the nests being built up from the plateau with twigs carried across from the mainland; at the time of my visit, however, the daily rains were of such violence as to wash all such structures, together with the guano that had covered the surface of Pelado, into the Bay of Santa Elena.

To southward of the Gulf of Guayaquil the Man-o'-war Bird appears to be merely a rover. It is seen regularly down the desert coast to Talara and Point Pariñas, and is not uncommon at Paita and in the Bay of Sechura. During the annual period of countercurrent activity that takes place after the beginning of summer, a few of the birds follow the warmer waters down to Lobos de Tierra, where I saw one on January 9, 1920, to Eten and Pacasmayo on the mainland coast, and at rare intervals even as far as Salaverry. Latitude 6° S., in the neighborhood of Point Aguja, is probably the southernmost point at which Man-o'-war Birds may be expected in numbers and with regularity between January and March or April of normal years.

Green (1887, 41) states that the pectoral muscles of a Man-o'-war Bird equal one-fourth of the weight of the body, and that the wings are proportionately larger than those of any other bird: According to Beebe (1924, 321), examples of this species have forty remiges, as against the thirty of a gull, while the wing-expanse is nearly 40 per cent greater than that of a booby of only slightly lesser bulk. Despite this equipment, the Man-o'-war Bird can only take flight readily from the edge of a cliff or from the elevation afforded by a tree or bush. Once in the air, it is at ease, and it can withstand wind that would wreck many another strong flier. During a terrific February storm on the east coast of Florida, Bangs (1902, 395) observed Man-o'-war Birds cutting into the teeth

of the gale, or driving before it, apparently without any sense of being incommoded. Wayne (1894, 85) states that during a late August hurricane on the South Carolina coast, the Man-o'-war Birds were not beaten down, even though pelicans were strewn along the beach for miles. Cyclonic storms are, nevertheless, important agencies in the distribution of Man-o'-war Birds, and Reid (1884, 263) has noted that the Bermuda records of the species have usually been made after the passage of late summer "twisters" from the West Indies.

The breeding period of the Magnificent Man-o'-war Bird, like that of many other tropical oceanic species, is continuous, though at many localities the season tends to become more or less dated with reference to cycles of wind and rainfall. Certain tropical colonies seem to be well filled with breeders throughout the year, and at some of these points of concentration it is doubtful whether there would be room enough for the nests if all the wanderers along adjacent coasts were to return for reproduction at the same time. One of the advantages of all-the-year nesting is that it provides for the multiple use of breeding territory at such small rocks and islets as may comprise the principal headquarters of a species.

As among the boobies, the female Man-o'-war Bird is larger than the male, although this size difference is by no means accompanied by the type of plumage reversal that one finds among the phalaropes. The male Man-o'-war Bird of the species *magnificens* retains at least his superior brilliance in coloration. There is much evidence, nevertheless, that the female is the dominant member of the family, and that the male accepts the greater burden of nest-care and incubation. Some of the best observations bearing upon this question have been made at the Galápagos Islands by naturalists who failed to distinguish between the two resident species, *magnificens* and *minor*, recording their notes, indeed, under the old comprehensive name *Fregata aquila*. The error is not likely to prove of great importance, however, because the mating and nesting customs of both species are probably very similar in pattern. Beck (1904, 5) and Beebe give the impression that the selection of territory is made mainly by the males, which carry the first twigs to the tops of the dense interlocking branches of shrubs, and then blow up their brilliant red pouches and display to the utmost, either as a means of warning off other males, of attracting females, or both. Inflation of the pouch is accomplished by a pumping, gulping action, as the air from the lungs comes through its small lumen. The exact manner in which a female is attracted to a particular male does not seem to be known. Beck, however, observed behavior which led him to believe that the birds are more or less polyandrous, or at least that during early stages of courtship the females divide their responses among several suitors. Both birds of the pair take part in nest-construction, but the females do most of the carrying, for if the males fail to stand constant guard other Man-o'-war Birds swoop down and quickly purloin all of their sticks and twigs so that within three minutes not a vestige of a nest remains. The twigs are acquired in various ways— either by being picked up from the ground as the birds sweep by in flight, being snapped off the tips of dead stalks and branches, being gathered from old or unwatched

nests, or being stolen from such boobies as may be carrying them home for purposes of their own. The boobies seem to have full realization of what their persecutors are after when a nest-making Man-o'-war Bird gives chase, or perhaps they realize that by dropping a stick they may at least save their dinners.

When the nest platform has been completed, the male continues to sit upon it with the red balloon fully distended, even while he appears to be sound asleep. At the descent of a female to the nest, the male will rise to a backward-leaning posture, with the female sitting similarly in front of him. Both birds then raise their bills, spread out their long wings over the adjacent shrubbery, and wave the heads and roll the bodies while emitting resonant gurgling or chuckling notes. At the same time the pointed, iridescent scapular feathers stand up like bristles, and both members of the pair swell and tremble with an amorous ardor, of which the gorgeous red globe of the male is the most striking symbol. Pairing takes place on the nest as the climax of such demonstrations.

When a courting male leaves the nest, the balloon is slow to collapse. Being caught by the wind, or perhaps merely offering an awkward resistance to the wind, it causes the bird to wobble about in a strange manner. The whole business of an inflated sac ceases with the beginning of egg-laying. Beebe found that a bulbous pouch invariably meant an empty nest, while a deflated pouch signified that the male was covering the egg. Furthermore, the red color of the ornament fades as soon as its annual function is fulfilled, and it becomes pale orange.

Rarely, two eggs or even two well-grown chicks have been found in the same Man-o'-war Bird nest, but it is not known whether the production of such was by one or two pairs of parents. Beebe made the interesting observation at the Galápagos that yearling young still attempt during the courtship season to associate with and solicit food from their parents which, of course, have lost every trace of interest in the younger generation by the time the new breeding season has begun.

Both sexes share the duty of incubation and brooding, but Chapman (1908, 148) noted at the Bahamas that there seems to be no regularity as to when each member of a pair takes its post. Other observers, on the contrary, have found that the hours may be apportioned according to a fairly definite schedule, with the males bearing the brunt. Beebe reports that at the Galápagos it was the custom of the males to sit during the morning while their mates were fishing, and that when his vessel approached Tower Island hundreds of female Man-o'-war Birds kept company overhead, with not a single male among them.

As already noted, the nests of Man-o'-war Birds are variously situated according to circumstance. In some localities, as at Bimini in the Bahamas, they are placed upon such dense thickets of cactus that it is impossible to approach near them from any direction (Cory, 1880, 200). At Little Swan Island, Lowe (1911, 213) found them in the very tops of trees 10 meters tall, among which a number of dead adults, suspended by their necks from forked branches, told of the hazards of such sites. He saw the birds, in fact, frequently lose their balance on the unstable twigs of these tree tops, sometimes tumbling through to come

slithering down from branch to branch to the rock-heaped ground underneath, where they were in a sorry plight. Any frigate-bird on the ground is a helpless creature unless it can scuffle or climb to some jumping-off place. The islanders living at Orquilla informed Lowe that if one chances to fall into the water, it experiences enormous difficulty in rising again unless a fresh breeze is blowing. As a matter of fact, I can find not a single authenticated reference to a Man-o'-war Bird alighting on the water, or swimming or floating, except when wounded. Gifford states that if one of these birds is forcibly immersed its feathers become soaked within a very short time. The creature thus seems to occupy the same place in the Pelecaniform group that the Sooty Tern does within its family, both scrupulously avoiding getting their feathers wet.

At the nesting ground the Man-o'-war Birds are quite tame. In spite of their formidable bills, says Lowe, they are the most mild mannered of all sea fowl. Not only do they become conditioned to sit tight on the nests when men approach and touch them but, moreover, with their close neighbors, the boobies, they behave as though nothing had ever occurred to mar the eternal friendship between the two. Nesting boobies and Man-o'-war Birds, a meter or two apart, pay rather less attention to each other than either would to members of its own species. The change in behavior when the boobies are returning to the nesting ground well laden with fish is most extraordinary, and it indicates how wholly the reactions of birds are determined by the stimulus of the moment, which retains neither place nor meaning in their consciousness after that moment has passed.

In robbing other birds, the Man-o'-war freebooters pursue them singly or in pairs, following with the utmost agility every gyration of the victim, and usually continuing the chase until disgorging has been forced. Then the robber tips forward and catches the secondhand fish in air. The terrorization of boobies, and the recovery of the ejected prize, was described by Columbus in the log of his first voyage of discovery. During such pursuits, the Man-o'-war Bird does not hesitate to apply stronger persuasion than mere threats. At El Muerto Island I saw various Blue-footed Boobies with crippled legs which I attributed at first to injuries received from fishes, of which several predacious and large-mouthed sorts are known in the surrounding waters. The lightkeeper assured us, however, that they had been lacerated by Man-o'-war Birds. In view of the testimony of Gifford (1913, 36) of a Swallow-tailed Gull which had its leg dislocated by the marauders at the Galápagos, I think there can be no doubt about the source of the boobies' injuries. Friedmann (1927, 148) observed a Man-o'-war Bird rob as active and aggressive a species as the Kelp Gull. Watson (1908, 312) states that they frequently despoil other members of their own kind, and he has seen them swoop down over the Sooty Tern colonies at Dry Tortugas, causing a terrible commotion but, oddly enough, he learned of no case in which they had attempted to rob the terns of their insignificant small fry, or to harm the young in their nests. Neither did he ever observe the Sooty Tern attacking Man-o'-war Birds, although the noddies frequently do.

The conditioned tameness of the Man-o'-war Birds during their breeding

season is replaced by shyness, or at least by a cautious indifference, at other times of year. This, however, is readily modified if their feeding associations bring them into close contact with human beings who carry no threat of harm. Feilden (1889, 501) tells how the flying-fish catchers from Barbados become surrounded by great flocks of Man-o'-war Birds, boobies, and Audubon's Shearwaters on the fishing grounds an hour's sail from the island. Off the ports of northern Peru, it is customary to begin to clean the day's catch as soon as the homeward trip is begun. Therefore the wakes of the Indian fishing-boats become filled with scrambling Man-o'-war Birds, which swoop up to the very stern to seize fish-guts at the surface of the water or even to snatch them out of the air. I suspect that the presence of a fishing encampment at Lobos de Tierra is what tempts the birds down to that island from Sechura Bay. The Man-o'-war Birds become equally accustomed to frequenting such spots as slaughterhouses on the seacoast or on the banks of tropical rivers. At the water front of Guayaquil, a city far upstream from the ocean, there is an abattoir so situated that part of the offal falls on the bank and part into the stream, the proportions depending upon the state of the tide. Here one can watch a completely amicable division of spoils between the Man-o'-war Birds and the Black Vultures, for the latter ignore all the tidbits afloat as completely as the Man-o'-war Birds disregard whatever drops ashore. Elsewhere on the coast of Ecuador I have tossed refuse from the bird-skinning table onto the sand and into the water, and have observed again the manner in which these two species of scavengers divide the world into shares. Such observations incline me to doubt the often repeated story that Man-o'-war Birds pick up newly hatched sea turtles while they are still on the beach on their way toward the ocean. On the other hand, if they can gather sticks from the ground, why not turtles? Small examples of the latter have frequently been found in Man-o'-war Bird stomachs, but so have squids and other organisms which they perhaps never catch themselves but frequently filch from the boobies.

Despite what I have said about the acquired confidence of the Man-o'-war Birds, I believe that, except during the nesting period, they always retain certain susceptibilities not shared by most members of their order. Boobies, pelicans, and cormorants on the mud flats of the Gulf of Guayaquil, or the rocks of Point Santa Elena, were usually left unmoved by the report of my gun, even though it had been aimed with fatal effect at one of their own number. The Man-o'-war Birds showed no such stolidity, for a single shot was always enough to cause them to leave an island or any other locality, and to sail away to a great distance. Neither do I believe that they were accustomed to being shot at, or that they had acquired any repellent associations with the sound of a gun.

In this connection it should be mentioned that Man-o'-war Birds are capable of being easily tamed after capture, even though, as Allen (1905, 120) states, their tempers are never to be trusted. He found in the Bahamas that birds which had been deprived of their liberty for a short time, and had been fed with fish, seemed to be quite content to sit upon a perch and wait for meals to be handed or tossed to them. In fact, it became difficult to make them fly away unless

they were actually thrown into the air. Such ready adaptability to a new rôle explains why the Pacific man-o'-war birds could be used as "carrier pigeons" by the Polynesians. Among the Samoan Islands and elsewhere it was customary to erect perches for the man-o'-war birds outside human dwellings, and to accustom the birds to being fed as they sat upon them. When their subsequent foraging excursions would lead them to other islands roundabout, the birds would drop down to be fed upon similar perches and thus, after the Christianization of Samoa, the white and native pastors found an ocean postal service ready for their use, just as the primitive people had formerly transmitted small objects, such as shell fishhooks. Buller (1905, 50), quoting Turner, speaks of the carrying of a note between two islands about 100 kilometers apart. The message had been placed in a reed cylinder and attached to the wing of a frigate-bird on a Friday. It was delivered on the subsequent Sunday afternoon. While the message-carriers were presumably of the species *minor*, rather than *magnificens*, there is every reason to think that the latter would be amenable to the same purpose.

According to many accounts, Man-o'-war Birds of all sorts become extraordinarily slumberous, or almost stupefied, at night, so that their capture at the roosts is a simple matter even during the non-breeding season. They usually return to their roosting trees some time before sunset but, instead of perching at once, they sail slowly and magnificently about overhead until just before dusk. Du Tertre (1667, **2**, 269) speaks of an Ile des Frégates off Guadeloupe in the Lesser Antilles, where great numbers of these birds were accustomed to spend the night. Several times each year great hunts were organized by the French colonists and negroes, and in one of these Père du Tertre took part. The birds were surprised among the branches where they could easily be caught, notwithstanding that many of them disgorged good-sized fish as though they were about to take flight. Within the space of two hours du Tertre himself killed more than a hundred, but he gives no clue to the total extent of the slaughter on this raid. Man-o'-war Birds were valued for their fat, which was regarded as a sovereign remedy for rheumatic troubles and, as de Rochefort (1658, 148) adds, for paralysis and dropsy!

Despite the eagerness with which Man-o'-war Birds rob each other of nest material, as previously described, the structure they produce is hardly an admirable one for the safety and comfort of the single offspring. Beck states that when the incubating Man-o'-war Birds take flight from the nest, they sometimes roll the egg off with themselves. An island in Fonseca Bay, on the Pacific coast of Honduras, was formerly a favorite Man-o'-war Bird center and here, on New Year's Day, Taylor (1859, 150) found nests with eggs on nearly every tree and bush, high and low, but hardly any was composed of more twigs than a ring-dove would have used. In some cases one could look up through the slight platform and see the egg from beneath. After the hatching of the egg, such scanty platforms tend to become more firmly matted together by the droppings of the chick. Todd (1916, 174), who visited a colony at the Isle of Pines, speaks of how tenaciously young Man-o'-war Birds cling to their frail nests.

The trait has no doubt been enhanced by selection, for the alternatives to sitting tight might be either to drop into the jaws of waiting crocodiles, or to be hanged by the neck in the crotches of twigs. Salvin (1864, 375) thus describes a colony in the nursery stage on an island off Belize, British Honduras, during April:

> It was a curious sight, on thrusting one's head out of the top of a tree, to watch the inhabitants around. Three-fourths of the nests had young birds in them, of various ages: the more advanced were commencing to shoot their scapular feathers; others, younger, looked like puff-balls of pure white; while those which had just escaped from the shell were lying helplessly, as young birds do, on the frail structure of sticks composing their nests. So slight were these, that the young in their earliest infancy must have a perilous time of it. The youngest were guarded by one of the parent-birds, which balanced itself on the edge of the nest. From the unhatched eggs the birds could hardly be prevailed upon to stir. I have several times noticed this reluctance on the part of birds building open nests to leave their eggs exposed to the direct rays of the tropical sun, whereas on cloudy days the same solicitude was not exhibited.

Chapman (1908, 148) has studied a nesting colony of between two and three hundred pairs at Cay Verde in the Bahamas. During April most nests here contained young about half-grown, but there were still some fresh eggs, and a few fledglings were already flying. The Man-o'-war Birds' day, like that of the boobies, began early and by 5.30 A.M. they were soaring about over the rookery. At the end of the day, however, they settled to rest while it was yet light, considerably before the retiring time of the boobies. At this season the gular pouches of most of the males had faded from carmine to orange as a sign that courtship, which marks the physiological peak in the life of the bird, had passed. The newly hatched, naked young were closely brooded, not being left alone or exposed to the sun until they had become covered with white down.

As the wing feathers of young Man-o'-war Birds sprout through the down, the nestlings assume attitudes of extreme dejection, with the wings drooping, doubtless from the weight of blood in the turgid quill shafts. Sometimes the chicks lie with their heads hanging over the rim of the nest. They look much like young pelicans, and utter squealing, chirping calls, besides rattling their bills, all these actions likewise being reminiscent of pelicans at the same stage. The adults are almost voiceless except for the gurgling vocalization produced during courtship. At other times of year their sound-making is limited to a clattering of the beak. Gosse (1847, 422) refers to a reiterated "chuck-chuck" coming from the Man-o'-war Birds as they are about to alight, but it is not certain whether this is a vocal note, or what might be called an instrumental sound, produced by the beak or the wings.

Despite the fact that the Man-o'-war Bird is a notorious highwayman, it seems probable that the bulk of its food is captured by its own direct efforts. The birds are certainly capable of catching extraordinarily active fishes, such as the halfbeaks that slither along the surface of the water (Finsch, 1900, 446), and flying fish. Lowe (1911, 213) watched one pursue, overtake, and seize a flying fish in the air while half a gale of wind was blowing. According to my own observations, the birds make a better job of capturing a lively animal than of picking up a dead one, and there may be much truth in the statement of Green (1887, 41), who was a very critical observer, that Man-o'-war Birds do

most of their own fishing when the wind is high and the ocean turbulent, reserving the booby-plundering game for calm weather. Most of the fish found in their stomachs are of relatively large sorts. Hallinan (1924, 307) took an example 35 centimeters long from a female shot at Panama. At the Dry Tortugas, Watson found that local Man-o'-war Birds had eaten flying fish, herring, and mullet, but none of the small fry upon which the terns feed. The Man-o'-war Birds seem compelled to capture their food in a spectacular manner, often plunging toward the sea from a great height, striking downward with the beak, making a sound like the hiss of an arrow shot into the water (Robinson and Richmond, 1895, 653), and then, without wetting feathers or feet, rising and dexterously tossing up the prey before swallowing it. They are not known to dive, and Gould (1841, 146) states that if any floating object sinks even a short distance beneath the surface it is lost. Banks (in Hooker, 1896, 330) describes Man-o'-war Birds "stooping at albecores so large that twenty times their strength could not have lifted them." In this case, however, the prey pursued by the large fish was doubtless the real magnet that had drawn the Man-o'-war Birds. I, too, have seen them following foraging schools of large mackerels and carangids, and Scouler (1826, 199) long ago remarked that the Man-o'-war Bird seems to be in alliance with the bonito for maintaining a perpetual warfare against the flying fish.

In places where fresh-water ponds are accessible, the Man-o'-war Birds visit them at times. At Little Abaco, in the Bahamas, Bonhote (1903, 312) saw small bands come during March mornings to splash against the water of a pond like swallows, never settling but rising again and going off to sea within a few minutes. Noble (1916, 364) reports similar behavior at Guadeloupe. In the crater-lake called El Junco, at an altitude of 800 meters or more on Chatham Island of the Galápagos, Man-o'-war Birds have likewise been observed to strike and splash against the surface. There can be little doubt that on such occasions they drink fresh water, though many members of the species must go through their lives with no opportunity to do so.

RIDGWAY'S MAN-O'-WAR BIRD

Fregata minor ridgwayi

Fregata minor ridgwayi Mathews, 1914, Austr. Avian Rec., 2, p. 120 (Culpepper Island, Galápagos).

Names: Listed in all the older writings under the specific name *aquila*.

Characters: Sexes dimorphic in color pattern, but the brown alar band present in both. Culmen somewhat flattened, resembling the condition in *aquila* rather than that in *magnificens*. Ventral surface in the male duller than in either of these species.

Adult male: General plumage black, distinctly brownish on the entire ventral surface, and with a broad radial alar bar of grayish brown feathers which includes the innermost secondaries as well as the median coverts; the feathers from forehead to back are lanceolate and have a high degree of metallic iridescence, which is chiefly bottle-green and blue on the head, and green and bronzy purple on the back. Iris brown; bill leaden or horny gray; orbital ring black; gular sac red during the breeding season; legs and feet red or flesh color.

Adult female: Very similar to the female of *Fregata magnificens*, but with the throat and fore neck whitish or ashy instead of blackish. Orbital ring red.

I have measured no specimens of the Galápagos race of *Fregata minor*, and the figures of Gifford (1913, 104) are intermingled with those of another species. Its size, however, seems to be not very different from that of the next subspecies, *Fregata minor nicolli*. The distinctive characters have not been adequately pointed out.

The juvenal plumage resembles that of *magnificens*, but the white head and breast are more or less heavily tinged with rufous. The egg measurements recorded by Gifford include eggs of *magnificens*, so that it is impossible to discriminate.

Distribution: Confined, so far as known, to the Galápagos Archipelago, and recorded specifically from Culpepper, Wenman, Tower, and Hood Islands. Once taken near Clipperton Island (Swarth, 1931, 40).

Only at the Galápagos Islands do the ranges of the species *minor* and *magnificens* overlap. Gifford did not discriminate between the two in his important account, but Swarth has shown that many of his data can be properly allocated from the context. Gifford's photographs made at Hood Island show the present species.

It is only fair to say that the distinguishing characteristics between a Galápagos race of *minor* and those in other parts of the world have never yet been satisfactorily pointed out, but I am here using the subspecific name *ridgwayi* as a matter of convenience.

At Hood Island the naturalists of the California Academy Expedition found Ridgway's Man-o'-war Birds nesting, remarkably close to the ground, on the tops of small clumps of *Sesuvium*. The nests were made of dried stems of the same plant piled on top of the green vegetation, and forming just enough of a platform to provide a spring-off. Mating, copulation on the nest, and eggs or young chicks were observed during February, September, and October, so it is probable that breeding is practically continuous. This is further indicated by the fact that one male with a bright red distended pouch was seen on the nesting ground in June, when the throats of all others had turned dull. Newly fledged flying young observed in June were believed to have hatched from eggs laid in February, which gives a clue to the combined periods of incubation and nestling life. Males and females were indiscriminately sitting on nests during both February and September, the males often uttering the chuckling call. They were silent when approached, but often vigorously defended their homes with their bills. One downy young Man-o'-war Bird at Hood Island was being cared for by a Masked Booby (*Sula dactylatra*).

Gifford lists 24 islands and islets of the Galápagos inhabited by man-o'-war birds. It is probable, as Swarth remarks, that both resident species are generally distributed, with segregation of the respective nesting grounds.

SOUTH TRINIDAD MAN-O'-WAR BIRD

Fregata minor nicolli

Fregata minor nicolli Mathews, 1914, Austr. Avian Rec., 2, p. 118 (South Trinidad Island).

Names: Formerly listed in several accounts under the name *aquila*.

Characters: Similar to the preceding subspecies, and to the typical form of *minor*. The subspecific peculiarities of the South Trinidad race have never adequately been pointed out. Mathews and Iredale (1921, 60) state that it is characterized by a large bill and "a very broad pale wing band."

Bills of adults of both sexes are generally horn-color, but very rosy on the latericorn and the sides of the mandible. Males have scarlet pouches (when courting), and bright red legs and feet. In females the bare orbital ring is red and the feet are apparently pink.

1 adult male, South Trinidad: wing, 575; tail, 425; exposed culmen, 115.2; width of maxilla at base, 33.8 mm. The length in the flesh of this example was 95 cm., its wing-span 206 cm.

4 females, South Trinidad: wing, 595–627 (605); tail, 400–426 (414); exposed culmen, 116.5–125 (120); width of maxilla at base, 34–36.5 (35); depth of closed bill at mid-point, 16.5–20 (18) mm. Among these examples the length was 99–103 (100), and the wing-span 206–220 (211) cm.

Youthful stages differ from those of *Fregata magnificens* chiefly in that the white areas are more or less heavily overlaid with the rufous coloration which is especially characteristic of the species *minor* and *ariel*.

Distribution: Confined, so far as known, to South Trinidad Island and the neighboring Martin Vas Rocks.

Chiefly upon a basis of geographic probability, I make use of the subspecific name *nicolli*, leaving to future taxonomic work the task of properly distinguishing the South Trinidad Man-o'-war Bird from other forms of the species *minor*.

The American Museum possesses six specimens of this race which were collected at South Trinidad by members of the Cleveland Museum Expedition during December, 1924, and January, 1925. At that time the birds were found nesting at Dom Pedro Segundo Islet of the Martin Vas group, as well as at South Trinidad (Simmons, 1927, 27). Dom Pedro supports only growths of grass and sedge, rather than shrubbery, and the presence of the nesting Man-o'-war Birds is another of many indications that representatives of the species *minor* are less dependent upon trees and bushes than are those of the species *magnificens*.

Both this Man-o'-war Bird and the lesser one of South Trinidad are probably extremely sedentary. On the 'Terra Nova' expedition, in July, 1910, Dr. Wilson found that examples of both the resident species followed the vessel only about 18 kilometers from the island (Lowe and Kinnear, 1930, 187). I have already shown that the form from the Brazilian coast described by Ribeiro as *Fregata minor januaria* belongs, in reality, to *magnificens*.

Fregata minor nicolli, and also the Lesser Man-o'-war Bird of South Trinidad, have presumably entered our field from the southeast. Lowe and Kinnear are incorrect in believing that there is a difficult "climatic barrier in the shape of the cold roaring forties" between the Indian Ocean and the South Atlantic. The southern tip of Africa falls just short of the 35th parallel of south latitude, besides which, as I have already shown, the Sub-Tropical Convergence takes a definite southward loop in that region.

LESSER MAN-O'-WAR BIRD

Fregata ariel trinitatis

Fregata ariel trinitatis Ribeiro, 1919, Arch. Mus. Nac. Rio de Janeiro, 22, p. 192 (South Trinidad Island).

Names: A synonym is *wilsoni*, which has been used both specifically and subspecifically.

Characters: The species is the smallest of the genus. The subspecific characters, which may distinguish the South Trinidad bird from races of the Indian and Pacific Oceans, have not been adequately pointed out. The male of *ariel* is marked by a conspicuous white patch on either side, under the wing.

Adult male: Generally black, the ventral surface, which has a brownish cast, broken by a large white patch on either side of the abdomen; lanceolate feathers of crown, scapulars, and interscapular region glossed with green, blue, and purplish iridescence; considerable very dark bluish and bronzy gloss is also present on all the coverts of the wing. Iris brown; bill gray or blackish horn-color; gular sac red, at least during courtship season; bare eyelids, legs and feet, black.

Adult female: Almost identical in appearance with the female of *Fregata minor* but with a reddish or chestnut collar crossing the lower hind neck, separating the mottled brownish pileum from the dark back; throat dirty white; breast and sides white; belly black. Eyelid, gular sac, and feet fleshy red.

1 adult male, South Trinidad: wing, 537; tail, 268; exposed culmen, 81; width of maxilla at base, 26; depth of closed bill at mid-point, 12.5 mm. The length in the flesh was 74, the wing-span 176 cm.

1 adult female, South Trinidad: wing, 558; tail, 326; exposed culmen, 93.3; width of maxilla at base, 27.5; depth of closed bill at mid-point, 13.3. The length in the flesh was 82, the wing-span 190 cm.

An immature example of unknown sex, which I examined at South Trinidad on April 8, 1913, had the head and neck white, with a chestnut stripe running from the mentum down the front of the neck to the upper breast; back, wings, breast, flanks, tail, upper and under tail coverts iridescent greenish black, the feathers of the scapular and interscapular region edged and tipped with brown; the usual scale-like row of brown feathers, with darker shafts and whitish edges, extending along the wing from wrist to elbow; belly white; feet flesh color; skin of throat blue.

In connection with the last, it is of interest that Gifford (1913, 102) notes that the skin over the entire body of the downy young of *Fregata minor* at the Galápagos is china-blue in color, this including also the feet and the bill.

I have seen neither chicks nor eggs of the South Trinidad Lesser Man-o'-war Bird.

Distribution: Confined, so far as known, to South Trinidad and Martin Vas.

The first example of the Lesser Frigate-bird, which is chiefly a species of the Pacific and Indian Oceans, was reported from South Trinidad by Sharpe (1904, 214). The race *trinitatis* was subsequently described by Ribeiro, but its relationship with those inhabiting other parts of the world has not yet been satisfactorily pointed out. Simmons (1927, 27) observed this and the larger Man-o'-war Bird flying about the Martin Vas Islets at the time of his visit in December. He subsequently found the lesser species breeding at South Trinidad, the egg being laid and the chick reared on the fallen trunks of Brazilwood (*Caesalpinia*) trees, with a scanty nest construction in the form of a handful of twigs.

Our only specimens are a pair collected by the Cleveland Museum party at the anchorage of the 'Blossom' off South Trinidad. At the time of my own brief visit to the island, in April, I saw many immature examples over the surrounding waters, and circling about some of the lofty spires, such as the Ninepin. One was caught on a fishhook from the brig 'Daisy,' but the captain retained the skin, which I have described above.

I saw a small troop of the Lesser Man-o'-war Birds fishing for themselves. Half a dozen of them hovered in a row over a school of small surface fish, facing in a direction opposite to that in which the fish were moving. While the birds poised close over the water, they beat their wings slowly. Then at the right moment they would strike downward, swinging their long bills like scimitars back beneath their bodies, the hooked tip each time seizing a fish from the rear. Every bird seemed to catch three or four a minute, and yet to make no commotion among the moving school of its victims.

THE ANSERIFORMES

THE GEESE AND DUCKS

FAMILY ANATIDAE

Ducks, geese, and swans make up a cosmopolitan group of birds. The South American representatives that come within the scope of this book are, however, so few that a general account of the family would be out of place.

In Part I frequent reference has been made to the Black-necked Swan, to several of the geese of the peculiar genus *Chloëphaga*, and to a variety of continental ducks which regularly reach salt water toward the southerly extremity of South America. Many of the distinctive species and genera are of Andean range in more northerly latitudes, illustrating the principle that birds from probable sub-antarctic centers of dispersal have found a favorable environment at higher latitudes in the direction of the tropics.

Most of the geese of the genus *Chloëphaga* are grassland fowl, to be associated with fresh water, but the Kelp Goose is a species of the foreshore, and it feeds exclusively upon marine organisms.

In South America there are no true "sea ducks" corresponding with the many northern-hemisphere species of that category. The closest approach to such is offered by the three extraordinary species of steamer ducks (*Tachyeres*), which are, in a sense, analogues of the northern eiders.

The widely distributed pintail division of the genus *Anas*, comprising the ducks often grouped under the generic name *Dafila*, has an isolated representative at South Georgia, and another at the antarctic island of Kerguelen in the southern Indian Ocean. The South Georgian "Teal" is, indeed, a diminutive replica of the Brown Pintail (*Anas spinicauda*). The habitat of the South Georgian species lies directly to leeward of Tierra del Fuego, in the belt of strong westerly winds, and its origin presents no special problem except that regarding the age of the endemic, insular form.

The males of no South American duck have an eclipse plumage, which is so characteristic among northern-hemisphere species.

Relatively little is yet known about the migration of South American Anatidae. Certain Patagonian species move northward at the approach of winter, but migratory flights are at least more sporadic than in holarctic areas. During periods of drought the exodus may be no less irregular as to direction than as to season. Reference has already been made to movements from the continent to the Falkland Islands (p. 207), and to the flight in numbers of such species as *Anas spinicauda* and *Oxyura vittata* across Drake Strait to the South Shetlands (p. 219).

Many southern South American Anatidae, including such diverse types as the swan, the native geese, and the steamer ducks, show a curious functional resemblance in the particular form of the extremely hard, hooked, knife-edged nails at the tips of both mandibles. Among certain species this structure serves admirably for snipping limpets and other univalve mollusks from the rocks, although the character is shared equally by related fresh-water and upland forms.

KELP GOOSE

Chloëphaga hybrida hybrida

Anas Hybrida Molina, 1782, Sagg. Stor. Nat. Chili, p. 241 (Chiloé Island).

Names: Antarctic Goose; "Cagüe" or "Caranca" in Chile. Synonyms of the specific name include *antarctica* and *ganta*.

Characters: The only species of the genus in which the adult male is of wholly white plumage, the female black with white bars and other white markings.

Adult male: Plumage entirely white. Iris brown; bill black with an elongate flesh-colored spot on the culmen above the nostrils; legs and feet citron-yellow.

Adult female: General color brownish black, heavily barred with white on the sides and breast, the lower back, rump, tail, and abdomen white; crown and nape brown (between drab and hair-brown); forehead, face, throat, and neck blackish brown, the feathers finely and obscurely margined with buffy white, a color which in some cases prevails about the base of the bill; a white circumorbital ring; breast, caudad to the abdomen, and sides of body, black, strongly barred with white, each feather bearing from 4 to 12 alternating black and white bars, the terminal bar being black; in fresh plumage these bars extend dorsally beyond the sides of the breast and are faintly indicated as marginal lines across the upper back; upper back, scapulars, and tertials rich brown (close to clove-brown or fuscous); the primaries similar but darker; lesser and median wing coverts, margin of wing, secondaries, and under coverts white, producing large carpal and manal spots in the wing when spread, the greater wing coverts metallic green on their outer webs, forming a pronounced speculum; individually these feathers are tipped with black and narrowly margined with white. Iris brown; bill flesh color; legs and feet yellow.

12 males: wing, 363–385 (370.5); tail, 127.5–139 (131.5); exposed culmen, 35.5–38.3 (36.7); width of maxilla, 18–20 (19.1); tarsus, 66.3–71.1 (69.4); middle toe and claw, 76–83.2 (81.2) mm.

16 females: wing, 334–359 (348.7); tail, 126.5–137.5 (130.2); exposed culmen, 34.6–38.6 (36); width of maxilla, 16.3–19.4 (17.9); tarsus, 61.3–66.1 (63.7); middle toe and claw, 70.4–78.8 (75.5) mm.

Adults show little seasonal change in plumage save that caused by wear and replacement.

Youthful females have only indistinct crown-patches, and the barring of the belly extends caudad almost to the crissum. In the center of the belly, furthermore, it breaks down into an indistinct mottling. The green speculum formed on the wing of adult females by the secondary coverts is entirely lacking in young birds, the corresponding region being plain brownish black. Moreover, the upper tail coverts are dark instead of white. Two such young examples were taken at Bertrand Island and in Beagle Channel, on April 22 and May 4, 1915, respectively.

The sequence of plumages in young males is beautifully illustrated by a series of specimens, as follows:

Gable Island, May 2. Still largely in plumage resembling that of the female, except that the head is more whitish, as always, and there is, of course, no green speculum in the wing. A few white feathers have come into the black back, but the flanks and breasts are barred, and the belly sparingly so.

Beagle Channel, July 29. Prevailingly white except for the wings. The remaining barring on the body plumage is asymmetrical, being much more conspicuous on the right side and flank than the left.

Strait of Magellan, November 26. White, save for the wings and a few dark feathers on back and breast.

London Island, January 18. White except for the primaries and a single two-barred feather on the breast.

Bertrand Island, April 22. White, but with the primary row made up of mixed mottled and pure white quills.

The foregoing 5 immature males, and many comparable birds, had small gonads, and were recorded by Beck as non-breeders.

Downy young represented in the Brewster-Sanford Collection include birds not long out of the egg, and goslings about twice as large. The smallest are 4 that appear to be of one brood, 2 of

which are males and 2 females. These were taken at Stewart Island in December, 1914. Their bills are black but white-tipped on both mandibles, and the egg-tooth is intact on 2 of them. The legs and feet were blackish gray in life. The down is long and soft, whitish, but shot through with a dirty, dusky color both above and below, the head being the whitest part. Looping around the eye is a pronounced dark stripe, in contact with the upper eyelid and covering the forward part of the lower lid as well, and then extending a short distance behind the eye. A brood of much larger goslings is of almost identical appearance as regards plumage, except that the dusky brownish areas are more conspicuous on the back. The bills, moreover, have lost their conspicuous whitish tips, and the feet are brownish black. These are 2 males and 2 females taken at Caroline Island, December 14 and 16, 1914. A third brood is represented by a single gosling of the same size as the last, taken at Wollaston Island, January 5, 1915.

Eggs are said to be creamy white, closely resembling those of the Flightless Steamer Duck (*Tachyeres pteneres*) but slightly smaller. This is confirmed by our specimens of eggs of the Falkland Kelp Goose, described hereafter.

Distribution: From the vicinity of Corral, Chile, southward to the Strait of Magellan, the southernmost Fuegian islands, and Staten Island.

The Kelp Goose is a robust, strictly coastal member of a curious South American genus, the species of which occupy various ranges between the highlands of the southern Andes and the sea, and reaching to islands as remote as the Falklands. In both plumage and structure the Kelp Goose is the most distinctive member of the group, its very much larger feet and relatively shorter tarsus being in themselves sufficient to separate it subgenerically from the other species (Wetmore, 1926, 415).

The range of the Kelp Goose extends from a point on the Chilean coast near Corral, or about latitude 40° S., southward through the archipelagoes to Cape Horn and Staten Island. It is also common in the westerly part of the Strait of Magellan, and apparently once bred as near to the Atlantic end as Elizabeth or Isabel Island, which is just to westward of the Second Narrows. The Kelp Goose is, however, a largely pedestrian bird of the intertidal zone and, like the Flightless Steamer Duck, it avoids coasts subject to enormous daily variation in the tidal level. For such reasons it is rare or absent along the eastern coast of Tierra del Fuego and the corresponding stretch of generally straight and cliffy shore of Atlantic Patagonia.

The Kelp Goose has a number of peculiarities in addition to the very great difference in the appearance of males and females, which reaches an extreme of sexual dimorphism. It never goes far inland nor far from salt water, and yet, on the other hand, as Coppinger (1884, 56) writes, it rarely wets its feet except on the damp seaweed of the foreshore. Only after the young hatch do the Kelp Geese take for a time to life afloat. At other periods of the year the birds walk their own beats along rocky or shingly coasts, avoiding sandy stretches, and browse upon a delicate green dulse which the Chileans call "luche." Furthermore, the Kelp Geese are seldom to be seen in flocks as are other members of their genus, and, except during the season of family parties, just before the full-grown goslings separate from their parents, they are usually to be found only in pairs, the exquisite white gander standing out like a spot of snow against the dark Magellanic background. His mate, partly because of her obliterative pattern and partly through the sheer contrasting glamour of the male, is likely

to be overlooked, even though she may be standing beside him. If the gander is actually determined to be mounting guard in solitary state, or, like an ermine-coated king in the midst of a court composed of gulls and cormorants, it is likely that the goose is covering eggs in a hidden nest close by. Under such circumstances, as Coppinger remarks, her plumage assimilates so thoroughly with the dark, wind-blown seaweed and the rank grass that she has no need to stir until she is almost stepped upon.

Chiloé is the type locality of this species, and the western rocky coast of the island probably marks the northern limit of the breeding range. At the Guaitecas and Chonos Islands and, in fact, throughout the insular complex stretching toward the Strait of Magellan, it is everywhere abundant on rocky shores, as reported by Blaauw (1916, 480), Hellmayr (1932, 317), and others. During the Brewster-Sanford Expedition, Beck first encountered Kelp Geese at islets about 25 kilometers from Ancúd, in northern Chiloé, on April 7, 1914. The behavior of the birds impressed him then as gull-like rather than goose-like. They kept to the windward shores of the islets, where surf was pounding heavily on the rocks, and seemed very wary of a boat, usually flushing far out of gun range. During the following month, at Cuellon in southern Chiloé, Beck met pairs as well as family groups along the coasts which were here, too, rocky and surf-beaten.

Subsequently, along broken and rugged shores of the channels leading toward Cape Horn, Beck became more and more familiar with the Kelp Geese, found their newly hatched young at Caroline, O'Brien, and Peyron Islands, during December and January, and observed that the parent geese sometimes leave the goslings in hiding on land while they swim to an adjacent stretch of rocks in search of pasturage for their own needs. He learned, too, that when a brood of the young geese is taken by surprise, the goslings invariably separate, each one scurrying off at top speed in a different direction. In addition to the specimens listed in the head matter, Beck collected others, which cover every season and eight different months of the year, in Beagle Channel and at Caroline, London, Timbales, King, and Bertrand Islands.

His notes upon the condition of the gonads show that the height of the breeding season is reached during November, and that the moult of the wing quills, which may make the Kelp Geese for a time quite flightless, is begun soon after the eggs have hatched and while the whole family has taken together to a swimming life. At Hermite Island, in December, Reynolds (1934, 84) saw a score of Kelp Geese flap out on the water, apparently unable to fly. He took them to be either yearlings, or non-breeders which had moulted exceptionally early. Completion of the moult may require four months or even longer, though it is hardly likely that the birds are ever completely flightless for that length of time. Beck's specimens confirm the belief expressed by Hellmayr, upon the basis of Conover's observations, that geese of this species do not breed at the end of their first year of life.

Reynolds (1934, 350; 1935, 83) reports that the Kelp Goose is the common *Chloëphaga* of the Cape Horn region, and refers to nests with eggs at Grévy,

Herschel, and Wollaston Islands. During December, 1932, he encountered numerous families with three or more chicks, either small or half-grown. The adults did not hesitate to lead their offspring out to sea into the immediate proximity of sea-lions although, as Reynolds remarks, the birds are rarely seen on the water at any other time of year. He adds the following account of a probable battle between rival ganders, and its result.

While entering harbour at Deceit there was a distant beating of white wings on the water. The scene was passed on the way to the anchorage, and a Kelp gander was noticed motionless and decrepit-looking on the shore. In the water opposite to him was a second male (vanquished by the first ?) on his back with his wings tangled in the kelp and his feet kicking in the air, but his head held just above the water. In a few minutes the boat returned to the place to find a Giant Petrel tearing at the mutilated remains of a sodden carcass.

Such battles are fought mainly with the large dull spur or tubercle present on the wrist of both sexes. The nail of the bill also looks formidable, although I have no evidence that it is used in conflict. It is shaped extraordinarily like that of the steamer duck, and seems particularly well adapted for prying such clinging creatures as limpets and chitons from the rocks. The evidence, however, that the Kelp Geese feed on other than vegetable food is unconvincing. Blaauw (1913, 144) succeeded in transporting a captive example over the Andes and through the tropics to Holland by feeding it with dried luche, which he soaked in water before the bird's meal, and by supplementing this with green cabbage leaves. Since luche is also used as human food in Chile, it is somewhat surprising that the Kelp Goose has almost universally been found to be practically inedible. The Fuegian Indians apparently had no such prejudice because, according to de Agostini (1924, 279), they were accustomed to catch Kelp Geese in snares made of the sinews of the guanaco or of shreds of whalebone, and likewise of conducting fire-lighting expeditions at night to the small roosting islets, where they could beat down great numbers of the birds dazzled by the glare of their torches.

FALKLAND KELP GOOSE

Chloëphaga hybrida malvinarum

Chloëphaga hybrida malvinarum Phillips, 1916, Auk, 33, p. 423 (Port Stephens, Falkland Islands).

Characters: "Similar to *C. hybrida hybrida* from Patagonia and the Straits of Magellan, but larger, especially in length, depth and breadth of culmen. Pileum in the females, paler and more grayish; drab to light drab (Ridgway, 1912), instead of cinnamon brown" (Phillips).

1 male: wing, 390; tail, 138.7; exposed culmen, 38.8; width of maxilla, 21.1; tarsus, 76; middle toe and claw, 85.2 mm.

4 females: wing, 360–380 (368); tail, 132.5–135.7 (134.1); exposed culmen, 36–40.4 (38.7); width of maxilla, 18.6–19.4 (19); tarsus, 67.3–70 (68.3); middle toe and claw, 77.1–80.9 (79) mm.

Four nearly fresh eggs taken at Bleaker Island, December 12, 1915, closely resemble steamer duck eggs. They are creamy white, smooth, and slightly variable in form, two of them being somewhat pointed at the smaller end. Measurements of the set are: 79.3 x 54.2, 80.2 x 55, 78.4 x 55.4, and 77.7 x 55.2 mm.

Distribution: The Falkland Islands.

The sealers and other early visitors to the Falkland Islands soon learned to classify the several forms of peculiar native geese on gastronomic grounds. As

related by Clayton (1776, 104), the kinds were known as, (1) the Mountain Goose, which feeds among the hills and is the best eating; (2) the Valley Goose, which is fairly good eating, best and fattest between February and April; and (3) the Sea Goose, which forages on the shore and is edible only for starving men. In modern terminology these three birds are, respectively, the Brent Goose (*Chloëphaga rubidiceps*), the Upland Goose (*Chloëphaga picta*), and the Falkland Kelp Goose, the last being the subject of this biography.

When describing an endemic Falkland race of the Kelp Goose, Dr. Phillips stressed the larger size of the bill in comparison with that of the typical form of southern South America. The specimens collected by Mr. Beck show, however, that the superior size of Falkland birds is no less marked in the length of the wing and of the leg and foot. During the course of the Brewster-Sanford Expedition, Beck collected five specimens near Port Stanley and Port Louis, in the months of November and January, and at Bleaker Island took the set of four eggs referred to above, which were in a grass-built nest, well lined with feathers and down, a few steps from the water's edge. Vallentin (1924, 315) says that the set of eggs usually numbers from two to four, but Cobb (1934, 54) has found that it may go to six.

Today the Kelp Goose is more abundant in the western part of the archipelago than elsewhere. Vallentin, who has studied the species in West Falkland, writes as follows:

> When once paired, these birds are inseparable, and the snow-white gander is a most conspicuous object amid a landscape of greys and browns and can be easily distinguished at almost any distance. The female is spotted and barred with black and white feathers, and therefore very difficult to distinguish, even at close quarters. Often when out nesting, I have seen several of the males a long distance away and have marked their positions, for they invariably move off on the approach of a stranger. On reaching the spot where I first saw them, a search in circles radiating from this centre would then be made, and many times I have often nearly stepped on the sitting goose before seeing her. There is a very sheltered spot in the north-west corner of the West Falklands called Whaler Bay, for in the old days it was the favourite resort for whalers and sealers, driftwood, peat, and plenty of fresh water being easily procurable. At present it is even less disturbed than before, no one except in quest of sheep ever visiting the spot; hence the birds are very seldom, if ever, molested. Frequently while having my lunch there near the sea-shore quite a number of these birds would gather round and amuse me with their quaint ways. By far the most inquisitive was the goose, who would boldly walk up to within two or three yards of my seat, and prance about, raising and lowering her head, and uttering soft notes of apparent self-satisfaction the while. Soon the snow-white gander would come near, but he was at once driven off, and then the antics were renewed. After a time, several birds of both sexes would come up, and then a free fight always followed, the victorious pair remaining masters of the field.

From Cobb's no less entertaining than informing account I draw much of the following matter, taking the liberty of intercalating a little text from other sources.

The Falkland Kelp Goose is highly ornamental, but hardly useful in the opinion of human beings whose thinking is closely connected with their stomachs. Moreover, its eggs, even in the freshest state, come under the heading of those suitable to give away. If an ill-disposed person wants to be nasty, he

will introduce some Kelp Goose eggs among those of the Upland Goose, and thus betray somebody into eating the former.

On the other hand, the Kelp Goose has no especially bad habits from man's supremely self-centered point of view. Its neighbor, the Upland Goose, eats grass and therefore competes with sheep, so that in the Falklands a price has been placed upon its head. The Kelp Goose harmlessly clings to its rocky shores, and feeds upon a green seaweed known as *Porphyra umbilicalis* which abounds in the intertidal zone. Contrary to statements frequently made in the literature, it does not subsist upon mollusks and other neritic animals, but sticks almost altogether to algae except in the autumn, when the fruits of the crowberry or diddle-dee are ripe, at which time it wanders inland by pairs in search of this terrestrial food (Vallentin). At all other seasons the Kelp Geese avoid not only the dry land, but also the water! Rather than take refuge in swimming or flight, they will run along the rocks in front of a man for a good distance. If a bird that has been shot happens to fall into the water, its fluffy plumage quickly becomes water-soaked in a manner that seems extraordinary for a member of its family (Brooks, 1917, 152).

The flight of the Kelp Goose is clumsy. It appears "down by the stern," and does not rise high. The principal use of the wings seems to be to carry the birds to their nightly roosts on small tussocky islands, a short distance off the coasts of the main bodies of land. At dusk the Kelp Geese fly to such refuges from all directions, a custom which may well be a survival from the time when so-called foxes abounded in the Falklands.

> Before nesting commences there is a deal of courting and sorting out of undesirable partners. The females seem to outnumber the males very considerably, so that the eligible ganders are mobbed by perhaps seven or eight fascinating young geese, and, like human beings, find some difficulty in selecting the right one. When she has been selected, she is given the difficult job of driving off all the rejected from the gander, scolding as she rushes first at one and then at another of the geese, which, being geese, appear still hopeful that something will turn up to give them a chance (Cobb, 1934, 55).

Since the male of this species is not harried like the unfortunate Upland gander, he behaves quite as though aware of his own conspicuousness, and of the futility of attempting to hide. The only ordinary defensive reaction is a tendency to move away from the nest when danger threatens, and even this has been questioned by Cobb.

The Kelp Goose nests rather later than the other geese of the Falklands, few eggs appearing until November. The female carefully covers the eggs with feathers and grass when she leaves them. The goslings are hustled to the nearest water as soon as they hatch out. Cobb states that the gander, in contrast with the valiant behavior of the male Upland Goose, takes no part in the defense of the young when danger strikes.

Brooks writes that when the female becomes nervous, she utters a harsh *Uh-húh-uh-húh-uh-húh*, with a rising inflection. The male's only call is a thin and feeble *Seep-seep*.

SOUTH GEORGIAN TEAL

Anas georgica

Anas georgica Gmelin, 1789, Syst. Nat. 1, pt. 2, p. 516 (South Georgia Island).

Names: The duck of South Georgia has been described under the specific names *antarctica* and *xanthorhyncha*, besides which it has been listed as *eatoni*, which properly belongs to the species of Kerguelen Island.

Characters: A small duck of the pintail group, closely resembling *Anas spinicauda* of continental South America, from which it differs in its smaller size, the more dense spotting of the throat and fore neck, and in having 16 instead of 14 rectrices.

Adult male: Crown rufous brown, streaked with black; sides of head buffy or grayish brown, more finely speckled with blackish; neck still lighter, becoming gray or grayish white on the throat, where there is a thick sprinkling of small guttate or sagittate brown central spots on the feathers; dorsal surface prevailingly brown, the upper back buffy brown, the tertials mainly olive-brown, but all the feathers with grayish or buffy margins; tertials with a central, more or less velvety, black stripe, chiefly on the inner web; wing coverts hair-brown, with darker shaft streaks, the distal row buffy white, succeeded on the secondaries by a velvety black speculum with a faint green lustre, and again by the buffy white band marking the end of these quills; primaries hair-brown, slightly darker on their outer webs and distally blackish; rectrices hair-brown, the central elongate pair with rufous margins; chest more rufescent than back, each feather having a large subterminal blackish brown spot surrounded by a lighter rufous brown margin; the feathers of the breast and belly are similar, except that the margins are lighter, the center of the belly being almost white; under wing coverts and axillaries hair-brown, the longer members with whitish tips and more or less white sprinkling. Iris dark brown; culmen, nail, and distal borders of the maxilla black; remainder of the tip of bill slaty blue; sides of maxilla Naples yellow, becoming greenish where it blends with the blue tip; legs and feet olive-green mottled with sooty brown, the joints and webs darker.

Adult female: Similar, but with a dark brown speculum showing no more than a distal suggestion of velvety black; the band formed by the tips of the secondaries is likewise more buffy, and the velvety black stripes on the tertials are less conspicuous.

8 males: length (skins), 418–445 (432); wing, 211–222 (217); tail, 93–104 (100); exposed culmen, 32–36 (34); width of bill at base, 12.5–16 (14); tarsus, 35.5–39 (37); middle toe and claw, 45–51 (48) mm.

4 females: length, 390–412 (404); wing, 195–207 (201); tail, 85–93 (89); exposed culmen, 31–34 (33); width of bill at base, 12–15 (13); tarsus, 35–36 (35.9); middle toe and claw, 46–49 (48) mm.

Immature birds generally resemble adults. In downy young the head, neck, sides of breast, upper back, and a narrow collar around the neck are cinnamon-brown, the lower back and rump darker, close to clove-brown; paired yellowish white spots, or a broken stripe, behind wings and at side of rump; a faintly indicated post-ocular light mark; throat, breast, and belly dull yellowish or dark olive-buff.

Eggs are five to a clutch, rounded-ovate, cream-colored, with a highly polished surface. Measurements seem not to be on record.

Distribution: Endemic at South Georgia; formerly abundant along the northwestern coast of the island.

This teal was among the birds noted by Captain James Cook, in January, 1775, on the occasion of the first recorded landing at South Georgia. Until after the beginning of the present century it was probably abundant in all of the great fiord-like valleys on the northwestern coast of the island. Von den Steinen (1890, 219) and other members of the German Expedition at South Georgia observed several flocks numbering about a hundred individuals at Royal Bay, and later records indicate that such aggregations were not extraordinary during the winter season, when the little ducks were accustomed to

leave the snow-covered tundra and meadow land and to congregate on the seacoast, particularly about the mouths of glacial streams. The reduction in numbers is undoubtedly due to the fact that the teal has been persistently shot for the pot since South Georgia has become a more or less permanent home of whalemen. The birds are no longer numerous, and the latest writer (Matthews, 1929, 583) states that it is now unusual to find flocks of more than half a dozen ducks on the beaches in winter. Fortunately, the configuration of the land at South Georgia is of a character to prevent the complete extermination of the teal, for the northern fiords to which the whaling stations are confined are separated from adjacent fiords by almost impassable glaciers and ice-capped ranges. Therefore the ducks might conceivably be wiped out in one valley and yet be common just beyond the next ridge.

The South Georgian Teal is a pioneering member of a group of ducks inhabiting the southern tip of the continental region, thirty degrees of longitude directly to windward. Its closest relative is evidently the widely distributed South American Brown Pintail (*Anas spinicauda*). In most of the earlier literature the pintail is listed under the generic name *Dafila*, while the South Georgian Teal has usually been relegated to *Nettion*. The resemblance between these two species is very striking, and the case furnishes an excellent example of close taxonomic relationship which has been obscured by nomenclature. Considering the similarity between these two ducks, it is somewhat surprising that the South Georgian Teal has 16 rectrices whereas the Brown Pintail has only 14. Usually, among the Anatidae as in other families, the larger species have the greater number of tail feathers, but here the rule is reversed.

At the Bay of Isles, South Georgia, I found the teals fairly common in December, 1912. They were most in evidence on grassy islets in the bay, and were remarkably unsophisticated, allowing bands of sealers to walk right up to them as they fished for amphipods in the kelp fields at low tide, or dabbled in fresh-water pools that filled every hollow of the tussock-grown islands. The tameness of the birds, despite long persecution, shows once more the genetic rather than empirical nature of such traits in island species. Like some of my predecessors in the field, I found that males outnumbered females. At any rate, I had collected a considerable series of drakes before being able to find any of the other sex. This may have been partly due, of course, to the fact that many of the ducks were engaged at the time in incubation.

On December 20, 1912, I photographed a pair of teals feeding in a trickle of water which ran through tall tussock grass from the melting edge of a glacier. The birds were well hidden by the screen of grass, and I almost stumbled over them before seeing them. They appeared quite unconcerned, however, and continued prodding about in the mud. When I had come within two steps of them, they raised their heads and waddled farther off among the hummocks, from where they peered out through drooping grass. All but the bright eyes and yellow bills blended completely with the surroundings. Matthews has well said that their pattern fits in so thoroughly with the environment that it is sometimes only the movement of the conspicuous yellow bill that calls one's

attention to their presence. Many observers have noted the birds' preference to lose themselves in the grass when they are approached, rather than to seek safety in the air, and it is likely that before the arrival of men and guns at South Georgia they used their wings only for relatively short and infrequent flights.

During the last few days of February, 1913, I found the teals common and exceedingly tame on the eastern shore of Possession Bay, far back from the open ocean and remote from a whaling station. Here they fed in the ponds and in the wet runways between tussock hummocks. Many times pairs came whizzing toward me down the wind, wheeling to face it just before they pitched on the ground or water, sometimes within a few paces of me. I often startled parents with their broods, and heard the sharp note of alarm as the ducklings scampered to cover. Whenever a brood was threatened, the mothers exhibited very well the series of reactions which are sometimes interpreted as resourceful or self-sacrificing. The ever-present enemy was, of course, the skua and, when a teal and her ducklings were surprised, the parent would beat the ground like a maimed creature, in a manner which needs no description, while the downy young disappeared like magic in the tussock grass. On one occasion I saw a skua pounce down upon a female teal as she was fluttering lamely in front of me, whereupon the duck sprang off the ground and easily outdistanced her enemy. Twice, however, skuas seized and carried off in their bills teals which one of the officers of the brig 'Daisy' had just shot.

Finding the ducklings proved a difficult matter. I have hunted on hands and knees for half an hour without succeeding in locating even one of the silent, invisible youngsters in the thick grass. Our ship's fox terrier, however, was more successful. On February 6, after the dog had been whistled back from following a mother teal, it sniffed about the spot where the family had been flushed and presently caught one tiny duckling. The latter had evidently hatched only recently and was a brown, long-tailed, confident little bird. It sat on my hand and preened itself, stroking its back with its bill and scratching its head with a foot. It could also jump from considerable heights to the ground without being injured.

On February 28, I finally discovered a teal's nest on top of a tussock hummock, close beside a pond and about 200 meters from the shore of Possession Bay. It was covered by standing blades of dead grass, which completely arched it over. The sitting duck peeped out when I approached, but did not leave until I touched the pedestal of the hummock. The nest was lined with dry grass and a very few feathers, and held five eggs which lay with their small ends together in the deep bowl.

Five eggs or chicks seem to be the usual complement, though four eggs were noted by members of the German Expedition (Pagenstecher, 1885, 13). Naturalists of the German party observed pairing of the teals on November 19, the first eggs on December 8, and the first young on December 18. Probably most of the young hatch during December and January, but late layings, such as I have noted above, are likely to be forced through destruction of the first eggs by skuas or perhaps by rats. Chicks in the down have been observed as late as

March 15. The single nest I found had no definite lining of down, but Matthews and others have observed an abundant supply which makes the interior of the bowl look grayish white.

It would be simple to speculate, as I have once before (Murphy, 1916, 275), concerning the selective advantage of the South Georgian Teal's small brood in a region where climatic conditions are in some respects exceedingly severe. Among many northern-hemisphere waterfowl, which lay a large number of eggs, the downy young are particularly likely to fall a prey to such enemies as predatory carnivores, fish, or turtles, whereas at South Georgia the chief danger probably lies in the destruction of the eggs before hatching, either through exposure or through discovery by the skua. The number of eggs produced by species of birds under practically all environmental conditions is, however, so variable, and subject to so many exceptions, that an adaptive significance is at best uncertain.

The South Georgian Teal undoubtedly takes a good proportion of its food from salt water, but the birds spend so much time dabbling in ponds and runnels that I presume they must also find both animal and vegetal sustenance ashore as well as in the bays. A number of observers have found that they are commonest along the beaches at low tide and most likely to remain in hiding over the period of high water.

The call of the male is a shrill whistle, repeated several times and frequently uttered in flight. The duck utters a soft quack, and a gurgling note which von den Steinen likened to the bursting of large bubbles.

The Steamer Ducks

The steamer ducks, which are confined to southern South America, have been the subject of active controversy for an extraordinarily long period of time. Since the early days of discovery in the Falkland Islands and the Magellanic region it has been known that certain of these birds can fly well, while others are capable only of racing along the surface of the water, employing the short wings as "side-wheels." It has been pointed out many times that individual ducks ascertained to be only "steamers" are the larger and bulkier of the two kinds, while the fliers have a more slender build and obviously longer wings. At the same time, the general resemblance between the two is strong, and they are known to occur in the same region, and sometimes in company. Furthermore, both types "steam," though only one flies.

From such facts various inferences have been drawn. One group of workers has held that the distinction between the two is solely a matter of age, all steamer ducks passing through a youthful flying stage, after which they settle down and wax fat. Even the discovery that the flying birds lay eggs and rear young, and that they are quite capable of launching into flight from their nests, has not sufficed to convince certain taxonomists and field ornithologists that more than one species exists.

Another school of students has held that the "steaming" and the flying

ducks are two distinct species, the possibility of subspecific relationship being eliminated because large parts of the breeding ranges of the two sorts are shared in common. The opinion of the aborigines, and of sheepmen and other white residents of Tierra del Fuego, supports the two-species hypothesis; the Indians, indeed, have different names not only for the two kinds of adult ducks, but even for their respective ducklings.

Still a third theory to explain the two kinds of steamer ducks is that of Chapman, which is given below in his own words.

The history of the long and bewildering disagreement is well summarized in the exhaustive writings of Phillips (1925, **3**, 287) and Lowe (1934, 471). The former of these authors arrives at no final conclusion, although he believes that the findings cannot all be explained on the basis of one natural species. Lowe has fully satisfied himself that there are two distinct species of steamer ducks, and he presents tabulated matter and figures to illustrate the thoroughgoing differences between the adult ducks of the two kinds and between their respective young. His color-plate alone, indeed, shows convincing distinctions between ducklings of the two sorts.

Most ornithologists, after studying Lowe's text, would regard the problem as solved, and yet as keen a naturalist as Lord William Percy (1934, 867), who has a deep knowledge of the ducks of the world and who has closely observed steamer ducks in the field, apparently remains unconvinced. The fact is, as I shall demonstrate conclusively, that while Dr. Lowe has developed his thesis correctly up to a certain point, he has not gone far enough; he has, to be sure, pointed out two well-marked species of steamer ducks but has, on the other hand, added to the current tangle by assuming that the flightless species of Magellanic South America is the same as the flightless species of the Falkland Islands.

The obstacle to solution of the question proves to lie in the widely accepted fallacy that the ultimate truth about these birds is to be learned only through field observation. As a result of his extensive experience in Chile, Chapman (1933, 362), for example, writes:

> I venture to suggest that there is but one species of Quettro, that young in their first winter always fly, that those individuals that nest on salt water, and hence on their feeding-grounds, lose the power of flight when mature, while those that nest on fresh water and fly to their feeding-grounds retain the power of flight at all ages. This is only a working hypothesis to be tested by field studies and by weights and measurements of specimens of flying and flightless birds collected throughout the year.

Now I acknowledge that provisional observation of the behavior of living steamer ducks is the necessary basis for any sound conclusion. The fact that certain specimens collected by Mr. Beck during the Brewster-Sanford Expedition are marked "shot while flying over land" establishes, for instance, a standard of comparison, the characteristics of which are to be balanced against those of other ducks, with large bodies and short wings, which could not be made to leave the surface of the water and which, in fact, were incapable of flight. Beyond such fundamental data, however, the steamer duck problem is not a

field problem at all, but a purely taxonomic problem. With two or three specimens at his disposal, a systematist might reach any one of several conclusions; with twenty specimens he might become hopelessly befuddled, particularly if only part of the common range were represented, and if there were not enough examples to indicate the normal adult plumages of each sex. But the study of a hundred specimens covering all ages, all seasons, both sexes, and the entire range of the genus—continental and Falkland—serves to clear up every doubt. The steamer ducks then fall into their respective categories and prove to be no more puzzling, no less conventional, and to have no wider limits of variation than any other closely related members of a single genus.

The material upon which I base such confident opinions comprises 106 specimens, of which 12 Falkland birds were kindly lent to me by the Museum of Comparative Zoölogy. The remainder were collected by Beck at Chiloé Island, at many localities in and around Tierra del Fuego, on the Atlantic coast of Patagonia, and at the Falkland Islands. This large series of steamer ducks, when arranged like with like, shows that there are three distinct forms, as follows:

1. A flightless bird inhabiting the Falkland Islands.
2. A different flightless bird inhabiting the continental region, that is, all the Magellanic insular and coastal waterways from Chiloé to Cape Horn.
3. A flying bird inhabiting all parts of the combined ranges of the two flightless forms, both in continental and Fuegian waters and at the Falklands.

The series shows, further, that each of these three forms of steamer duck is readily identifiable at every age and in every stage of plumage; there is not a "doubtful" specimen among the hundred. Moreover, it is during downy stages that each one of the three is most distinct from the other two; as the ducks mature they come to have an increasing superficial resemblance, although they are still readily identifiable by mutually exclusive features of pattern, structure, and proportion. Finally, the curious probability is brought out that the Flying Steamer Duck is in some respects more closely akin to the flightless duck of the Falklands than the latter is to the flightless duck of the continent! By kinship I mean, of course, general resemblance; we know nothing about the genetic or blood relationship of the three. In Beck's field notes I find several somewhat surprised yet canny references to the fact that the adult flightless bird of the Falklands looks more like the flying bird than it does like the mainland flightless bird.

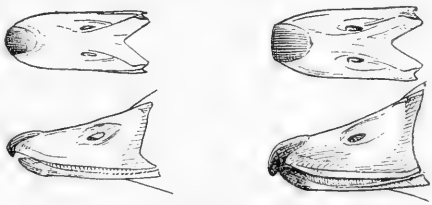


FIG. 73. Beaks of two species of Steamer Ducks, to illustrate particularly relative size and the form of the maxillary and mandibular ungues. The drawings represent mature males.

Left, Flying Steamer Duck (*Tachyeres patachonicus*); *right*, Magellanic Flightless Steamer Duck (*Tachyeres pteneres*).

The differences between the forms of steamer ducks are of such quality and

degree that they might be regarded as subspecific, but the geographic relationships obviously make it necessary to grant each form specific rank. Fortunately, they have all long since been described, and to avoid further confusion of ideas I list herewith the three species chronologically, under English and technical names, one or more of the latter being resurrected from the synonymy. It should be noted that the earliest name of all, *Anas cinerea* Gmelin 1789, is not available for any steamer duck, since that combination had previously been applied to the Gadwall.

1. Falkland Flightless Steamer Duck.
   Tachyeres brachypterus (Latham) 1790.
2. Flying Steamer Duck.
   Tachyeres patachonicus (King) 1830.
3. Magellanic Flightless Steamer Duck.
   Tachyeres pteneres (Forster) 1844.

Various ornithologists, including Blaauw (1917, 274), Bennett (1924, 280), Phillips, and Lowe have tabulated data purporting to distinguish two species of steamer ducks, the criteria including habitat, behavior, size, plumage, morphological proportions, eggs, etc. Some of the characteristics are sound, some have no significance, and some are confused because of the authors' failure to recognize three species instead of two. Phillips's color-plate, for instance, illustrates all three species under a single name, including the downy young of the flightless Falkland bird; Lowe mixes up the eggs of the two flightless species, and uses the name *brachypterus* to apply to both the Falkland and the continental flightless ducks. In the drawings by Mr. Jaques which accompany this text, some of the diagnostic features show more clearly than they could be expressed in words. Further details are brought out in the descriptions under the three specific headings. The following constant differences, referring to all three species at various stages of growth, are worthy of special note.

Eggs: The eggs of the three steamer ducks look much alike but exhibit a size difference which corresponds with that of the three species of birds. Vallentin's (1924, 322) opinion that the eggs of the flying and Falkland flightless ducks can readily be separated if they become mixed is not to be relied upon, but average measurements reveal a size sequence as follows:

pteneres	*brachypterus*	*patachonicus*
11 eggs, 84.7 x 57.3	10 eggs, 82.1 x 56.6	29 eggs, 76.4 x 52 mm.

Downy young: Newly hatched ducklings are more distinctive in appearance than are birds at any later stage. The diagnostic characters are as follows:

T. pteneres (continental flightless species): Dorsal color, bister; no supra-orbital stripe; one post-ocular and one post-auricular white spot; bill, slaty, with the nails of both maxilla and mandible pronounced and black.

T. brachypterus (Falkland flightless species): Buffy or olive-brown dorsally, but with a broad grayish white yoke across the scapular region; a continuous supra-orbital and post-auricular white stripe; bill substantially as in the preceding species.

T. patachonicus (flying species): Dorsal color, earthy brown; a broad, white, diffuse stripe running through the eye and looping behind the cheeks; bill, bluish slate-color, of smaller size than in the preceding two species, and with the maxillary unguis inconspicuous and of a horny color, the mandibular unguis being barely discernible.

In connection with these diagnoses of newly hatched steamer ducks, Fig. 74 should be compared with plate 11 and text-figure 9 of Lowe's paper.

Adults: Plumage characters of the full-grown ducks are somewhat difficult to summarize because of the many similar phases exhibited by both sexes of the three species before the birds attain maturity. Detailed descriptions precede the several biographies. A unique character of *T. brachypterus* is the more or less distinct ring of glossy golden feathers around the neck. It is usually evident in females to a greater extent than in males, but no old Falkland birds seem to be without a trace of it.

The difference between the Flying and the continental Flightless Steamer Duck is particularly pronounced in the form of the primary quills and the color pattern of the secondaries, the latter being the feathers which carry the large white speculum of the wing. Not only the length, but also the breadth, of the primaries are from a quarter to a third greater in *patachonicus* than in *pteneres*. In both species the outermost one or two secondaries have a slight and variable dark subterminal spotting. If we disregard this, and count the secondaries inward, we find that in *patachonicus* the first ten, eleven, or twelve quills are white, the first dark marks appearing on the inner web of the eleventh, twelfth, or thirteenth feather. In most instances the next succeeding feather is entirely dark. In *pteneres*, only six, seven, or eight secondaries from the outermost are white, the gray markings usually beginning on the inner web of the eighth or ninth, succeeding quills after the first spotted one being more or less dark on both webs or entirely dark.

Fig. 74. Pattern and relative pigmentation of the nestling down in two species of Flightless Steamer Ducks.

Upper, *Tachyeres brachypterus* (Mus. Comp. Zoöl. 70522, Falkland Islands); lower, *Tachyeres pteneres* (Brewster-Sanford 5100, Amer. Mus. Nat. Hist., Beagle Channel).

Size, weight, and length of the wing and other appendages also seem to offer constant and tangible means of distinguishing between all three species, although I unfortunately lack adequate flesh measurements and weights for the species *brachypterus*. Figures applying to the other two steamer ducks are as follows:

	pteneres	*patachonicus*
Length in the flesh	2♂ 836	10♂ 704 mm.
	1♀ 737	14♀ 655
Wing-span	3♂ 1075	10♂ 1088
	1♀ 994	14♀ 1025

It will be observed that the smaller species has much the longer expanse. The size difference between these two is brought out still more strongly by the respective bulks, for the heaviest male of the flying species falls considerably short of the weight of the lightest female of the flightless species.

	pteneres		*patachonicus*
Weight	2♂ 5897	min.	5♂ 2892 grams
	6180	max.	3175
	6039	aver.	3073
	4♀ 3629	min.	6♀ 2438
	4763	max.	2835
	4111	aver.	2616

The heaviest male among a number of Falkland flightless birds (*T. brachypterus*), taken at a season when the ducks were not very fat, was found by Brooks to weigh 4309 grams.

The size of the maxillary nail is very large in the continental flightless bird, small in the flying duck, and intermediate in the Falkland flightless species. Extreme and average measurements of the width of this structure in adult males are as follows:

pteneres	*brachypterus*	*patachonicus*
13♂ 15.4–18.5 (17.1)	7♂ 11.9–14.2 (13.3)	16♂ 10.6–13 (11.7)

Finally, the ratio obtained by dividing the length of the wing into that of the tarsus proves to be constant within narrow limits, and apparently diagnostic. The averages for males of the three species are, *pteneres*, .261; *brachypterus*, .237; *patachonicus*, .203.

Significant osteological differences between the species *patachonicus* and "*brachypterus*" (= *pteneres*), including figures and illustrations which show the relative lengths of humerus and sternum in the two, have been set forth by Lowe

The evolutionary probabilities seem to be that the Flying Steamer Duck (*patachonicus*) represents the common ancestral type which, through mutation, has given rise to flightless species both in the Falklands and in South America.

The bird of the latter region (*pteneres*) has departed most widely from its ancestors, though the Falkland bird (*brachypterus*) has developed certain peculiarities of its own, such as the glistening feathers that encircle the neck of the adult, and the light natal down.

MAGELLANIC FLIGHTLESS STEAMER DUCK

Tachyeres pteneres

Anas pteneres Forster, 1844, Descrip. Animal., p. 338 (Tierra del Fuego).

Forster's detailed Latin description of the plumage, size, and habits leaves no doubt that he referred to the Magellanic flightless species. He records a weight of "16 libras" which, if he made use of the Prussian pound in vogue until after 1840, would be equal to 7.48 kilograms, a weight which is perhaps slightly excessive but could apply in any case only to the flightless bird. The length recorded for the culmen in "uncia" amounts to 61.5 mm., which likewise fits the flightless bird.

Forster evidently examined a number of specimens, however, for he describes both sexes in full, and I believe that some of the measurements he records for length of body and wing-span may refer to the smaller or flying species. While his description is perhaps to this extent a composite, his name may justly be restricted on the weight of evidence to the larger or flightless species.

Names: Racehorse, Sea-horse, Loggerhead; the Spanish name "Pato Vapor" is, of course, a translation of the English steamer duck. Aboriginal names used in Chile include "Quetro," which is variously spelled. Synonyms of the specific names are *cinereus*, *brachypterus*, *macropterus*, and *patachonicus*, two of which properly apply to the other two species.

Characters: A large, heavy steamer duck, the bill, leg, and foot of which are at all stages much larger than the same structures in the flying species, while the wing and tail are relatively much shorter.

Adult male: Head pale neutral gray, with a slightly mottled effect owing to partial exposure of the lighter bases of the feathers, the pileum darker, forming a distinct cap; lores also prevailingly darker than cheeks; a whitish streak extending from both eyelids caudad toward the auricular region; a broad and elongate patch on the throat, varying in hue between brick-red and russet; mantle, scapulars, back, rump, upper tail coverts, breast and flanks, slate-gray, with a more or less scaled appearance owing to lighter centers on some of the feathers, and rarely with a slight wine-colored tinge on the margins of feathers of the scapulars, lower back, and flanks; breast in some specimens more or less tawny owing to a rufous mesial band present between the gray tips and light bases of the feathers in this region; abdomen and under tail coverts white; wing with carpal and metacarpal tuberosities, the latter forming a pronounced, rough, and dull-pointed spur; primaries fuscous-black, as are also the rectrices; remainder of wing slate-gray, like the back, except for a large and conspicuous white speculum formed by the tips of the greater coverts and all of the outer secondaries; wing-lining centrally white. Iris brown, eyelid black; bill bright yellow, orange and carunculated at the base, the nails of both maxilla and mandible black, of pronounced relief, and of shiny, corneous surface; legs and feet yellow, with the soles and claws blackish.

The general color of the head in adult males varies according to wear, the cheeks and the sides of throat and neck becoming whitish as the tips of the gray feathers decompose; likewise the reddish spot on the throat is large and conspicuous only in fresh plumage, becoming almost obsolescent with continued abrasion. Furthermore, there is considerable age or individual variation in this mark, fledglings and young adults appearing to show less of it than thoroughly mature birds. It seems, however, never to be entirely lacking.

Adult female: Generally similar to the male, but slightly smaller, with a tendency toward more wine-colored scalation on the plumage of back and flanks, and with a darker head, the cheeks and sides of throat being of a mottled dark vinaceous drab or dark purplish drab color instead of gray; bill yellowish, rather than bright yellow, and usually of a much darker appearance in dried skins.

13 males from various parts of southern South America, between Chiloé Island and the islets south of Tierra del Fuego: wing, 260–288 (275); tail, 85–99 (93.5); exposed culmen, 55.2–64.5 (60); width of maxilla, 33.1–36.1 (34.6); width of maxillary nail, 15.4–18.5 (17.1); tarsus, 66–78.6 (71.7) mm.

11 females, same localities: wing, 255–271 (263); tail, 85.5–93.8 (88.3); exposed culmen, 53.9–60.7 (58.6); width of maxilla, 31–33.3 (32); width of maxillary nail, 14.7–16.8 (15.7); tarsus, 63.4–70.6 (66.5); middle toe and claw, 99.6 mm.

Fledglings of both sexes in this species have the dark parts of the plumage entirely gray, without wine-colored margins on the feathers of breast and flanks, the only exception being that the reddish spot on the throat is clearly indicated. They closely resemble the young of the flying species (*patachonicus*) at the same stage, but have about twice the bulk, with correspondingly larger bills and feet.

In downy young of the three forms of steamer ducks, the specific characters show even more markedly than they do at later stages. Young ducklings of *pteneres* have the dorsal surface dark bister-brown, with scarcely any trace of light spotting caudad from the head, on the sides of which there are a pair of post-ocular white areas. A broad, definite grayish brown collar crosses the throat and upper breast. The down of the whitish belly is somewhat hair-like and silky. The bill is entirely blackish, broad, deep at the base, with the maxillary lamellae showing clearly in lateral aspect; the nails of both maxilla and mandible are broad, distinct, and tumescent, with a hard, polished integument. The mandibular rami tend to spread apart basally. The feet are blackish in life.

The above description is based upon ducklings from 20 to 40 cm. in total length, the youngest of which had not been more than a day or so out of the egg.

The eggs of all three species of steamer ducks have been badly mixed in the literature of all dates, for which reason many of the recorded measurements are not to be trusted. All are ivory-white or creamy, and the shape is variable within narrow limits, but the shells of eggs of the two flightless species are thicker than those of the flying species, as pointed out by Lowe.

Our single full set of eggs of *pteneres* numbers six, but larger clutches have been frequently reported. The average dimensions of 11 are 84.7 x 57.3 mm., the extremes measuring 88 x 61 and 81 x 55.

Distribution: Coasts and islands of southern South America from the vicinity of Corral, Chile, southward to the islets near Cape Horn and Staten Island. Breeding from the Gulf of Ancúd and Chiloé Island to southern Fuegia, and in the western part of the Strait of Magellan.

According to Phillips, the first description of the Steamer Duck, and of its habit of racing over the water at astonishing speed in the Magellanic region, is that of Pedro Sarmiento de Gamboa (1580), who cruised from Callao toward the southern tip of the continent. The shipwrecked sailors of Lord Anson's fleet gave the bird the English name Racehorse "from the velocity with which it moved upon the surface of the water, in a sort of half flying half-running motion" (Byron, 1748, 50). Molina (1782, 239) refers to it as the Quetru, under the curious technical name "*Diomedea chiloensis*," which he describes as a bird with an ash-colored, fluffy plumage of such soft texture that the inhabitants of Chiloé, where the duck is abundant, spin the feathers and make bed coverings of them. Both Phillips and Lowe cite many other early accounts, and Darwin has written the following *multum in parvo*, which calls for comment in almost every line, and which, in fact, is a "design for a biography":

These great logger-headed ducks, which sometimes weigh as much as twenty-two pounds, were called by the old navigators, from their extraordinary manner of paddling and splashing over the water, race-horses, but now much more properly steamers. Their wings are too small and weak to allow of flight, but by their aid, partly swimming and partly flapping the surface of the

water, they move quickly. The manner is something like that by which the common house duck escapes, when pursued by a dog; but I am nearly sure that the steamer moves its wings alternately, instead of, as in other birds, both together. These clumsy birds make such a noise and splashing, that the effect is most curious. The steamer is able to dive but a very short distance. It feeds entirely on shell-fish from the floating kelp and tidal rocks; hence the beak and head are surprisingly heavy and strong, for the purpose of breaking them. So strong is the head, that I have sometimes scarcely been able to fracture it with my geological hammer; and all our sportsmen soon discovered how tenacious these birds were of life. When pluming themselves in the evening in a flock they make an odd mixture of sounds, somewhat like bull-frogs within the tropics (Gould, 1841, 136).

As regards weight, the greatest of naturalists probably dropped his customary caution in crediting 22 pounds. That figure has, to be sure, been outdone on paper, for Captain Cook records Steamer Ducks at Staten Island weighing 29 or 30 pounds. Such bulks, as Phillips notes, are patent exaggerations, but the largest males doubtless attain a maximum of about 14 pounds (6350 grams).

Reynolds (in Lowe, 1934, 472) says of the progression of the Flightless Steamer Duck: "It flaps over the sea at a great pace, throwing up so much spray that at a distance it is the flying water rather than the bird that draws the eye." Cunningham (1871, 350) reports that flocks in motion sometimes raise "a wave of surf fully a foot and a half in height." The wings and feet both play a part in this churning of the water and, in another account, Reynolds (1934, 350) notes that while the wings are beating, the long strides and backward kick of the legs can also be observed. According to Phillips, the wings are not moved alternately, as Darwin thought, but simultaneously as in any other bird, although the great splashing gives the appearance of uneven locomotion. I believe, however, that something still remains to be said about this point.

Darwin speaks of the wings as "weak." Rather, they are merely small and, as Lowe has indicated, capable of somewhat limited extension. The bones, muscles, and tendons are all well developed, and the pectoral muscles are fully as massive as in a flying waterfowl of equal size. There is no reason to believe that the Steamer Duck's method of making headway requires any less expenditure of muscular energy than flight through the air; the probabilities would, indeed, be the other way. As regards their rate, Gay (1847, 457) states that it requires a boat with six oarsmen to overtake them, but most of the early writers allege that the birds can outdistance any rowboat, however well manned. They have been credited with speeds up to 15 miles per hour (24 k. p. h.). Beck found that they would gain for a time when pursued by a launch making 8 miles an hour, but that after a chase of 2 to 3 kilometers they would begin to weaken. He learned, too, that the birds would rarely deign to change their course when he tried to intercept them in a skiff. They would rely rather upon increasing their speed at the critical time.

Darwin's statement that the Steamer Duck is able to dive but a short distance doubtless deserves challenging, though there seems to be little to quote upon the subject. Nicoll (1904, 49) writes that it dives well and remains under water a "considerable time." Reynolds adds that it "is, of course, an expert diver,

and in the beautifully clear waters of the Beagle Channel I have noted the movement of its partially extended wings as it passed beneath the boat." Old and young alike, according to Blaauw (1916, 488), are accomplished divers, and Beck found at Chiloé that the Steamer Ducks not only dive skilfully after they have been exhausted by long pursuit, but that they are capable of swimming with the body entirely submerged and the head barely above the surface.

As to the extraordinary toughness, tenacity of life, and "almost reptilian vitality" of the Flightless Steamer Duck, the experience of Percy and of all other recent observers agrees with that of Darwin, who tested a skull with his hammer! Beck's chief difficulty during his collecting work was not to hit the birds, but to kill them; Nicoll found that even BB shot was effective only at a range of 15 meters or so.

In Lowe's recent monograph on the Steamer Duck, Reynolds has pointed out a fact of great zoögeographic significance, namely, that the flightless continental species avoids highly tidal coasts. It is absent, for example, along the unbroken shores north and south of the eastern entrance of the Strait of Magellan, where the daily ebb and flow of the tide attain record proportions. Along the southerly and westerly sides of the Fuegian complex, however, and in the rugged, broken channels that exhibit relatively little tidefall throughout their extent northward along the Pacific coast to the Gulf of Ancúd, this species is everywhere at home. It reaches fresh water only about the mouths of streams, if at all, and in its choice of nesting sites it shows a strong predilection for small islets and points rather than for the shores of bights and coves. Such information clarifies many published notes regarding the ranges of the Flightless and Flying Steamer Ducks, and gives at least a provisional clue to the identity of specimens recorded from the east coast of Patagonia. De Agostini (1924, 114) reports that the flightless species, as he observed it in Tierra del Fuego and Staten Island, never ventures farther than 10 kilometers from any shore.

During the Brewster-Sanford Expedition, Beck first became acquainted with Steamer Ducks along the shores of Chiloé. Here, in April, May, and June, 1914, he found birds of both the flightless and the flying species together, although between December and February of another year no flying birds whatsoever were to be found in this same region (Chapman, 1933, 361; Percy, 1934, 867). The supposition is that during the latter season the flying birds were nesting around lakes or up streams, at a distance from salt water.

On the water and on islets off Ancúd, and also in many coves near the southwestern corner of Chiloé, Beck found the flightless birds common, associating either in small flocks or in pairs. Single birds were rarely if ever to be seen, and it is of interest that Reynolds believes that all forms of steamer ducks mate for life. Most of the birds encountered by Beck at Chiloé had to be taken by strategy, principally by approaching them from the windward or by giving chase in a launch until they took to diving and eventually made a miscalculation.

Southward through the Chilean Archipelago, the western half of the Strait of Magellan, and along the channels leading toward Cape Horn, Beck found the Flightless Steamer Duck everywhere common. On the shore of O'Brien

Island, on January 14, 1915, he saw a flock of nearly a hundred, and in neighboring waters were many broods of young of various ages, including ducklings as small as others he had met in the vicinity forty days earlier. Five newly hatched birds had been observed at London Island on November 30. Reynolds (1935, 84) has recently reported that "contrary to expectation" the Flightless Steamer Duck proved to be the commoner breeding species near Cape Horn in December, 1932. He found pairs, solitary males standing guard, and family parties with small young at Barnevelt Islet, to eastward of Deceit.

Aside from some thirty mature Flightless Steamer Ducks obtained by Beck between Chiloé and the Cape Horn district, he also collected downy ducklings as follows:

One male and two females, apparently of a single brood, London Island, November 30, 1914.

One male, Stewart Island, December 3.

One male, Timbales Island, December 4.

Two males, apparently of one brood, Beagle Channel, January 11, 1915.

Older young, and fledglings with very short, sprouting primaries include odd birds or entire broods taken in Cockburn Channel, March 5; Bertrand Island, April 22; Gable Island, Beagle Channel, May 4; Chiloé, May 19; and Ushuaia, July 19. Although many of the fledglings look like examples of *Tachyeres patachonicus* at the same stage of growth, they are readily distinguishable by size, the length and thickness of the tarsus and foot, the form of the bill, and the much more marked tumescence of the ungues of both maxilla and mandible.

Most of the adults taken by Beck at Chiloé in May were in worn and moulting plumage, one or two being so ragged that the dense gray undercoat of down shows through the sparse feathers. In these and other examples some of the remiges had become frayed practically down to the shaft as a result of their frequent battering against the water. Among most such birds the two outermost primaries were new, the inner ones at the point of being shed in sequence. Beck believed that females shot in June already exhibited incipient enlargement of the ovaries in anticipation of the courtship season, which probably begins two months later or thereabouts. Percy found that almost all the ducks had young at Chiloé by December 20.

The relative wariness or tameness of the Continental Flightless Steamer Ducks seems to be determined in part by their experience. Percy reports that wherever they are unmolested they are not naturally shy or wild, but a very little persecution makes them so, and they then exhibit excellent judgment in the selection of rocks upon which to rest, places that are unapproachable from any direction without warning. At Melinka, in the Guaitecas group, Blaauw remarks that they become almost as tame as domestic ducks. In their daily movements, according to Phillips, who quotes Percy and others, they are day-feeders, like other sea ducks. Regularly, and usually more than once in 24 hours, they leave the salt water around such a locality as Chiloé, and go inland to drink at springs of fresh water. The individuals seem to be highly sedentary creatures both afloat and ashore, with a strong penchant for particular coves,

kelp beds, roosting rocks, etc., throughout the year. Large flocks usually prove to be made up of yearlings or other immature birds. Feeding time is chiefly at high water, when the ducks forage along the fringes of the kelp fields. As soon as the rocks are uncovered they split up into pairs or small parties, clamber onto their favorite perches, and spend hours resting, preening, and quarreling. They accept the responsibility of defending the rock upon which they sit against all comers, opening their beaks and "making faces" at any approaching bird. Small groups get along peaceably enough, and manage to sleep for long stretches, but under conditions of a concentrated population, there is always a constant movement caused by the never-ending demand for a good rock.

Reynolds, in Lowe's paper, thus defines the Flightless Steamer Duck's defense of territory in courtship, etc.

> A warlike bird, with a singular method of attack, it fights its like and chases the smaller flying kind, *T. patachonicus*. The approach is identical in both cases. It flattens itself out, head down, neck extended, swims almost submerged, gradually disappears, and reaches its unsuspecting adversary from beneath. I have not noticed *T. patachonicus* do this, and do not believe it has the habit. My mother remembers seeing fighting Steamer Ducks . . . picked up by Yahgan Indians in a canoe, and that when adults were engaged in strife the young often took refuge on land.

Even more detailed account of the contests between rival male Steamer Ducks will be found in the biography of the Falkland flightless species.

Reynolds continues that the continental species nests abundantly on islets of Beagle Channel, and on promontories of the Fuegian mainland. The nest is rarely as far as 300 meters from water, and usually close to the edge of it. The eggs, which usually number from five to eight, are laid under shrubbery or other concealment. A nest found by Beck within a few steps of the water at Isla Grande, on December 2, 1914, was well lined with down and contained six slightly incubated eggs. Reynolds writes:

> The duck sits exceedingly close, and must be nearly trodden on before she moves; moreover, she takes full advantage of unlimited cover found everywhere in the form of vast tangles of bush and shrub. The drake, by swimming up and down and calling, and when most excited accompanying his calls with an angry shaking of the head, does his best to give the nest away.

Nicoll reports that the Steamer Duck's call-note to the young is a croaking quack. Cunningham (1868, 127) reports two very distinct notes, one like the mew of a cat, the other a sort of low, hoarse growl. Falkland observations suggest that the latter of these pertains to the male, the mew to his mate. Percy found that the male of the continental flightless form has a variety of notes, that most frequently heard being a shrill *qu-i-e-u-ll* repeated about twenty times, after which there is a quick *kek-kek-kek-kek*. The last is, however, sometimes left out (Phillips, 1925, 294).

Mollusks of many sorts make up the principal part of the Flightless Steamer Duck's food, though fish and various crustaceans have likewise been found in their stomachs. Since they obtain the bulk of their food from the kelp beds, they do not have to dive deeply. Beck found small shells and gravel in the stomachs of very small downy young, and mussels (*Mytilus*) up to 55 millimeters in length, chitons, limpets, and snails in those of adults. A male taken

at Magallanes in late July, 1914, contained a conical marine snail (*Euthria*) 32 millimeters in length and 14 in diameter, a chiton (*Plaxiphora setiger*) about 27 millimeters in length, and 12 imperforate limpets (*Nacella fuegiensis*) measuring up to 38 millimeters in length, 27 in breadth, and 12 in the height of the shell. The power of the ducks' gizzards to crush and triturate such objects is most impressive. Percy found that 12 birds taken at Chiloé in December and January were crammed to the gullet with small crustaceans of the kelp, resembling a "wood-louse."

Little is known of the Steamer Duck's enemies, but the mortality of the young is obviously high. Beck once saw a caracara destroy three out of a set of four eggs in a nest near the Strait of Magellan. Reynolds states that even the adults fall victims to the foxes along Beagle Channel.

The following quotations are from the notes of Lord William Percy, as published by Phillips (1925, 292 and 296):

The immature and non-breeding birds were in small parties or large packs which seemed to consist of one-, two-, and three-year-old birds and very few showed the white head of the adult male. The daily habit of these packs, one of which numbered 83 birds in the Guaytecas Islands, and another 87 birds at Pumalin (i.e., Yelcho on the mainland), was to feed during high water along the fringe of kelp, and so soon as the rocks became uncovered, to split up into small parties, or more generally pairs, clamber up on to the rocks and spend the hours of low water preening and quarrelling. They are then most entertaining birds to watch for they seem possessed of only one idea apart from sleeping and preening and that is to defend the rock upon which they sit against all comers. There would always be birds floating along the edge of the rocks which had not found a suitable perch, and the possessors of a rock, if unable to deter newcomers from joining them by opening their beaks and 'making faces' at them, were frequently compelled to withstand a direct assault. The newcomer is generally repelled as he is at a disadvantage in clambouring up the rock, but such slight assistance as a swell giving him the necessary impetus not infrequently enables him to displace the holders of the rock of which the newcomer or newcomers then proudly take possession, ruffling up their feathers and 'making one more face at the departing forms of the dispossessed. A small party is generally fairly friendly and will sleep peaceably for hours but amongst a large pack there is always a constant movement caused by this continual demand for a good rock.

The most interesting habit of these birds which I noticed on the small islands off Chiloé was that they regularly left the sea more than once in the 24 hours and went considerable distances inland to springs of fresh water. On one island solely inhabited by breeding pairs, there were several large caves extending more than 100 yards into the hillside. At the head of these caves, and also at other places more than 300 yards from the sea and through more or less dense vegetation, were small trickles of fresh water coming down the rocks. All round these spots the ground was trampled down and covered with the tracks of Steamer Ducks, and between every tide the fresh tracks of the birds could be seen imprinted in the sand leading from the sea and back to it. The tracks of broods were never seen at these places, but on one occasion in Jan. 1924 a pair of old birds with four downy young were discovered at the head of one of the largest caves. The male and two young broke past in the dark but the female was struck by a native with a stick and two of the young caught. All three were kept by one of the inhabitants of Ancud for some weeks but the female had been injured by the stick and eventually they all died.

The natives say that the old birds go to the springs to drink fresh water and that they take their young to the caves to roost. That they nest on occasion in the caves is evident from several old nests which were seen, but it seems improbable that such a marine duck as a Steamer Duck requires fresh water. I noticed that there was a fine green slime where the water dripped down the rock and on one occasion saw a pair of old birds in another locality apparently 'grazing' on a large sloping face of rock where on subsequent inspection nothing could be seen but this same green

slime. Whatever be the explanation of these extended peregrinations on dry land they constitute an interesting, and as far as sea ducks are concerned, unique habit in my experience.

I think it is worth while to quote the following remarkable experience which William Percy had with a family of Steamer Ducks, for it shows that they are endowed with a very different psychological make-up from that seen among our more typical northern ducks. He writes:

"On Jan. 2, 1924, I was sitting on a small island in the Guaytecas group when a pair of Steamer Ducks with a brood of six came swimming amongst the kelp within 40 yards. They fed there for one half hour gradually getting to within 25 yards of where I lay. The young were not more than a week old and as I required a bird of that stage I finally decided to shoot one. Choosing the moment when one bird was separated from the rest I fired and killed it, turning it over in the water so that it lay on its back. The rest of the brood immediately took refuge at their mother's side and she and the male remained perfectly still where they were. I did not move and was then vouchsafed the most remarkable display of emotion that I have ever witnessed in a duck. The male remained gazing at the splash made by the shot for perhaps three seconds, then gave a harsh cry at which the remaining young dived at once. Then 'steaming' straight at the dead bird with beak wide open, and lashing the water into foam with wings and feet, he appeared on reaching it to be about to give it a violent blow with his bill, but instead dived under when within six inches of the dead body, reappeared a few yards beyond, 'steamed' on 15 yards, and then turned about and repeated the process. He must have repeated this performance 15 or 20 times before I was tempted to end his pathetic frenzy by shooting him, when he suddenly stopped, joined the female who had remained quite stationary with her brood at her side all the time, and went slowly off to sea apparently quite unconcerned. I had not moved, and do not think the birds had seen me at all. It seemed as though the male, on seeing the splash made by the shot, and his dead offspring in the middle of it, had concluded that something under water had done the damage, and I am now convinced that the rest of the performance was an attack on a supposed submarine enemy. In any case it was a most impressive spectacle which displayed as no other experience with these birds did, the astounding power which they can exert in the water, the surface of which was made to foam and boil as if a large fish was causing the disturbance."

FALKLAND FLIGHTLESS STEAMER DUCK

Tachyeres brachypterus

Anas brachyptera Latham, 1790, Ind. Orn., 2, p. 834 (Falkland Islands).

Names: Called Loggerhead at the Falklands to distinguish it from the Flying Steamer Duck or "Canvasback." The synonyms of the specific name are the same as those for the other two species.

Characters: A flightless duck, generally similar to the preceding species, but with a close superficial resemblance to the Flying Steamer Duck. Bill narrower than in *pteneres*, the maxillary unguis smaller in both diameters, and distinctly less hooked.

Adult male: Resembling *Tachyeres pteneres*, but head more whitish, the cap of darker gray being much less pronounced; neck with a distinct silken yellowish or golden sheen never present in *pteneres;* dorsal plumage much warmer in hue, approaching violet-gray, and the feathers of back and flanks with extensive wine-colored or auburn margins, approaching the condition in the species *patachonicus;* red color of the throat darker and richer than in *pteneres*, being close to mahogany-red or bay and, instead of being confined to a central ellipsoidal area, it tends to spread widely onto the sides of the neck and even to the face. Flesh colors apparently as in males of the former species.

Younger males exactly resemble females, which are described below. Three such collected by Beck, and others collected by Brooks for the Museum of Comparative Zoölogy, are indistinguishable from the eight adult females upon which the following description is based.

Adult female: Smaller than the male, with a bill which is greenish yellow (very dark green in dried skins); plumage of the entire back, sides of breast, and flanks even more pronouncedly scaled than in male birds, the breast sometimes becoming strongly rufescent with the wearing away of the gray tips of the feathers in this region; base of neck showing a glossy, golden yellow ring,

somewhat indefinite in extent, but more pronounced than the same feature in males, and peculiar to this species; remainder of head and neck, except for the white ocular streak and an indistinct grayish crown, dark reddish, of a tone somewhat more purplish than the "bay" of Ridgway's "Color Standards." Beck records the bill as" greenish, yellowish on the top," the feet as yellowish, with the webs and soles blackish.

7 males from the Falklands: wing, 272–282 (276); tail, 91.5–101.6 (96.7); exposed culmen, 53–60.8 (55.3); width of maxilla, 30–32.5 (30.9); width of maxillary nail, 11.9–14.2 (13.3); tarsus, 63.1–67 (65.4); middle toe and claw, 96.8 mm.

8 females: wing, 251–274 (261); tail, 87.2–99.5 (93.4); exposed culmen, 52–58.3 (54.8); width of maxilla, 26.9–30.1 (28.4); width of maxillary nail, 11.8–13.6 (12.9); tarsus, 55.2–62.8 (59.5) mm.

I have not seen fledglings of this species, and so can state no peculiarities of their plumage. They would be readily identifiable, however, by bill characters alone.

In newly hatched young, the color and pattern are very different from the same stage in either of the two other species. Ducklings of the Falkland flightless bird are dorsally of very much paler brown than *pteneres*, and have a unique gray collar across the upper back. The white mark behind the eye and cheek is continuous instead of being interrupted so as to form two spots. In *brachypterus*, indeed, the supra-ocular stripe beginning at the base of the bill is continuous with a broader post-auricular stripe which extends to the back of the head. The form of the bill resembles that of *pteneres*, but the maxillary and mandibular ungues are considerably narrower and of less pronounced relief.

We have one set of six eggs. The measurements of these and four other Falkland eggs recorded by Lowe give an average of 82.1 x 56.6, and extremes of 86 x 57, 79 x 57, and 80.3 x 55.4 mm.

Distribution: Endemic at the Falkland Islands.

The name Loggerhead, as applied to steamer ducks, probably originated at the Falklands. It was used by Clayton (1776, 104), who describes the speedy flapping of these birds across the water. He writes also that when they are driven ashore they are capable of running very fast for a short distance, but that as soon as they tire they squat and allow themselves to be caught. Both Flightless and Flying Steamer Ducks were well known at the Falklands in early days, but the latter have assuredly become rare, while the native flightless ducks are still abundant and generally distributed. In consideration of the respective salt- and fresh-water proclivities of the two, Bennett has suggested the appropriate names Sea-logger and Lake-logger.

It would doubtless be acceptable and conventional procedure to regard the Falkland and continental Steamer Ducks as subspecies of a common species, rather than to grant each full specific rank. The reason why I have chosen a different course has, however, an excellent measure of justification. It has to do with the fact that the Falkland flightless bird has a particularly strong resemblance to the flying species. Except for the shortness of its wings, and its hypertrophied size, it shows, indeed, many signs of closer affinity with *patachonicus* than with *pteneres*. This fact, no doubt, accounts for a misconception of Phillips, who writes that in the Falklands certain males of the large gray type of steamer duck mate with small females of the red type. The field observations and collections of Beck and Brooks show that both adult females and immature males of *brachypterus* are superficial counterparts of some examples of *patachonicus*, but that the differences are, nevertheless, constant. Under such circumstances, I believe that the recognition of three species is the better conclusion in the present state of our knowledge. Beck's diary for October 22,

1915, contains the extraordinarily acute observation that the "steaming" Flightless Loggerheads of the Falklands regularly rise higher out of water, when running at full speed, than do the non-flying birds of the continent. Thus, functionally as well as in appearance, the Falkland flightless duck is somewhat intermediate between the two other species.

The members of the 'Challenger' party were much impressed by the tameness of the Falkland Loggerheads, in contrast with the extreme wildness of their relatives in the Strait of Magellan. As Thomson (1878, 179) points out, the former had been safe in their island solitude up to within a recent period, whereas the Magellanic ducks had been undergoing selection for ages upon the basis of their capacity for eluding hungry Indians. Even today, after much more than a century of human occupation, the Falkland Loggerheads are still notoriously tame, the Fuegian birds as wild as formerly but probably no more so. The lack of shyness of the Falkland ducks is therefore to be regarded as a genetic trait, like that of many species of the Galápagos Archipelago, and not as mainly related to the birds' individual experience.

Beck made the greater part of his collection of Falkland Flightless Loggerheads in the vicinity of Port Stanley, where nesting birds were common during October, 1915. On November 4 he saw a number of broods of five or six newly hatched downy young in Berkeley Sound. A half-grown duckling was collected on December 15, besides which I have had for comparison the three younger birds taken by Brooks at Port Stephens, West Falkland, also during December. On October 17 Beck discovered a nest with six fresh eggs in a sand-drifted hummock on the beach near Port Stanley, only a step or two from the water.

Cobb (1910, 66; 1934, 80) and Vallentin (1924, 322) have given us fairly comprehensive pictures of the Falkland Loggerhead, adding their own keen observations to the data recorded by earlier workers such as Abbott. In the absence of other marine ducks, the Logger has the ocean pretty much to itself, though it is often rather closely associated with cormorants, gulls, and grebes.

When they start scuttling or "steaming," according to Cobb, the ducks flap their wings simultaneously, changing to alternate strokes after they have got up speed. Vallentin also believes that they sometimes beat the water in this way, which agrees with the opinion of Darwin. Perhaps motion picture records made at close range will be the only way to decide this moot point.

Early in the austral spring, the male Loggerheads establish a claim to nesting territory by remaining close to the shores of their choice and entering into combat with all rivals. Vallentin says that pairs not infrequently invade the holdings of other pairs, the male leading. Both sexes then take part in the encounters, rushing forward, each duck trying to seize an opponent by the neck and to hold its head under water while beating with the hard callosities on the wings. The struggling birds spin round and round, making such a commotion in the water that the eye cannot follow their movements. If one succeeds in submerging the head of the other, the beating is redoubled and the water is frequently reddened by blood. A defeated bird makes its escape as best

it can, and the victor paddles off uttering growls of joy, while his mate expresses the same triumphant emotion by mewing like a cat.

Nesting commences in September or early October, although Cobb states that odd nests in use have been found throughout the year. The nest is usually close to the sea, but may be placed some distance back if there is no concealing growth of diddle-dee or other vegetation at the verge of the water. At times a mass of dry kelp just above high watermark, a clump of tussock, or an abandoned Jackass Penguin burrow may suffice as a hiding place. The nest itself is a scoop in the soil, well lined with down from the mother's breast. The eggs number anywhere from four to ten, or even eleven, though clutches of six, seven, or eight are the most common. Vallentin has found new-laid complete sets between October 12 and November 9. Only completely fresh eggs are palatable, and these are collected for eating in the Falklands, and are even pickled for winter use.

While the duck incubates, the drake patrols offshore, uttering his bullfrog note of alarm at the sight of an intruder. After incubation is under way, the duck will sit until your foot, or that of your horse, is at the point of stepping upon her, whereupon she will go off with a great fluster and hullabaloo.

As noted above, Beck saw the first ducklings on November 4, and Brooks (1917, 156) reports new broods up to December 26. They are, of course, able to dive well as soon as they hatch. At this time the parents lose their tameness and become very wary, leading the brood well offshore at the distant approach of a man. It is a pretty sight when a family is riding a choppy sea, the infants striving to keep close behind their parents. If the brood is taken so by surprise that there is no time for an orderly retreat, the female makes off with the ducklings while the old man valiantly stands rear guard. Big broods seldom last long, for the youngsters get picked off by skuas and gulls. Vallentin tells of a brood composed of seven in January which had diminished to a solitary fledgling by March.

When the ducklings are old enough to fend for themselves, the adults drive their own offspring out of the home territory, not hesitating to dive beneath them or "steam" toward them with apparent ferocity, and to strike with the spurred or knobbed wings. The fledglings thereupon congregate in flocks of hundreds, remaining in such formations, according to Cobb, throughout the winter and the following breeding season, and thus not nesting until they are at least two years old. Such packs move about without scattering, resting on beaches and flats, occasionally crossing to ponds close behind the beaches, but apparently doing all of their feeding in the sea. When one bird dives, they all go down, remaining beneath the surface for about 15 seconds, and then shooting up more or less simultaneously in the manner of our northern-hemisphere scoters. Both fledglings and adults are fond of dipping in shoal water along stony beaches. They make an unusual amount of noise when diving, writes Brooks, and on a quiet evening the splashes suggest the rising of trout in some northern "still-water."

Phillips states that the grunting or bullfrog call of the Loggerhead is usually

attributed to the female, although both Darwin and Vallentin credit it to the male. Brooks describes the regular note of the female Falkland Loggerhead as a hoarse, rasping, snoring sound which can be heard at a considerable distance. The ordinary note of the drake he calls thin and wheezy—*kée-u-kée-u-kée-u*—more like a sneeze than anything else.

Their food includes all manner of small marine animal life. A single stomach dissected contained limpets, small chitons, mussels, various gastropods and bivalves, shrimps, and two species of crabs, the carapace of the larger being two inches long by one inch wide which with its legs must have been a large object to swallow (Brooks, 1917, 156).

A female skinned by Cobb contained more than 450 mussel shells of various sizes; a drake, three crabs and a quantity of sand and bivalves. Beck recovered limpets, other mollusks, crustaceans, and "small bugs." Vallentin reports echinoderms (*Hemiaster*) and adds that the strong beaks of the Loggerheads can break almost any bivalve in the Falkland region.

The Loggerheads show evident fear of sea-lions at the Falklands, and sometimes make toward the land to escape from or avoid them (Vallentin). On the other hand, a creature ashore, such as a dog, may excite their curiosity enough to cause all the birds within eyeshot to swim toward it.

FLYING STEAMER DUCK

Tachyeres patachonicus

Micropterus patachonicus King, 1830, Proc. Zoöl. Soc. London, 15 (western part of the Strait of Magellan).

King's description is completely diagnostic. He states that the bird he is describing is grayish lead-color above, with the throat and scapulars rufescent, the abdomen and the speculum of the wing white, the bill greenish black with a black nail, and that it is of lesser size than "*Micropterus brachypterus*" by which he meant, of course, the mainland, rather than the Falkland, flightless species.

Names: Canvasback at the Falkland Islands. The synonyms of the specific name are those of the other two species.

Characters: Smaller than either of the preceding species, with wing and tail of greater absolute, as well as relative, length, a bill of different shape as well as lesser size, and a notably shorter and more slender tarsus.

Adult male: Similar in general plumage-pattern to the male of *pteneres* but with a stronger tendency toward rufescent scalation on the back, scapulars, and flanks. Iris brown; bill orange-yellow, with bluish areas around nostrils, paling to whitish toward the tip; unguis black; legs and feet yellow, the webs dark.

The oldest males, as indicated by maximum size and by bills which remain yellow even in dried skins, are also the least rufescent. They have clear gray heads, except for the white postocular stripe and the reddish throat patch. Younger males resemble females in the extension of reddish coloration to the sides of the head or even to the forehead and crown. The color of their bills also resembles that of females.

Adult female: Similar in color and pattern of plumage to the female of *brachypterus*. Bill yellowish on the culmen, blue along the cutting edge, the very small and narrow maxillary unguis being black. The dertrum, or nail of the mandible, has very little tumescence, and in dried skins is practically of the same color as the dark mandibular rami.

17 males from Chiloé Island, many localities in and about Tierra del Fuego, and the Falkland Islands: wing, 287–316 (300); tail, 92.4–123.4 (107.1); exposed culmen, 48.2–56.8 (52.4); width of maxilla, 25.1–28.9 (27.2); width of maxillary nail, 10.6–13 (11.7); tarsus, 55.4–69.3 (60.8); middle toe and claw, 90–95.2 (92) mm.

23 females from Chiloé, the Strait of Magellan, Tierra del Fuego and adjacent islets: wing, 276–301 (285); tail, 88.7–105.5 (98.9); exposed culmen, 50–59.3 (52.3); width of maxilla, 22–27.3 (25.4); width of maxillary nail, 9.8–12.3 (10.8); tarsus, 50.3–60.7 (56.4); middle toe and claw, 80–87 (84.1) mm.

Fledglings of this species have little more than half the bulk of the young of *pteneres* at the same stage of growth. Aside from size and the well-marked difference in bill formation, the two are practically alike, although *patachonicus* shows a faint rufescent wash on the feathers of wings, back, and flanks, such as is not detectable in the larger species. The pattern of gray on the head and of red on the throat is the same in the two.

The duckling of this species has been sufficiently described in the introductory section. Diagnostic characters show in the plumage-pattern, the structure of the bill, and in size, besides which Lowe has pointed out more deep-seated morphological distinctions.

Vallentin (1924, 322) states that the eggs of the Flying Steamer Duck are more regularly oval than those of the Falkland flightless bird, but this opinion is to be received with caution because some of the measurements he records obviously refer to eggs of *brachypterus* rather than of *patachonicus*. The latter bird is relatively rare in the Falkland Islands and, because of its superficial resemblance to the local flightless species, popular confusion concerning the two is even worse than in other parts of the steamer ducks' range.

From the Fuegian region, 29 positively identified eggs of *patachonicus* have average dimensions of 76.4 x 52; extremes measure 77 x 53 and 75 x 51 mm.

Distribution: Southern South America and the Falkland Islands. The continental range is apparently the same as that of *Tachyeres pteneres*, except that it includes also some of the lakes of eastern Patagonia and other inland bodies of fresh water, and extends eastward to coasts of extensive daily tidal fluctuation in Tierra del Fuego, and northward along Atlantic shores to about latitude 48° S.

Reynolds (in Lowe, 1934, 474) summarizes the behavior of the Flying Steamer Duck as follows:

Tachyeres patachonicus is capable of sustained and rapid if somewhat heavy flight. Not infrequently, especially in summer, it takes what appear to be joy-rides over land. Two, three, or four individuals leave the sea together, flying inland. They either describe a huge semicircle, returning to the beach, or they may go completely round and pass the observer a second time. At intervals during these flights, but for short periods only, they simultaneously check the rapid movement of the wings, and stoop downwards, pausing momentarily after each successive wing-beat. The effect is curious, and unparalleled by any other Fuegian Duck.

At times *T. patachonicus* may well be taken for a flightless bird, and some of the confusion in distinguishing between the two species is probably due to the unaccountable reluctance to rise so often demonstrated by this species. Commonly on the sea it may be shot at or otherwise alarmed, and, instead of flying, dives and then steams, or simply steams out of range. It steams in the same manner as the larger flightless bird, but its progress is more buoyant. It does not kick up so much spray, and its speed is, I should think, greater. In summer it is constantly seen on the wing on all sides; in winter it rises less often, but in places sleeps regularly on ice at some distance from the sea.

Mr. Beck first met the Flying Steamer Duck in the mouth of the river at Ancúd, Chiloé, on May 1, 1914. A pair came flying past his boat, and when he winged one the other bird circled back so that he was able to collect it also. On this and subsequent occasions he found the flying birds much easier to kill than the low-floating, flint-headed flightless ducks, which paid no more attention to No. 6 shot than to snowflakes, and which sometimes recovered and "steamed" out of sight after being knocked over with a charge of No. 3.

Near Cuellon, Chiloé, on May 19, Beck recognized one pair of Flying Steamer Ducks resting on the water among many flightless birds. They took wing as

his boat drew near, and he shot them both. The incident deserves mention because it indicates the distinctive appearance of the flying species. Since steamer ducks usually swim with their tails carried upright, the greater length of the rectrices gives the flying birds a much more long-tailed look than that of the flightless species. Furthermore, when Flying Steamer Ducks "steam," they often end by lifting themselves until their bellies and feet are just clear of the water, and then proceed at this level, with the tips of their wings barely touching the surface at every stroke. On the other hand, they are capable of getting well into the air within a space of 2 meters, even in a dead calm.

In early June, during a period of very rainy and windy weather, Beck devoted much time to the pursuit of Flying Steamer Ducks in the bay of Ancúd. On June 6 he encountered about a hundred ducks of both species, mostly in groups of from four to fifteen, on or near a spit which blocked an inlet. Some of them flew off at his approach. By working to windward of a pair, he shot the female, but the drake continued and subsequently pitched close to a couple of big Flightless Loggerheads. Beck gave chase to the three, and learned that the flying bird swam a trifle more slowly than the flightless pair. The former took wing, after it had fallen behind, and flew about 200 meters before settling again on the water. By continuing his tactics of keeping to windward, Beck collected on this day eleven Flying Steamer Ducks. They rarely dived at the approach of his craft, but preferred to take wing. Some of them flew heavily, not rising far above the water, while others mounted high into the air and passed quite out of sight.

On June 10, Beck saw many more of the Flying Steamer Ducks in pairs and small groups. After he had routed them several times by his efforts to collect specimens, some of the birds flew a distance of 5 kilometers, into the very head of the bay. Beck pursued the groups from the middle of the forenoon until 3.15 P.M., pulling as hard as he could row in his skiff, working alone, and allowing the dead ducks to float in clusters on the water in order to lighten the boat. He collected 18 flying birds, the males of which had an average weight of 3175 grams and the females of 2665 grams. He notes that of the birds to which he gave chase on this day, nearly all rose high into the air, not more than six "steaming" away from his boat. Aside from the characters of behavior, Beck noted that the black nail of the bill in the freshly killed flying ducks was much smaller than the nail of even fledgling examples of the flightless species. The tubercles on the wrist were paired in the flying as in the flightless species, but of considerably lesser size in the former.

Many of the Chiloé birds taken in June, particularly the females, showed distinct signs of the annual enlargement of their ova. The most richly colored of the males had bright orange-yellow bills, but the less mature males and all of the females showed more or less bluish in their bills. Furthermore, the bills of many old birds were somewhat carunculated at the base, this being a character sometimes alleged to be restricted to the flightless species.

Farther southward, toward the tip of the continent, Beck met with many

Flying Steamer Ducks on salt water during their breeding season. Reynolds writes of the species in Tierra del Fuego:

> In winter it is restricted to the coast, where in summer many breed; but others penetrate far inland, spreading wherever there is water from the sea to the mountains. Hantu Lake, 28 miles from the Atlantic, is a favourite nesting ground. I have seen plenty of pairs with ducklings there, and have two eggs in my collection taken from its shore (in Lowe, 1934, 475).

Beck found only a few of the Flying Steamer Ducks at Deceit Island, and elsewhere close to Cape Horn. Reynolds (1935, 85) has since reported that it is much rarer here than the flightless species, although he found a pair or two breeding on Grévy Island in December, 1932, and caught a female as she flew off the nest. At Ushuaia and in other parts of Beagle Channel, Beck found the flying species at least as common as the flightless during the latter half of July. This was in the middle of the austral winter, and many full-grown young were with the adults. Reynolds, too, says that the flying species is no less common than the other in Beagle Channel, while on the long northeastern coast of Tierra del Fuego, where the flightless species is not to be found at all, the flying bird is more abundant than elsewhere.

At Punta Delgada, on the Strait of Magellan, Beck shot a steamer duck in flight between a pond and the salt water on July 23, 1914. Aside from this and other adults collected in the Fuegian region, he obtained a male and a female young duckling, apparently of the same brood, and two females of another and older brood, at Stewart Island, on December 3, 1914. It is noteworthy that downy young of both the flying and the flightless species were collected at Stewart Island on the same date. Another downy youngster was collected at Isla Grande on December 4.

Fledglings of the flying species, no less than those of the flightless, acquire their wing quills very slowly, so that they have only barely sprouted primaries for a considerable period after the down has entirely disappeared. Three of the flying species in this stage were taken at Ushuaia on April 1. At the same period adults in the vicinity had lost most of their rectrices, while the remiges were in the midst of moult, old worn primaries standing in juxtaposition with fresh ones.

At the Falklands the Flying Steamer Duck, or "Canvasback" is now relatively rare, whatever its status may have been in the early days. Perhaps the statement by Bennett (1924, 280) that the flesh of the flying bird is excellent eating, while that of the Flightless Loggerhead is inedible, tells the story. At any rate, Beck observed very few of the flying species during his extensive Falkland field work, and collected only a single pair at Bleaker Island, December 12, 1915. Popular confusion regarding the steamer ducks is, as already noted, worse in the Falkland Islands than anywhere else, chiefly because of the close resemblance in plumage between the flying and the insular flightless species. The islanders know that some of the ducks can fly, but most of their other criteria of discrimination are worthless. Neither Beck nor Brooks (1917, 155) received any really helpful information from the friendly Falklanders on this point, and the literature shows that descriptions of the appearance and

habits of the "Canvasback" and the "Loggerhead" are a largely hopeless muddle. If Brooks had succeeded in collecting any flying birds, he would no doubt have solved the problem, for his comments on Blaauw's discussion are exceedingly shrewd. One might say, indeed, that the truth about these troublesome birds has been barely missed on a number of occasions.

The Flying Steamer Duck is equally at home in either fresh or salt water and, as Reynolds has recently pointed out, it is the only species inhabiting coasts characterized by great tidal changes. This explains why Blaauw (1916, 491) and others have found it the only common steamer duck in northern and eastern Tierra del Fuego. It has, furthermore, been collected a number of times along the Atlantic coast of Patagonia, on the Andean lakes of the pampas in Chubút. Abbot (1861, 162) describes nests far from the sea in the Falklands, and Reynolds (1934, 351) reports on others about Lake Yewin and similar bodies of fresh water in the interior of Tierra del Fuego.

The nesting season seems to be identical with that of the Flightless Steamer Duck. Oustalet (1891, 229) reports newly hatched young in Beagle Channel on November 13 and February 1, and states that Picton Island, at the eastern entrance of this waterway, is a favorite nesting ground. He also reports the species as common on Staten Island. The eggs often number seven, though eight or nine have also been reported. Several writers have alleged that eggs can be distinguished from those of the flightless duck by their shape. However, Reynolds states definitely in Lowe's account that the eggs of the flightless species are half again as heavy as those of the flying duck.

The food of the Flying Steamer Duck is in part similar to that of its two larger relatives, but seems to comprise a smaller proportion of thick-shelled mollusks, and more prawns, crabs, and other crustaceans.

THE CHARADRIIFORMES

This order includes three great divisions. The suborder Charadrii embraces all the snipe-like and plover-like birds; the suborder Lari is made up of the skuas, gulls, terns, and skimmers; the suborder Alcae, which belongs exclusively to the northern hemisphere, comprises the auks and their kin, all of which fall outside our field.

In the Charadriine division only three families, namely, the oyster-catchers, phalaropes, and sheath-bills, are covered by biographies in this book, but many related shore birds have been referred to under distributional discussion in Part I. South America, Africa, Australasia, and other southern continental regions, as well as equally peripheral districts in Polynesia, are rich in endemic species and genera of the Charadrii. It is likely that many of these are relics of stocks which originated long ago somewhere in the vast holarctic terrestrial centers, but which now survive only toward the extremities of the earth's radiating land areas. The zoögeographic conception is a tested one for other vertebrates, and is readily understandable if the continental relations are con-

sidered in north polar projection. The dominant groups of shore birds today, at any rate, are either holarctic or cosmopolitan, and many species among them make extremely long annual migrations between the northern and southern hemispheres, breeding only in the former. The phalaropes, together with numerous species of snipes and plovers, are examples of this kind. On the other hand, the oyster-catchers of the southern hemisphere have "moved in to stay" and are relatively sedentary, while the sheath-bills have progressed farther toward the Antarctic than any other shore birds and have, so to speak, burned their bridges behind them. They are, indeed, so remote in both systematic and geographic senses that their relationships are very dubious.

Among the endemic Limicoline types of southern South America are several forms which appear to be "structurally ancestral" to shore birds of a number of more widely distributed families. *Oreopholus*, a primitive plover-like bird of the Andean plateaus, is a good example. Most of its peculiar relatives in the same region are likewise inland and montane species rather than birds of the seacoast. They form a somewhat bizarre aggregation, either with no close kin elsewhere in the modern world or with relatives confined chiefly to areas toward the tips of other southern-hemisphere continents and insular extensions; they include the Painted Snipe (*Nycticryphes*), such monotypic genera as *Ptiloscelys*, *Zonibyx*, *Pluvianellus*, and *Phegornis*, and the strange seed-snipe (*Attagis* and *Thinocorus*).

An attempt to discuss the relationships of the shore birds as a whole would be out of place in this text. It is worth pointing out, however, that their morphology, biology, and distribution still offer a rich field for research, despite the enormous existing literature pertaining to the members of the suborder.

The Larine group of the Charadriiformes will be considered below.

THE OYSTER-CATCHERS

FAMILY HAEMATOPODIDAE

The oyster-catchers are a well-marked group of plover-like birds found on most tropical, temperate, and sub-polar seacoasts throughout the world. They are absent from Polynesia and from other remote oceanic islands. The northerly and southerly limits of the family breeding range are, respectively, Iceland and Cape Horn. Certain Old-World forms follow up the valleys of great river systems, and are found far inland. In plumage-pattern the birds are either particolor in large contrasting areas, or wholly dark. Formerly the black or brown oyster-catchers were specifically distinguished from the pied birds, but Stresemann (1927, 71) has shown that all but one of the solid-colored forms are mutational phases of white-breasted oyster-catchers, and are to be regarded as no more than geographic races of the latter.

Furthermore, the American white-breasted oyster-catchers were formerly held to belong to a different species (*palliatus*) from the palaearctic forms

FIG. 75. Wing-patterns of three subspecies of Oyster-catchers, to illustrate a character correlated with geographic distribution.

Left, *Haematopus ostralegus ostralegus*, ♀, Denmark; middle, *H. o. palliatus*, ♀, South Carolina; right, *H. o. pitanay*, ♀, Pisco, Peru.

(*ostralegus*). These two aggregations have, however, such close affinities in geographic, taxonomic, and doubtless genetic senses that Stresemann, Peters (1934, 231), and other authorities now unite them in a single species, the range of which is very nearly as extensive as that of the entire family. The resemblances between the Old- and New-World white-breasted oyster-catchers become particularly significant when plumage is considered in relation to age, for the American forms retain as adults essentially the juvenal phase of the Old-World bird.

I have shown (Murphy, 1925, 3) that the typical subspecies of Europe (*Haematopus ostralegus ostralegus*) is characterized by a pattern of white quill-markings which extends to the shaft of the outermost primary, and that the oyster-catchers inhabiting more distant regions, both in the Old World and in America, show progressively reduced quill blotches until, in the peripheral races of the Australian region and of the west coast of South America, the primary quills are entirely dark and without spots of any sort. In other words, if we place the richly marked European Oyster-catcher at the focus of a more or less concentric series, and proceed eastward and southeastward through and beyond the palaearctic region, or southwestward across both continents of America, we find running through the successive races of oyster-catchers a similar and progressive type of variation, which is correlated with geographic distribution.

In South America the family is represented by three species, namely, *ater*, *leucopodus*, and *ostralegus*. Of the last named there are four subspecies, three of which occupy more or less discontinuous stretches of continental coast, while the fourth is confined to the Galápagos Islands. Tendency toward the development of local races seems to bear a direct ratio to discontinuity of littoral distribution. Perhaps it would be more correct to say that the effect of isolation has

thus shown itself in the evolution of distinct races. At any rate, *Haematopus ostralegus*, with interrupted ranges on both the east and west coasts of North and South America, has divided into several subspecies. *Haematopus ater*, on the other hand, occupies an unbroken range around Cape Horn and along the southern Atlantic and Pacific coasts of South America, and specimens from even widely differing environments appear to be indistinguishable. *Haematopus leucopodus* also inhabits a continuous and relatively compact range, near the southern tip of South America, and seems to have undergone no geographic subdivision. The South American Black Oyster-catcher (*Haematopus ater*) is the most distinct and divergent member of the whole family. Its bill differs so much from that of other species that even a separate genus has been proposed for this bird. Its feet are also very large, but the group as a whole shows remarkable plasticity of foot structure, even within the limits of a single species.

AMERICAN OYSTER-CATCHER

Haematopus ostralegus palliatus

Hæmatopus palliatus Temminck, 1820, Man. d'Orn., edit. 2, 2, p. 532 (South America, subsequently restricted to Venezuela).

The typical form of this species is the oyster-catcher of western Europe, the original citation of which is:

Hæmatopus Ostralegus Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 152 (Öland Island, Sweden, from first reference in a range stated as Europe and America).

The American race is sufficiently distinct to be described without detailed reference to the typical race.

Names: Oyster-catcher, Clam-bird; "Ostrero" is the Spanish name; in northern Brazil the bird is called "Pirú-pirú," while along the southern Brazilian coast it is known as the "Batuira do Mar Grosso"; in some of the Spanish-speaking countries the names "Pilpilen" and "Tira-tira" are applied either to this oyster-catcher or to closely related subspecies. Synonyms of the specific or subspecific names include *brasiliensis*, *hypoleuca*, and *arcticus*.

Characters: Rump and lower back grayish brown or black, concolor with back, in which respect it differs from the white-rumped typical race of Europe; no white on the vanes and shafts of the outer two or three primaries.

Adults (sexes alike): Head, neck, and upper chest uniform black, with very faint gloss of bluish green; a white bar or streak immediately beneath lower eyelid; back, scapulars, rump, median-anterior upper tail coverts, and greater part of wings plain grayish brown or brownish gray (nearly hair-brown or deep drab); the sixth and seventh from the outermost primaries have distal or subterminal white areas, usually 25 mm. or more in length, on the shafts and webs of the feathers; these are sometimes extensive, wholly crossing the outer web of the feather, and more rarely the condition, in reduced guise, is observable on the fifth, fourth, or even the third quill; tips of middle wing coverts (broadly), whole of exposed portion of greater coverts, and proximal secondaries (next to tertials) immaculate white; distal secondaries deep brownish gray, their inner webs and basal portion of outer webs white, the outer webs edged with white distally; primary coverts and primaries dull black or dusky (fuscous black to dark chaetura drab); lateral and terminal upper tail coverts white, the latter sometimes (rarely) with a few dusky spots or blotches, the median anterior coverts sometimes margined with white; tail deep brownish gray, becoming darker (sometimes nearly black) distally, the lateral rectrices with basal half or more white; under parts of body, including lower chest, axillars, and under wing coverts, immaculate white, the under primary coverts sometimes more or less broadly tipped with brownish gray, and the carpo-metacarpal region with more or less of dusky spotting; bill (in life) vermilion-red,

deeper (tinged with carmine) in middle portion, the basal portion more orange-red, the tip yellowish; naked eyelids vermilion-red; iris bright yellow; legs and feet very pale flesh color or pinkish white (modified from Ridgway, 1919, 32).

12 males from Venezuela, Colombia, the Lesser Antilles, Panama, and the southeastern United States: wing, 237–259 (248.7); tail, 90–104 (97); exposed culmen, 74–89 (82.1); tarsus, 56–64 (59.5); middle toe and claw, 44–50 (46.7) mm.

8 females from Panama and the southeastern United States: wing, 235–271 (258.8); tail, 93–102 (99.3); exposed culmen, 76–94 (88.2); tarsus, 57–64 (61.4); middle toe and claw, 44–50 (47.5) mm.

Young birds are much like adults, but the bill is brownish, the iris brown, the feet dull livid grayish, the head and neck dusky, the pileum and cheeks speckled with dull fulvous, the feathers around the base of bill whitish; furthermore, the upper parts are grayish brown, each feather rather broadly margined with dull buffy or fulvous.

In the downy chick the head and neck are dull light brownish gray, finely mottled with a darker hue, and with a narrow post-ocular line of black; the remainder of the dorsal surface is light buffy gray, with dark mottlings, and relieved by two parallel stripes of black extending from the upper back to the rump; under parts white.

Eggs: Two or three, more often the latter, and very rarely four. They are ovate to elongate-ovate in shape and have only a slight gloss. The ground color is usually "cartridge-buff," sometimes "pale olive-buff," and rarely "deep olive-buff" or dull "chamois." They are irregularly and rather sparingly marked with spots and small blotches, occasionally with a few scrawls of black, brownish black, or very dark browns, "mummy brown" or "bister," and have underlying spots in various shades of "Quaker drab" or "mouse-gray." The measurements of 56 eggs average 55.7 x 38.7 mm.; the eggs showing the four extremes measure 62 x 38.9, 57.2 x 42.2, 51.8 x 39.9, and 52 x 33.5 mm. (Bent, 1929, 312).

Distribution: Atlantic, Gulf, and Caribbean coasts of North and South America from Virginia to Brazil or beyond; the West Indies (except the Bahama Islands which have an endemic race); the Pacific coast of America from the Isthmus of Tehuantepec to Colombia or northern Ecuador, apparently intergrading in the last-named region with a more southerly subspecies.

Although records of Oyster-catchers from the West Indies and the northerly coasts of South America seem to be somewhat rare or indefinite, I have found either specimens or well-attested citations from Cuba, Haiti, Porto Rico, the Virgin Islands, Guadeloupe, Aruba Island, Curaçao, the Caribbean beaches of Colombia and Venezuela, and from many localities along the shores of Brazil. Wetmore (1926, 144) states that on the morning of June 16, 1920, as his steamer came toward the wharf in the harbor of Rio de Janeiro, seven Oyster-catchers circled past. Burmeister (1856, 366) writes that the bird is rather common along the whole eastern coast of South America between the mouths of the Amazon and the Río de la Plata. This information gives no clue, however, as to the boundary between the ranges of the two Atlantic subspecies of South America, namely *palliatus* and *durnfordi*.

In North America the Atlantic range, which formerly extended northward to the estuary of the River St. Lawrence, has been greatly reduced since the settlement of the country. The Oyster-catcher is now rare north of Virginia. No doubt its numbers, if not its range, have been adversely affected in the southern continent as well, for it nowhere appears to have maintained the abundance of former times, and has become in many places a relatively scarce bird.

At the Isthmus of Panama, the range of the Atlantic race of the Oyster-catcher breaks through, so to speak, to the Pacific. Along this western coast it

then spreads northward as far as Mexico, and southward to an undetermined point in Colombia or northern Ecuador. Rendahl (1920, 24) found this subspecies common on the islands of Bayoneta and San Miguel, of the Pearl Island group, in the Gulf of Panama. He observed in one of his specimens a reduction of the white markings on the proximal primaries. This, in conjunction with related evidence, is significant as indicating an intergradation with the race occupying the arid coast between Point Santa Elena, Ecuador, and south-central Chile. A further note on the subject will be found in the account of the west coast form (*H. o. pitanay*).

In the absence of specimens, it is impossible to fix the identity of Oyster-catchers recorded from southern Brazil and Uruguay. Further collecting may prove, moreover, that the Oyster-catcher of the eastern United States is subspecifically separable from that of northeastern South America. The former, upon the basis of the series compared, averages very slightly larger, the white chin (not mentioned by Ridgway) is conspicuous only among North American examples, and the white markings on the shafts and outer webs of the primaries extend, on the average, farther toward the outer border of the wing. All of these differences, however, appear not to exceed the range of individual variation among birds from one locality. Examples from Venezuela and Colombia are essentially topotypes, and these agree well with others from Texas, the Pearl Islands, and the eastern seacoast of the United States.

While accepting Peters's (1934, 231) classification of the American white-breasted oyster-catchers as subspecies of the Old-World form, it is only fair to point out that the American races resemble one another more than they do the typical race of Europe. We may, therefore, speak of the several American subspecies as the "*palliatus*" group of the species.

The following résumé of the life history of the Atlantic White-breasted Oyster-catcher is based largely upon the report of Bent (1929, 309), and refers in the main to observations made in the southeastern United States.

The usual impression of this large and showy wader is a fleeting glimpse of a black and white bird disappearing in the distance over hot, shimmering sands. It is one of the shyest and wildest of our shore birds, seeming ever on the alert to escape danger. Even during the breeding season, when anxiety for its eggs or young prompts it to be less wary, it flies around the intruder in wide circles, well beyond gun range, yelling its loud notes of protest. It was evidently about as shy even in the days of Audubon and Wilson, for both mentioned its wariness.

White-breasted Oyster-catchers prefer broad sandy beaches to rocky or shingly coasts. They therefore commonly consort with various little plovers and other beach birds. The latter, however, are more or less protectively colored, while the Oyster-catcher is not only large but is most conspicuously garbed.

The nests are usually on the higher parts of sandy beaches, well above normal high watermark. The site is often on a slight mound, which gives the watchful birds a lookout. The nest itself is generally a mere hollow without lining, but in some instances it may be paved with a mosaic of shell fragments. Nests would be difficult to find but for the noisiness of the parent birds and the fact that

innumerable rather heavy, three-toed footprints are likely to point toward them from all directions. An incubating bird has been observed to carry off the eggs between its legs, and to deposit them one after another in a new site, while the original nest was under observation. Usually one pair of breeding birds seems to require and dominate a good-sized strip of territory, though occasionally nests have been found rather close together. The period of incubation for the European Oyster-catcher has been determined as from 21 to 24 days, and doubtless that of the American bird is not materially different. While both sexes cover the egg, the greater share is taken by the female. Very soon after the young hatch they are able to run so rapidly that it is difficult to catch them. At a note of warning from their watchful parents they "freeze," upon which their obliterative coloration makes them practically invisible.

During the non-breeding season Oyster-catchers are inclined to be gregarious, and often form flocks containing well toward a hundred individuals. Such bodies of birds like to fly back of the beaches to fresh-water ponds where they may drink and bathe, although they seem rarely to go far from the sea. Such birds appear perfectly aware of their conspicuousness, making no attempt at concealment but usually take the precaution to keep well out of gunshot. They pay no attention to decoys of any sort. They are excellent swimmers and can dive when necessary.

Forbush (1928, 48) reports watching Oyster-catchers disabling the small "coon" oysters with a single clip of the powerful bill. These mollusks are exposed at low tide along the bars of Florida, and the birds know how to open them as well as any professional oysterman. They feast upon the bivalves until their flesh veritably acquires the flavor of an oyster. They not only knock or pry shellfish off rocks and mangrove roots, but also probe deeply for them in the sand. Items of their food include many other kinds of bivalves and gastropods, such as clams, mussels and limpets, as well as marine worms, shrimps and other crustaceans, and many insects.

PERUVIAN OYSTER-CATCHER

Haematopus ostralegus pitanay

Haematopus palliatus pitanay Murphy, 1925, Amer. Mus. Novit. No. 194, p. 1 (Pisco Bay, Peru).

Names: The commonest Peruvian name is "Brujillo de Pecho Blanco," or "white-breasted wizard"; "Pitanay" is another vernacular name, of Indian origin; "Pilpilen" or "Pipilen," and "Tira-tira," are among the names used in Chile.

Characters: Differs from *H. o. palliatus* in its smaller size (smallest race of the American group in all dimensions except length of bill), and in the great reduction or, more frequently, the complete elimination, of white subterminal shaft-markings and of a pattern of clear white blotches on the inner primary quills. The flesh colors are like those of the preceding form and of the other American subspecies. Lane (1897, 303) particularly describes the bill of a Chilean example as "poppy-red at base, merging into carmine, which assumes a bright transparent yellowish hue at the tip."

A specimen taken at the Chincha Islands, Peru, weighed 794 grams (Coker, 1919, 496).

9 males from Ecuador, Peru, and Chile: wing, 232–250 (240.2); tail, 91–100 (95.5); exposed culmen, 72–83.5 (76.4); tarsus, 51–57 (53.9); middle toe and claw, 37–42 (40.5) mm.

6 females from Ecuador, Peru, and Chile: wing, 239–270 (247.6); tail, 91–103 (95.6); exposed culmen, 77–87 (82.3); tarsus, 54–60 (56.5); middle toe and claw, 39–44 (41.1) mm.

Distribution: Pacific coast of South America from western Ecuador southward to Chiloé Island, Chile.

Comparison of about a score of birds of this race with other oyster-catchers indicates that in most dimensions it is the smallest of the American or "*palliatus*" group.

Chilean and Peruvian specimens show no trace of white upon the shafts and webs of the primaries. Among four birds from the neighborhood of the Gulf of Guayaquil, Ecuador, however, two have a mottled whitish patch on the outer web of the seventh primary, unaccompanied by white shaft-markings. Such examples are, to this extent, intermediate between *pitanay* and *palliatus*. It thus appears that evidence of intergradation turns up along the humid Pacific coast of northern South America, between the Pearl Islands (*cf.* note on p. 977) and the beginning of the desert shore.

The northern limit of the range of this subspecies, as represented by typical examples, is doubtless in western Ecuador, where the arid coast begins to be interrupted by patches of rain forest. I have collected specimens at Point Santa Elena in February, and others have been taken or observed during American Museum Expeditions at Puná, Tembleque, and Jambelí Islands, in the Gulf of Guayaquil, during July (Chapman, 1926, 190). From this region the range of the subspecies extends southward to, and slightly beyond, the other end of the rainless zone, in Chile. This Oyster-catcher is therefore one of a number of endemic birds which make up part of the distinctive shore fauna of the Humboldt Current zone. In view of the extreme aridity characterizing nine-tenths of its range, it is interesting to note that *pitanay* is not a "pale" race, but that, on the contrary, the brown of its dorsal surface is definitely, though only slightly, darker than that of the Atlantic-Caribbean-Isthmian subspecies *palliatus*.

Chilean records of this Oyster-catcher are now numerous enough to indicate the extreme southerly border of the range. It occurs along the beaches of Arauco (Lane, 1897, 303), and Mr. D. S. Bullock has recently sent the Museum an adult female taken at Mocha Island on December 8, 1932. His manuscript notes state that these birds are common all around the shores of the island, breeding during November and December, but that in winter they migrate northward. Sclater and Salvin (1870, 499) have long since recorded this Oyster-catcher from Chiloé, and Hellmayr (1932, 382) finds that specimens from that island are typical of the subspecies *pitanay*. Here, at the southern limit of the range, it was found by an expedition of the Field Museum of Natural History, nesting during December and January with two other species of oyster-catchers, *H. ater* and *H. leucopodus*.

Throughout what may perhaps be called the optimum portion of the range of the subspecies, that is, along the desert coast of Peru and northern Chile, observations of this Oyster-catcher are too numerous to cite. Among the localities represented by specimens are Lobos de Tierra Island, Ancón, Asia Island,

Pisco Bay (mainland and islands), San Gallán Island, San Juan Bay, Independencia Bay, Tarapacá, etc. Along such coasts the White-breasted Oystercatcher is a bird of broad sandy beaches. It leaves the rocky stretches mostly to its congener the Black Oyster-catcher (*Haematopus ater*), so that the habitats of the two species alternate instead of coincide. The sheltered, southerly or windward ends of a number of bays in Peru, such as the great cove of Paracas in Pisco Bay, and the mainland shores of Independencia Bay, are lined with long reaches of beautiful flat strand, and here the "Pitanayes" feed with flocks of plovers, sandpipers, curlews, and Gray Gulls (*Larus modestus*), greedily devouring the sand crustaceans which the Peruvians call "mui-muis" (*Emerita*), and occasionally making loud, delirious music as they circle over the water to alight farther up the beach.

Because of their preference for such smooth beaches, these Oyster-catchers are more characteristic of the mainland than of the guano islands. Only a few of the latter have strands more than a stone's throw in length, and the "Brujillo Negro," rather than the white-breasted species, is the common insular form. On the rocky coast of San Gallán Island I recorded one Pitanay on November 26, 1919, but it was evidently only a transient for it was not seen again, while the black birds were numerous and breeding.

Coker (1919, 195) writes as follows of this bird, which he frequently encountered during his field work along the coast of Peru:

> With its distinctive cry and striking color markings, the white-breast brujillo is unmistakable, whether in the air or on the land. In flight the conspicuous white band on the upper surface of the wing, the white breast, the almost black head, and bright red bill directed downward and continually opening and closing, make this bird as conspicuous as does its shrill excited cry. While on the ground they usually make a single isolated call, but when flying high-pitched cries are uttered almost incessantly. On one occasion, in the little Bay of Chilca, about a dozen of these birds in a group on the shore, becoming excited from some cause, fairly filled the small amphitheater with their shrill voices. This was an unusual aggregation, for I rarely observed them except in pairs, whether at rest or in flight.

The nest and eggs of this Oyster-catcher have apparently not been described. Germain (1860, 314) says merely that in central Chile it lays two or three eggs near the sea during October or November. Bullock, however, has recently found nests on Mocha Island, and has sent a photograph to the American Museum, along with the skin of an adult bird. The nests were among sparse vegetation just above high tide line. Sets of two fresh eggs were taken on November 28 and December 2, 1932. A female bird examined by Coker at the Chincha Islands, Peru, in June, had only very minute eggs in the ovary. In another, taken in late August, the ova were three to four millimeters in diameter. It seems probable that throughout the range this Oyster-catcher breeds only during the southern-hemisphere spring.

The stomachs of two of my own specimens collected along the central part of the Peruvian coast contained animal matter and gravel. The former included in one instance 97 per cent of ground-up marine worms (Polychaeta), 2 per cent of bits of a bivalve (*Thais* or *Concholepas*), and 1 per cent of barnacles (*Balanus laevis*). The other stomach contained practically 100 per cent of triturated hippas

(*Emerita analoga*) and traces of a crab (*Plagiusa chabrus*). The determinations were made at the United States Biological Survey. Coker found small pebbles, bits of crustaceans, opercula and shell fragments of gastropods, and mussel shells in the Peruvian birds he examined.

GALÁPAGOS OYSTER-CATCHER

Haematopus ostralegus galapagensis

Haematopus galapagensis Ridgway, 1886, Auk, 3, p. 331 (Chatham Island, Galápagos).

Names: The Galápagos race has been listed in the earlier literature under the specific name *palliatus*.

Characters: Differs from the two preceding races in having a darker coloration dorsally, heavier mottling on the breast along the junction of black and white plumage, and notably large feet.

2 males: wing, 250–254 (252); tail, 96–104 (100); exposed culmen, 80–86.5 (83.2); tarsus, 54–55 (54.5); middle toe and claw, 49 mm.

4 females: wing, 250–256 (252); tail, 91–96 (92.7); exposed culmen, 80–88 (84.2); tarsus, 53–57 (55.2); middle toe and claw, 48–51 (49.5) mm.

Distribution: The greater part of the Galápagos Archipelago, though not reported thus far from the outlying northern islands, Culpepper and Wenman (Swarth, 1931, 57).

In this race we find the maximum of pigment saturation within the "*palliatus*" group, combined with total lack of a white pattern on the primary quills, and extraordinarily long toes. The heavy mottling of the breast is also characteristic of the Lower Californian subspecies (*frazari*) and the Patagonian subspecies (*durnfordi*), but not, as a rule, of the subspecies *palliatus* and *pitanay*. However, this feature is evidently carried by a gene common to the American white-breasted group as a whole, because it crops out sporadically among Oyster-catchers from the eastern United States and elsewhere. Gifford (1926, 49) states that among young Galápagos birds this line of demarcation is sharp, while in adults it is highly irregular.

The Galápagos form is apparently closest to that of Lower California. Swarth (1931, 58) writes that this resemblance is

> . . . of note, considering how meager are the indications in the Galápagos avifauna of affinities toward the west coast of North America. Murphy (1925, pp. 6, 11) points out that the Atlantic form of the Oystercatcher (*palliatus*) crosses to the Pacific side in the Panama region, as indicated by the white-marked primaries of birds from that section, and considering the strong West Indian complexion borne by the aquatic avifauna of the Galápagos it might well have been predicted that the Oystercatcher, too, would be of the Atlantic strain. The fact remains that in the Galápagos birds the primaries bear no white marks along the quills, and that they are closely similar to the Lower California form.

Snodgrass and Heller (1904, 262) found the Oyster-catchers nearly everywhere along the shores of the Galápagos, though nowhere abundant. On the western side of South Seymour Island the birds seemed to concentrate at times in pools just back of the shore. They were always tame, a fact confirmed by Beebe (1924, 109), who states that the Oyster-catchers not only cackled with anticipation whenever the seine was drawn at Indefatigable Island, but would also run between the legs of a motion picture camera tripod while the photog-

rapher was grinding. Their tameness resembled that of other native Galápagos birds, but set them sharply apart from the reactions of such migrants as turnstones, with which the Oyster-catchers associated.

The nest and eggs of the Galápagos Oyster-catcher seem never to have been described. The not quite conclusive notes of Rothschild and Hartert (1902, 412) indicate that the very dark pigmentation of this race is shared by the downy young. Older chicks appear to resemble similar stages in the other American races (Gifford, 1926, 48). Gifford also presents evidence that the adults moult their flight feathers twice a year. His notes suggest that the breeding season of this form probably comes, like that of Peruvian and Chilean Oyster-catchers, between September and January. This, however, will require confirmation.

The fullest account of the Galápagos Oyster-catcher is that of Gifford, by whom the race was observed in 1905–1906, during the expedition of the California Academy of Sciences. He writes that the birds were evenly distributed on twelve or more islands which he names, but rarely were more than three or four individuals seen at one time.

> Singly or in pairs, we met with them along the rocky coasts, where they did most of their feeding. Occasionally they were seen on the sandy beaches, which are quite extensive on the larger islands. As a rule they were very fearless, and several were killed with stones.
>
> In traveling over the smooth beaches this species either walks or runs, being able in the latter case to travel quite rapidly. One day on South Seymour two kept just ahead of us for about one hundred yards along a beach, running slowly all the time. When anchoring at James Bay, James Island, on August 6, three flew by the vessel, and later we met them on the beach. They alighted a hundred yards or so above us, and then started on the run in our direction. They acted as though they were racing, keeping abreast most of the time, and maintaining a steady pace. When among the rocks, these birds do considerable jumping from one rock to another, often using their wings to aid them.
>
> Their flight is nothing like that of a snipe for swiftness and gracefulness, nor is it as erratic as the Hudsonian Curlew's. Usually, when over the water, the birds fly at a height of ten or twenty feet, while along the shores they keep lower down. Their wing-beats are more rapid than a gull's.
>
> On two occasions this species was observed swimming, but not through choice. In one case a wounded one took to the water, and, upon being approached with the boat, dived three or four times. . . .
>
> Aside from one instance, these oyster-catchers are always noted feeding on the rocks from which they pick their food. The food consists of small chitons, small crabs, sea-slugs, and key-hole limpets, which are chiefly obtainable at low tide. These creatures are all swallowed whole.
>
> Many times the presence of this species is made known, not by the eye, but by the ear. As a rule they call when disturbed, and when flying from place to place. The call is loud and piercing, and consists of a series of piping notes given in quick succession, and slightly resembles the call of the Wandering Tattler. Single short staccato notes are also uttered when a bird is approached.
>
> Three specimens, which showed signs of breeding, were taken on Gardner-near-Hood on September 28, 1905. Sexual organs of birds taken at Sappho Cove, Chatham, February 14, and at Academy Bay, Indefatigable Island, July 16, were small. A female with medium-sized ovaries was taken on Narborough on March 22.
>
> On February 1, two young ones scarcely able to fly were taken on southeast Hood. They were feeding in company with two adult birds, presumably their parents. On March 22 a young one of about the same age was taken on Narborough. Another was taken on South Seymour on July 26, and still another on northeast James on August 4.
>
> While I was approaching a wounded one on northwest Indefatigable, one of several Galápagos

Hawks roosting in the vicinity made a sudden swoop at it. Uttering a shrill cry, the oyster-catcher sought safety by jumping into the water close beside a sheltering rock. It is doubtful whether the oyster-catchers are harassed by the hawks under normal conditions.

Like the Wandering Tattler, but not to such a great extent, this species has the habit of bobbing the posterior portion of the body up and down.

One bird taken had the outer covering of the upper mandible loose and apparently ready to shed, for it was very easily detached, leaving a new, hard, and darker-colored bill beneath. Another specimen was minus the greater part of its tongue, having only about one quarter of an inch of it left.

PATAGONIAN OYSTER-CATCHER

Haematopus ostralegus durnfordi

Hæmatopus durnfordi Sharpe, 1896, Cat. Birds Brit. Mus., 24, p. 107 (in key), p. 117, pl. 6 (Tombo Point, latitude 44° 06′ S., coast of Patagonia).

Names: In Argentina, "Teru de la Costa," to distinguish it from the inland "Teru," or lapwing. Early references to this Oyster-catcher are listed under the specific name *palliatus*.

Characters: Very unsatisfactorily known. Specimens have white-marked primaries, similar to those of *H. o. palliatus* taken on the Atlantic coast of tropical South America. In the heavily mottled line of demarcation between black and white plumage on the breast, however, this race differs from *palliatus*, and bears a close resemblance to *H. o. galapagensis*. The general superficial likeness of Patagonian to Galápagos birds is, in fact, strongly marked, although the former lack the hypertrophied feet of the latter. Murphy (1925, 7) has shown that many of the characters ascribed to the type of *durnfordi*, or to examples subsequently studied, are untenable, and that the subspecies stands in need of adequate characterization.

An adult female shot in the province of Buenos Aires on November 3, during the courtship season, had the center of the bill between scarlet and jasper-red, shading at the base to a color between bittersweet-orange and flame-scarlet, and at the extreme tip to antimony-yellow; bare eyelids slightly darker than orange-chrome; iris cadmium-yellow; tarsus and toes cartridge-buff; nails buff (Wetmore, 1926, 145).

3 males: wing, 244–253 (247.3); tail, 92–100 (97); exposed culmen, 71–79 (76); tarsus, 52–56 (53.7); middle toe and claw, 42–44 (43) mm.

3 females: wing, 245–255 (250); tail, 94–100 (97.3); exposed culmen, 76–90 (82.3); tarsus, 54–58 (56); middle toe and claw, 42–44 (43) mm.

Of the eggs, Gibson (1920, 61) writes that they are very handsome, and if from their protective coloration not particularly distinguishable *in situ*, show up prominently in a cabinet. The ground color is either of a pale yellow or warm buff, marked with purplish spots and large, bold, dark brown or black blotches with some streaks of the same; below the surface there are occasionally a few smaller pale mauve spots and markings. They are of an oval-pointed shape, and average 55 x 37 mm.

Distribution: Atlantic coast of southern South America, from Uruguay or southern Brazil (?) southward at least to the Province of Chubút, Argentina.

The type of this Oyster-catcher came from Tombo Point, Patagonia, but the collector, Durnford (1878, 403), states that it is also a common bird about the mouth of the Río Chubút, a little to northward of the type locality. From this part of the Patagonian coast I have seen no specimens, but six birds from more northerly Argentina, namely from Lavalle and Cape San Antonio in the Province of Buenos Aires, represent a subspecies of Oyster-catcher distinct from that of the northern Atlantic coast of South America. Since the outstanding characteristic of these specimens is a general superficial resemblance to birds of the Galápagos race, a matter stressed by Sharpe (1896, 117), they probably represent the form which occupies the Atlantic coast from some unknown point in

Uruguay or southern Brazil southward to the limit in range of the species *ostralegus*, which is perhaps in the neighborhood of the Gulf of San Jorge, Patagonia. Although this southerly extremity has not yet been determined, it lies, no doubt, well to northward of the Magellanic humid zone, in which *H. leucopodus* replaces the nearly cosmopolitan white-breasted species, *ostralegus*.

If the assumed range is correct, *H. o. durnfordi* is the subspecies of Oyster-catcher collected by Darwin on the shores of the Río de la Plata (Gould, 1841, 128), and since then reported upon by Gibson (1920, 60), Wetmore (1926, 144), and others.

Gibson writes that this Oyster-catcher is the principal resident of the lonely Atlantic seacoast to southward of Cape San Antonio. It is scarcely less at home in the salt lagoons of the Rincones, which lie to westward of the Cape, *i. e.* on the Río de la Plata side, and also among the "cangrejales" of the same region. During flood seasons, such as occurred here between 1913 and 1915, with large areas running to fresh water, the Oyster-catchers totally abandoned the whole shore of the Plata estuary, and betook themselves to the outer seacoast.

These birds, continues Gibson, are always found in pairs. They are not particularly shy, and their loud, clear notes are frequently heard while they are on the wing. They are relatively late breeders among resident beach birds along the outer coast of Buenos Aires, the usual season being between early December and the middle of January, although Gibson once took a young chick as early as December 8. The nest is a mere scrape among shells and jetsam, usually some distance above high watermark, and often on a slight rise of ground from where the sitting bird can dominate all parts of the outlook except the sand dunes behind. For such reasons the nests are most readily found when an observer approaches from an inland direction. The eggs never exceed two in number, and Gibson has found single well-incubated eggs, or single chicks in a family, to be not uncommon.

Wetmore (1926, 144) extends Gibson's observations by the following interesting notes made between eastern Argentina and the Uruguayan shore of the Río de la Plata. He first encountered the birds on mudbanks at the mouth of the Río Ajo, below Lavalle, on October 25, and early in the next month found them fairly common on the broad strand southward of Cape San Antonio.

> Here oyster catchers in pairs fed in the shallow sweep of the surf, often where waves of more momentum than usual came nearly to their bodies. The birds walked slowly, with necks drawn in and heads inclined forward, seldom extending the neck to full length unless on the wing. Their flight was swift and direct, usually only a few feet above the sand, but not infrequently, to avoid me, in a semicircle that carried them over the dunes or out over the sea.
>
> They were difficult to kill at any great distance because of their dense plumage and heavily muscled bodies. A female and two males were shot on November 3, and a second female on the day that followed. The nesting season was about at hand, and it is probable that some had eggs at that season, as females shot were nearly ready to lay. One male in mating ardor pursued a female in swift flight that carried them turning and dodging over the dunes along the beach until the birds were lost to sight. On November 15, at the mouth of the Rio Ajo again, where several oyster catchers were seen, one pair had a nest somewhere on a small strip of sandy beach. I hid behind a clump of grass and watched from a distance, but though the birds returned in a short time, I failed to locate either eggs or young.

At Ingeniero White, on December 13, an oyster catcher was eating small crabs that it pursued quickly across the mud or secured by pulling them out of holes sunk in the clay. Four oyster catchers were recorded on the coast near Montevideo, Uruguay, on January 16, 1921, and several noted on the sandy beach at La Paloma, Rocha, on January 23, may have had young, as they circled past me with shrill whistles.

FUEGIAN OYSTER-CATCHER

Haematopus leucopodus

Hæmatopus leucopodus Garnot, 1826, Ann. Sci. Nat., 7, p. 47 (Falkland Islands).

Names: Pied Oyster-catcher; Black and White Curlew, in the Falkland Islands; "Ostrero Overo" is one of the Spanish names, distinguishing the species from the "Ostrero Negro" or Black Oyster-catcher. Synonyms of the specific name include *leucopus, luctuosus, arcticus,* and *bicolor.*

Characters: A slender-billed, black and white oyster-catcher, the back and scapulars being deep blue-black like the head and neck, instead of brown; breast uniform blue-black; feet extremely small.

Adults (sexes alike): Head, neck, mantle, lower back, and rump glossy black, except for a small crescentic white spot below the eye; breast black like the neck, with a sharp line of demarcation where it meets the white plumage of the ventral surface of the body; primary quills black with no white along the shafts or webs; secondaries, except two or three of the innermost, white, their coverts black with broad white terminations; remainder of upper wing coverts glossy black; under wing coverts black, the axillaries white; rectrices terminally glossy black, their basal halves white, the shafts agreeing in color in each area; upper and under tail coverts white. Iris brilliant yellow—Fuegian examples, carefully examined in the flesh, all had a black spot, in the form of a crescent moon, in the yellow iris beneath the pupil (Reynolds, 1934, 352); eyelid yellow; bill red, scarlet, or orange-red (blackish for the distal two-thirds of its length in young birds); feet white or faintly rosy (flesh colored or grayish in younger birds). The iris is brown in chicks, changing to yellowish and then to clear yellow as the birds mature.

19 males: wing, 237–259 (251.9); tail, 94–108 (101.6); exposed culmen, 68–76 (73.2); tarsus, 46.5–49 (47.5); middle toe and claw, 37.5–40 (39.1) mm.

11 females: wing, 244–260 (251.5); tail, 93–106 (98.8); exposed culmen, 72–85 (79); tarsus, 43–51 (48.3); middle toe with claw, 37–41 (39.1) mm.

Chicks have a plover- and tern-like plumage above, but the pattern of white under parts is like that of old birds. From the down they moult into a plumage which differs from that of the adults in that the dark parts are brownish black instead of a rich green-black or blue-black. In fresh juvenal plumage, moreover, the dark feathers of the upper surface have rufous edgings, and those of the breast faint white edgings.

Judging from a juvenal taken at Río Gallegos, August 27, 1915, the first plumage is worn through the first year, new feathers being acquired just before the breeding season.

Two sets of eggs taken by Beck in East Falkland are in clutches of one and two, respectively. They represent both typical ovate and elongate-ovate forms, have much darker ground color than those of the Black Oyster-catcher of the same region (*Haematopus ater*), and the markings are chiefly made up of larger surface and sub-surface spots, with more of a tendency toward concentration about the large end. The ground color is of an olive-gray hue, the surface blotches dark brown. The single egg constituting one set measures 62 x 39.7 mm., the two of the other set 58 x 41.3 and 58.3 x 41.1 mm. Descriptions by Vallentin (1924, 308) and others agree, except that some examples of eggs are said to be evenly marked with brown or blackish spots and blotches over their entire surface. A series of 19 recorded by Vallentin measured 59–63 mm. in length by 42–43 mm. in breadth.

Distribution: Chiefly the Magellanic humid zone, but somewhat farther northward along the Patagonian coast; from the Río Chubút, Argentina, southward to the Falklands, Tierra del Fuego and Staten Island, and northward along the Pacific coast to Chiloé Island, Chile.

At the Falkland Islands, the type locality of this handsome Oyster-catcher, it is known as the Black and White Curlew. As a matter of fact, its long-drawn wailing cry, which sometimes sounds extremely melancholy as it rings across

the moorlands, very much resembles that of the true Curlew in the British Isles. It is shrill and ear-piercing at close range, but plaintive and silvery when heard at a distance. This call is quite different from the steely, rapid-fire note of alarm often uttered. The latter is entirely "oyster-catcher-like" and when seventy or eighty of the birds are flushed while feeding together, they can make an amazing amount of noise.

Cobb (1910, 71; 1933, 26), from whose accounts most of the foregoing is drawn, has given the best life-history notes on this Oyster-catcher at the Falklands. His description of the smart and dainty bird, with its coral-red bill, pale flesh-colored legs and feet, and striking plumage-pattern, running along screaming incessantly, its bill almost touching the ground and its tail erected vertically so as to show the white fan beneath, is a vivid one. Crawshay (1907, 123) also speaks of its pugnacity. As one rides or walks in Tierra del Fuego, he says, the Pied Oyster-catchers are forever flying forth, making one raise one's hand in defense against the formidable-looking scarlet bill. After tilting in this fashion they circle around, skim the grass, and come at one again. On the ground they often assume a curious posture, with the back to the wind, the neck stretched out, and the tail blown over the head.

In moments of composure the Fuegian Oyster-catcher may rest upon one leg, with the bill turned back under the wing coverts but with one golden eye kept open for the slightest movement of a watcher, which will send it off again and bring forth a new tirade. The birds spend much time preening and invariably look well-groomed. When they are angry they point their wings straight upward and hold them there in the proud manner of skuas. During their breeding season their wideawakeness is redoubled. They then seem, says Cobb,

> . . . to be everlastingly on edge and as ready to resent intrusion from Sea Hens, hawks, or gulls as from human beings. By all their noisy agitation, however, they frequently show where the eggs are, whereas silent behaviour on their part would probably leave them unnoticed, as the blotched, protective colourings on these eggs often harmonise with their surroundings. As it is, they play a regular game like a children's game of "hot and cold"; the nearer one gets to their eggs, the more noise they make, and vice versa.

The range of this Oyster-catcher evidently begins on the Patagonian coast close to the point at which that of *Haematopus ostralegus durnfordi* ends. Doubtless the two species overlap slightly, as they do also at the northern limit of the range of *leucopodus* on the west coast of South America, *viz.* at Chiloé Island. From these districts on the Atlantic and Pacific coasts, respectively, the Pied Oyster-catcher occurs southward to Cape Horn, including within its range all the complicated waterways of the Magellanic region. Throughout Tierra del Fuego it is, in fact, a much more common bird than the Black Oyster-catcher, and is likewise less confined in its local distribution to the edge of salt water. It is to be found scarcely less in the inland lagoons and upon extensive grass flats, meadows, and semi-desert stretches. Scott and Sharpe (1910, 270) report examples from Lake Blanco in the province of Chubút. In such respects it seems to bear a closer relation in habit to the European Oyster-catcher than do any of the American members of the species *ostralegus*.

References indicating the wide distribution of this Oyster-catcher are very numerous, and they tend to show that migratory movements are slight and indefinite, and that the species holds its ground even during the winter at the southern extremity of its range. Crawshay (1907, 123) tells us that in Tierra del Fuego the only notable difference in seasonal distribution is that the birds tend to cling to the seacoast in winter, while in spring and summer, when their piping calls are the bird notes that usher in the dawn, they disperse over large areas of snow-free land. After the end of the breeding season, they once more assemble in flocks and become beach combers.

Oustalet (1891, 121), Salvadori (1906, 25), Paessler (1909, 103), and Murphy (1925, 11) record the Fuegian Oyster-catcher from a large number of localities in Staten Island, Tierra del Fuego, and among the islets to southward and westward, at all seasons of the year. Reynolds (1934, 352) not only describes the recent nesting of a pair at the Isla de los Conejos, in Beagle Channel, but tells also of seeing a bird of the species flying across the mountains of Tierra del Fuego, between Bahía Moat and the Atlantic coast. He noted this errant individual by chance, when a gunshot among the hills north of the eastern end of Beagle Channel was answered by the loud cry of an "Ostrero" from the air between cloud-enveloped peaks.

On the Brewster-Sanford Expedition Mr. Beck saw much of the Fuegian Oyster-catcher during his long wanderings in southern South America. He collected specimens at various localities in the Falklands, at the mouth of the Río Gallegos in Patagonia, in the Strait of Magellan and Beagle Channel, at Cape Horn, False Cape Horn, Grande, London, O'Brien, Navarino, Bertrand, Timbales, and Caroline Islands. All of his specimens, and every other I have examined, represent a single race which exhibits much individual variation as regards dimensions. Thus two adult breeding females taken on the same day at Timbales Island, Chile, have bills measuring 72 and 83.5 millimeters, respectively. This is greater than any observable variation which might be attributed to geographical grounds. A female from Caroline Island has a bill 85 millimeters in length, the longest found in either sex. Ridgway's (1919, 29) key character, "depth of bill less than 10 mm.," proves not to hold, although the species has, indeed, a strikingly slender bill. Furthermore, it is characterized by remarkably short, stubby toes and broad nails. In these respects it differs from the black species, and somewhat less than the "*palliatus*" group. It has a particularly wide flange on all three claws. Except for the absence of the hind toe, the feet closely resemble those of sheath-bills.

Beck's journal abounds in scattered references to this Oyster-catcher. During July, or midwinter, of 1914, he observed that flocks of hundreds were accustomed to fly in early morning across the Strait of Magellan from near Magallanes, in order to feed on the flats of Tierra del Fuego throughout the day. Toward dusk they would all return to rest for the night on the gravelly beach of Punta Arenas. At Río Gallegos, during the latter part of May, 1915, he observed large numbers every day, during the hours of receding tide, working across the extensive mud flats to feed upon the small clams and mussels which were abundant in certain

patches. This custom evidently increases with the advance of southern-hemisphere winter, for on August 19 of the same year Beck followed across the flats of Río Gallegos a flock of Pied Oyster-catchers which he estimated to number not less than four thousand. When the flood rushes in, such birds rest and nap in full-bellied contentment.

According to Cobb (1933, 26), the Fuegian Oyster-catcher begins to nest earlier in the year than the Black Oyster-catcher, mating in the Falklands during September and sometimes laying eggs before the end of that month. This is confirmed by Beck's capture of downy young at the Falklands early in November. On the other hand, Vallentin (1924, 308) states that eggs are commonest during the first part of November, and Beck found on East Island two nests with eggs as late as December 10, 1915. In these instances, the nests were only a few steps from those of Kelp Gulls. Nearer the southern tip of South America, namely at Isla Grande, Beck collected in December females which had obviously not yet laid their eggs. The nesting season is perhaps a relatively long one, without close synchronization among the population as a whole, or it may be that accidents to an early set of eggs account for some of the later breeding records.

The nests and eggs of the Fuegian Oyster-catcher have been described by many observers. McCormick (1884, 328) refers to a nest with two eggs on the banks of an arm of Berkeley Sound, Falkland Islands, which he found on November 22. This was on dry seaweed just above high watermark, but one would infer from the author's remarks that this species commonly nests farther back from the open beaches than does the Black Oyster-catcher. Crawshay (1907, 124) states that this is true for at least some of the birds in Tierra del Fuego, where they breed commonly on open grass flats. Several times he found nests on slightly raised hillocks which cover much of the lower terrain in that region.

Cobb states that in the Falklands the eggs are sometimes laid among beach pebbles without any attempt at nest-making, while again nests lined with dry grass are found in the tussock bogs. Once in a while, he goes on, a site may be chosen well inland, among low thickets of the diddle-dee or native heath. Doubtless the commonest types of nests are on the beach, not far above high watermark, but among dry seaweed so speckled with lichens as to show that the water is unlikely to reach it.

Observations upon the young and their care are scarce. As among other species of oyster-catchers, however, the chicks begin to move about while they are still small; but they are quick to "freeze" at the sharp signal from the parent birds, and do not stir again until they receive the announcement of "all clear."

BLACK OYSTER-CATCHER

Haematopus ater

Hæmatopus ater Vieillot and Oudart, 1825, Galerie Oiseaux, 2, p. 88, 1, pl. 230 (Strait of Magellan).

Names: Black Curlew at the Falkland Islands; "Ostrero Negro" is the Spanish book-name; in Peru the vernacular name is "Brujillo Negro." Among specific names, the following four appear in the literature relating to this species: ***niger, unicolor, townsendi, quoyi.***

Characters: An entirely black species (the only one in South America); from black oyster-catchers found in other parts of the world, as well as from all white-breasted species, it differs widely in the form of the bill, the excessive compression and depth of which approach that of skimmers (*Rynchops*). The distinctive character of the bill is apparent even in chicks taken from the egg.

Adults (sexes alike): Head, neck, rump, and entire ventral surface slaty black, with a slight brownish cast on the belly where, moreover, some of the feathers have barely perceptible grayish terminal margins; back and upper surface of wings clear brown, varying in hue between raw umber and sepia, being darkest on the wing quills; tail quills darker than the remiges, or nearly black; ventral surface of wing and tail quills gray, with a silvery sheen on the outer webs, and with shafts which are whitish in this aspect though brown dorsally. Iris brilliant opaque yellow; bill and eyelids red or orange-red; legs and feet pale flesh color or white. The irides of young birds are yellowish brown; those of chicks brown.

17 males: wing, 253–269 (261.5); tail, 93–106 (99.8); exposed culmen, 68–74.5 (71); depth of bill, 14.8–16.3 (15.5); tarsus, 52–57 (54.3); middle toe with claw, 48–53 (50.2) mm.

9 females: wing, 251–280 (267.7); tail, 96–108 (102); exposed culmen, 72–84 (79.5); depth of bill, 15.2–17.8 (16.1); tarsus, 54–59 (57.3); middle toe with claw, 49–54 (51.8) mm.

The measured specimens come from seventeen localities which cover the greater part of the range of the species.

Downy young are only slightly darker than those of the "*palliatus*" group of *Haematopus ostralegus*, which they much resemble. The white area in the downy stage of *ater* is, however, confined to the breast, instead of covering also the belly and flanks.

The juvenal plumage, as exemplified by a specimen taken at Ancúd, Chiloé Island, on April 17, 1914, is similar to that of the adult except that the head and chest are brown rather than black, the belly still paler, and the greater part of the body marked with buffy or ochraceous fringes to the feathers. This is especially heavy on the wings and belly. On the back a subterminal band of dark brown is also visible on many feathers. The buffy fringes occur upon the forehead and throat, but scarcely at all on the nape. The tips of some of the primaries are also marked with a light edge. Evidence of this plumage is carried all through the first year, the light edges being gradually effaced by wear, but being still perceptible on juvenals taken from May to October. Such birds have a golden speckled appearance.

The eggs of this Oyster-catcher, when in the nest, are pinkish white, with dark brown and dull black spots and hieroglyphics. The ground color is thus considerably lighter than in eggs of *Haematopus leucopodus*, and the brown markings are inclined to be more streaky than in that species. Eggs of a series reported upon by Vallentin (1924, 308) measured from 60–68 mm. in length by 42–45 mm. in diameter. Beck took four sets during the Brewster-Sanford Expedition, of which three were made up of two eggs and the fourth of one. They came from the Falkland Islands and from islets near Cape Horn. The principal characteristic of their marking is that many of the blotches and vermiculate streaks are buried more or less deeply beneath the limy surface of the shell, so that they appear as veiled mottling, much grayer and less distinct than the superficial areas of pigment. Moreover, these dried shells would be described as of buffy white, rather than greenish white, ground color. The dimensions of the four sets are as follows: 61.2 x 40.3; 62.9 x 41.2 and 63.3 x 42; 63 x 43.1 and 63.3 x 42.8; 63.7 x 43.2 and 63.3 x 43.7 mm. The eggs of this species thus appear to be larger than those of any other American species of oyster-catcher, the eggs of *Haematopus leucopodus* being next in average size.

Distribution: Coasts of southern and western South America, from islands in the estuary of the Río de la Plata southward to the Falkland Islands and Cape Horn, and northward along the Pacific coast at least to latitude 7° S. in Peru. The species breeds throughout this range. It has also been taken at the Juan Fernández Islands, where its status is uncertain.

This large and stocky Oyster-catcher, the "Brujillo Negro" or "little black wizard" of the Peruvian coast, is a bird of somewhat astonishing distribution. Naturalists acquainted with it only in a cold and blustery meteorological environment, near the southern extremity of South America, would naturally

regard it as a typical example of the Magellanic bird-world, and would associate it with the habitats of the Sheath-bill, King Shag, and skuas, or more particularly with that of its own close relative, the Pied or Fuegian Oyster-catcher. Nevertheless, the Black Oyster-catcher seems quite free of certain regulations of nature which restrict the breeding ranges of the Pied Oyster-catcher and of many other birds to the Magellanic district. Northward through the Chilean sub-antarctic islands as far as Chiloé, the Black Oyster-catcher and *Haematopus leucopodus* are found together. At this point, however, the northward extension of the last-named species ends, while the range of the Black Oyster-catcher continues along the desert shores of Chile and Peru to within seven degrees of the equator. The species thus represents an extreme combination of sub-antarctic and Humboldt Current distribution. The only other birds which have quite so great an extent of continental range are a few forms, like the Kelp Gull, which are at the same time pan-antarctic, and the Bigüá Cormorant, which is unique. Of all the other coastal birds peculiar to southern South America and the closely adjacent islands, I should say that the Black Oyster-catcher occupies the range characterized by the greatest continuous length and the most pronounced climatic diversity.

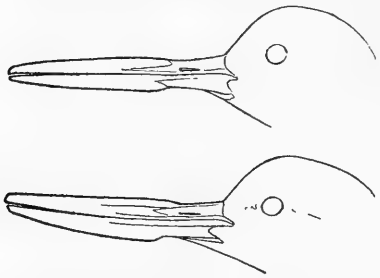


Fig. 76. Bills of two species of South American Oyster-catchers.

Upper, *Haematopus ostralegus pitanay*, ♀; lower, *H. ater*, ♀.

I have compared and measured upwards of thirty specimens, taken at seventeen localities between Ancón, Peru, which is north of Callao, and the extreme southern tip of South America, by which I mean the very rocks on the ocean side of Cape Horn. The series includes also eight from the Falkland Islands. Among all these birds I can see no evidence that more than one race of this Oyster-catcher is distinguishable, despite the almost anomalous nature of the range.

The coastal extremes in the Atlantic distribution of the Black Oyster-catcher appear to be at islands in or near the estuary of the Río de la Plata, and at Cape Horn, northward from which along the Pacific coast of the continent the birds are to be found to Lobos de Tierra Island (latitude 6° 30′ S.), where an example was observed by Coker (1919, 496). Until recently, Tombo Point, Patagonia, which is latitude 44° 6′ S., was considered the northernmost station on the Atlantic coast (Durnford, 1878, 403), but Smith (1927, 287) has given what seems to be an indubitable nesting record of this species from the main island of the Coronilla group, off the coast of Uruguay. He states that he saw several adults of the Black Oyster-catcher on this rocky islet, and that a nearly grown bird and two downy young were brought aboard his vessel. Since there is no other black species of oyster-catcher in South America, I should say that the identification of this zoölogist may be regarded as conclusive.

It is curious that Darwin's comprehensive journal, covering many parts of the Magellanic region, makes no mention of either of the two resident oyster-catchers. Practically every other work dealing in part with the ornithology of the southern South American seashore refers to one or both species. The records for *Haematopus ater* are far too numerous to cite, although it is worth noting that Salvadori (1900, 625) includes it among the resident birds of Staten Island, and that both von Schalow (1898, 644) and Salvin (1875, 372) record it from Mas Afuera Island of the Juan Fernández group. Hellmayr (1932, 382) states that its occurrence in Mas Afuera is open to doubt, but he has perhaps overlooked Salvin's explicit testimony that he had examined two specimens from that island, which agreed with Falkland examples.

Beck collected Black Oyster-catchers at eleven localities between Cape Horn and the northern end of the Chilean archipelagoes, during the course of the Brewster-Sanford Expedition. He and I, or other members of American Museum parties, have shot or observed the bird at the following Peruvian stations: Chilca Bay, Pescadores Islands, Asia Island, Chincha Islands, Paracas Bay, Independencia Bay, Santa Rosita Island. From the arid section of the Chilean coast records are numerous. Farther southward, there are several from Mocha Island, where Mr. Bullock, moreover, has recently found seven or eight pairs of these birds breeding around the coasts. On November 29, 1932, he collected an adult female, which I have examined. Bullock's manuscript states that the species is found at Mocha during every month of the year. All observers appear to agree with Crawshay (1907, 125) that the Black Oyster-catcher is exclusively a shore-dwelling bird.

During my first expedition to the coast of Peru, I became well acquainted with the Black Oyster-catcher, and found it particularly characteristic of rocky stretches of coast, or of beaches where shingle, rattling and grinding under the surf, took the place of sand. Therefore, while the species inhabits the same region as *Haematopus ostralegus pitanay*, which might almost be called a pan-tropical bird, it does not ordinarily occupy the same environment. It may be said rather to alternate with the white-breasted species, and it is, *par excellence*, a bird of the outer coasts and promontories, and of the turbulent, beetling shores of numerous islands, large and small.

My notes refer in particular to three pairs that evidently occupied contiguous nesting territories near the northwest point of the mountainous island of San Gallán, just outside Pisco Bay. The greater part of the water front was here impracticable to traverse on foot. From the behavior of the birds, I judge that one pair had a nest very close to the niche of level ground behind the beach in which I slept on the nights of November 26 and 27, 1919, but, although I watched them at all times when not otherwise occupied, I failed to spot the site of their home. These Brujillos were very musical, and piped a great deal as they flew nervously from the crest of the beach to some small jetty of rock, and back again. They were incessantly active rather than shy, and at times they could be approached within a few paces as I walked toward them along the ridge of the shingle. My Peruvian companions held that their loud, slow,

yet excited calling was a sign and an accompaniment of heavy surf, in other words, a complaint against the pounding rollers that interfered with their feeding. When the ocean is placid, I was told, the birds utter softer, sweeter notes, which culminate in a very rapid trill, and which the Peruvians interpret as their song of contentment. Whether or not the inference is correct, I heard on many subsequent occasions this pleasing tremolo, to the accompaniment of waves which lapped the shores rather than assaulted them. Singing or silent, these Oyster-catchers have a habit of carrying their bright red bills slightly parted.

In the Falkland Islands, where this bird is known as the Black Curlew, it is in general less numerous than the other species, although Vallentin (1924, 308) states that the Black Oyster-catcher is the more abundant in the northern part of West Falkland. It is the quieter of the two Falkland species and, furthermore, its color tends to make it less conspicuous on the shingle beaches or against a background of dark kelp. Sometimes the coral bills and pale pink legs may be picked out by the eye sooner than the body of the bird. The two species associate in flocks during the winter season, and they come together at other times to feed avidly upon limpets made sick by the vast masses of rotting kelp occasionally piled up by storms in sheltered creeks and coves of the Falklands (Vallentin, 1924, 379).

The Black Oyster-catcher lays two eggs at the Falkland Islands about the beginning of November, or a month later, on the average, than the Fuegian species (Abbott, 1861, 155). Cobb (1933, 39), however, refers to fresh eggs found during a season extending from late October to the end of January. In Peru the birds are courting by September or early October. At Caroline Island, Chile, Beck found two eggs just hatching on December 9, 1914. A skua was squatting near-by, as if watching the process hopefully. Beck's notes also contain the following records from the purlieus of Tierra del Fuego, Chiloé Island, and the Falklands: a female sitting on eggs, False Cape Horn, December 23; one fresh egg in a nest within 7 meters of the nest of a Kelp Gull (*Larus dominicanus*), Peyron Island, December 19; two slightly incubated sets of two eggs in nests at the edge of a colony of terns (*Sterna hirundinacea*), Bleaker Island, Falklands, December 12; two eggs in a nest not far from a gull colony, East Falkland, December 10; a newly hatched chick with an addled egg in a nest near Port Stanley, December 7; adults with well-grown young, Ancúd, Chiloé, April 7; a dozen birds, including full-grown young, at a cove near Cuellon, Chiloé, May 21.

The nests, as a rule, are on the beach, just above high watermark, sometimes in the lee of stones or boulders, and, according to McCormick (1884, 328), the parents evince great anxiety, and flutter about with loud outcries, when one chances into the neighborhood of their home. The nest itself is seldom more than a slight depression among pebbles or dry kelp, although occasionally a few bleached twigs or ancient bones enter into its construction. Cobb states that exceptionally high tides frequently wash the eggs away. The birds themselves, like other oyster-catchers, can swim rather well when they need to.

Vallentin reports that nesting pairs can best be approached on horseback. Then, if both are at the nest, they will walk away singly and slowly. If the observer dismounts and sits down, one will sooner or later return and, after strutting about and scolding a bit, will presently settle upon its eggs. Despite its red bill, a sitting bird is almost impossible to discern among the dried stalks of giant kelp along the beach, until it moves.

The Black Oyster-catchers feed upon the same sort of food as the Pied species. A stomach from Elizabeth Island in the Strait of Magellan contained mussels. Vallentin describes the dexterity with which the birds dislodge limpets (*Patella aenea*) from the rock. They approach one of these univalves while it is not tightly appressed against the stone, quietly place the bill beneath the edge of the shell, and with a sudden twist of the head detach the mollusk, which is immediately devoured. All the movements are so rapid that it is difficult to tell, even through binoculars, just how it happens. One point, however, is very noteworthy, namely that the Oyster-catchers select as prey only the moderate-sized limpets, for example those not more than about 45 millimeters in diameter. Larger shells are invariably passed by, as though the bird realized the limit of its strength or the maximum extensibility of its gullet.

The stomach of a specimen I shot on the Peruvian coast was filled with food made up of the following organisms and proportions: remains of barnacles (*Chthanalus cirratus* and *Balanus*), 38 per cent; one small fish, 30 per cent; one crab (*Petrolisthes spinifrens*), 30 per cent; 14 operculi of gastropods (*Thais* or *Concholepas*), 2 per cent.

Cunningham (1871, 123) states that both the Black and the Pied Oyster-catchers are excellent eating. I did not experiment with the present species, but the examples which I preserved seemed extraordinarily tough. Their skins separated from the underlying tissue with more difficulty than in the case of any other bird I can recall.

THE PHALAROPES

FAMILY PHALAROPODIDAE

The phalaropes, or sea-snipes, are the only truly oceanic shore birds. They swim well, make long migrations far from land, and two of the three species spend all or a large part of their non-breeding season in a pelagic habitat. Structures correlated with such a mode of life include compressed tarsi, lobed toes, and dense, compact plumage of a texture resembling that of gulls or petrels. Presumably, the oceanic habits of the phalaropes are secondary, that is, the group has been derived from some generalized and more terrestrial limicoline stem.

As breeding birds, phalaropes are restricted to the northern hemisphere, all but one of them, in fact, to arctic or sub-arctic latitudes. In the South American region they are known only as migrants, or as non-breeders which may remain south of the equator during the northern-hemisphere summer period. The three species of phalaropes belong to three genera, and the following key for the identification of specimens is taken from Ridgway (1919, 417):

a ¹ Bill broad, somewhat expanded subterminally; nostrils separated from loral feathering by a space about equal in length to basal depth of maxilla; tarsus not more than one-sixth as long as wing, not longer than middle toe with claw; lateral membrane of anterior toes very broad, the outer margin of the segments strongly convex . . . . . *Phalaropus.*

a ² Bill slender, not at all expanded subterminally; nostrils close to loral feathering; tarsus at least one-fifth as long as wing, longer than middle toe without claw; lateral membrane of anterior toes narrower, the margin of the segments much less strongly convex, or the margin continuous, without convex segments.

b ¹ Bill attenuated terminally (tapering in both lateral and vertical profiles); tarsus shorter than exposed culmen, about one-fifth as long as wing, but not longer than middle toe with claw, lateral membrane of toes broader, distinctly scalloped; tail graduated . . . . . *Lobipes.*

b ² Bill subulate (of nearly uniform thickness, both vertically and horizontally, throughout); tarsus longer than exposed culmen, about one-fourth as long as wing, decidedly longer than middle toe with claw; lateral membrane of toes very narrow, not distinctly if at all scalloped; tail doubly emarginate . . . . . *Steganopus.*

The phalaropes are peculiar in that the females of all three species are more richly colored than the males and are also of larger size. These characters link up with behavior, for the females are the aggressors or pursuers in courtship, while the males assume the usual "feminine" rôle in the incubation of the eggs and the care of the young. Plumage descriptions are given below under the specific headings, but it must be borne in mind that phalaropes encountered in South America are certain to be mainly or completely in winter plumage, and therefore lacking the nuptial pattern which serves readily to distinguish them at long range. Afloat or ashore, however, phalaropes are usually very tame, and if they can be examined well, either through glasses or even with the naked eye, the form of the bill, together with certain plumage markings, is sufficient for identification. The Red (*Phalaropus*) and the Northern (*Lobipes*) Phalaropes, for example, each have a conspicuous white wing-bar formed by coverts, but that of the Red Phalarope becomes much more obvious in flight because white secondary quills also enter into its make-up. The Red Phalarope is the larger of these two species, though size is untrustworthy and difficult to determine except when direct comparison is possible. The bill of the Red Phalarope is, however, relatively heavy, broad, and subterminally expanded, while that of the Northern Phalarope is extraordinarily slender and needle-like. These differences can usually be made out even at relatively long range. In neither species is the bill longer than the head.

Wilson's Phalarope (*Steganopus*), the third species, lacks the broad single wing-bar, narrow white edgings on the coverts producing rather the appearance of several fine bands which are not discernible at a little distance. Furthermore, in winter plumage it lacks the conspicuous black post-orbital stripe which is common to both the Red and the Northern Phalaropes, and the bill, which is extraordinarily slender, is very much longer than in either of the preceding species, being definitely of greater length than the head. In general form and plumage, as well as in the length of its legs, Wilson's Phalarope has a much more sandpiper-like appearance than either of the others. In the main, it is also less pelagic than the Red and the Northern Phalaropes. Most of the South

American records of its occurrence seem to be from coastal regions rather than from the high sea, although there is at least one conspicuous exception for the South Pacific, cited hereafter.

Beebe (1924, 28) writes as follows of phalaropes as he observed them in the waters of the tropical Pacific, at long distances from the continental coast.

> Sea-ducks haunt the shallower banks of the coast, gulls trust the air of the widest sea, gannets dive deep into the waves for their prey, while skimmers plough their tiny furrows through the ocean, but phalaropes actually live on the surface of the open sea. With their long legs for wading, with narrow lobes instead of broad webbing between their toes, without the slender, narrow wings upon which albatrosses hang through days of storm and stress of weather, phalaropes seem little adapted for pelagic life, and yet here and on the Pacific, hundreds of miles from land, I have seen them in enormous flocks—daring wind and water, spending the whole winter out of sight of land, trusting to the floating bounty of the sea for food, and to the buoyancy of their dense plumage and air-filled bodies for safety. I have never seen them in a full storm, but in a half gale, with spray blowing, and every watery hilltop fountaining into ugly lashing foam, I have watched their marvellous seamanship, paddling steadily up wind, able, by some perfected knowledge, to keep in the sliding, shifting valleys and free of the choking spume-drift.

Vast flocks of phalaropes which, so far as known, included both the Red and the Northern species but not Wilson's, were noted by both Beck and myself during our respective field work on the west coast of South America. During the southward journey from San Francisco to Callao, in December, 1912, and January, 1913, Beck observed phalaropes frequently from Acapulco, Mexico, to his destination. The largest flocks were seen off the southern side of the Gulf of Guayaquil, and from there to the inshore waters near Paita, Peru, on January 3. Again, in August of the same year, he encountered many at Arica, and he collected examples of the Red species in the latitude of Valparaiso during the following November and December.

My own notes speak of thousands upon thousands routed off the water by my steamers and other craft along various parts of the Peruvian coast, during September, October, December, January, and March. Named localities include the waters to seaward of Zorritos, Point Pariñas, Foca Island, Mazorca Island, San Lorenzo Island, and the Pachacamác Islands. Both the Red and the Northern species were observed, but the only examples I collected represented the latter.

Phalaropes have a curious habit of spinning on the water, both while they are wandering at sea and while they are feeding in the lakes and ponds of their breeding grounds. Several observers have offered evidence that this peculiar action serves as a means of drawing small forms of aquatic life to the surface from depths beyond the reach of the birds. In the ordinary procedure the phalaropes revolve rapidly while they beat the water with quick strokes of their wings, after which they appear to pick up minute floating objects (Pike, 1915, 293).

I found that phalaropes were well known to the Peruvian Indian fishermen under the name "Pollito de Mar," which they described to me as a little white and gray sea bird that comes only during the verano (after September).

RED PHALAROPE

Phalaropus fulicarius

Tringa fulicaria Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 148 (Hudson's Bay).

Names: Gray Phalarope. Synonyms of the specific name include *glacialis*, *rufus*, *platyrhynchus*, *rufescens*, *griseus*, and *cinereus*.

Adult female in northern-hemisphere summer: Anterior and upper parts of head, including chin, anterior portion of malar and loral regions, and entire pileum down to upper eyelid (except posterior portion) uniform dark gray or blackish slate; sides of head, including greater part of loral region and whole of suborbital and malar regions, immaculate white; neck, all round, and entire under parts deep purplish cinnamon or vinaceous brown; hind neck mixed slate color or slate-gray and cinnamon; back and scapulars light ochraceous or buff, striped with black; wing coverts slate color or deep slate-gray, the greater coverts tipped with white, the coverts along edge of wing grayish dusky; bill greenish yellow (in life), the tip black; iris brown; legs and feet pale grayish blue (in life).

Adult male in northern-hemisphere summer: Similar to the female but slightly smaller and decidedly duller in coloration; pileum and hind neck streaked with ochraceous or buffy, white on sides of head more restricted and less sharply defined, and cinnamomeous of under parts usually slightly paler and broken, more or less, by admixture of white.

Northern-hemisphere winter plumage (sexes alike): Head, neck, and under parts pure white; the occiput and orbital region slate color or blackish slate; upper parts plain light bluish gray.

16 males: wing, 119–130 (125.2); tail, 59–70.5 (62.9); culmen, 18.5–23 (21.9); tarsus, 19.5–21.5 (20.7); middle toe [without claw], 19.5–21.5 (20.5) mm.

11 females: wing, 129.5–139 (135.1); tail, 63–71 (66.4); culmen, 21–24 (22.5); tarsus, 20–22.5 (21); middle toe [without claw], 19–21.5 (20.4) mm.

Young: Pileum, hind neck, back, and scapulars dull black, the feathers edged with pale tawny or brownish buff; wing coverts, rump, and upper tail coverts slate-grayish, the middle wing coverts margined with pale buff, the upper tail coverts with ochraceous or tawny; head and neck (except as described) and under parts white, the throat and chest tinged with brownish buff (Ridgway, 1919, 418).

Distribution: Breeding range holarctic and circumpolar, almost altogether to northward of the arctic circle. Winters at sea, chiefly in the southern hemisphere, and southward to the latitude of the Falkland Islands, Patagonia, and New Zealand.

The Red Phalarope is the most northerly member of the family in its breeding habits and probably the most southerly in the extent of its migration. It is also the most oceanic, travelling almost entirely by sea and rarely being found inland (Wynne-Edwards, 1935, 294). The southward migration, which may begin in July, is evidently capable of being very rapid, for examples of the species have been recorded from near Buenos Aires on August 12, and off Coronel, Chile, on September 13 (Meinertzhagen, 1925, 326). Other southern-hemisphere districts in which the Red Phalarope has been taken include the Falkland Islands, several localities along the coast of Chile, the Juan Fernández Islands (Schalow, 1898, 644), the Galápagos Islands, and along various parts of a course between Panama and the Marquesas Islands (Jespersen, 1933, 217).

During the Brewster-Sanford Expedition, Beck collected specimens at Valparaiso on November 19, 1913, several of which still show traces of the red nuptial plumage on the belly and in the under tail coverts. On the voyage between the mainland and Mas Atierra Island he saw numerous flocks. Nicoll (1904, 50) reports the species as abundant at Valparaiso in February, and Meinertzhagen notes specimens collected there as late as March 18.

The Red Phalarope, when in the gray garb of its southern-hemisphere sojourn, more or less resembles the Sanderling (*Crocethia*) both in appearance and in style of flight. It is known to include tiny fish, pelagic crustaceans, and small jellyfish in its bill of fare, and is said at times to forage in the wake of whales.

NORTHERN PHALAROPE

Lobipes lobatus

Tringa tobata (sic, *lobata* in Emendanda) Linnaeus, 1758, Syst. Nat. edit. 10, 1, p. 148 (Hudson's Bay).

Names: Red-necked Phalarope. Synonyms of the specific name include *hyperboreus*, *fuscus*, *ruficollis*, *vulgaris*, *angustirostris*, *tropicus*, and *antarcticus*.

Adult female in northern-hemisphere summer: Upper parts dull dark slate-gray or blackish slate, the back and scapulars striped with buff or ochraceous; greater wing coverts broadly tipped with white; chin, throat, and under parts of body immaculate white; sides of neck, fore neck, and chest plain cinnamon-rufous; bill black; iris dark brown; legs and feet bluish gray, the toes with joints darker gray or dusky.

Adult male in northern-hemisphere summer: Similar to the female, but slightly smaller and decidedly duller in coloration, the dusky grayish of upper parts duller and less uniform, the cinnamon-rufous of neck almost confined to sides of neck, the chest mixed white and grayish, more or less tinged with cinnamon-rufous.

Winter plumage (sexes alike): Forehead, superciliary stripe, sides of head and neck, and under parts, white, the sides of chest washed or clouded with pale gray; pileum grayish, the feathers with dusky shaft-streaks and whitish margins; a blackish spot in front of eye; suborbital and auricular regions mixed dusky and grayish white; upper parts chiefly gray.

11 males: wing, 102–109 (105.1); tail, 46–50 (48.3); culmen, 21–23 (22); tarsus, 18–20 (19.2); middle toe [without claw], 18–20.5 (19.5) mm.

11 females: wing, 105–116 (110.2); tail, 48.5–52.5 (50.2); culmen, 20–24 (22.4); tarsus, 18.5–21 (19.8); middle toe [without claw], 18–20 (19.1) mm.

Young: Pileum dusky, with or without streaks; back and scapulars blackish, distinctly margined with buff or ochraceous; middle wing coverts margined with buff or whitish; auriculars dusky; forehead, lores, supra-auricular stripe, and under parts white, the chest and sides of breast sometimes suffused with dull brownish (Ridgway, 1919, 424).

Distribution: Breeding range holarctic and circumpolar, both to northward and southward of the arctic circle, but in America not south of Labrador and northern Manitoba. Winters in all oceans of the southern hemisphere, southward to the latitude of Patagonia.

The Northern and Red Phalaropes sometimes travel together and, when the two are mingled, the streaked back and the noticeably slenderer head and neck of the present species are perhaps better marks for discrimination than those mentioned above.

The Northern Phalarope has been taken as far south as the Patagonian coast in the Atlantic, and Philippi (1902, 65, pl. 27) has recorded and figured, under the name *Phalaropus antarcticus*, examples collected off the coast of Chile. During the winter months of the northern hemisphere, this species is to be found in vast numbers along the whole length of Peru. We have two males in winter plumage which I shot, respectively, offshore from the Pescadores Islands, Ancón, December 15, 1919, and off Talara, January 20, 1925. Other observations from my notebooks are as follows, the order being from south to north along the coast:

October 19, 1919. Large flocks in Pisco Bay.

December 5, 1919. Flocks off Chilca; very active at five o'clock in the morning.

October 9, 1919. Thousands in oily looking patches on the water along the coast to southward of San Lorenzo Island.

October 7, 1919. A flock of about 200 in the Bay of Callao. It moved as a unit, the birds frequently rising, flying a short distance, and settling together. Similar flocks encountered while *en route* toward the Pescadores Islands.

September 10, 1919. Northern Phalaropes in flocks offshore from the Pescadores Islands.

December 8, 1919. Thousands upon thousands flushed by the southbound steamer near Mazorca Island, and for a long distance southward.

January 23, 1920. Large flocks north of Eten.

January 16, 1925. Two good-sized flocks off Foca Island.

January 21, 1925. Northern Phalaropes abundant everywhere between 6 and 37 kilometers due west of Point Pariñas.

January 20, 1925. Enormous flocks off Talara. The birds seem to favor a special belt of water, just outside the coolest littoral zone. For more than an hour our launch chugged through their legions.

March 4, 1925. Flocks all along the coast, in foamy, sudsy water, between Talara and Zorritos.

The last three observations in the list above were made while the countercurrent, El Niño, was running southward past Point Pariñas. Evidently the Northern Phalaropes are not incommoded by the high temperatures that speedily follow cessation of upwelling in the Humboldt Current. In current-rips between Cocos Island and the continent, Beebe (1926, 45) observed flocks of Northern Phalaropes massed upon the water. They took flight just ahead of his vessel and followed every zigzag of the foam lines as they sought new feeding grounds. Twice Beebe saw individual birds standing upon floating logs.

WILSON'S PHALAROPE

Steganopus tricolor

Steganopus tricolor Vieillot, 1819, Nouv. Dict. Hist. Nat., 32, p. 136 (Paraguay).

Names: Synonyms of the specific name include *wilsoni*, *frenatus*, *incanus*, and *stenodactylus*.

Adult female in breeding plumage: Forehead and crown pale bluish gray, the former with a blackish line along each side; occiput and nape white, passing into bluish gray or slate-gray on back and scapulars; stripe on side of head, chiefly behind eye, and continued down side of neck, black, passing on lower neck into rich dark chestnut, this continued backward, more or less brokenly, along each side of interscapular region, the outer portion of the scapular region also with a stripe of chestnut; short stripe from above lores to above eyes (not extending to bill), suborbital and rictal regions, chin and throat immaculate white; fore neck and chest soft buffy cinnamon, deeper laterally and posteriorly, and fading gradually into creamy buff on breast; rest of under parts immaculate white; wings brownish gray, the coverts and tertials margined with paler; rump brownish gray; upper tail coverts white, the longer feathers marked more or less with mouse-gray subterminally; tail mouse-gray, the lateral feathers irregularly barred on the inner web and narrowly tipped with white; bill black; iris dark brown; legs and feet black.

Adult male in breeding plumage: Smaller and much duller in color than the adult female, the beautiful pattern and richly contrasted colors of the latter but faintly indicated.

Northern-hemisphere winter plumage (sexes alike): Upper parts plain light gray, except upper tail coverts which, together with superciliary stripe and entire under parts, are white, the chest and sides of breast faintly tinged with pale gray.

10 males: wing, 116–125 (121.1); tail, 48–54 (51.2); exposed culmen, 28–31 (30.5); tarsus, 28.5–33 (30.1); middle toe [without claw], 22–25 (24) mm.

11 females: wing, 130–137.5 (132.6); tail, 52.5–65 (55.9); exposed culmen, 31–36 (33); tarsus, 30.5–33 (31.7); middle toe [without claw], 24.5–26.5 (25.3) mm.

Young: Crown, back, and scapulars dusky, the feathers conspicuously margined with buff; wing coverts grayish brown, margined with pale buff or whitish; upper tail coverts, superciliary stripe, and lower parts white, the neck tinged with buff (Ridgway, 1919, 431).

Distribution: A purely American species, breeding in central and western North America, and migrating to southern South America, where it is found inland to a greater extent than on salt water.

Wilson's Phalarope was described from Paraguay, and at least one of the synonyms of its specific name is based upon a Chilean specimen. Its migration takes it southward to Patagonia and even to the Falkland Islands, yet it is primarily a bird of inland waters rather than of the ocean. Such predilections are correlated with physical structure. The toes of Wilson's Phalarope lack the large scalloped lobes and pronounced webbing of the other two species, and it is distinctly less of a swimmer and diver. Wetmore (1922, 8), who observed the species on mud flats in the province of Buenos Aires and near saline pools on the pampas, states that there is little to distinguish it—in its gray winter plumage—from small sandpipers, though it is readily detected by anyone familiar with its soft calls.

The only remote pelagic record that I can find for Wilson's Phalarope in the southern hemisphere is the extraordinary one of Alexander (1927, 247), who observed the species in latitude 14° 26′ S., longitude 100° 40′ W., about halfway between the Galápagos and Easter Island, on February 26, 1926.

The Brewster-Sanford series includes no specimens from the west coast of South America, but Beck took 12, equally divided as to sex, about ponds at Mar del Plata, Argentina, on September 29 and October 12, 1914. No trace of the breeding plumage remains in any of these; a number of the specimens are evidently birds of the year. They are all described as having yellow or yellowish green legs and feet. The Museum Collection contains also two females taken at Guayaquil, on August 21, 1912, by W. B. Richardson. At least one of these appears to be a bird of the year, and at any rate the date is doubtless late enough for the examples to have made a southward migration from the breeding ground. Meinertzhagen (1925, 342) records birds taken in Ecuador on August 28.

THE SHEATH-BILLS

FAMILY CHIONIDIDAE

The sheath-bills, the only birds without webbed feet that reach the antarctic, are a curious, aberrant group of shore birds of half circumpolar range. The one species inhabiting the American quadrant of Antarctica, *Chionis alba*, was formerly separated generically from those of the southern Indian Ocean region, but Peters (1934, 308) now includes all forms within a single genus. The eastern

representatives are sedentary, living on islands close to the Antarctic Convergence. The American species apparently crosses Drake Passage with considerable freedom, between the Antarctic Archipelago and the Fuegian and Falkland districts. Most, if not all, of the islands of the Scotia Arc appear to lie within its breeding range.

In the sheath-bill, as Kidder and Coues (1876, 85) have said, we have "a genus with the general appearance, gait, and flight of a pigeon, with the beak and voice of a crow; with the habits of a wader, yet dreading the water, and with the pugnacity and familiarity with man of a rasorial bird." The affinities of the sheath-bills, as shown by their morphology, eggs, and behavior, have been studied by Coues, Lowe (1916, 122), Layard (1867, 438), and others, and their apparent relationships with skuas, gulls, oystercatchers, seed snipes, and other Charadriiformes have been variously pointed out. Wetmore (1934, 7) places the family between the seed snipes and the birds of the suborder Lari, thus removing them from the vicinity of the oyster-catchers, which they seem in many ways to resemble.

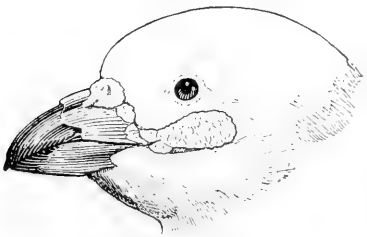


FIG. 77. Head of male Sheath-bill, South Shetland Islands.

SHEATH-BILL

Chionis alba

Vaginalis alba Gmelin, 1789, Syst. Nat., 1, pt. 2, p. 705 ("New Zealand" = Falkland Islands).

Names: Wattled Sheath-bill, Paddy, Reefer, Kelp Pigeon, Rock Pigeon or Sore-eyed Pigeon, Snow-drop; "Ptarmigan" to the Norwegian whalemen; "Paloma Antarctica" is a recorded Spanish name. Synonyms of the specific name include *chionis*, *nivalis*, *vaginalis*, *forsteri*, *necrophaga*, and *lactea*.

Characters: A white, somewhat pigeon-like shore bird, with a short and stout bill, which on the maxilla is basally covered by a horny "sheath."

Adults (sexes alike, except that males may show more papillation on the bare skin of the face): Plumage entirely white, over an abundant gray down. Iris brown (Cobb, 1933, 62, reports "dark blue"); face, which is bare to a point below the eye and more or less carunculated near the base of the bill, flesh color, the papillae mostly white; bill distally brown, proximally yellow or greenish yellow, sometimes with reddish or violaceous hues, especially on culmen and gonys; legs and feet gray or dusky bluish.

4 males: wing, 246–260 (255); tail, 112–135 (126.2); exposed culmen, 30–34 (32.5); tarsus, 42–47 (45); middle toe and claw, 64–65 (64.5) mm.

10 females from the South Shetlands, South Orkneys, South Georgia, Tierra del Fuego, and the Falkland Islands: wing, 234–255 (242.2); tail, 118–133 (124.2); exposed culmen, 30–32 (30.8); tarsus, 39–44 (41.5); middle toe and claw, 60–64 (61.8) mm.

Length of body and wing-expanse as reported by Gain (1914, 159) are: males, length, 405–435, wing-spread, 810–840; females, length, 400–410, wing-spread, 760–805 mm.

In an adult skeleton of unknown sex, the dimensions of the elements of the wing are as follows: length of humerus 75.6; radius 81.2; ulna 77.1; extreme length of midwing from proximal end of

ulna to distal point of carpals 84.6; length of hand from carpal break to tip of terminal phalanx 78.5 mm.

Clarke (1913, pl. 2) figures a chick in transition between down and contour plumage. The head, sides of back and neck, lower back, and abdomen are clad in gray down mottled with brown, the pileum and nape being brownest; white feathers cover the wings, scapulars, and flanks, indicating that the juvenal plumage resembles that of adults.

The same author describes eggs from the South Orkneys as elongate-ovate, the white shell boldly blotched with grayish black or dark brown and liberally freckled with the same colors. They vary little in size, and measure from 54 to 58 mm. in length by 37 to 39 mm. in breadth.

Distribution: Breeds at islands of the Scotia Arc, including South Georgia, the South Sandwich, South Orkney, and South Shetland groups, and various islands of the Antarctic Archipelago southward beyond latitude 65° S. The species occurs regularly at the Falkland Islands, Staten Island, the Diego Ramirez Islets, many parts of the Magellanic region, and the Atlantic coast of southern Patagonia; it may possibly breed in some of these localities.

The Sheath-bill is a puzzling bird as regards distribution as well as relationship; although it is common along the water front of Magellanic South America and the Falkland Islands, its eggs have never been found with certainty in any part of this region. Bennett (1926, 32) states, moreover, that at the Falklands it is less numerous in summer than in winter. Very probably it may prove to be a breeding species only within the Antarctic Zone of surface water. Its migrations into milder regions appear to be sporadic rather than regular, for a large proportion of the population spends even the winter in high southern latitudes. Observations reported by Eights (1838, 213), Menegaux (1907, 69), Andersson (1908, 53), Wilkins (1923, 494), and others tell us, for instance, that Sheath-bills are of regular occurrence throughout the year at such localities as Elephant Island, Deception Island, Paulet Island, and even farther southward in West Antarctica.

Since the Sheath-bill is a practically omnivorous scavenger, the presence of human beings at the more southerly stations may have more or less to do with its persistence in residence. Thus Gain (1914, 159) states that after the antarctic winter had set in at Petermann Island, Sheath-bills gathered in April and May from surrounding localities to spend the lean months of the year about the wintering station of the French Expedition. Valette (1906, 584) also reports that at the South Orkneys Sheath-bills were his only familiar winter companions among the birds, and that they appeared daily at the door of the hut of the Argentine meteorological observers in order to accept left-overs from the table. Toward the end of August these birds quite inexplicably disappeared, the reason not being learned until early September, when the Sheath-bills were accidentally discovered on the outlying pack-ice, living around the nurseries of Weddell seals and finding a rich larder in the placental blood and afterbirth of new-born cubs. Valette even saw several of them attempting to devour the umbilical cord while it was still attached to the baby seals! Members of the wintering Scottish Antarctic Expedition at the South Orkneys likewise had the company of at least a few Sheath-bills throughout the dark season, the birds dispersing in spring only after activity in the penguin colonies had commenced. Finally, Lester (1923, 174), who wintered on the Danco coast beyond latitude 64° S., also found the Sheath-bill to be the only resident bird in winter. At his base

they subsisted largely upon scraps of seal meat left by the dogs, and anything else they could steal. Their numbers about camp varied from two to ten, and in one respect, at least, they proved a nuisance, for, recognizing by scent or in some other way the seal oil with which the canvas roof had been waterproofed, they devoted much of their time to trying to peck through it.

The travels of the Sheath-bill are of extraordinary interest and are still very imperfectly known. At times the birds have such strong grouse-like terrestrial proclivities that one might doubt their ability to take wing at all. They have, nevertheless, a strong, pigeon-like style of flight, and not only do they cross the broad expanse of Drake Passage, but they have been casually observed in many parts of the southern ocean at a great distance from land. Furthermore, they have been seen on floating ice, in company with Adélie and Ringed Penguins, as reported by Donald (1894, 333), and it was, no doubt, through a combination of long flights and ice-ferrying that birds of the genus *Chionis* originally acquired their present distribution, which extends more than a third of the distance around the world in the zone of westerlies. For such reasons I confidently expect the discovery of some form of Sheath-bill at Bouvet Island, from which none has yet been reported.

Darwin, for one, was impressed by the great distances from land at which the Sheath-bill was to be seen (Gould, 1841, 118); Reichenow (1908, 566) reports sighting them "300 miles" at sea. One still farther astray, "400 miles from the nearest coast," is recorded by King (1839, 538), who also writes that somewhat nearer South America a Sheath-bill flew aboard his ship. A similar happening is mentioned by Stenhouse (1929, 186) who states that during the cruise of the 'Adventure,' between the years 1826 and 1830, an example flew on board. Andersson (1908, 43) saw this species far east of the Falklands in latitude 52° 22′ S., longitude 54° 26′ W., namely, in the direction of Shag Rocks and South Georgia. On April 3, 1842, a Sheath-bill hovered above the masts of the 'Terror,' in latitude 57° S. or thereabouts, two days before Beauchêne Island, the southernmost of the Falklands, was sighted (McCormick, 1884, 280), and "about 100 miles off Cape Horn" two once alighted in the rigging of a ship (Fristedt, 1894, 330). Paessler (1913, 46) saw a pair in flight over the ocean a long distance to eastward of Puerto Deseado, Argentina, and during the course of the Brewster-Sanford Expedition Mr. Beck was surprised to find that Sheath-bills frequently flew up astern of his schooner when he was far at sea, and behaved, while they remained, almost like oceanic birds such as petrels or gulls. Eights states that Sheath-bills which had become practically domesticated at the South Shetland Islands elected to remain on the ship when it departed! It would be hard to credit such a story were it not for the support of Moseley (1879, 209), who writes that a Kerguelen Sheath-bill attached itself to the 'Challenger' during the southward voyage to Heard Island, occasionally leaving the vessel to fly around and then return.

On the east coast of South America the Sheath-bill apparently ranges northward at times to the neighborhood of the Gulf of San Jorge. Río Gallegos is a favorite winter headquarters, and in this region, at Punta Loyola, Beck found

about 40 of them feeding on mussel beds with the gulls during August, 1915. At this time the weather was cold and the ground frozen. The Sheath-bills were not in the least shy, and would permit approach within photographing distance, provided Beck moved cautiously. The natural response of these birds is often simply to gather around anyone who takes them by surprise, rather than to be startled and to fly away. If a stone is thrown at them, they sometimes merely look at it as though amused, and watch it roll.

At the Falklands, Beck found that the Sheath-bills he collected during the southern-spring period were birds with non-functional gonads, a fact which would tend to confirm the supposition that they do not breed in this subantarctic locality. Doubtless such examples should be regarded not as migrants to the Falklands, but rather as birds which lacked the physiological incentive to return to their antarctic nesting grounds. Cobb (1933, 62) states that he has counted more than 100 Sheath-bills together at Bleaker Island during the months of May and October. Their favorite resorts here are about the penguin and shag rookeries, where they are constantly on the lookout for both droppings and eggs. A joyful and almost humanly sentient greeting they give to any man who seems likely to disturb a colony of cormorants and thus to open up a supply of eggs. At some real or fancied alarm the Sheath-bills all behave as though they had a recognition of guilt, rising as one bird, clearing out of the rookery, and subsequently sidling furtively back again, one by one, on foot.

At South Georgia we enter the known nesting ground of the Sheath-bill. For some reason the birds seem to have become greatly reduced in numbers at this island, for, during my own visit in 1912 and 1913, I saw extraordinarily few in comparison with the population indicated by earlier accounts. Possibly the whalemen have shot them off as game, for, despite their none-too-pleasant feeding habits, Fristedt states that they are delicious eating. The fact that the Norwegians at South Georgia call them "Ptarmigan" no doubt bodes ill for their welfare. Olstad (1930, 7) states, furthermore, that their eggs are constantly destroyed by the introduced rats, so this, too, adds to the possible causes of the diminution in their numbers. The first Sheath-bill I saw at South Georgia appeared on a ledge of rock at the Bay of Isles, while I was passing beneath it in a whaleboat. The behavior of the bird was extraordinarily pigeon-like as it minced along, keeping abreast of us out of sheer curiosity, and bowing and nodding at every few steps.

About the middle of October, according to several accounts, the Sheath-bills, which gather in localities favorable for shelter and food during the deep snows of South Georgian winter, rather suddenly disperse for the breeding period and are, thereafter, much less conspicuous until the following autumn. Possibly this is the true reason why I saw so few of the birds, for, since the date of my summer visit, Wilkins (1923, 485) has found an average of one Sheath-bill to each three kilometers while following closely a long stretch of the coast. About the time of the first snows they tend to resume their barnyard and dump-heap habits, and the long period of their aloofness and independence makes no

difference, as Valette has remarked, as to their renewed fearlessness and sociability toward human beings.

I find no information regarding the courtship of Sheath-bills in American Antarctica, but that of the Indian Ocean species (*Chionis minor*) has been described as extraordinarily pigeon-like, the male bowing and bobbing and strutting about, making a cooing sound all the while (Moseley, 1879, 209). The nests at South Georgia are built among large blocks of stone not far from the water, as a rule, and are composed of wisps of tussock grass, algae, moss, and feathers, usually more or less strewn over with bits of decayed food, limpet shells, and other refuse. Valette states that the nests he found at the South Orkneys were far from works of art, despite the great amount of small bones, fragments of eggshells, mollusks, and the moulted tail feathers of penguins, which had been dragged in among clefts of the rocks. Bennett (1926, 321) once found a bulky nest made entirely of penguin rectrices. When returning toward their homes from feeding expeditions, the Sheath-bills usually alight upon some conspicuous rock in the vicinity and then dart for the hidden sites.

The Sheath-bill lays two or three eggs which, according to Bennett (1927, 259), appear more than a week apart, as a result of which the chicks, while all are still alive, are likely to be even more different in size than the young of penguins. With the appearance of the first egg, one parent immediately commences to incubate. This custom is the usual one among antarctic birds, because frost is always a factor to be reckoned with, and numerous eggs are burst by the cold. Most observers agree that more than one Sheath-bill chick in a family is rarely seen at South Georgia, and it is probable that the other one or two are either eaten by the parents or succumb because of the long intervals between the laying of the eggs. Possibly the Sheath-bills, like the skuas, are not easily conditioned to more than one egg or chick, which may account in some degree for the partial elimination of their own offspring. This is always a likelihood among birds which are as ready to devour the eggs and young of other species as the Sheath-bills are. Lowe (1916, 122) states that the chicks are apparently nidicolous for some time after hatching, but all field observers report them running about actively while they are still very small. Sörling, as related to Lönnberg (1906, 56), captured two mated pairs of Sheath-bills at South Georgia, and the chick of one of the families. The parent birds in captivity continued to feed and brood their young one; these parents, however, escaped from their cage, whereupon Sörling transferred the chick to the other enclosure, and it was at once adopted and cared for by the other pair of adults.

Nest-building at the South Orkneys begins toward the end of November, and by the middle of December, according to Valette, all the birds are incubating. Eggs have been procured in the Antarctic Archipelago by December 19, and downy young still in the nest at Paulet Island on January 15. A single large downy chick, first observed at Hope Bay on February 24, moulted practically all of its down during the next two days (Andersson, 1908, 53).

Fresh eggs marked on December 11th hatched on January 7th, an incubation period of twenty-eight days. The newly-hatched young are clad in brown down and show conspicuous bare patches;

they are not by any means pretty objects like the young penguins and skuas. On January 29th white feathers were beginning to develop under the down of these chicks; and by February 11th the down had nearly all disappeared (Clarke, 1913, 245).

The Sheath-bills are both sociable and quarrelsome among themselves. At times they seem to enjoy each other's company, and even to play together by chasing one another around a rock and back again. Upon the first sign of competition in feeding, however, they stand up to each other and tilt, or stretch up on tiptoe, open their greenish bills, and utter angry cries. Toward other animals they are fearless and impudent. They walk about on the backs of sea-elephants, exciting no more response than the traditional flea on the bull's horn. Of cats and dogs about the whaling stations they are no more afraid than of man. In fact, the one creature of which they evidently stand in awe is the skua, and with this bird alone they avoid rivalry around a seal carcass. However, Valette tells us that actual fear of the skua is shown only during the first few days after the latter's arrival at the South Orkneys. Later, he states, the Sheath-bills acquire a feeling of indifference, if not of amity toward it. Of course, the intimate relationship between the Sheath-bills and many other birds with which it associates is hardly ever without malice aforethought. At the South Orkneys one has been seen calmly boring in under an oblivious incubating shag, with the object of extracting an egg from the nest (Brown, Mossman, Pirie, 1906, 174). The fact that the Sheath-bill should be an inveterate egg-thief is by no means as remarkable as Lowe (1916, 122) believes, because this trait is a widespread one among birds of limicoline affinities. No one, perhaps, would suspect the Bristle-thighed Curlew or the Turnstone (*Arenaria*) of being accomplished nest robbers, and yet they are.

During the summer the Sheath-bills bathe frequently at the shallow edges of the cold coves. They seem to have a certain dread of deep water, and will test it mincingly before feeling quite content. Nevertheless, they can swim well when necessary, despite the fact that their feet are unwebbed. In winter they react to low temperatures in several different ways. Valette states, for instance, that at the South Orkneys they often retire, for the duration of the short spells of extreme cold to which these islands are subjected, to natural caverns of the rocks well up on the slopes of the hills. Furthermore, they puff out their feathers during the cold to increase their blanket of atmospheric insulation, causing themselves to look like white balls of fluff. They are fat to begin with, for they are practically blubber-covered, like a seal, the layer over the abdomen often being a centimeter or more in thickness. Finally, they tuck up their feet alternately among the feathers of the belly, and hop about one-leggedly, even while feeding. Valette has observed the Sheath-bills going about their usual activities when the thermometer registered −42.2° C., which is exactly 40° below the Fahrenheit zero. He determined the body temperature of these birds as +40.2° C. The figure obtained by the naturalists of the Scottish Expedition is slightly higher, namely 41.8° C.

Except in places where their confidence has been abused, the Sheath-bills are easy to catch in the hand, their immediate reaction to which is to defecate.

It seems as though this were as specific a defensive mechanism as the response of the Giant Fulmar to disgorge through the beak. Von den Steinen (1890, 216) found that Sheath-bills very quickly became suspicious of a trap. The first few birds he caught easily, but after that the others would not succumb to the ruse, even though a live bird were left inside as a decoy.

In addition to its predacious foraging and scavenging, as described above, the Sheath-bill also feeds much in the intertidal zone, devouring some algae as well as a wide variety of animal life. Small fishes, limpets and many other mollusks, lichens, the shells and contents of birds' eggs, and pebbles, have been found in the stomachs of specimens dissected by many of the authorities already quoted.

In connection with the feeding habits of this curious bird, the morphological notes published by Valette are of interest, particularly his reference to the very large intestinal caeca. According to his measurements, the entire alimentary tract is 155 centimeters long, the length of the respective elements being as follows: esophagus 15; stomach 7; small intestine 125; large intestine 8; length of each caecum 25 centimeters.

The Sheath-bills drink like gulls, filling the beak and then lifting it high to swallow; when the water is frozen they have been observed to eat snow.

I judge that the offensive odor of the Sheath-bill, mentioned by several observers, is associated chiefly with the eating of carrion. The birds I skinned had no distinctive odor.

THE SKUAS AND JAEGERS

FAMILY STERCORARIIDAE

The Skuas, Genus Catharacta

The great skuas, as distinguished from the lesser skuas or jaegers, comprise a bipolar genus of predacious sea birds, of which one form inhabits the northern hemisphere and several the southern. If all of these forms are to be regarded as representing a single species (*Catharacta skua*), as arranged by several recent reviewers, we have here the only example of a bipolar species to be found in the whole class of birds. However, I regard it as still an open question whether the skuas may not comprise at least four species, of which one is the sub-arctic bird, a second that of the South American coasts, a third the circumpolar high antarctic form, and a fourth the circumpolar group of lower antarctic and sub-antarctic distribution, which is admittedly made up of two or more subspecies. The solution of this problem rests less with laboratory systematic work than with observation in the field. Claims in the literature, which are to some extent supported but not fully confirmed by specimens, indicate that more than one kind of skua may nest at the same locality as, for example, the South Shetland Islands. Such a situation, if authenticated, would be entirely out of line with the whole conception of subspecies, and would indicate that the

various representatives of the group are biologically more distinct one from another than is suggested by their differences of color or dimensions.

Whatever value may ultimately be assigned to the different types of skuas associated with definite breeding localities, it is certain that these birds are excellent examples of a somewhat unconventional type of differentiation in nature. One reason is that an extraordinarily wide range of similar variation seems to characterize most of the different species or subspecies. In other words, a distinctive average type of plumage may develop among the members of a single race, but this in almost no case seems to apply to the entire population. There is, on the contrary, always a small proportion which exhibits a range in color and pattern almost as wide as that within the genus as a whole. For such reasons, taxonomic distinctions must be based upon average differences rather than universal differences. Measurements seem to be of little more practical avail than pattern and color because of their wide range among the members of any segregated breeding population, and because of an apparent tendency in some instances for the birds nesting within a single region to fall into two size groups, the differences between which are related neither to age nor sex. For all such reasons it becomes extremely difficult to find intrinsic characters by means of which the various forms of the skua may be classified without the necessity of referring to geographic names on the labels. Even with the last-named help, indeed, the difficulties are by no means ended, for I have seen a large number of well-labeled specimens, taken at points far from breeding grounds, which do not fit properly into series of any of the breeding populations thus far known.

It should be added that the migratory travels of skuas still appear to be full of mysteries and anomalies. According to the latest description of ranges (Peters, 1934, 309), the Northern Skua wanders only as far southward in the Atlantic as New England and Gibraltar. The Chilean Skua, however, is credited with crossing the narrow zone of tropics in the eastern Pacific and leaping, so to speak, from the Humboldt Current to the California Current, in which it has occurred as far north as British Columbia. Furthermore, the South Polar Skua, which breeds chiefly to southward of the antarctic circle, has been taken two or more times off Japan. I have compared a specimen from the Sagami Sea, which is now in the Museum of Comparative Zoölogy, with numerous examples taken in Ross Sea and Weddell Sea, and I find that this Japanese bird is an exact counterpart of those from the Antarctic. Finally, Forbush (1928, 51) reports that skuas of some sort are most plentiful on the Grand Banks of Newfoundland during July, August, and September, and that they have likewise been found in numbers on the fishing grounds off Nantucket between June 19 and November 5. It has been suggested that these skuas, which occur in the temperate North Atlantic during the breeding season of the northern-hemisphere form, may perhaps be migrants from some of the sub-antarctic or antarctic breeding grounds. This is a problem which can be solved only by adequate collecting and comparison. In Part I of this book (p. 138), I have already reported the presence of skuas between the equator and the West Indies during the month

of May. The region belongs to intermediate latitudes, in which no specimens of either the northern or the southern forms have thus far been collected.

Lowe and Kinnear (1930, 113) have recently made a detailed study of the pan-antarctic skuas and of the South Polar Skua, arriving with some diffidence at the conclusion that all the skuas in the world comprise a single species which breaks up into seven geographic races. Their long tables of measurements present some of the difficulties to which I have called attention above, and they admit that it is very difficult to gauge the extent to which an acknowledged geographical segregation of color characteristics can be delimited or defined. The last clause refers to the fact that a cinnamon-red suffusion is a feature of the Northern Skua and of the so-called Chilean Skua, while it is altogether lacking in the South Polar Skua. Among the birds of the sub-polar, pan-antarctic islands, such as the Falklands, the islands of the Scotia Arc, Tristan da Cunha, the Crozets, Kerguelen, and the islands south of New Zealand, this cinnamon-red character is more or less sporadic.

It has remained for Hamilton (1934, 163) to analyze the figures presented by Lowe and Kinnear and, through the use of frequency-distribution graphs based upon fairly large series of specimens, to illuminate a highly puzzling subject. While Hamilton does not by any means succeed in answering the question as to whether the skuas comprise one species or four, he does throw much light upon the pan-antarctic birds inhabiting seven or more groups of islands, and it is these in particular which are the most puzzling members of the genus. No unprejudiced ornithologist, I am sure, can look at the graphs of Figure 1 in Hamilton's paper without realizing that this is the method by which such problems should be approached, and that it is one which could be applied even more usefully to a larger mass of statistical data. Apart from the clear picturing of the normal range of variation, these graphs illustrate the true place of the anomalous or exceptional dimensions which always crop out, even in relatively large series of organisms, and which have in many instances been the bane of systematists. In former studies of my own, relating to shearwaters of the genera *Calonectris* and *Puffinus*, I have called attention to the usefulness of similar graphs in interpreting such problems (Murphy, 1924, 248; 1927, 11).

Another interesting result of Hamilton's statistical work is his exhibition in percentages of the departure from the mean, and the amplitude of variation, in the dimensions of skuas from various breeding grounds. Such data, when based upon an adequately large number of wholly comparable specimens, will eventually enable us to comprehend the amount of normal variation to be expected within a single race of birds, a conception which cannot fail to be of great aid to sound and conservative taxonomic work. The following table gives Hamilton's figures for his largest series of skuas from one locality, together with corresponding data concerning other species of sea birds taken from earlier papers of my own. The point is that the normal extent of variation seems to be of closely similar grade among species not closely related.

RANGE OF SIZE VARIATION, PER CENT

	Lengths of		
	Wing	Bill	Tarsus
40 specimens of the Falkland Island Skua (Hamilton, 1934, 169).	10.6	16.9	13.3 %
100 breeding males of the South Georgian Diving Petrel (Murphy and Harper, 1921, 529).	16	13.4	16.4
97 specimens of the Atlantic Wilson's Petrel, including moulting and immature birds (Murphy, 1918, 127).	14	17	16
100 breeding specimens (50 of each sex) of the Cape Verde Shearwater (Murphy, 1924, 246).	12	22	15
100 breeding specimens (50 of each sex) of the Azorian Shearwater (Murphy, 1924, 247).	10.9	18.4	14.3

Hamilton has taken full account of previous research into the status of the skuas, including the pioneer work of Saunders and others, as cited by Mathews (1912, 491). Following is a summary of Hamilton's conclusions regarding the several groups, together with a critique based upon my own studies which, to only a slight extent, have led me to hold opinions differing from his.

1. The Northern Skua (*Catharacta skua skua*) is geographically isolated from the others. It has usually, but not always, a strong chestnut cast in its plumage.

2. The Chilean Skua (*Catharacta skua chilensis*), a bird of both coasts of South America, is suffused with an even deeper chestnut or cinnamon color than the Northern Skua. Hamilton adds, however, that this form "extends to the Falkland Islands also," and states that on the eastern side of that group he has seen it mixing freely and breeding with the native Falkland form! Such a condition is biologically impossible if the Chilean and Falkland Skuas are to be regarded as races of a single species. Furthermore, Hamilton has here failed to heed his own warning that "field observations must be accepted with reservation" (p. 164), for all of the forty specimens he actually collected at the Falklands proved to be of one race, and the same is true of about twenty examples taken at these islands by Beck during the Brewster-Sanford Expedition, as well as of as many more that I have examined in various museums.

I believe that the explanation of Hamilton's statement is made clear by several of our American Museum skins from East Island and Bleaker Island, of the Falklands, which show a much more rufous condition on both the back and the breast than do most Falkland birds. In other respects, however, such as in their relatively smaller bills, these reddish birds agree with their Falkland neighbors rather than with birds from the breeding center of *chilensis* among the Magellanic islands. The only conclusion that we are justified in making is that there is a certain overlapping in the plumage characters of the Chilean and Falkland Skuas, although the average difference in appearance is quite marked. The same may be said regarding other races or units of these puzzling birds.

3. The South Polar Skua (*Catharacta skua maccormicki*) is a strictly antarctic form distinguished by the entire absence at all stages of chestnut coloring, to a

certain extent by the peculiar vinous tinge of the lower surface, and usually by the presence of a collar of more or less golden, acuminate feathers.

Hamilton (pp. 173, 174) infers that the true South Polar Skua does not occur at the South Shetland Islands, from where it was abundantly recorded by Gain (1914, 109). He states that during the course of a number of visits to the South Shetlands made by Mr. A. G. Bennett and himself no specimens of *maccormicki* have been collected, and that the whole area, as far south as latitude 65° S., is occupied by a different and darker form.

That the last statement is erroneous is indicated by the fact that Mr. Bennett has sent to the American Museum two absolutely typical examples of *maccormicki* collected at Wilhelmina Bay, on the Danco coast (64° 30′ S., 62° W.), on February 8, 1922. These are quite indistinguishable from specimens taken in the polar regions of Weddell and Ross Seas. It thus appears that the breeding ranges of the South Polar Skua and of a form of the "Brown Skua," which occupies many islands of the Scotia Arc, actually do overlap in West Antarctica, as alleged by Gain. If such distribution becomes confirmed, it will clearly be necessary to recognize the South Polar Skua as a fully distinct species from those inhabiting the islands to northward.

4. The "Brown Skua," as recognized by Hamilton, comprises two subspecies, of which one (*antarctica*) is found at the Falkland Islands (and also according to Hamilton at the South Shetlands, but the specimens I have seen compel me to disagree with this). The remaining "Brown Skuas," which Hamilton calls by the inclusive subspecific name *lönnbergi*, occupy the remainder of the world's antarctic and sub-antarctic islands, such as the South Orkneys, South Georgia, Tristan da Cunha and Gough, the Prince Edward, Crozet, and Kerguelen groups, and the southern outliers of New Zealand. With these I should also include the large dark birds of the South Shetland Islands, as will be pointed out below.

Hamilton's statistical studies indicate that the last word has by no means been said regarding finer subspecific division of the skuas at these various insular groups. He makes it clear, for example, that the breeding skuas of the Tristan region cannot be lumped with the birds of the Falkland race, as they have been to date. The important point in his conclusions is merely that the skuas of all the circumpolar islands, from the Scotia Arc eastward to New Zealand, are at least more closely related to one another than they are to skuas belonging in other geographic ranges.

Hamilton has stated a matter which I can abundantly confirm, namely, that plumage characters among the skuas are in the main of very doubtful taxonomic value because of the enormous variation among the several groups. It may be true that the cinnamon or rufous coloration never appears in the South Polar form, but I know of no other qualification which can be defended as a general tenet. There are relatively dark as well as pale members among the South Polar birds. Falkland and South Georgia specimens likewise exhibit every phase between very pale and very dark birds, and some of them show pronounced golden hackles. I have seen light examples from the Falklands, moreover,

TABLE OF SKUAS IN THE AMERICAN MUSEUM COLLECTION

	Wing			Tail			Culmen			Tarsus			Middle toe and claw		
	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.
1. *C. s. chilensis*, 28 typical specimens from the Magellanic region and the west coast of South America.	370	412	**380.4**	131	158.4	**144.8**	48.9	56.1	**52**	60.6	71.5	**67.5**	69	77.5	**74.1 mm.**
2. *C. s. chilensis*, 3 dark brown specimens from off Valparaiso, Chile, and Cerro Azul, Peru	365	393	**377.3**	131.6	142.4	**137.3**	47.4	50.2	**49**	58.2	62.3	**61.4**			**65.5**
3. *C. s. maccormicki*, 9 specimens from near Little America, Ross Shelf Ice	390	410	**397.5**	140	152	**147.4**	47.6	51.8	**49.3**	62.4	65.6	**64.1**			
4. *C. s. maccormicki*, 2 specimens from the West Antarctic Archipelago, lat. 64° 30′ S., long. 62° W., and Deception Island	394	406	**400**	144.5	146.6	**145.5**	49	51.8	**50.4**	63.2	66.4	**64.8**			
5. *C. s. antarctica*, 16 specimens from the Falkland Islands	366	398	**379.6**	139.6	156.7	**146.8**	46.5	50.8	**48.7**	64.3	70	**67.4**			**73**
6. *C. s. antarctica*, 1 specimen, lat. 21° 40′ S., long. 34° 12′ W., South Atlantic Ocean			**391**			**140.5**			**50**			**61.2**			**63.7**
7. *C. s. lönnbergi*, 3 specimens from Deception Island, South Shetlands .	398	400	**399**	146.2	154	**151.4**	54.2	55.8	**55**	69.6	73.3	**72**			**80.3**
8. *C. s. lönnbergi*, 14 specimens from South Georgia	397	416	**407**	143.4	162.4	**153.4**	53.5	58.2	**55.6**	70.8	79.3	**75**			
9. *C. s.*, subsp., 2 specimens from Mar del Plata, Argentina	396	402	**399**	146.5	152.3	**149.4**	57.3	61	**59.1**	69.5	75.5	**72.5**			**78.7**

which have a clear vinous belly, indistinguishable from the ventral surface of many typical examples of *maccormicki*. Furthermore, as already noted, rufous feathers may be present in both the back and belly of Falkland specimens. In addition to well-marked average differences, it may be said also that probably no specimens from the Falklands, or other islands north of the antarctic circle, have the clear straw-yellow heads and necks of the lightest phase of the South Polar Skua. Finally, it appears that even the very red form, *chilensis*, also has a somewhat rare dark brown phase, without a trace of rufous coloration. At any rate, I can explain in no other way three such examples taken in the Humboldt Current, off the coasts of Peru and Chile.

While the measurements of Lowe and Kinnear and those of Hamilton lead to many of the same conclusions as do the figures I myself have recorded, there are uniform discrepancies between the two series which evidently result from a slight difference in technique. Thus most of Hamilton's figures for bill length are somewhat shorter than mine derived from birds of the same respective regions. In making my own measurements for this dimension, I inserted the calipers between the feathers of the forehead until the point rested at the very base of the horny covering of the maxilla. The accompanying table and the subsequent discussion are, therefore, based entirely upon specimens compared and measured by myself in the American Museum of Natural History and elsewhere. These data relate entirely to southern-hemisphere birds of the South American region, and they are listed in the same order as that of the digest of Hamilton's conclusions given above. Among skuas in general there seems to be no size difference dependent upon sex. Average measurements for males and females approximate the same figures in adequate series of properly comparable specimens. I have, therefore, not segregated the sexes in my table. Furthermore, since I cannot decide whether the skuas represent one species or four species, I am for the present arbitrarily regarding all of them as geographic races of a single species.

Since descriptions of the southern-hemisphere skuas can most intelligibly be given in comparative terms, I append descriptions of the Northern, Common, or Great Skua taken from Ridgway and from Witherby.

Catharacta skua skua Brünnich

"Adults (sexes alike).—General color dull grayish brown, the interscapulars, scapulars, and wing-coverts with median streaks of pale cinnamon, the feathers of head and neck with similar but narrower streaks; under parts somewhat paler than upper parts, usually more or less suffused with cinnamon, the sides and flanks indistinctly striped or broadly streaked with the same; remiges, primary coverts, and alula dark grayish brown or dusky, the primaries white basally, forming a distinct patch, the concealed basal portion of secondaries also white; tail uniform dusky; bill dusky horn color or dull blackish; iris dark brown; legs and feet dull blackish.

"Young.—Head, neck, and under parts plain grayish brown, the last tinged with cinnamon or dull rusty; upper parts darker grayish brown, paler on back and lesser wing-coverts, where indistinctly spotted with dull rusty or cinnamon; otherwise essentially like adults, but bill, legs, and feet more brownish.

"Downy young.—Plain buffy or cinnamomeous gray, darker (sometimes more cinnamomeous) on upper parts" (Ridgway, 1919, 677).

"Adult male and female.—Fore-head and crown dark brown, distal portions of feathers with broad central streaks (not very prominent) of pale rufous-brown (often a few white feathers on head); feathers of back and sides of neck lanceolate, and dark brown with prominent straw-yellow median streaks; mantle, scapulars and upper tail-coverts dark brown, distal portions of feathers with broad central streaks of rufous, centre of tips paler and becoming whitish when worn; back and rump same but rufous and pale tips less conspicuous; lores, round eyes and chin more uniform dark brown, but feathers more or less tipped yellow-buff; throat streaked and marked rufous and pale buff but not so prominently as sides of neck; rest of under-parts grey-brown mottled rufous and feathers of flanks and under tail-coverts with more prominent central tips of pale buff and rufous; axillaries and under wing-coverts dark brown, feathers with varying amount of rufous at tips; tail black-brown, white at extreme base concealed by coverts; primaries black-brown, white at base (on outer 5 feathers 30–60 mm. beyond coverts and making larger white patch on underwing), in outer (2nd) primary outer web only white at extreme base which is almost concealed by coverts, four inner primaries and secondaries black-brown with concealed basal part of feathers white, shafts of primaries whitish-straw almost to tips and those of secondaries on basal two-thirds; primary-coverts black-brown; rest of wing-coverts as upper-parts but greater with only small rufous and pale central tips. This plumage is probably attained by a body-moult early in year, but no birds from Jan. to March are available. Winter.—One adult (Dec.) is moulting remiges and wing-coverts and body-moult is nearly complete, while others from June to Sept. are moulting on body but not wings or tail. New feathers of neck are rounded and brown without straw-coloured median streaks, and there is no yellow-buff on feathers of throat and ear-coverts, otherwise plumage appears to be like summer" (Witherby, 1924, 777).

CHILEAN SKUA

Catharacta skua chilensis

Stercorarius antarcticus b. *chilensis* Bonaparte, 1857, Consp. Av., 2, p. 207 (Chile).

Names: Cinnamon Skua; "Gaviotón"; "Pájaro Ladrón" or "Halcón de Mar" in Chile and Peru. Synonyms of the specific name include several which have been applied to skuas in general, such as *antarctica* and *catarractes*.

Characters: One of the two smaller forms of southern-hemisphere skuas, the other notably small-sized race being that confined to the Falkland Islands. Typically the brightest and most cinnamomeous of all skuas, though "brown" phases perhaps exist. Nearly all adult examples, however, differ from the Northern Skua in that the axillars, under wing coverts, and ventral surface are mostly cinnamon or cinnamon-rufous, instead of grayish brown. The general plumage-pattern is in other respects generally similar to that of the Northern Skua. Iris brown; bill dark reddish umber; tarsi black, sometimes mottled with yellowish; toes black, the webs dusky brown.

Measurements of about 30 specimens are recorded in the table on p. 1011. The following dimensions refer only to adults from breeding stations:

7 males from nesting grounds at islands near Tierra del Fuego: wing, 390–398 (394.8); tail, 140–158.4 (148.3); exposed culmen, 49.4–56.1 (52.2); tarsus, 60.6–72.3 (68.6); middle toe and claw, 74.3–75.5 (74.9) mm.

5 females from the same localities: wing, 387–411 (395.6); tail, 135.6–143 (139.1); exposed culmen, 51–56 (53.3); tarsus, 66–70 (68.2); middle toe and claw, 72.1–77.5 (74.7) mm.

Youthful examples have less solid cinnamon coloration on the feathers than adults, but they are still much more rufescent than the young of any other skua. The downy chick closely resembles that of the Northern Skua. The bill is slaty, and there are light-colored areas on the legs and feet.

Oates (1901, 226) states that the eggs are indistinguishable from many eggs of the Northern Skua. A common type is of grayish buff ground color, spotted and blotched with pale yellowish brown and underlying pale purple. He records an example from Sea-lion Island, in the mouth of the Río Santa Cruz, Patagonia, which measures 73.7 x 52.1 mm. Paessler (1922, 444) gives dimensions of two eggs from Santa María Island, Bay of Arauco, and one from Tierra del Fuego, as 69 x 51.6, 67 x 48, and 72 x 50.5 mm. One egg of a set originally containing two was collected by

Beck from beneath an incubating male bird at Caroline Island, December 14, 1914. It is buff, with only few and faint markings, and measures 69.2 x 59.5 mm.

Distribution: Breeds in Tierra del Fuego, the neighboring islets, and northward through the Magellanic region of the west coast of South America to the Bay of Arauco, Chile; ranges northward along the west coast to northern Peru and casually to the northern hemisphere; on the east coast of South America it is said to range northward to Rio de Janeiro.

Throughout the length of the Humboldt Current the "Pájaro Ladrón" (thief-bird) is a familiar sight, harrying the boobies and Fork-tailed Gulls (*Creagrus*) or fishing on its own account. Its white wing-patches and its beating flight, which is far swifter than it appears to be, advertise the bird at long range. In Peruvian coastal waters I have frequently seen the skuas pass so close to my steamer or fishing-boat that their cinnamon breasts showed clearly. On the other hand, very dark brown birds, of a type not ordinarily described in the literature on this race, are by no means uncommon. I have seen a considerable number of these in life, as well as four specimens among a total of about twenty-three collected in the shore waters between Corral, Chile, and Callao, Peru.

The Humboldt Current is, of course, the migratory range rather than the breeding range of the Chilean Skua, and yet I find by going through my notebooks and those of Mr. Beck that we have observed it in northern waters during the whole period of its breeding season, as well as throughout the southern winter. Characteristic records, from north to south, are as follows, birds collected being noted by an asterisk: Lobos de Tierra Island, September 7; Salaverry, January 5; Mazorca Island, September 10, common; near Huacho, June 16, several; *off Callao, June 19 (MacFarlane (1887, 206) likewise reports the skuas as abundant in the Bay of Callao during August and September, pursuing the gulls); *off Cañete, June 26; *off Cerro Azul, July 2; *off Pisco Bay, June 27–29, numerous; *near the Ballestas Islands, October 19, two collected.

Along the coast of Chile the records of this skua are very numerous, and a summary of the more important observations and collections has recently been given by Hellmayr (1932, 414). Bullock saw an example in the coastal waters of Mocha Island on December 14, 1932, but he did not find the species in residence. The northernmost definitely known breeding locality is at Santa María Island, in the Bay of Arauco, where Paessler (1909, 101) has collected eggs. The same author, however, has observed toward the end of December, at Punta Angamos, Mejillones Bay, adults with young birds which he believed to be not far from their breeding grounds. During the Brewster-Sanford Expedition, Beck collected numerous examples off Corral during September and October, and others within or near the harbor of Valparaiso during March. While he was voyaging by schooner between Valparaiso and the Juan Fernández Islands, in December, 1913, he occasionally saw skuas up to distances of 150 kilometers or more from the mainland coast. On June 6, 1914, he observed a number fishing off Ancúd, Chiloé Island, and from this point southward through the Magellanic region they appeared frequently in his notes and in his bag of specimens.

Information is unsatisfactory regarding the occurrence of the Chilean Skua along the east coast of South America. The only Brewster-Sanford specimen is

one captured at Río Gallegos, Argentina, on June 3. Oustalet (1891, 172) records four examples taken near the mouth of the Río Santa Cruz in November, and in the British Museum there are at least two specimens from the coast of Brazil. It seems probable, however, that most of the migrant skuas that have been taken along the Argentine, Uruguayan, and Brazilian coasts, are not of this form, but are brown birds from the Falklands or from breeding grounds at other Atlantic islands.

All of the Chilean Skuas collected by Beck within the Magellanic breeding range were "pink-breasted" birds. It is therefore possible that the several dark brown examples taken off the coast of Peru and central Chile, and listed in line 2 of the table on page 1011, are representatives of some other form. Unfortunately, the measurements of these specimens are of little aid in determining the matter. Ruddy birds, which had passed the physiological peak of their reproductive rhythm, were taken in the Strait of Magellan toward the end of February, and breeding examples were collected at London, Caroline, and Vauverland Islands, to southward and westward of Tierra del Fuego, during December and January. A male taken at Caroline Island on December 19 was close to its nest, in which were two eggs ready to hatch, and two young just out of the egg were found at Vauverland Islet, in the Gulf of Nassau, on January 6. Another nest, on the exposed top of a tiny holm off Caroline Island, is described by Beck as a slight ring of grass. It contained two heavily incubated eggs on December 14.

Chapman (1933, 371) speaks of the surprising number of skuas observed on a motor trip in Tierra del Fuego about the end of January, and it thus seems very curious that the species is not even listed in Crawshay's (1907) comprehensive book on the birds of that region, especially since many earlier observers have recorded it from the Strait of Magellan.

Judging by the plumage condition in our excellent series of specimens, the greater part of the moult in the Chilean Skua takes place while the birds are on their winter wanderings. Most of those shot within the breeding area are in fresh and bright plumage. A June example from Callao, on the other hand, is exceedingly worn and frayed, with quill replacement under way, the inner primaries being quite new. There seems to be considerable variation in the relative length of the jaeger-like middle pair of rectrices in this species, and doubtless also in other skuas, a fact which makes the length of the tail perhaps the least useful measurement for comparative purposes.

The habits of the Chilean Skua are similar to those of other forms more fully described in the following biographies. Nicoll (1904, 47) writes,

> This fine Skua was not uncommon in the Straits of Magellan and Smythe's Channel. Several times four or five birds followed us in to our anchorage. They were very wary, and I found that the best way to procure them was to tie a dead Cormorant to a long string and let it drift away from the ship. A Skua would soon discover it and come down to tear it to pieces; when thus engaged it might be approached without difficulty.

Paessler (1922, 444) reports that the Chilean Skua is feared by practically all other birds within its range, not excepting even the valiant Kelp Gulls. If a

carcass is tossed overboard from a steamer, quickly to be surrounded by the hungry gulls, they appear to make place respectfully as soon as a skua joins the throng. The skua will attack even a cormorant, especially when the latter has captured fish too large for it to swallow immediately, and will literally take the prey out of the beak of the fisher if the latter does not dive at once. Only the big Peruvian Pelicans seem to be immune from the attacks of the skua. The swift South American Terns (*Sterna hirundinacea*) are pursued until they eject the hard-won fishes from their throats and, as a rule, the pirate has little difficulty in recovering such food before it reaches the water. Fish of various unnamed sorts have been reported as the stomach contents of Chilean Skuas collected in the Strait of Magellan and elsewhere. An example which I shot in Pisco Bay, Peru, during October, was filled with anchovies, and a second taken on the same occasion contained one silverside (Atherinidae) and several examples of a herring that the Peruvians call "machete" (*Potamalosa notacanthoides*). The latter were fragmentary, and are perhaps more likely to have come by way of the gullets of boobies or cormorants than to have been captured by the skua.

SOUTH POLAR SKUA

Catharacta skua maccormicki

Stercorarius maccormicki Saunders, 1893, Bull. Brit. Orn. Club, 3, p. 12 (Possession Island, Victoria Land, latitude 71° 14′ S., longitude 171° 15′ W.).

Names: This species has also appeared in the literature under the specific name *antarctica*, and an example which wandered to Japan was described under the name *matsudairae*.

Characters: Generally much paler than the Northern Skua and than other forms of the southern-hemisphere skuas in fresh plumage, and without cinnamon-red suffusion in the plumage. Ventral surface usually pale buffy brown; neck conspicuously streaked with yellow or "golden" hackles; white area at base of primary quills larger than in other forms. Natal down unique in color, being at first bluish gray instead of buffy.

A medium-sized skua, averaging slightly larger in most dimensions than *C. s. chilensis* or *C. s. antarctica*, but with a relatively short tarsus. Notably smaller, except in wing-length, than the pan-antarctic Brown Skua.

Measurements are recorded in the table on p. 1011. The average weight of four examples obtained during the 'Terra Nova' expedition was 1224 grams. The body temperature of a South Orkney example was 41.1° C. (Valette, 1906, 57).

Variation is wide, as discussed above and in the following text. In an average example described by Saunders (1896, 321, pl. 1) the crown was clove-brown, the acuminate feathers of nape and neck strongly marked with golden straw-color, the upper breast streaked with the same, though in less degree; the remaining parts of the ventral surface gradually darkening to coffee-brown on the abdomen; mantle, wings, and tail chiefly umber. Iris brown; bill, legs, and feet black or blackish.

Fledglings show a bright blue patch of skin above the tibio-metatarsal joint. The newly hatched chick is covered with gray-blue down, which subsequently turns brownish, apparently as a result of absorption of oil from the subcutaneous tissues.

Eggs number two in a set, and closely resemble those of other skuas, being equally variable. Oates (1901, 226) notes, in addition to dark examples, several of clear greenish blue ground color, sparingly marked at the large end with a few smears and blotches of yellowish brown. 26 examples from Cape Adare measured between 65.5 and 78.7 mm. in length, and between 47.7 and 52 in breadth. Eggs from West Antarctica attributed by Gain (1914, 114) to the South Polar Skua measured 65.5 x 48, 75 x 51.5, 74.5 x 52, and 71.5 x 41 mm.

Distribution: Breeds apparently on all suitable shores of the antarctic continent, as in Ross Sea, Weddell Sea, Queen Mary Land, etc., and also in the West Antarctic Archipelago northward to latitude 65° S. or beyond. Winters chiefly at sea, and has been taken at the South Shetland and South Orkney Islands; apparently wanders at times into the North Pacific.

The South Polar Skua was discovered during the first visit of the 'Terror' to Ross Sea, in January, 1841, being recognized at once by the members of the British Expedition as quite different from the skuas they had observed at the Auckland and Campbell Islands on the southward voyage (McCormick, 1884, 154). It undoubtedly holds the distinction of being the southernmost bird on the globe. Amundsen encountered two at the inner edge of the Ross Shelf Ice, in latitude 84° 26′ S., on January 9, 1912; and in December of the same year, Mawson (1915, **2**, 289) observed one which flew off in the direction of the pole when he was in Adélie Land, more than 200 kilometers from the sea and at an altitude of 1100 meters. Gain believes that two or three seen by Scott and Wilson in latitude 80° 20′ S., more than 300 kilometers from open water, had been attracted this enormous distance by the wind-borne odor of the blood of a sledge dog slain some time before!

Little is known about the normal pelagic range of the South Polar Skua, but it is highly probable that the season of its complete and definite winter migration away from the breeding grounds is spent almost altogether in the pack-ice.

In most parts of the far south, six or seven degrees of latitude seem to stand as neutral ground between the range of the South Polar Skua and that of any member of the genus inhabiting the ring of islands in the southern oceans. In West Antarctica, however, this barrier largely disappears, for the pale Polar Skua comes into such close contact with the Brown Skuas of lower latitudes that the separation of the two, as they are recorded in the literature, becomes a matter of considerable difficulty. Hamilton (1934, 174) discusses the question as follows:

> L. Gain (1915) [=1914] has stated that he found McCormick's Skua on Deception Island, South Shetlands, where it was mixing with the Brown Skuas but was more numerous. He found *maccormicki* nesting as far north as Admiralty Bay, 62° 6′ S., and mentions it as nesting at Port Lockroy in Wiencke Island, 64° 49½′ S. In the course of a number of visits to the South Shetlands by Mr. A. G. Bennett and myself no specimen of *maccormicki* has been collected, and in my observation the whole area as far south as 65° of latitude is occupied by the darker bird, i.e. *C. s. antarctica*.
>
> The brown form is abundant and nests at Deception, and while Gain records having seen it as far south as Wiencke Island at the south end of the Belgica Straits he states that it did not nest in the Straits. In 1922, however, I found that Port Lockroy had become a nesting site.
>
> It may be suggested that the Brown Skua, which is slightly larger than *maccormicki*, favoured by the abundant food supply derived from the extensive whaling operations subsequent to 1909, had succeeded in ousting *maccormicki* from its former breeding places in the South Shetlands, at least as far south as Port Lockroy. It is well known that the skuas are most combative birds and even given to cannibalism at times.

Now I have already shown that absolutely typical specimens of *maccormicki* have been collected by Mr. Bennett himself in this very region. These are the birds recorded in line 4 in the table on page 1011. One of them was a female

with enlarged ovaries, taken at Deception Island on December 11, 1921, and the second a female from Wilhelmina Bay on the Danco coast, taken on February 8, 1922. Furthermore, Gain has distinguished between the South Polar Skua and the Brown Skua in a manner that cannot be controverted. He summarizes the division in the west antarctic ranges of these two forms as follows: the Brown Skua nests at the South Shetlands, on the opposite coast of Louis Philippe Land, and elsewhere to northward of De Gerlache Strait, the northern end of which is in approximately latitude 64° S. The South Polar Skua nests at the South Shetlands, along the shores of De Gerlache Strait, on the islands of Wiencke, Booth-Wandel, and Petermann, and along all coasts of the archipelago to southward. The newly hatched young of the South Polar form are very different in appearance from those of any other group of skuas, for they are of slaty gray color instead of being buffy. Gain (1914, 115), in describing this coat as "un duvet gris bleuté," shows positively that he distinguished between the South Polar Skua and the Brown Skua.

It thus appears that the breeding ranges of the two forms are in such close contact as to suggest that there must be two fully distinct species. In considering this matter, however, attention should be paid to the possibility of recent and more or less artificial changes in distribution, due to whaling operations.

In more northerly parts of West Antarctica, the Polar Skua has been observed at Laurie Island of the South Orkneys during November and December, the birds being readily distinguishable from the native skuas by their smaller size and lighter coloration (Valette, 1906, 57). An example was shot here on November 11, 1904, and examined by members of the 'Scotia' expedition who were entirely familiar with the breeding birds of the island (Brown, Mossman, and Pirie, 1906, 348).

In the collection of the American Museum this species is represented by the two specimens from West Antarctica already referred to, by examples obtained in the Weddell Sea region by Bruce and by Filchner, and by nine birds collected near the eastern end of the Ross Shelf Ice during the first Byrd Antarctic Expedition. The examples from opposite coasts of the antarctic continent are not distinguishable in size or pattern, as has already been reported by Lowe and Kinnear (1930, 122). It is worth remarking, moreover, that animals of high antarctic latitudes rarely exhibit racial differentiation; they are circumpolar in the fullest sense of the term, and doubtless have practically continuous breeding ranges around antarctic coasts in so far as physiographic conditions permit. Measurements of the adult breeding specimens from Ross Sea are listed in line 3 of the table on page 1011.

The following data on the life history are taken chiefly from the accounts of Gain, Levick (1914, 125), Bernacchi (1901, 204), and Wilson (1907, 36).

When the skuas return from their migrations to their breeding grounds in West Antarctica, most of them are in relatively dark plumage which, however, becomes rapidly bleached by the actinic rays of the sun passing through a practically dustless atmosphere. Similar action of such light has already been referred to, in connection with its effect upon antarctic penguins. By January,

the prevailing coloration of many of the birds is what Gain expressively calls "chamois très clair," or even whitish. Moult and replacement of feathers in this form immediately succeed breeding activities, and with this change the birds again take on a somewhat darker aspect.

On all antarctic shores the skuas seem to begin to arrive from the north in late October, their numbers increasing very rapidly after the appearance of the first penguin eggs in early November, so that by the end of that month the entire population is back at the breeding ground. The nesting of the skuas at Cape Adare has been observed to begin by November 12, the chosen sites being mostly on small headlands or in screes overlooking penguin colonies. The French naturalists found an aggregation of upwards of 200 pairs on a sunny, northern exposure of Petermann Island, extending from the shore to an altitude of 130 meters. The nest itself is nothing more than a scrape, without lining, and is often one of several that the hen makes before laying. Eggs have been found at Cape Adare as early as November 29, but most records for West Antarctica are a month or more later than this, although Gain reports that he procured the first eggs at the beginning of December and the first hatched chicks a month later. Two eggs constitute the whole set, there being an interval of two days between the laying of each. If the first set is removed from a nest, a second will be produced, but not a third. If, however, only one egg is taken, the birds will merely continue to incubate the remaining egg, for an empty nest is the essential stimulus to relaying. Incubation lasts about four weeks.

The newly hatched chicks quarrel in the nest from the date of hatching; therefore they tend to separate from one another, as a result of which one of the two is sure to ramble outside the field of conscious parental protection, whereupon it is equally certain to be pounced upon and killed by a hungry neighbor or by its own deluded parent. The adults are little given to brooding their young or otherwise guarding them from the elements and, according to Wilson, less than fifty per cent of the skuas survive beyond early infancy in these regions of rigorous environment. For one reason or another, the parents themselves very frequently eat their own young. Gain found many chicks thus destroyed—not entirely devoured, but with their eyes and entrails picked out. Moreover, it is a common occurrence for half the offspring to be eliminated even before hatching, through the swallowing of one egg by a parent.

Young skuas are fed not from mouth to mouth but from the ground, and before they are many days old they learn to pick about, in the manner of domestic chickens, among the pebbles near their nests. Gain says that the adults merely deposit fragments of fish and crustaceans close to the nest, allowing the chicks to help themselves. By the end of February, the oldest young are capable of flight, and the beginning of departure for the north takes place in early March.

At the South Shetlands, according to Gain, the skuas not only hunt for fish and crustaceans, and rob such birds as cormorants of their spoils, but they also do not disdain to eat seaweed, moss, and lichens, when other food fails. They are quick to take advantage of the slaughter of whales, and to gobble up the

placenta of the newly born Weddell and crab-eater seals. The bulk of their food here as elsewhere, however, comprises the eggs and chicks of various sorts of penguins. Eggs are stolen whenever left exposed, and can be picked up almost without a pause in the skuas' flight. In victimizing young penguins, they attempt to cut one off when it is somewhat separated from its fellows, contriving to urge or drag it little by little away from the center of population, and then strike it on the head and gradually worry it to death, ending by picking out the eyes and making two holes in the back through which the tissue of the kidneys can be extracted. Hundreds of bodies of young penguins, trampled into the soil, show evidence of these particular mutilations and can be found about the edges of all the colonies. There is, indeed, no defense against the appetite of the skuas except a fitness and willingness to fight back. They are as ready to eat their own kind as any other species of animal; Levick has given a ghoulish description of how sick skuas are spotted and tormented by their own fellows, being free from actual attack only so long as their lessening strength still enables them to fend off the unhurried but inexorable brethren.

The great strength of the Polar Skuas enables them to carry off chunks of food heavier than themselves. They are, of course, noisy when competing and feeding together, the sound of their bickering being likened by Levick to the medley of a flock of farmyard ducks. Besides such chatter, they have a repertory of gull-like shrieks and screams.

At the end of summer the skuas leave the Antarctic Archipelago; the last birds to depart from the Petermann Island district were noted by members of the French Expedition between April 15 and 20. During the winter absence, when the birds spend most of the time in the pack-ice, they secure the better part of their food through what might be called honest efforts, instead of by means of highway robbery and despoliation. At sea they appear in the main to subsist upon the abundant euphausians of the ice-floes, the same organisms which support the wintering Adélie and Emperor Penguins, the Snow Petrel, and the crab-eater seal.

FALKLAND SKUA

Catharacta skua antarctica

Lestris antarcticus Lesson, 1831, Traité d'Orn., livr., 8, p. 616 (Falkland Islands).

Names: Sea Hen or Port Egmont Hen; "Gaviota Parda" is an Argentine name. Synonyms of the specific name include those applied to other skuas such as *catarractes*, besides which the subspecific name *falklandica* has also been applied to this form.

Characters: Smallest of the skuas; of highly variable plumage, but most closely resembling the Brown Skuas of the pan-antarctic islands. Further discussion of feather characteristics is reserved for the text below.

The following measurements form the basis of those listed on p. 1011, but are here segregated as to sex. They all refer to resident, breeding adults from the Falkland Islands:

10 males: wing, 366–387 (376.4); tail, 139.6–154.5 (145.8); exposed culmen, 46.5–50.3 (48.7); tarsus, 64.3–70 (66.9); middle toe and claw, 72.2 mm.

6 females: wing, 378–398 (384.6); tail, 140–156.7 (151.7); exposed culmen, 47–50.8 (48.9); tarsus, 64.7–69.6 (68.2); middle toe and claw, 73.9 mm.

The natal down is buffy, like that of all skuas save *Catharacta skua maccormicki*.

The eggs, according to Vallentin (1924, 305), appear to be of two phases, of which one is dark and "normal," while the other is pale bluish white, with a few brown spots. Eggs of the latter type are particularly common at Carcass Island, but have been found also at Port Egmont and elsewhere.

Five sets of two, taken by Beck at East Island, December 10, 1915, may be described as follows, with reference to his field numbers:

135. From one of about 20 nests within a small area. Eggs very different in both shape and color, although similar in the pattern of their markings. One of them has a ground color close to grayish olive, while the other and smaller is buffy brown. The overlying marks are irregular dark brown spots, varying in size from tiny points to blotches with a diameter of 15 mm. or more. The blotches buried beneath the surface of the shell are, of course, paler. 68.1 x 50.5; 63.7 x 58.3 mm.

134. Generally resembling the preceding set, but with more pronounced differences of form, ground color, and pattern between the two eggs. The markings on one include heavy scrawls in addition to more or less regular blotches. 72.3 x 49.1; 67 x 58.7 mm.

133. In ground color the most dissimilar set of the series. One is pale pea-green, with sparse spots which are likewise pale because the pigment underlies the limy coating of the shell. The second is grayish olive, with brown blotches on the surface. 69.9 x 59 1; 69.1 x 50.6 mm.

137. Grayish olive, one with a distinctly more brownish cast than the other; spotting rather sparse and pale. 71 x 50.1; 70.5 x 49.9 mm.

138. Of only slightly different ground color and rather heavy brown blotching, but dissimilar in shape, one being rotund and the other considerably pointed at the smaller end. 74 x 50.6; 73 x 53.2 mm.

Distribution: Known as a breeding bird only from the Falkland Islands, from which it ranges northward along the South American coast to beyond the latitude of Cape Frio, Brazil. (The resident skuas of Gough Island and Tristan da Cunha appear to represent a distinct race, and to have closer affinities with the skuas of South Georgia than with those of the Falklands.)

The Falkland Skua, as shown by the statistical studies of Hamilton and the measurements of 16 Brewster-Sanford specimens listed in line 5 of the table on page 1011, is a very distinct race, most closely related neither to the Chilean nor to the South Polar Skua, but rather to the "brown" birds of the circumpolar pan-antarctic islands. It has, however, a wide range in coloration. Our Falkland specimens exhibit, indeed, every phase between very dark brown birds and others as pale as the lightest from South Georgia or elsewhere. Many of them also have pronounced golden hackles on their necks. Even in the lightest examples, however, the dorsal surface is always somewhat streaky or spotty, and no Falkland bird shows the clear chamois color of the head and mantle that characterizes certain South Polar Skuas, even though a few of them do have a vinous belly practically indistinguishable from that of *maccormicki*. Rufous feathers, similar to the typical plumage of *chilensis*, are often present to a limited degree in the backs and breasts of Falkland Island specimens, as previously noted. But Falkland birds are not larger than the South Polar Skuas, as stated by Bennett (1920, 256). On the contrary, the measurements in my table show that they are definitely smaller in every dimension except length of the tarsus. The Falkland Skua is, in fact, the smallest of all known forms of the genus, the difference being particularly striking when Falkland birds are compared with the larger representatives from other islands of the Scotia Arc or from those that extend eastward toward the New Zealand region between the 40th and 60th parallels of south latitude. Even the birds of Tristan and Gough are larger than those of the Falklands.

It is clear from what I have written above that the names and identities of

skuas captured along various parts of the South American coast have been badly confused. Most of the published records have a quite uncritical basis, so that they give us no dependable clue as to the actual place of origin of migrant birds. The fact is emphasized by two skuas collected by Beck at Mar del Plata, Argentina, during early October, 1914, and listed in line 9 of the table on page 1011. These birds are Brown Skuas bearing a general resemblance to certain Falkland specimens; nevertheless, they show by their measurements that they are of quite different provenance. The point of this comment is that we shall know practically nothing about the pelagic range of Falkland Skuas until more comprehensive collecting has been followed by far more thorough systematic work. It is therefore of special interest to point out that a skua which I shot from the brig 'Daisy,' on October 26, 1921, in latitude 21° 40′ S., longitude 34° 12′ W., is absolutely indistinguishable in appearance and measurements from Falkland birds. This specimen is listed in line 6 of my table. The point on the ocean at which it was taken lies southeast of the Abrolhos Islands, and about halfway between Cape São Thomé and the island of South Trinidad.

Birds listed under the name of the Falkland Skua have been recorded from the Patagonian coast (Dabbene, 1918, 218), from the eastern entrance of the Strait of Magellan in mid-May (Paessler, 1909, 101), and from the coast of Buenos Aires between the end of April and the end of August. At the last locality they are commonly observed in pairs, or in bands of a half dozen or more (Daguerre, 1922, 261). Such observations may well refer to Falkland birds, but in view of the character of the two specimens shot by Beck at Mar del Plata, there can be no certainty about it.

During the course of the Brewster-Sanford Expedition, Beck collected about 20 specimens of the Falkland Skua, and on December 10, 1915, he took at East Island five sets of fresh or very slightly incubated eggs.

At the Falklands the skua is known by the nearly universal sailor's name of Sea Hen. The birds arrive from their pelagic wanderings during the first half of October, and remain until April, by which time all but stragglers have departed. They make their nests as a rule on relatively high ground and, although they are not deliberately placed close together, a community of interests supplied by neighboring rookeries of gulls, penguins, or cormorants usually results in a sort of colonial aggregation of the skuas. The foundation of the nest is little more than a scrape in the soil, but this is frequently lined to a slight extent with grass. Two eggs, or rarely three, are laid late in November or during the first half of December, and a month later the fluffy balls of buffish down hatch out.

Although the Falkland Skua is a wary bird during part of the period of its residence, it never hesitates to attack a man or dog boldly during the nesting season. The birds scream harshly and swoop at any intruder that comes near their young. The sheep dogs are much afraid of them and learn to throw themselves upon their backs when the skuas attack, and many human beings at the Falklands have been stunned by the blows of the birds after they had unwittingly approached too close to a nest (Vallentin, 1924, 305).

The height of the breeding season comes about Christmas time, and Cobb (1933, 50) writes as follows of the dash and verve of the Falkland Skuas at this season.

It means a merry Christmas for any human being or dog who dares to approach anywhere in their vicinity, either on business or for pleasure; if the latter, it is mostly on the Skuas' side. Gathering sheep for shearing in a Sea-Hen-infested area is no joke.

These birds are always labouring under the delusion (which is not always a delusion, by the way) that all men and dogs seen are after their little ones. This makes them croak with rage and sail at top speed straight for the head of the unfortunate dog or man—which they miss by inches as a rule, but occasionally hit. If they hit, it is worse than unpleasant, for they are exceptionally strong on the wing and are capable of making one see stars by daylight with their terrific biffs on the back of one's head.

Men have been knocked down by them and dogs so terrified that they take refuge from them under the friendly lee of the horse's heels, knowing that it is the highest point that will be struck, if any. They refuse to get on with their job of gathering the sheep, which in itself is a crime, and the beginning of more troubles for the Sea Hen family.

At times the air is so full of these birds that the only way to progress at all is to lash a sheath-knife to a stick and hold it above one's head. There is no second innings for the Skua that strikes the knife.

A favourite game played by a pair of Sea Hens is to rake you fore and aft simultaneously. Starting a savage swoop almost synchronising with mother's, father will do his best to scalp you from the front, while his better half tries to make your back hair stand on end from the rear, which is a hair-raising game in more senses than one, should they succeed in knocking off your hat.

Cobb describes, furthermore, the raid of a skua into a larder of gull eggs:

At one rookery the writer watched a Sea Hen arrive, chased by a pair of pied Oyster-Catchers; the gulls arose in a body, chortling, laughing, and screaming, and joined in the pursuit, leaving all their eggs uncovered. The Sea Hen dodged and sailed through the whole lot backwards and forwards, enjoying the fun—as an international footballer might run through a crowd of boys—although a gull tweaked it by the tail, while the Oyster-Catchers screamed at and worried it. Finally, with a long, low, unexpected swoop, it carried off an egg in its bill.

In addition to pilfering from the penguin, shag, and gull colonies, the Falkland Skuas are of course always ready to pick up small petrels or young birds of any kind. Cobb writes that they bully the shags into disgorging their breakfasts, and that a skua will start eating goose eggs a yard from a grazing horse's nose. When a sheep is being skinned, they will assemble and wait to inherit the carcass, and they are quick to attack lambs or sickly full-grown sheep. As scavengers they rank, in fact, with the local Turkey Vultures. Beck records seeing groups of them sitting among the Kelp Gulls near a slaughterhouse on the shore of Stanley Harbor. At some of the outlying islands of the Falklands, he found that the tables had been turned on the skuas, which were regarded by the inhabitants as game birds. Eighteen or more of them were shot and eaten by the residents, for example, during his visit to Sea Lion Island in December.

BROWN SKUA

Catharacta skua lönnbergi

Catharacta antarctica lönnbergi Mathews, 1912, Novit. Zoöl., 18, p. 212 (New Zealand seas).

In adopting this name for all the circumpolar Brown Skuas, except the race of the Falkland Islands, I am following the conclusions of Hamilton (1934, 173). The following additional races have, however, been described:

Catharacta lonnbergi clarkei Mathews, 1913, Birds Australia, 2, p. 494 (South Orkney Islands).
Catharacta lonnbergi intercedens Mathews, 1913, Birds Australia, 2, p. 494 (Kerguelen Island).

Names: The representatives of this form have been variously called Sub-Antarctic or Antarctic Skuas, or have been known by the names of their respective insular localities; Sea Hen and Sea Hawk are appropriate sailors' names; synonyms of the scientific name include most of the names which have been applied to other forms.

Characters: Largest of the skuas, the size character showing in every dimension, but particularly in the length and bulk of bill and tarsus. Prevailingly "brown" in plumage, *i.e.* with a minimum of "chamois-color" and of cinnamon, but subject to wide individual variation, as described in the following text. Some specimens, even in fresh plumage, are very whitish on both mantle and ventral surface.

Measurements are listed in lines 7 and 8 of the table on p. 1011. The following refer to breeding adults of each sex from South Georgia:

6 males: wing, 401–416 (407); tail, 153.5–162.4 (156.9); exposed culmen, 54.3–58.2 (56.5); tarsus, 70.8–79.3 (75) mm.

8 females: wing, 397–416 (407); tail, 143.4–157 (150.5); exposed culmen, 53.5–56.7 (55.5); tarsus, 72.8–79 (75.3) mm.

The length of middle toe and claw in 11 examples of both sexes is 76.8–84 (78.7) mm.

Birds from the South Shetlands are of identical size and appearance. Valette (1906, 56) reports that the length in the flesh of a Brown Skua from the South Orkneys was 63 cm.; its wing-spread was 150 cm., and its intestines measured 95 cm. It had a bifurcated tongue.

The juvenal plumage in this race, according to my own abundant observations and the testimony of other observers in various parts of the pan-antarctic region, is nearly uniform brown, except for the white wing-patch; pale or rufescent feathers are lacking. The natal down is buffy.

The dimensions of three South Georgian eggs, as recorded by Szielasko (1926, 38), are 77 x 53, 76 x 52, and 73 x 48 mm. In the single instance when three eggs were found in a nest, one was infertile.

The only surviving example of a set of two eggs which I collected at Cumberland Bay, South Georgia, December 3, 1912, is somewhat pointed at the smaller end, of grayish olive ground color, rather generally though sparingly flecked with small spots and blotches, most of which are light brown or pale purplish because they lie beneath the surface of the shell. A few spots of external pigment are umber. The egg measures 74.9 x 52.8 mm.

Distribution: Circumpolar at islands lying in the Antarctic and Sub-Antarctic Zones of surface water, except for the Falklands and probably Tristan da Cunha. Breeding in the West Antarctic Archipelago to about the 65th parallel of south latitude, and at such antarctic islands of the Scotia Arc as the South Shetlands, South Orkneys, South Georgia, and presumably the South Sandwich chain. To eastward this race occurs at Bouvet (Vanhöffen, 1901, 311; Reichenow, 1904, 349), the Prince Edward and Crozet groups, Kerguelen, Heard (Moseley, 1879, 230), and perhaps St. Paul; also at the following islands to southward and eastward of New Zealand: Stewart, Chatham, Snares, Auckland, Campbell, Antipodes, and Macquarie.

Bennett (1920, 256) agrees with Hamilton in stating that there are two distinct types of Brown Skuas at the South Shetlands, aside from the South Polar Skua. I have no specimens which would throw further light upon this question, and its solution must await study of adequate material. Might it be possible, however, that the small skuas of the Falklands have begun to migrate into the Antarctic since the beginning of modern whaling?

Hamilton's detailed study of measurements and plumages of more than a hundred Brown Skuas taken in all parts of the circumpolar area shows that data are not yet adequate for distinguishing several subspecies from the pan-antarctic ring of islands. To be sure, he arrives at the conclusion that specimens from the New Zealand region average barely larger than those from New-World islands. The figures I have listed in the table show, however, that the bills, tarsi, etc., of certain specimens from South Georgia are practically as large as

the maximum among New Zealand birds, while the length of the culmen in a skua collected at Mar del Plata, Argentina, is greater than that of any example recorded from New Zealand.

During the South Georgia Expedition of 1912–1913, I became extremely well acquainted with the Brown Skua, which has left, I believe, a more vivid impression in my memory than any other bird I have met. The skuas look and act like miniature eagles. They fear nothing, never seek to avoid being conspicuous, and, by every token of behavior, they are lords of the far south. In effect, they are gulls which have turned into hawks. Not only are they the enemies of every creature they can master, living almost entirely by ravin and slaughter, but they also have the appearance of a bird of prey in the general color of their plumage, the pointed, erectile hackles on the neck, the hooked bill, and the long, sharp, curved claws, which seem incongruous on webbed feet. They are tremendously strong, heavy, and vital birds which, in the air, look massive rather than speedy. It is therefore somewhat surprising to learn that they can overtake in free flight such swift, long-winged petrels as the Shoemaker (*Procellaria aequinoctialis*). Energy is apparent in every movement of the skua—in its rapacity, in the quantity of food it can ingest within a few moments, and in the volume and continuousness of the screams that issue from its throat. Doubtless, its physiological processes are relatively rapid, even for the group of vertebrates which has the highest metabolic rate. It is therefore not surprising that Valette (1906, 56) found the skua's body temperature of 42.3° C. (108.1° F.) to be higher than that of the other warm-blooded animals at the South Orkney Islands.

The wide range in color of South Georgian Skuas has been attested by Hamilton and by Matthews (1929, 581), and is confirmed by my own field notes as well as by the thirty or more specimens I have examined. The variation on this single island is probably as great as that shown by Brown Skuas throughout the whole geographic range between West Antarctica and New Zealand. But even the grayest of the South Georgia birds, which are nearly white on their backs, never show the clear "chamois-skin" which so often characterizes the head and mantle of the South Polar Skua. As Hamilton has pointed out, feather tissue deficient in pigment abrades much more rapidly than feathers or parts of feathers which are dark. For this reason, the plumage of Brown Skuas often bleaches and wears away with great irregularity, so that the birds become ragged and frayed in an asymmetrical pattern. Rufous and cinnamon feathers, similar to the typical plumage of the Chilean Skua, appear sporadically among South Georgian birds, just as among skuas of the Falkland race. So far as my field observation goes, the plumage that immediately succeeds the down is always of a uniform dark brown. Therefore, while the very light new feathers of some skuas are probably not indicative of advanced age, they at least appear only subsequent to the post-juvenal moult. All of these circumstances are matched among the few South Shetland specimens I have seen, and they agree with published descriptions relating to the resident skuas of the South Orkneys.

The South Georgian Skuas, like those of other parts of the Scotia Arc and

of the Falklands, are migratory birds, returning to their home island at the commencement of the southern spring, and going to sea again before the end of April. The first arrivals have been observed toward the close of August, but the largest influx is apparent about the middle of October, preceding which date, according to Lönnberg (1906, 58), very large numbers of skuas are to be observed at sea to northward of latitude 47° S. On November 14 at Kerguelen, Werth (1905, 570) saw pairs in pursuit flight, which was probably part of the courtship performance. Nesting commences in November and the eggs, which usually number two, but sometimes only one and still more rarely three, are found from the middle of the month until well into December. Two eggs, laid about the end of December, are reported from the more southerly latitudes of the South Orkney and South Shetland Islands.

The first eggs at South Georgia were seen by the long-resident members of the German Expedition on November 20, and the first young about Christmas time (von den Steinen, 1890, 259). On December 31, 1912, however, I found at Cumberland Bay several nests containing large downy young, indicating a considerably earlier egg-laying period. At Kerguelen, the period of incubation, as determined by Studer (1879, 107), is about five weeks, the duties thereof being shared alternately by both parents (Loranchet, 1916, 306). A creditable nest of tussock grass, moss, bits of seaweed, and other vegetable material is commonly formed on a flat mossy area of a headland. The chosen site may be at any altitude from just above sea level to 700 meters. It usually overlooks the ocean and is rarely, if ever, far from penguin colonies or from the subterranean breeding grounds of petrels, both of which are regarded by the skua as its private larder.

When I reached South Georgia in late November, most of the skuas already had eggs. The birds were standing or squatting everywhere on the summits of hillocks and promontories, or soaring in circles during periods of the day that were quiet and sunny. At such times they looked more than ever like broad-winged, Buteonine hawks. When I walked along the beaches, the skuas feeding close to the water's edge would pay little attention to me. As a matter of fact, when they stepped out of the way, their manner seemed rather one of courtesy than of caution. However, there was one particular gray skua which attacked me without provocation on several different days along the beach of the Bay of Isles. The terrain was of such a nature that there could be no nest near-by; moreover, I never saw this bird's mate. Yet, when I was least suspecting, I would be startled by a furious rush of wings, and would dodge instinctively just in time to let the gray skua skim over my head. After two or three such dashes, it would make off. As soon as I turned up into the grasslands behind the shore, however, I would never be left long in doubt regarding my invasion of breeding territory. The old birds would become quite frenzied as their nest was approached, and would swoop at me in the well-known manner, varying their attack by standing on the ground close by, with wings pointed straight upward and heads downward, and screaming at the tops of their lungs. After the young birds had hatched, the parent skuas became more ferocious than

ever. They would begin the attack when I came within 100 meters of the nest, continuing it until I had passed at least that far out of the neighborhood. On one occasion when I was banding a chick in the nest—he screaming lustily all the while—both parent birds actually struck with the quills of their wings the barrels of the gun I held above my head as a protection against their assaults. Seeing the cranium of a whale-bird lying on the grass, I offered it to the infant skua, which swallowed it with evident satisfaction and immediately ceased its clamor.

By subsequent experience I found that it was also possible to distract the fixity of the old birds' attention by supplying a distinct new stimulus. Thus, if I should toss on the ground a bit of food, the latter would claim at least the temporary attention of the parents. On one occasion a pair of skuas immediately ceased their attack when I shot a South Georgian Pipit, a small land bird which frequently nests within the skuas' territory, and which is apparently not subject to their attacks. On this occasion they did not find the dead pipit, but within a few moments they became entirely absorbed in the red cartridge shell ejected from my gun. Each skua picked it up, and one of them carried it about in its bill for some time. These birds may have had sufficient experience to associate the report of guns with the possibility of obtaining a prize, for on other occasions skuas succeeded in stealing and carrying off examples of teals, terns, and petrels shot by members of my party.

The ease with which a certain train of behavior may be broken is very suggestive in connection with the usual lack of intelligence, as opposed to purely instinctive behavior, among birds. Sörling, as recounted by Lönnberg, examined three eggs of one pair of South Georgian Skuas and then returned two to the nest, placing the third on the ground a short distance away. As soon as the first parent settled beside the nest, it ate the egg which had been removed, and then snuggled down to brood the other two. On another occasion, Sörling interfered with the natural sequence of an adult skua's reactions to the extent of assisting a hatching chick out of the eggshell. The parent, which had been thus disturbed by the well-meant offices of man, devoured its offspring the instant it returned to the nest. While the South Georgian Skuas in rare instances rear both of their chicks, it is far more common for only one to attain even the fledgling stage. I suspect that the destruction of the other is accomplished much more often by its own parents than by neighbors, to which Gain charged the death of the young South Polar Skuas. What happens is doubtless very much as follows: so long as the chicks remain within the nest-bowl, they are regarded by the parents as rightful occupants. Sooner or later, however, and usually within a few days after hatching, one or both will cross the threshold to pick about over the surrounding territory. When a parent returns with food, the chick remaining in the nest, or one of the two outside the nest, awakens the feeding response, and food from the gullet of the adult will be ejected on the ground beside it. This reaction being completed, the other and less fortunate offspring is likely to be regarded as a wholly extraneous object—in other words, as something to be eaten.

The incident of the skua which ate its chick that had been helped out of the shell may signify that the parent needs to be conditioned to the presence of an active young bird by having the latter hatch beneath it. Furthermore, it seems likely that conditioning to a single chick is as far as the process can usually go, and this fact accounts equally for the eating of the second. We might put the matter otherwise by saying that the reactions of the skua are in somewhat unstable equilibrium with relation to two chicks; one is reasonably safe, but two produce a conflict between a parental response and a desire to eat and, sooner or later, the latter wins out.

Whatever the biological meaning of this type of infanticide, it no doubt works out as highly advantageous to the general balance of nature. The skuas are already extremely abundant as well as intolerably aggressive, and a further increase in their numbers, due to the rearing of a much larger proportion of chicks, would doubtless lead to overpopulation.

When the chicks first hatch, they lie closely in the nest and show no alarm in the presence of potential danger. After they are several days old, however, they will slip off at the first sign of a human intruder and crouch flat in the nearest hiding place. Although they regularly wander a short distance away from their homes for other reasons also, they always return to them, the nest remaining a focal point in the life of a family until the young are fledged. At the beginning of their flight period, they exercise a good deal by jumping into the air, facing the wind, accompanying the performance with a plaintive whistling note. At South Georgia I saw the first flying young on February 26, and within a few days thereafter they began to be common. All such were in uniform dark brown plumage, without a trace of yellowish or grayish feathers, a fact noted likewise by Pagenstecher and von den Steinen. The young remain dependent upon their parents for a considerable period after they begin to fly, and they keep in close touch by means of their whistling calls. They fly strongly, but when high winds are blowing they seem to experience much difficulty in alighting, or even in standing on the rocks in the teeth of the blasts. The older birds, however, are quite able to take care of themselves in any weather. Before taking flight from the ground, the skuas often hop along on both feet for a few steps. Their flight is surprisingly fast, their wing-beats being somewhat more rapid than those of most gulls. Not only do they soar, but sometimes they allow themselves to drift backward in quiet fashion as they face the wind. When they alight on the ocean, they always hold up their pinions for a time. If wounded on the water, they will not try to swim offshore in the manner of a typical sea fowl, but will rather make every effort to gain the nearest rocks.

The young leave South Georgia along with the bulk of the old birds about the end of April. A few skuas, however, linger later; the members of the German Expedition saw some well into June (Pagenstecher, 1885, 24). At Kerguelen, which has a generally milder climate than South Georgia, skuas are present all the year round, although much rarer in winter than at other times (Loranchet, 1916, 306). Menegaux (1907, 465) states that in West Antarctica the young skuas are the first to migrate away from the homeland. They leave the islands

of the Antarctic Archipelago about the beginning of March, and do not return before spring.

During the middle part of the day, especially when the sun is shining, the South Georgian Skuas bathe in the relatively warm water of pools in the flat grasslands. They shake and splash, and ruffle out their feathers, quite in the manner of song birds at a fountain. The edges of ponds and glacial streams seem to be accepted as neutral ground by the members of mated pairs not engaged at the moment in incubation. It was not uncommon to see forty or fifty skuas associating in the ponds of grassy glens about Cumberland Bay, or even to meet the birds when they were flying over the low mountain passes leading toward such places. These retreats are also favorite sleeping quarters after the breeding season is finished. On March 4, at Possession Bay, I found a great number of skuas just after dusk, each balancing on one foot at the edge of a runnel, most of them with the bill tucked under the wing coverts.

One usually thinks of the skuas' voice as a scream, because they make their most impressive picture when they stand in angry or defiant attitude, their wings held upright in the posture of those on ancient Norse helmets, and protest with ear-splitting cries. A quieter more conversational note, however, is much like the quacking of a duck and, before I became accustomed to it, I looked for a South Georgian Teal whenever I heard it. I do not remember ever hearing a skua cry out after being wounded by a shot.

The manner in which skuas quickly gather about one of their stoical, injured *confrères*, however, implies neither sympathy nor altruism. It is a good deal of a mystery, indeed, as to what sense so quickly leads them to assemble ominously near a hurt or sickly member of their own tribe, to follow it about relentlessly if it can still fly, and to stand by with complete patience until the victim succumbs, or until the moment for the *coup de grace* arrives. Hall (1908, 8) states specifically that skuas have been known to kill and eat their own wounded mates. I found that they would devour the flesh of their fellows which I had skinned as avidly as any other sort of meat. Von den Steinen carried a skua chick to a distance from its own nest, and when he put it on the ground it was instantly attacked by all the old birds in the neighborhood. Brown, Mossman, and Pirie (1906, 178) observed a battle almost to the death between two skuas on an ice-floe at the South Orkneys, while a third bird looked on from an adjacent hummock. The date was November 9, which suggests that the struggle may possibly have been connected with courtship. Such contests in nature are rarely fatal, since supremacy is the only point to be established. In this instance, however, the beaten skua, while too fatigued to defend itself further, was torn to pieces by a Giant Fulmar.

The diet of the skuas is, of course, not confined to other birds. They hunt along the beaches for food cast ashore, and even capture fish that rise to the surface, though I have never seen one dive for food. Werth (1925, 570) reports that they practice the well-known gull trick of dropping shellfish from the air in order to break them. Sealing and whaling operations supply them with a wealth of provender, but aside from such artificial food resources I believe that

penguin eggs and chicks, whale-birds, and diving petrels make up the bulk of their food during the nesting period. While they force larger sorts of birds to disgorge more or less at this season, I presume that this freebooting method is of greater importance to the skuas during their pelagic migrations than it is at the breeding grounds. I have seen them attempt to carry off fledgling Kelp Gulls, but always unsuccessfully, because of the pugnacity of the old birds in defense. The South Georgian Terns likewise band together and are quite capable of putting the skua to flight.

Hall credits the skua with being able to carry away a Kerguelen Teal. The mate of my brig, the 'Daisy,' shot two South Georgian Teals, both of which were seized by skuas before he could retrieve them. One was dropped and subsequently recovered by the gunner, but the other was carried, dangling from the skua's bill, far up the hill of Albatross Island at the Bay of Isles. Out of curiosity or hopefulness the skuas always follow a man who goes a-birding with a gun, and under such circumstances he must be quick to save his game. I believe that they soon learn to expect to be fed by human beings, which may be why one skua used to follow me regularly as I rowed back and forth in my dory between ship and shore at South Georgia. It would set its wings and glide very slowly along, scarcely more than arm's reach above my head.

Of all the Brown Skua's bird victims, the worst sufferers are probably the whale-birds (*Pachyptila*), which they seize as the latter come out of their burrows. On one occasion an example which we had dug out fluttered away a few paces before we could capture it, whereupon it was immediately seized and carried off by one of a group of skuas which had gathered to watch the digging. When, however, the whale-birds once get a good start, their highly erratic flight enables them to escape. I have described such an incident in the life history of *Pachyptila desolata*. The neighborhood of a skua nest containing a chick that has been for some time out of the egg is sure to be littered with the bones and feathers of whale-birds.

I have never seen the skuas bear food in their bills to the nesting site; it appears that they always swallow it first and later disgorge in the presence of a chick. Szielasko (1907, 597) believed, however, that at South Georgia the skuas made deposits of food supplies in such hiding places as an unused burrow of a petrel. At any rate, he once found a dozen dead whale-birds in such a hole, and he concluded that they had been cached by a skua. I have no observations bearing upon this suggestion. Buller (1888, 63) gives an excellent description of how a captive skua from the New Zealand region would hold down its prey with its sharp-clawed feet, pluck off some of the feathers, and devour the flesh. The bodies of small birds would be bolted entire, but species the size of *Pachyptila* would usually be more or less plucked, as well as disjointed, before being engulfed. In some cases, however, the carcass of even a large petrel might be swallowed whole, so that the tips of its wings would protrude from the skua's mouth for some time during the digestive disintegration of the first end to go down. The long bones would be subsequently regurgitated.

At South Georgia one is always impressed by the fact that during days of

high winds, when sea birds gather in great numbers in the fiords, the skuas pay no attention to the whale-birds among which they mingle. It seems as though they must have become conditioned by experience to the futility of pursuing the agile petrels in the free and windy air. Perhaps for the same reason the skuas ignore also the little Mother Carey's chickens, such as Wilson's Petrel. I have frequently seen the latter species dancing on the water astern of my anchored brig, and passing within easy bill's reach of skuas swimming or fluttering in their search for scraps of blubber. But even more inexplicable is the skua's attitude toward the tiny South Georgian Pipit (*Anthus antarcticus*). Time and again I have seen examples of the latter practically run across the webbed feet of their big, bloodthirsty, and generally untrustworthy neighbors. Whatever the reason, the pipits apparently enjoy total immunity; it is quite as though an ogre indulged himself in a single chivalrous whim.

Elsewhere I have spoken of the speed of the skua in flight, a fact impressed upon me while watching the bulky birds overhaul and keep pace with Kelp Gulls and various large petrels, harrying and worrying the victim in an attempt to gain a secondhand dinner. They are always ready to make themselves annoying and impudent toward any species, however large—Hall (1902, 8) states that even the Black-browed Albatross will settle in the ocean in order to escape the molestations of the skua—and they will steal the eggs not only of the grounded and therefore helpless penguins, but even those of Wandering Albatrosses and Giant Fulmars.

The skuas were always at hand when the crew of the brig 'Daisy' slew a sea-elephant. The sailors, of course, credited them with having a keenly developed sense of smell, a supposition favored likewise by many naturalists, including Gain, who has written an account of the South Polar Skua's uncanny ability to find its way to a scene of blood-spilling. During the skinning of seals, skuas will sometimes actually alight on a warm carcass at which men are at work; even after being repeatedly driven away, they continue to stand about in a ring only a few steps in diameter.

When mixed flocks of birds were feeding astern of my anchored vessel, the superior alertness of the skuas over all other species would become at once apparent. They always succeeded in getting the lion's share of food tossed overboard, and would snatch pieces of seal blubber or entrails practically out of the bills of mollymauks and Giant Fulmars. If a piece of food was dropped in the air by a skua or any other bird, it was invariably recovered by a skua before it had struck the water. Once a skua alighted on the mincing table on the deck of the 'Daisy,' where members of the crew were engaged in cutting up sea-elephant blubber. The bird fed from the edge of the knife, so to speak, and allowed itself to be touched.

One day when I had killed several King Penguins and was preparing to skin out their heavy bodies before carrying the skins across a wide moraine toward my boat, a score of skuas gathered about me within a few moments, and crowded forward for the leavings. Several took bits of flesh and fat from my hand. Pebbles tossed toward them caused them merely to watch, without any appre-

ciation of the fact that my gesture might have been menacing. I discharged a shotgun, with its muzzle held just over their heads, whereupon several of them merely leaped off the ground, and all ceased their clucking chatter for a few seconds. On this occasion I learned how useful I could make the skuas in cleaning the fat from the inside of penguin skins. When the latter, turned inside out, were placed before them, the skuas would pick off the blubber as cleanly as it could have been done with a scraper, and in much less time. They would snip off small bits with the hooks of their beaks, swallowing one after another about as rapidly as a chicken picks up strewn corn. On one occasion I had 35 skuas ready to work, each attempting to perform on my behalf this fundamental and arduous taxidermic process! My helpers battled unendingly, however, even when there was ample room for all, and one or sometimes two old champions monopolized each penguin skin most of the time, to the detriment of efficiency. In fighting, they raised their white-marked wings, and jumped at each other like game cocks, except that they did not use their claws. They knocked each other down in jolly fashion, and pulled out feathers, the battles being half on the ground and half in air. The victor always raised its wings and screamed before turning again toward the banquet and driving off the birds which had slipped into its place. Sometimes three or four of them would grasp one scrap of meat, and pull until it was torn asunder. They would lean back vigorously during such a tug-of-war, bracing their feet far forward and tilting their tails quite to the ground. If one bird flew away with a billful in order to devour it elsewhere, the others would doubtless suspect that he had a superior morsel, for immediately the whole pack would leave its plenteous repast and follow the fugitive, who was sure to be robbed unless he could gulp down his morsel in the air. Their general principle seemed to be that "the far off hills are greener."

Skuas can swallow enormous chunks of food, their throats bulging out bigger than the head during the process. Several of them at South Georgia took in without difficulty the eye-balls of King Penguins, spheres having the circumference of a half-dollar. To one skua I offered the egg of a Shoemaker. It promptly took it from my fingers, and swallowed it, shell and all. The average measurements of a score of eggs of this petrel exceed 83 x 54 millimeters. Lorancher (1916, 306) reports that he once saw a skua at Kerguelen bolt the head of a rabbit. This introduced mammal has become a regular part of their food at that island, and skuas have even been seen to attempt to filch a rabbit out of a dog's mouth.

I have written enough to show that the skuas are the berserkers among birds. They seem to have a diabolical gift to be a scourge. One day at South Georgia a group of them pulled open the knot of a fish-trap I had left on the beach, and dragged out and scattered the bones of a sea-leopard which the industrious copepods had been cleaning for the benefit of science. The incomprehensible part of this annoyance was that the trap lay beside the stripped carcass of a freshly killed sea-elephant upon which a thousand skuas might have feasted to repletion. But in spite of their voracity, rapine, and cannibalism, the skuas

quickly make themselves the beneficiaries of a peculiar, sentimental, anthropomorphic interest. When they crowd around you, and look up with bright, fearless, unsuspicious, brown eyes, accept the bounty you offer them, and show no more concern over the loudest shouts, whistles, or handclaps than if they were stone-deaf, you succumb to their charm, and subscribe to the principle that their supremacy of might must be deserved.

TRISTAN SKUA

Catharacta skua, subspecies

The skua of Tristan da Cunha and Gough Island, locally known as Sea Hen or by the inelegant name of "Dirt Bird," has by recent authorities been classified with the Falkland Skua under the subspecific name *antarctica*.

Measurements of 8 specimens published by Hamilton, when compared with those of 40 specimens of Falkland birds, show that, despite overlapping, the Tristan Skua is a larger form, particularly in the size of the bill and the length of the tarsus. The size-range, as shown graphically in Hamilton's diagram on page 170 of his paper, tends to link the Tristan race more closely with birds of the antarctic islands than with those of the Falklands. I have seen no specimens of the skua from either Tristan or Gough, but the measurements of the two birds collected by Beck at Mar del Plata in October, and listed in line 9 of my table, are of a size agreeing closely with the published dimensions of Tristan and Gough specimens, and it is not unlikely that they had migrated to the Argentine coast from one of these mid-Atlantic islands. The fact that the Mar del Plata examples do not fit well into any of our other series of skuas is an indication of how little we yet know, and of how cautious any ornithologist must be in accepting the published records and determinations of southern-hemisphere skuas.

When Wilkins (1923, 509) visited Gough Island in the Quest,' between May 28 and June 1, 1922, he found skuas not particularly numerous, but saw a total of about twenty. Only a week earlier, however, he had observed them in great numbers about each island of the Tristan da Cunha group, and had collected three adults at Nightingale. The supposition is that the autumn exodus of skuas from Gough Island had begun before the time of Wilkins's arrival.

Captain Comer, as reported by Verrill (1895, 450), found very large numbers of skuas at Gough Island, and killed about 300 of them for the sake of their feathers. Comer states that the Sea Hens begin laying there after the middle of September, and that they will replace their eggs if the nests are robbed. The Rockhopper Penguins of this island also begin to produce eggs about September 15, and it is coincidentally with this that the skuas move in from sea in force and begin to get their living by robbing penguin nests. They also kill young albatrosses, and all the smaller birds that they are capable of catching.

At Tristan da Cunha, according to Mrs. Barrow (1910, 275), the skuas are present all the year, and lay their first eggs during the month of August. Campbell (1877, 65) observed them perching on the branches of low trees at Inacces-

sible Island at the date of the visit of the 'Challenger' in mid-October. At this time a very few nests still contained eggs. During the same visit, Moseley (1879, 123) watched 30 or 40 skuas quarreling over the skinned bodies of penguins on the beach of Inaccessible. He states that, in addition to rifling the penguin colonies of eggs and chicks, the skuas feed even more upon the various "night birds," especially the Broad-billed Prions, which are pounced upon as they issue from their burrows. The ground was strewn with the skeletons and long feathers of whale-birds, the meat of which had been eaten.

Three eggs from Gough Island measure 66.6 x 50.3, 73.7 x 51.8, 73.6 x 50.8 millimeters. Ten from the Tristan da Cunha group average 70 x 51 millimeters (Mathews, 1932, 45).

This seems an appropriate place to quote the interesting, if somewhat indiscriminate, notes of Captain C. C. Dixon (1933, 134) on skuas observed during his long experience in the southern oceans.

> The skua does not as a rule follow the vessel—a few circle around at various distances, a zigzag or two along the wake where some birds may be picking up food, is the extent of its attention to the ship's presence. If it happens to see a bird picking up food, the skua generally makes a swoop at it so that it may drop it for his benefit. Then he is away on his wandering over the waters. Even if it is a parasite it does not lack courage for it will attack the smaller albatrosses in the air and force them to alight or disgorge . . . .
>
> Of all the ocean birds that I have had to do with the skua has the greatest hold on life. It has the cat's nine lives and a few extra for good measure. Whenever we desired to keep one of the various birds we caught for either scientific or commercial purposes, a sharp blow on the head usually finished it instantly. Not so the skua. One calm day we were out in a boat trying to capture a white-headed petrel, when a wandering skua was tempted by the bait. As I had never had one to dissect, I thought we might capture this one. It was easily hooked and drawn into the boat, given a sharp rap on the head that we thought was sufficient to kill it, but this only annoyed it, so it was given a regular knockout blow as we certainly had no desire to see it suffer. It fell into the bottom of the boat apparently dead, but soon revived. Then the second mate, who was pulling stroke oar, grabbed it and gave it a blow sufficient to kill a good healthy ox and wrung its neck. Now it did seem finished, and we devoted our energies to the capture of the white-headed petrel aforesaid. A few moments later the second mate gave a yelp,—the skua had given him a nasty jab in the leg and was scrambling over the gunwale of the boat. We did not try to detain it, for it surely had earned its freedom . . . .
>
> More than half the year's birds are seen in summer. Then there is a continuous diminution to the six per cent. that are met with in spring.
>
> On seven occasions in eighteen years I have seen four at once. It is frequently seen in pairs, but solitary individuals are more often seen than any other number.

The Jaegers, Genus Stercorarius

The jaegers are small-sized relatives of the skuas, and all three species of the former are birds of circumpolar, arctic, and sub-arctic breeding range which enter the South American region as winter migrants. Along both coasts of the continent, jaegers harry the smaller fishing species of sea birds and force them to disgorge. They are therefore called by some of the same names applied to the skuas, such as "Halcón de Mar" (sea hawk), "Pájaro Ladrón (thief-bird), and "Gaivota Rapineira" (robber gull).

The Pomarine Jaeger, largest of the three species, is the rarest in South

American waters, perhaps only because it winters chiefly in the open ocean at a great distance from land. It was not collected during the Brewster-Sanford Expedition nor during my own South American work, but Mr. Beck, who is eminently qualified to identify the species in the field, observed an example off Ancón, Peru, on May 8, 1913. A number of others have been collected in the neighborhood of the Galápagos Islands, in Callao Bay, and in the eastern South Atlantic, during the winter months of the northern hemisphere.

The two lesser species of jaegers are, on the other hand, regular winter visitors to both coasts of South America. The Parasitic Jaeger seems to be the commoner of the two close alongshore. Mr. Beck, indeed, suggests in his notes that the Long-tailed Jaeger may carry out the greater part of its migration either far at sea or over the continents.

The Pomarine Jaeger is completely distinctive, at least as regards specimens in the hand. The two other species are easily confused, especially when ages and plumages are as miscellaneous as they are likely to be in the winter ranges of the southern oceans. Between the Parasitic and the Long-tailed there is a well-marked though slightly overlapping difference in the length of the tarsus which makes a useful means of discrimination between them. This measurement for the whole series of Brewster-Sanford specimens is as follows, a notable point being that females of each species average slightly larger than males:

	Minimum	Maximum	Average
Stercorarius parasiticus 8♂	43	47.6	45.1 mm.
15♀	45.1	48	46.6
Stercorarius longicaudus 4♂	41.1	43.7	41.9
14♀	40.2	46.2	43.1

The bill character by which *parasiticus* and *longicaudus* are said to be distinguishable proves in some instances indecisive. However, all three species of jaegers, in practically any plumage after the loss of the down, can be reliably identified by the following excellent key compiled by Wetmore (1926, 129).

a¹. Bill higher than wide at base; wing usually more than 350 mm.; in adult the middle pair of rectrices broad throughout, twisted . . . . . *pomarinus.*

a². Bill not higher than wide at base, wing less than 345 mm.; in adult the middle pair of rectrices straight.

b¹. Length of horny cere (supranasal saddle) decidedly greater than length of dertrum; tarsi and feet black; three or more outermost primaries with shafts ivory yellow . . . . *parasiticus.*

b². Length of horny cere (supranasal saddle) not greater than length of dertrum; tarsi wholly or in part light in color, feet black; only two outermost primaries with shafts ivory yellow (the shaft of the third sometimes light, but with a brownish tinge) . . . . . *longicaudus.*

POMARINE JAEGER

Stercorarius pomarinus

Lestris pomarinus Temminck, 1815, Man. d'Orn., p. 514 (arctic regions of Europe).

Names: Synonyms of the specific name include *pomatorhinus*, *fuscus*, and *sphaeriurus*.

Adults, light-colored phase (sexes alike): Pileum, lores, and malar region, together with upper parts, except nape and hind neck, plain dark sooty gray; anal region and under tail coverts lighter

brownish gray, sometimes intermixed with whitish; rest of head and neck, including hind neck, together with under parts of body, immaculate white, the auricular region and sides of nape more or less strongly tinged with straw-yellow; bill dull brownish (whitish in life), its terminal third (approximately) black; iris dark brown; legs and feet blackish, the upper portion of tarsus pale bluish (in life).

Adults, intermediate phase (sexes alike): Similar to the light-colored phase but chest and hind neck barred or transversely spotted with dusky, and lateral under parts irregularly barred with the same.

Adults, dusky phase (sexes alike): Entirely plain dark sooty grayish brown, with a slaty cast in certain lights, the auricular region sometimes (usually ?) tinged with yellowish.

10 males: wing, 349–374 (361.9); tail, 172–243 (207.9); exposed culmen, 38–43.5 (40.4); tarsus, 48–54 (52); middle toe [without claw], 42–47 (44.6) mm.

9 females: wing, 351–370 (359.7); tail, 128–205.5 (181.2); exposed culmen, 38–44 (40.2); tarsus, 50–55 (52.1); middle toe [without claw], 42–48 (46.1) mm.

Young, light-colored phase: Head, neck, and under parts dull buff, everywhere barred with dusky, the bars broad and sharply defined on under tail coverts and flanks, indistinct on head and neck; upper parts dusky grayish brown, the scapulars and interscapulars tipped with buff, the rump and upper tail coverts spotted with the same.

Young, dusky phase: Entirely sooty grayish brown, the breast, abdomen, and sides narrowly and rather indistinctly, the under and upper tail coverts broadly and sharply barred with buff (Ridgway, 1919, 681).

Distribution: Breeds throughout a circumpolar range along the arctic coasts of North America and Eurasia, and also in Iceland. Winters in the southern oceans, southward to West Africa, rarely to the Indian Ocean and Australia, and in America from Virginia and the Gulf of Mexico southward to the Galápagos Islands and the coast of Peru.

The Pomarine Jaeger was observed once by Beck, off Ancón, Peru, as noted above.

Wynne-Edwards (1935, 298) reports that the autumn migration of this species in the North Atlantic begins first on the American side, and is about a fortnight later than that of the other two jaegers, perhaps because of its more northerly and hence later breeding custom. By November or earlier the vanguard of migrant Pomarines crosses the equator. The principal wintering grounds seem to be in the eastern tropical and South Atlantic, where the hydrographic conditions produce vast areas of relatively cool and rich surface waters. It has been observed that "where . . . jaegers are the commonest sea birds, they must depend largely on their own enterprise for food, rather than on stealing from other species." Wynne-Edwards continues:

> There is thus beyond doubt an important wintering-ground of the Pomatorhine Jaeger in the waters off the West African coast, having its focus a little south of Cape Verde, in 10° or 12° N., 17° W. Jaegers are numerous in winter from 8° to 25° N. off this coast. . . . To the south, for all we know, they may regularly be present off Angola and southwest Africa, but records for that area are very scarce. To the west they thin out rapidly.

Wynne-Edwards likewise draws a parallel to Meinertzhagen's conclusions regarding the phalaropes, and infers that Atlantic-American Pomarine Jaegers may cross the Isthmus of Panama on migration, in order to winter in the offshore waters of the Humboldt Current. While no direct connection between this species and phalaropes is suggested, it is of interest to note that Pomarine Jaegers have been seen to pursue, capture, and eat phalaropes (Tuttle, 1911, 482).

While there are a number of published records for the Pomarine Jaeger in the Gulf of Mexico, British Guiana, and the central South Atlantic, the South American status of the species must still be regarded as uncertain.

PARASITIC JAEGER

Stercorarius parasiticus

Larus parasiticus Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 136 (coast of Sweden).

Names: Synonyms of the specific name include *crepidatus*, *richardsonii*, and *spinicaudus*.

Adults, light-colored phase (sexes alike): Pileum and loral region grayish brown; rest of head, together with neck and under parts except under tail coverts, immaculate white, the head more or less strongly tinged with straw-yellow; upper parts uniform brownish gray, becoming darker or dusky on primaries and tail; anal region and under tail coverts uniform brownish gray; bill light horn-color, the terminal portion dusky or blackish; iris brown; legs and feet black.

Adults, dusky phase (sexes alike): Entirely plain dark sooty grayish brown, the neck more or less tinged with straw-yellow.

16 males: wing, 301–340 (320); tail, 164.5–235 (188.9); exposed culmen, 28–35 (31.2); tarsus, 39.5–45.5 (41.9); middle toe [without claw], 33–37 (34.8) mm.

14 females: wing, 317–341 (323.7); tail, 176–226 (199.7); exposed culmen, 29–34.5 (31.8); tarsus, 39–45 (42.1); middle toe [without claw], 32–38 (35.9) mm.

Young, light-colored phase: Head and neck streaked with dusky brown and cinnamon or cinnamon-buff, the latter usually predominating; under parts more or less distinctly barred or transversely spotted with the same; upper parts dusky grayish brown, the feathers tipped or terminally margined with cinnamon or cinnamon-buff.

Young, dusky phase: General color dusky grayish brown or brownish gray, the wings and tail darker; middle of neck, all round, indistinctly streaked with grayish white; under parts, except chest and upper breast, barred with grayish white, the bars broad and distinct on under tail coverts; scapulars, interscapulars, wing coverts, upper tail coverts, and feathers of rump narrowly tipped or terminally margined with pale dull buff (Ridgway, 1919, 687).

Distribution: Breeds throughout a holarctic range, from the British Isles and northern Labrador northward to the northernmost land areas within the arctic circle. Winters southward to the Cape of Good Hope, Australia, and New Zealand, along the Pacific coast of America from California to central Chile, and on the Atlantic coast from Florida to Argentina.

The Parasitic Jaeger has been observed by either Beck or myself along the coasts of Peru, Chile, Argentina, and Brazil during every month between October and March, and in June. Localities of interest are as follows:

Peru: Huacho, Cañete, Pisco Bay, June; Camaná, in pursuit of Franklin's Gulls, January.

Chile: Valparaiso, November, December, February, March—very common at times in the bay; Corral, November and March; Chiloé Island, June; Strait of Magellan, in pursuit of South American Terns (*Sterna hirundinacea*), March.

Argentina: Mar del Plata, October 9. "More abundant than ever before seen; flocks of dozens sitting on the water like gulls seven miles off shore. I counted fifty of this and the Long-tailed species in one scattering string" (Beck).

Wetmore (1926, 129) observed and collected examples of the Parasitic Jaeger southward of Cape San Antonio on the eastern coast of the Province of Buenos Aires, during November, 1920. At this time and place they were far less numerous than the Long-tailed Jaegers.

In the Brewster-Sanford Collection are 8 males and 15 females of *Stercorarius parasiticus* representing birds of many phases, including examples with white-barred, dusky, and clear brown or sooty, ventral surfaces. One specimen is rufescent on the throat and breast. All had black legs, which constitutes a point of distinction between the Parasitic and Long-tailed species. No sign of

sexual activity was indicated by the gonads of birds collected even as late in the year as the middle of March.

In addition to the specimens from the South American coast, the Museum contains a uniformly sooty-colored Parasitic Jaeger collected by myself in the equatorial Atlantic to northeastward of St. Paul Rocks, on September 27, 1912. South American records of the species are numerous and widespread, from the West Indies and Surinam (Kappler, 1881, 166) southward to Patagonia. An adult female "with healthy ovaries" has even been taken as far south as Barbados on July 10 (Feilden, 1888, 350).

Although jaegers are commonly stated not to molest petrels, Wynne-Edwards once saw two birds of this species tackling a Greater Shearwater.

LONG-TAILED JAEGER

Stercorarius longicaudus

Stercorarius longicaudus Vieillot, 1819, Nouv. Dict. Hist. Nat., 32, p. 157 (northern Europe).

Names: Whiptail. Synonyms of the specific names include *longicaudatus*, *cepphus*, *buffoni*, and *hardyi*, besides which the species has been reported upon under various names of the Parasitic Jaeger.

Adults (sexes alike): Pileum, loral, and orbital regions, and upper part of nape plain sooty black or dull slate-blackish; rest of head and neck, including hind neck and lower part of nape, straw-yellow, paler on chin and throat; upper parts, except as described, plain deep brownish gray (lighter on back, where still paler anteriorly), the remiges and rectrices darker, becoming nearly black terminally; two outer primaries with shafts white or yellowish white; chest (sometimes breast also, more rarely even upper part of abdomen) immaculate white, shading posteriorly into grayish, the under tail coverts, anal region, flanks, and (usually) abdomen being neutral gray; bill blackish terminally, the basal portion brownish or horn-color; iris dark brown; tarsi and basal portion of toes and webs light bluish gray in life, drying light olive or yellowish, the remaining portion of toes and their webs black (Ridgway, 1919, 694).

This Jaeger, like the two other species, also has a dark phase, but it is so rare as to be almost unknown, and no specimens of it exist in collections (*cf.* Wynne-Edwards, 1935, 308).

16 males: wing, 295–327 (309.1); tail (middle rectrices), 263–350 (299); exposed culmen, 27–31.5 (28.6); tarsus, 38–44 (41.1); middle toe [without claw], 31–36.5 (32.7) mm.

6 females: wing, 305–317 (313.3); tail (middle rectrices), 238–350 (295); exposed culmen, 27.5–30 (28.8); tarsus, 40–42.5 (41.8); middle toe [without claw], 31–34.5 (32.5) mm.

Immature: Under parts and upper tail coverts barred with varying degrees of ash-brown; very little yellow on the sides of the neck; otherwise similar to adults.

Young: Ash-brown above, the head darkest; the feathers of the mantle and tail coverts merely tipped with buff, but without any rufous tint; under parts dull grayish white, barred with ash-brown (Ridgway, 1919, 695).

Distribution: Breeds on arctic coasts of North America and Eurasia southward to northern Labrador. Winters southward to Gibraltar and Japan, and to the coasts of Peru, Chile, and Argentina.

The Long-tailed Jaegers of the Brewster-Sanford Expedition were mostly observed or collected well out at sea, the exceptions to this being examples shot in the bay of Valparaiso, during November and December, 1913. Others were taken about 150 kilometers to westward of Ancón, Peru, on June 11, 1913; on the voyage between Valparaiso and Juan Fernández during early December of the same year; and over the Atlantic within 20 to 30 kilometers of the coast near Mar del Plata, Argentina, in October, 1914.

In Beck's series of this species, as in that of *Stercorarius parasiticus*, females

greatly outnumber males, there being 14 of the former to only four of the latter. All of the examples are either white-breasted or barred. The darkest is a male, taken off Mar del Plata, which retains a single long central rectrix. At least one of the Valparaiso specimens, dated November 21, is a bird of the year, just changing from a very ragged and faded condition to a darker plumage in which each brown feather of the dorsal surface has a buffy white edging. On the labels of the Brewster-Sanford birds, the bill and feet are recorded as black, the tarsi as blue or grayish blue. All had small gonads except a female collected off the Peruvian coast on June 11, in which the ovaries were distinctly enlarged. If this bird was then on its way toward arctic Alaska, it had but a month for completion of the migration, courtship and mating, and the production of eggs, provided it was to keep up to schedule. The latest normal date for egg-laying is about mid-July.

Wetmore (1926, 130) observed and collected many Long-tailed Jaegers along the beach to southward of Cape San Antonio, eastern Buenos Aires, during November, when they seemed still to be southbound. Within a few days he saw upwards of 1200 examples. He writes:

> The birds traveled alone or in little groups of three or four, some wary and others very tame. They drifted along, frequently scaling for long distances or occasionally flapping their wings, never more than 50 feet in the air, often only a few feet above the sand. At intervals one dropped lightly to the beach near the water mark to pick up a few beetles that had drifted ashore after the storm and then remained to rest for a few minutes. Others more energetic harried the Trudeau's terns with agile wing strokes until they disgorged their prey of fish on the sand, when the jaeger stooped easily to pick it up and then continued its flight. Their steady southward movement without pause to circle about or return was most impressive.

Beck (1910, 62) has noted the extreme rarity of the Long-tailed Jaeger along the California coast, even though the two other species are common every year between August and October in the Point Pinos region. In his notebook, he has hazarded the opinion that the Long-tailed Jaeger may carry out a good part of its migration overland, a theory which has likewise been advanced by Bent (1921, 27). The idea is doubtless worth investigation, partly because of the many specimens of this jaeger that have been taken during migration at localities far from the sea, and also because the Long-tailed is at once the rarest of jaegers along the North American coasts and the commonest in the southern oceans. Wynne-Edwards (1935, 306), however, regards this species as by far the most pelagic of the three, and has described an impressive spring migration flight near the middle of the North Atlantic. He finds that such movements reach a maximum toward the end of May and are over before mid-June. The "autumn passage starts in the last week of July, reaches its height in the second half of August, and is practically over by mid-October." We now know that by the last date many of the birds have reached the northern border of the Sub-Antarctic Zone along the coasts of Argentina and Chile.

Wynne-Edwards gives the following pen-picture of this species:

> On a bright day the Long-tailed Jaeger is a graceful sight, buoyed along on light wings with its ten-inch "marlinspike" fluttering aft like a pennon in the breeze, and the yellow-tinged collar and white belly gleaming in the sunlight. Often in clear weather it sails at a great height, and

occasionally soars in wide circles like a buzzard; at other times it will chase and scrap with its companions or any bird at hand, swooping and swerving and turning on its back as if it had no joints at all. I saw this bird more often in parties than the others, though here as elsewhere, three, four and five were the favorite numbers. To some extent young and old travel together, though it was common in autumn to see groups of adults or of juveniles unmixed.

THE GULLS AND TERNS

FAMILY LARIDAE

The gulls and terns make up a well-defined group, divided into the respective subfamilies Larinae and Sterninae. The relationship between the two branches is close and clear, but no gull more than approximates the pointed, generally slender bill which is characteristic of terns. The Laridae as a whole are usually regarded as a "modern" product of the Charadriiform stock, at least by contrast with the auks, though fossil remains ascribed to the genus *Larus* are known from as far back as Upper Oligocene strata.

In temperate parts of the northern hemisphere, exclusive of the Pacific basin, the gulls fall into two well-marked divisions, namely, the hooded species and those without a hood. In both groups the immature birds have a dark tail band. Each group has also several representatives in the southern hemisphere, but only in the Pacific and in southern South America do we find species that agree with the northern forms in having a tail band when immature but differ markedly in other respects. Most of these are birds of relatively heavy build, with a tendency toward sooty coloration. Their principal characteristic, however, is the presence of a more or less defined hood in immature plumage, which is generally lost in the adult stage. *Leucophaeus scoresbii*, for example, loses its hood along with the disappearance of the tail-bar. Its range lies chiefly within the influence of the Cape Horn Current. *Larus belcheri* has a hood only in youth, but retains the barred tail in maturity. Its range is confined to the Humboldt Current region. According to Saunders, its closest relative is *Larus crassirostris* of the Pacific coast of Asia. Dwight, however, holds that *belcheri* has deeper, even if less obvious, affinities with several of its American neighbors.

Larus fuliginosus, of the Galápagos, which has a hood at all ages and loses the markings on the rectrices with maturity, may be close to the ancestral type of all the Pacific forms. *L. heermanni*, of the California coast, has a hood in the youthful stage and a black, white-tipped tail. *L. modestus*, of the west coast of South America, resembles it in the hood of immaturity and the general coloration, but differs in a tendency to lose the tail markings with advance in age.

Between South America and Australasia no gulls occur, although terns are plentiful. Even *L. dominicanus* is absent from the South Pacific islands. But in the Australasian region is found the large dark-mantled *Gabianus pacificus*, the huge blunt bill of which somewhat resembles that of *Leucophaeus scoresbii*, although the similarity, as pointed out below, may be no more than a specious one.

As Saunders (1879, 390; 1882, 520) has remarked, it is noteworthy that birds possessing such powers of flight as certain gulls and their allies should remain

within highly confined distributional limits when the more apparent influences which might formerly have proved a barrier to their extension have disappeared for ages. It would seem as though the connection between the coastal gulls of the northern and southern hemispheres is much closer in the Pacific than in the Atlantic. The cool eastern Pacific currents, flowing equatorwards, are no doubt in large measure responsible for this. A greater contrast could hardly be imagined than that between the gulls, terns, and many other elements of the bird life of the central Humboldt Current region in Peru and the avifauna of the Brazilian coast between Pernambuco and Bahia, along which a warm ocean current flows poleward.

In *Larus cirrocephalus*, a gull with a pale gray head which inhabits both southeastern South America and the opposite African coast of the Atlantic, we have the only hooded gull of the southern hemisphere with a range extending outside South America. Another South American hooded gull, *Larus maculipennis*, appears to be a representative of the palaearctic species, *Larus ridibundus*. Among gulls, as among shore birds, it is quite possible that South America is *par excellence* the last stronghold of certain "living fossils" which during long ages have been pushed out from the northern land areas toward the periphery of the world.

As Dwight (1925, 65) states by way of caution, however, one can hardly more than guess as to which of the gulls are of primitive type. The species that are darkest in the color of plumage, bill, feet, and eye would seem perhaps to have the best claim to be so regarded, because they resemble in their pigmentation and lack of pronounced pattern the young of many species which later develop highly specialized hues and patterns. The wings and tail of some species remain very much the same in both young birds and old, and from such "structurally ancestral" types the others have possibly been derived. The forty or more species of gulls are, nevertheless, in the main so homogeneous that they lend themselves to meaningful subdivision only with difficulty. It has proved quite possible, for example, to erect a multiplicity of monotypic genera, a procedure which tends to nullify the value of genera as taxonomic units. In this book I follow the arrangement of Peters (1934, 312), which is in most respects a further simplification of the masterly study of Dwight. The latter author, in reviewing the gulls of the world, has made use of the entire Brewster-Sanford series and has examined as well nearly all other specimens that have come under my own eye. I have therefore made free use of his excellent descriptions, and have quoted the greater part of his measurements applying to South American forms.

Pelagic gulls, such as are represented by the northern kittiwakes, are almost wanting in South America, most members of the subfamily within our field being continental or littoral. Even the Kelp Gull is for the most part an inshore bird, but the Swallow-tailed Gull (*Creagrus*), of the Galápagos Islands, makes long migrations on the high sea. It also forages well offshore during its daily feeding régime at the nesting ground, and it may be called as nearly pelagic as are most boobies.

Gulls, like albatrosses and certain other sea birds, are master fliers, and, since they lend themselves to familiar observation, their aërial technique has been made the basis of many studies. Miller (1923, 5) has found that in ordinary flight a gull of medium size will average about 120 strokes per minute. In the rapidity of the wing-beat lies the secret of flight not only of gulls but of birds in general. On the downward stroke a momentary vacuum is left above the wing; in other words, the air pressure is removed above but maintained beneath, so that the bird is supported theoretically by a force exceeding one kilogram per square centimeter of surface. The displaced air cannot rush in so quickly in the wake of a large wing as in that of a small one. This explains why a gull can support itself with only 2 strokes per second while a sparrow, with a much greater wing-expanse in proportion to weight, must make 13 strokes per second.

It is a common sight to observe a gull travel long distances at a speed of from 20 to 35 kilometers per hour without a single flap of the wings. It is probable that higher speeds would be recorded if faster steamers were to serve as a basis of comparison.

Miller concludes, (1) that gulls take advantage of currents deflected upwards from buildings, steamers, hillsides, etc. to indulge in soaring flight; (2) that they do not engage in prolonged soaring in the absence of such currents; (3) that the most favorable conditions for soaring about a steamer coincide with a moderately brisk wind from the bow or from either beam; (4) that the "soarable" position varies with the direction and speed of the wind and the nature of the object causing the updraught. With increasing briskness of wind about a vessel, the soarable area tends to move more and more to leeward; in a moderate wind the gulls are capable of soaring above the windward side.

Taking up, now, the terns, we find that the South American representatives of their subfamily can be relegated to several categories, the relative distinctness or affinities of which are at least clearer than in the case of most species or groups of gulls.

In the first place, there are three, namely, Trudeau's Tern, the Large-billed Tern (*Phaetusa*), and the Inca Tern (*Larosterna*), which are stamped with a remarkably high degree of endemism. Trudeau's Tern is the least notable of these, for its affinities are generally with members of a group within the genus *Sterna* which has a world-wide distribution, but the other two seem extraordinarily remote from their nearest relatives. The Large-billed Tern is chiefly riparian, while the Inca Tern is exclusively coastal and is confined to the Humboldt Current region.

Secondly, there are a number of native forms either specifically identical with, or more or less closely related to, widely distributed northern-hemisphere terns. The Gull-billed Tern (*Gelochelidon*), and the following species of *Sterna*, belong here: *hirundinacea*, *vittata*, *superciliaris*, *lorata*. The Cayenne Tern (*Thalasseus eurygnatha*) should doubtless be included with these. The members of this group are likewise chiefly coastal or riparian, but *Sterna vittata* inhabits isolated pan-antarctic islands as far southward as the shores of the polar con-

tinent. It is a species which has often been erroneously reported upon under the name of *Sterna hirundinacea*, but the latter is, in reality, closely confined to the South American continent.

The next aggregation would include winter migrants from North America, one or two of which have at the same time extended their breeding ranges southward as far as the northerly coasts of South America. In this list are the Black Tern (*Chlidonias*); the Common, Arctic, Roseate, and Least Terns, of the genus *Sterna;* the Royal, Elegant, and Cabot's Terns, of the genus *Thalasseus*. Several of these are highly pelagic during their migrations.

Finally, there are the pan-tropical oceanic terns, such as the Sooty, the noddies (*Anoüs*), the fairy terns (*Gygis*), and the gray ternlets (*Procelsterna*), the last belonging exclusively to the Pacific Ocean. All of these inhabit islands lying in remote reaches of the sea, but certain of them are, nevertheless, relatively sedentary and not given to long migrations away from their nesting grounds. The Sooty Tern and the noddies are, however, pelagic during the non-breeding season, but of the courses and extent of their wanderings practically nothing is yet known.

The South American Tern (*Sterna hirundinacea*) has been mentioned above as an endemic species related to terns of the northern hemisphere. It has the most extensive range of any tern strictly associated with the continent (*cf.* Fig. 23, p. 165), and its distribution is most illuminating when considered with relation to the hydrographic environment. In the southern parts of its range, as in Tierra del Fuego and the Falkland Islands, this species nests during the austral springtime. In the Humboldt Current region of the central Peruvian coast, however, it breeds in midwinter (June). The same trait is also characteristic of certain petrels of the Humboldt Current which, like the tern, may have reached such latitudes gradually from the sub-antarctic south. It is as though such species, so far as their period of reproduction is concerned, had carried their own optimum climate northward with them into the tropics.

DOLPHIN GULL

Leucophaeus scoresbii

Larus Scoresbii Traill, 1823, Mem. Wernerian Nat. Hist. Soc., 4 (1822) p. 514, pl. 6, fig. 1 ("South Shetlands" = probably Falkland Islands).

Names: Magellan, Blue, Red-legged, or Scoresby's, Gull; "Gaviotilla." Synonyms of the specific name are *haematorhynchus* and *neglectus*.

Characters: A medium-sized gull, with a stout, blunt, red bill, red feet, pale gray head and ventral surface, slaty, black mantle, white tail, white-tipped black wings, and a broad white wing band. In winter plumage the head is dusky.

Adults in breeding plumage (sexes alike): Head, neck, and most of ventral surface pale pearly gray, a little deeper on the back of the neck than elsewhere; chin, upper throat, and crissum nearly white; eye-ring white; mantle slaty black, the scapulars and secondaries broadly tipped with white; primaries black with white apical spots except on the outer two, the inner quills much more broadly white-tipped; secondaries grayer, very broadly white-tipped, forming a wing band 25–40 mm. in breadth; wing-lining deep gray; tail white, including the quill shafts. Iris grayish white, the skin of the lids crimson; bill, with deep mandibular angle, a straight gonys, and abruptly decurved maxilla, carmine or cherry-red; legs and feet vermilion.

In winter plumage the head has a dusky gray hood, reaching only to the sides of the somewhat speckled throat, and the eye-ring is only half white (posteriorly).

Following are measurements of specimens from Chiloé Island, the Fuegian region, Río Gallegos (Argentina), and the Falkland Islands.

18 males: wing, 316–339 (328.1); tail, 129–142 (135.9); exposed culmen, 35–42 (39.5); depth of bill at base, 13–16 (15.1); depth of bill at angle, 15–17 (16.2); tarsus, 47–54 (50.8); middle toe without claw, 40–45 (43.1) mm.

18 females: wing, 306–327 (319.2); tail, 126–136 (131.3); exposed culmen, 34–41 (37.2); depth of bill at base, 12–16 (13.9); depth of bill at angle, 14–17 (15.1); tarsus, 45–55 (48.6); middle toe without claw, 38–46 (41.1) mm. (Dwight, 1925, 134).

Younger examples have the dark slaty hood extending into the eye-crescent, the forehead, lores, and sides of head whitish, more or less spotted or streaked, and dark shaft streaks on the tail. The iris is brown; the bill basally flesh color, distally darker, with a blackish subterminal spot; the legs and feet brownish. In first contour plumage the back and mantle are hair-brown, tinged with sepia, the feathers being basally grayish white; upper tail coverts yellowish white; head, neck, and sides of throat pale brown; ventral surface and sides still paler, and somewhat spotty or streaky owing to white feather shafts and dark subterminal areas. The first five or six primaries from the outermost are entirely dark, and the tail bears a broad black subterminal band, which is heaviest on the central quills and gives out toward the laterals, the outermost occasionally being immaculate.

In natal down the back is grayish, rather indistinctly mottled or lined with clove-brown; the head is similar but more clearly spotted; the under parts grayish, darker on the throat and with finer speckling caudad. The general aspect of the down is very dark.

Three eggs are said to constitute the normal set. The three sets in the Brewster-Sanford Collection consist, however, of but one each and are doubtless incomplete, since all were quite fresh. These are variable in shape, one being short-ovate, another subpyriform, the third intermediate. The ground color of two is grayish olive, and of the third slightly darker and browner. All are rather evenly spotted and blotched with areas of brown pigment, which are dark and rich when at the surface and, of course, paler within the texture of the shell. In one egg the pigment forms a broken patch at the larger end, and in another an incomplete circle. The 3 examples measure 62.8 x 43.9, 61 x 45, and 56.2 x 44.5 mm.

Distribution: The Falkland Islands, Tierra del Fuego and its surrounding islets, the Atlantic coast of South America northward to the Gulf of San Jorge, and the Pacific coast to Chiloé Island. Two examples known from Mocha Island, Chile, November 25, 1932 (Bullock, MS). (Erroneously recorded as a resident in the Antarctic Archipelago.)

According to the original describer, the beautiful Dolphin Gull is "said to frequent the frozen regions of the southern ocean." The type specimen was brought to Europe by a sealing vessel that had visited the South Shetland Islands but, judging from other natural-history objects in the same consignment, the gull had in all likelihood been obtained *en route* at the Falklands. At any rate, the species is no more than a casual straggler to the southerly islands of the Scotia Arc, and the only antarctic record worthy of any credence is based upon a specimen said to have been obtained at sea near the South Shetlands (Saunders, 1901, 232). The species was not encountered by the French Expedition in West Antarctica, nor is it listed by Bennett (1926, 319) among the birds of Deception Island and adjacent regions. Therefore it cannot properly be considered an antarctic gull, as Dwight (1925, 137) has called it.

Peters (1934, 313) places this gull in the genus *Gabianus*, thus linking it with the large Australian species (*G. pacificus*) hitherto regarded as monotypic. The sole point of pronounced resemblance between *Gabianus* and *Leucophaeus*,

however, would seem to be in the bill or, rather, in the lower mandible. In discussing the highly variable shape of the bill of *Larus dominicanus*, I show elsewhere (p. 1061) how an extraordinarily deep mandible occasionally crops out among birds of this species, and I believe that to suggest a particularly close relationship between *Gabianus* and *Leucophaeus* on that score alone is to go much farther than the facts warrant. So far as we can judge, the affinities of the Dolphin Gull are rather with the "gray gulls," such as *Larus heermanni*.

During the Brewster-Sanford Expedition, Beck observed the Dolphin Gull at many localities from Chiloé Island southward to Cape Horn, thence northward to the Falklands, and up the Atlantic coast of Patagonia. Excellent series of specimens, representing birds of practically all ages and stages of plumage, were taken at Ancúd, in various parts of the Strait of Magellan and Beagle Channel, at False Cape Horn, Hoste and Morton Islands, the Falkland Islands, and Río Gallegos. On December 17, 1914, Beck found these birds breeding on a small inaccessible rock just off Hoste Island, and next day he located a similar colony of about 30 nests on one of the little Ildefonso Islets, which lie well out at sea to westward of the Horn. At both these places the Dolphin Gulls seemed to cling very closely to their breeding stations, for during a week's stay at an anchorage in Trefusis Bay, less than 7 kilometers from Hoste Island, Beck saw not a sign of the birds.

A year later he found the Dolphin Gulls just beginning to nest at Sea Lion Island, south of East Island of the Falklands, the very first eggs being laid here on December 17. Judging from Beck's notes on the labels of female specimens, mid-December appears to mark the beginning of egg-laying throughout both the Falklands and the Magellanic region. Birds of the species apparently breed while they are still young enough to have mottled brown heads. Most of the Sea Lion Island nests, which were constructed of grass-stalks and other vegetation, were built in clumps of tussock around the borders of a lagoon much frequented by penguins, ducks, and gulls, and a few were placed in insular hummocks standing near the middle of this pond.

Vallentin (1924, 305) and Cobb (1910, 68; 1933, 20) state that the Dolphin Gull is uniformly distributed throughout the Falkland Islands, and that it nests usually in small colonies which are likely to be in juxtaposition with those of other birds, such as the "Big Gulls" (*Larus dominicanus*). The former author infers that the predilection of the Dolphin Gull for breeding close to such untrustworthy neighbors as Kelp Gulls may offer the smaller species a certain amount of protection from the skua. Nevertheless, the latter universal enemy succeeds in destroying a large proportion of Dolphin Gull eggs or chicks. Vallentin adds that Dolphin Gull nests are as a rule more elaborate than those of most gulls, often forming good-sized heaps of grass and diddle-dee twigs. The colonies are equally likely to be at the edge of high water, as described above, or well inland among bogs or growths of scrub.

At low tide the Dolphin Gulls search the rock pools for food and assiduously pick over the great piles of kelp washed ashore by storms. They are always ready, however, to steal unguarded eggs from penguins and shags and, according

to Cobb, will even plunder the buckets and wheelbarrows of human eggers in the penguin colonies. Cobb has seen these birds treat the tough-shelled penguin eggs as many gulls do mussels, to wit, carry their prospective meal a short distance above the ground and drop it to crack it open. The fragile cormorant eggs are, of course, readily pierced by their stout bills. At Sea Lion Island Beck found that the Dolphin Gulls quickly gathered around the incubating Giant Fulmars, with the nauseating object of gobbling up the squids and carrion which the big petrels disgorged at human invaders of their territory. He learned at Kidney Island that the Dolphin Gulls make short work of the carcasses of Rockhopper Penguins and other birds.

In winter, according to Cobb, the Dolphin Gulls become half domestic around some of the outlying settlements in the Falklands. At this time of year the omnivorous creatures gather to feed with the poultry and, unless they are constantly shooed off, they succeed in getting much more than their fair share of the food. From this observation, together with the fact that Beck collected specimens at Ushuaia and near Cape Horn during midwinter and early autumn, I judge that the species is sedentary throughout its range, northward movements of individuals along the Atlantic coast being sporadic rather than seasonal. Oustalet (1891, 179) has already recorded examples from Gable Island, Orange Bay, and other Fuegian localities, during the months of July and August. Beck observed young and old birds feeding with Kelp Gulls and oyster-catchers at Magallanes, on July 4, 1914.

Hellmayr (1932, 413) is of the opinion that the Dolphin Gull occurs only as a non-breeder in the vicinity of Chiloé Island, even though he refers to a male collected there at the height of the nesting season. Beck's observations for this locality are inconclusive, since they were made in April. He saw many Dolphin Gulls off Ancúd, however, both feeding in tidal streaks with the terns and standing on small rocky islets occupied by sea-lions. The species has been taken so often at Chiloé, and even as far up the coast as Mocha Island, that I believe it breeds well northward through the little known archipelagoes of southern Chile.

Cobb (1933, 20) states that this gull at times utters a peculiarly piercing cry, which is notable in the Falklands for its capability of putting a horse into a panic.

DUSKY GULL

Larus fuliginosus

Larus fuliginosus Gould, 1841, in Darwin, Zoöl. Voy. 'Beagle,' 3, p. 141 (James Island, Galápagos Archipelago).

Names: Galápagos Gull; Sooty Gull; Lava Gull. A synonym of the specific name is *neptunis*, besides which this species has been reported upon under the specific names of several other species, such as *belcheri* and *heermanni*.

Characters: Of uniformly dusky grayish or deep brown plumage, with dusky wings in both young and adult stages.

Adults in breeding plumage (sexes alike): Head with a dark sooty brown or sometimes slightly grayer hood, which extends to the chin and is clearly marked off from the gray of hind neck and throat; eye-ring whitish gray; an obscure black eye-crescent; mantle deep mouse-gray, the rump

paler; chin brown, in contrast with the gray throat; remainder of ventral surface paling on breast and abdomen, the crissum becoming abruptly nearly white; primaries black, with yellowish white shafts, the inner quills with gray inconspicuous apical spots; tail clear pale gray, except for the middle rectrices which are as dark as the mantle, and the outer quills which are nearly white; upper tail coverts pale gray, under coverts still paler. Iris lemon-yellow, the eyelids dark crimson; bill dark bay, distally blackish, and with a burnt sienna tip to the maxilla; feet dark prune-purple (blackish in dried skins), the plantar surface of the webs bay, and of the toes rufous.

In non-breeding plumage the eye-ring becomes obscure anteriorly, the color of the eyelid is duller, and the bill turns nearly black except for a distal red area.

10 males: wing, 330–352 (345.4); tail, 140–151 (146.3); exposed culmen, 41–45 (43.5); tarsus, 53–58 (55.9); middle toe without claw, 41–45 (43.5) mm.

8 females: wing, 332–344 (337); tail, 132–141 (136.5); exposed culmen, 40–42 (41); tarsus, 52–55 (53.4); middle toe without claw, 39–42 (40.4) mm. (Dwight, 1925, 141).

These measurements substantially agree with those of 104 specimens recorded by Gifford (1913, 45), who also gives the length in the flesh of 2 females as 445 and 450 mm., and their wing-expanse as 1075 and 1095 mm.

Younger birds have the back slaty, the rump and tail coverts grayer, the head dusky gray or sooty brown, much darker than the tone of the back with which it blends. The ventral surface is sooty brown, somewhat grayer on the throat, breast, and under tail coverts. The tail shows a very definite subterminal band, made up of dark, somewhat irregular blotches, which are slightly if at all indicated on the outermost rectrices.

In juvenal plumage the prevailing tone is deep brown, the feathers with buffy edges. The iris is brown, the bill wholly blackish. The natal down is apparently unknown.

The only known egg was taken from the oviduct of a bird shot at Albemarle Island on November 10, 1897. It is of pale greenish ground color, with liver-brown spots and patches, and underlying blotches of purplish mauve, and measures 61 x 43 mm. (Rothschild and Hartert, 1902, 413).

Distribution: Resident at the Galápagos Islands, nesting at some and wandering to others after the breeding season.

The Dusky Gull, which appears to be entirely sedentary within the limits of the Galápagos Archipelago, since it has never been captured elsewhere, is a not-distant relative of *Larus modestus* of the Peruvian coast. Like the latter, moreover, it is a bird of sandy shores rather than of the sea cliffs. Still another point of resemblance to the mainland species is the fact that, despite the great amount of field work which has been carried out at the Galápagos Islands, the nest of the Dusky Gull has not yet been found, and the only known egg is one taken from the oviduct of a bird shot at Albemarle Island on November 10, 1897 (Rothschild and Hartert, 1902, 413). This discovery might be taken as indicating the time of the nesting season, were it not for the fact that specimens collected by Beck during the expedition of the California Academy of Sciences were found to have enlarged gonads during the months of May and July as well as in October and November (Gifford, 1913, 43). Gifford reports that pairs of the gulls would at times swoop at a human intruder as if attempting to frighten him away from a nest which, however, could never be located.

The friendliness and lack of fear that the Dusky Gulls share with so many other Galápagos animals have been commented upon by many visiting naturalists. These gulls were the constant companions of Beebe's party at the islands. They trotted up and down the beaches in train of human beings, and whenever the seine was drawn their excitement became keen. They would fairly hop up and down with eagerness when the fish began to leap over the net, and would

afterwards gorge themselves until the tails of little fishes protruded from their beaks. Ordinary apparatus they were content to watch in silence, but they apparently learned to recognize at once the long poles of the seine, which they greeted with outcries that were interpreted as rollicking peals of laughter (Beebe, 1924, 64).

At Indefatigable Island, Habel found the Dusky Gulls so inordinately friendly that they became a nuisance. They were forever devouring the meat he had hung out to cure, invariably returning as soon as they had been driven away. Of stones tossed toward them they took absolutely no notice unless they were actually hit (Salvin, 1877, 505). Gifford contrasts their trusting and ingenuous behavior with that of the migrant Franklin's Gulls, which come to the Galápagos from a part of the world in which nearly all creatures recognize man as at least a potential enemy. Tameness or wildness are, however, largely reactions of season or locality or, more directly, of physiological rhythm. The Franklin's Gulls are themselves absurdly tame in the plowed fields of their summer range in North America; it is only during the winter migration that they tend to become shy and easily frightened. In the same way, the Galápagos Fork-tailed Gull (*Creagrus furcatus*) can almost be posed for photography with the toe of one's boot on its own lava ledges. When, however, it travels far at sea as, for example, down the Peruvian coast, it becomes an extraordinarily shy bird which, nine times out of ten, takes flight from the surface of the ocean long before a small boat can approach it within range of a camera or even of a gun.

The natural food of the Dusky Gull appears to consist largely of beach crustaceans, but the birds are scavengers of the first order, quick to gather at the slaughter of a bullock, seal, or tortoise, and equally ready to appear in half-domesticated guise and to mingle with the chickens at such places as Villamil, the Ecuadorian village on Albemarle Island. At the scene of a recent slaughter in this locality, Gifford made the following observations regarding the habits of the Dusky Gull:

> Two or three adults were bullying the younger birds. Whenever an adult desired a piece of meat on which one of the younger ones was pulling, he would lower his head, arch his neck, and give a long cackling call, at the same time making a short rush at the enemy. The young birds always got out of the way when such tactics were pursued. There was one immature bird imitating the calls of the adults, its voice, however, being harsher. Both young and adults had a wholesome respect for dogs and chickens. They would allow a man to approach within four or five feet of them before flying or running (Gifford, 1913, 43).

The same author adds:

> At Wreck Bay, Chatham Island, about three weeks later, I saw three adults chasing other adults about and making the same long cackling calls, always standing very erect for a moment before giving the call. In this case their actions may have been a form of courtship.
>
> This species calls throughout the year, uttering a short squawk as well as the long cackling call, which latter can best be described as beginning with a chuckle and then breaking into a cackling laugh.
>
> Not infrequently this species was seen in company with various other birds. Of such association the three following instances are good examples: 1. One day in early March there were a good

many paddling about and calling in one of the lagoons near Villamil. Intermingled with them were Egrets, Galapagos Herons, Bahama Pin-tails, and Black-necked Stilts. 2. At southeast Narborough this species was noticed in company with Blue-footed Boobies, Flightless Cormorants, Brown Pelicans, and Galapagos Herons, on a small islet about ten by thirty feet in dimensions. 3. On a rocky point on the northeast side of James Island a gull was seen standing in the midst of a compact flock of Blue-footed Boobies.

Their competitors on the water seemed to be chiefly the Graceful Petrel and the Man-o'-war Bird. These two species were usually present whenever there was any refuse about. Other petrels of [sic] the Dusky Shearwater also entered in a lesser degree into the competition. About the settlements, chickens, dogs, cats, and pigs were their chief rivals.

The feet of individuals of this species seem to be subject to a good many accidents, for specimens with split webs were frequent and those with deformed toes occasional.

GRAY GULL

Larus modestus

Larus modestus Tschudi, 1843, Wiegm. Arch. für. Naturg., 9, pt. 1, p. 389 (shores of the Pacific Ocean = Lurín, South of Lima, Peru).

Names: Called in Peru "Mateo" and "Torero." Synonyms of the specific name include *bridgesi* and *polios*, besides which this gull has also appeared in the literature under the name *fuliginosus*, a species in reality peculiar to the Galápagos Islands.

Characters: A gull with rather slender black bill, of uniform mouse-gray body color, black wings, a banded gray tail, and a hood which is white in the breeding season but brown in winter.

Adults in breeding plumage (sexes alike): Hood completely white; mantle, rump, and tail coverts dark neutral gray; wings dull black, without edging on the quills except that the proximal 3 or 4 primaries are faintly tipped with grayish white; secondaries rather broadly white-tipped, forming a wing-bar; greater and outer coverts mouse-gray, the median and lesser coverts grayer; primary coverts and alula brownish black; axillars and wing-lining grayish clove-brown; tail clear gray, slightly and somewhat variably banded, the middle rectrices with dusky shaft streaks; ventral surface, caudad from the white hood, uniformly gray like the mantle. Iris brown; bill and feet black.

Adults in winter plumage have a wood-brown hood, somewhat paler and more pinkish than in younger stages, an inconspicuous grayish eye-ring, and a faint dusky eye-crescent. Dwight (1925, 146) states that although the plumage cycle normally requires three years, certain members of this species become virtually adult in their second year.

5 males: wing, 314–337 (329.2); tail, 117–131 (124); exposed culmen, 40–43 (41.8); tarsus, 48–55 (53.2); middle toe without claw, 34–41 (38.2) mm.

14 females: wing, 299–328 (318.7); tail, 116–122 (119.6); exposed culmen, 37–41 (39.6); tarsus, 46–51 (48.7); middle toe without claw, 33–37 (34.6) mm. (Dwight, 1925, 144).

The average weight of three specimens collected at the North Chincha Island, October 27, 1919, was 366.6 grams.

In the first winter or non-nuptial plumage the mouse-gray feathers of the dorsal surface have partly dusky centers, and the head is without a hood, the hind neck being darker than the back, the feathers basally grayish white. The ventral surface is largely mouse-brown, marked by dusky clouding. Worn feathers often become exceedingly bleached or almost yellowish. The tail is broadly and completely banded, the blackish area being as large on the external as on the central quills, and more nearly terminal.

In the juvenal plumage the dorsal surface is prevailingly pale clove-brown, the feathers rather broadly edged with grayish buff; the head and neck are similar but with very narrow feather margins, and there are broad pinkish buff edgings on the under tail coverts. The wings are brownish black, the secondaries alone showing pale grayish tips. The coverts, tertials, and scapulars are conspicuously buff-edged; wing-lining and axillars dark grayish clove-brown; tail brownish black with very narrow buffy white tipping, which often extends to the outer webs of the outer rectrices.

Natal down, nest, and eggs unknown.

Distribution: Breeding chiefly or exclusively on the mainland coast of Peru, and recorded from Cautín, Chile, northward to Manta, Ecuador.

This demurely garbed little gull, which behaves like a sandpiper, is one of the most familiar birds wherever rocky and beetling coasts give way to sandy beaches in Peru and the northern half of Chile. Its commonest native name, "Torero," has reference to the agile manner in which it dodges back and forth in front of breaking waves, with the movements of a bull-fighter facing his furious antagonist. Another name, "Mateo," is said to mean a "worrier," and to refer to the plaintive, mournful notes of this gull. I find, however, no linguistic authority for the word.

The Gray Gull is related to the Dusky Gull of the Galápagos Islands, and to Heermann's Gull of the Pacific coasts of Mexico and California. It particularly resembles the latter in that it has a dark hood when in winter plumage, which, through a pre-nuptial moult in September and October, is replaced by a white hood to be worn throughout the season of southern-hemisphere summer.

The Gray Gull has been collected by members of many American Museum expeditions to the west coast of South America, and we have specimens or satisfactory records from the following localities.

Ecuador

Manta and Machalilla, February 9, 1920. Many feeding along sandy beaches (Murphy).

Point Santa Elena, middle of February, 1925. Numbers seen and one collected (Murphy and Heilner).

Jambelí Island, Gulf of Guayaquil, July 18, 1922 (Chapman).

Flats of the River Guayas, near Guayaquil. Noted on several occasions between January 9 and March 7, 1925 (Murphy).

Peru

Point Pariñas and neighboring parts of the coast, January, 1925. Several specimens captured locally, or observed in an aviary at the police barracks in Negritos (Murphy and Heilner).

North of Paita, March 5, 1925. One seen (Jaques).

Eten, January 4, 1913. Flock on the beach (Beck).

Salaverry, March 5, 1925. Present in great numbers (Jaques).

Ancón. Observed and collected by Beck during April and May, 1913, and found at the same locality in groups of thousands by Murphy during December, and by Jaques during February.

On sandy mainland and insular beaches about the harbor of Callao, and at Chorrillos. A short distance to southward it was almost equally abundant during various parts of the year.

Pisco Bay region. Common everywhere during Beck's field work in June and July. Until about the middle of November, I also found these gulls at islands, such as the Chinchas and Ballestas, wherever there were small sandy

beaches, but at about this date they completely disappeared, probably to seek breeding sites on the mainland shores.

Independencia Bay. Extremely abundant during mid-November, 1919 (Murphy).

Mollendo. Common, January 10, 1925 (Murphy); Paessler (1932, 42) also records it from this port during June.

Ilo. A female taken August 23, 1925 (Fagan).

Chile

Beck observed this gull at Iquique, Antofagasta, Valparaiso, Talcaguano and Corral, between August and November, 1913, and collected numerous examples near the last two localities during October and the following March.

The Museum collection also has specimens taken at Tofo, north of Coquimbo, in July and February by Hallinan, and others from Puyehue, Cautín, collected by Bullock in January and February.

In view of the predilection of this gull for sandy beaches, and its known presence at many Peruvian islands, it is surprising that it has not been recorded from Lobos de Tierra, which has the most extensive beaches of any island on the west coast. I was there during January, which may have been the wrong season, but Coker apparently did not find the species during his much longer visit.

The records cited appear to cover the entire known range. So far as I can learn, the nest and eggs of the Gray Gull have never been described and probably never discovered. Specimens which I collected at the Chincha Islands about the end of October, 1919, were clearly at the verge of their season of reproduction. For many weeks the birds had been feeding regularly at the Chinchas and neighboring islands, but as noted above, they all departed rather abruptly about the middle of November. During my field work in Peru I combed over with great care the surface of upwards of 30 islands and islets, and succeeded in locating the nests of practically all the species believed to breed upon them during the period between October and January. I am quite certain, not only because of my failure to find the nests of the Gray Gull but more particularly because of its absence from the islands throughout the spring and summer seasons, that it retires to some part of the continental coast when the courtship period is at hand. During December the birds were more abundant than ever on the broad smooth beaches of Paracas Cove, at the head of the Bay of Pisco, and along similar extensive strands lining the southern and eastern shores of Independencia Bay. May it be possible that the Gray Gull, like certain petrels of the Humboldt Current region, makes its nest on the high pampa at some distance back from the ocean, or on the summits of the lofty, cloud-capped promontories which loom hundreds of meters above the breaking waves?

Whatever its nesting habits, it is certain that this gull feeds exclusively along sandy shores, where it mingles with sandpipers, plovers, migrant Hudsonian Curlews, and the resident, White-breasted Oyster-catchers, rather than

with other members of its own genus. I never saw one alight upon an exclusively rocky island. At the Chinchas, which are lined mostly with granite cliffs, there are a few small gaps or coves with short sandy beaches at their heads. In such spots as these the Gray Gulls gather, neglecting all other parts of the islands. During October and early November, 1919, the landing place at central Chincha Island, below the Guano Administration building in which I made headquarters, was occupied every morning and sometimes at other periods of the day by a ballet of the gulls, which were forever dancing back and forth in front of the lapping waves. To escape the inrushing water they preferred to run rather than to fly, and by the same means of progression they would pursue the backwash to its lowest ebb, hastily picking about in the sand before they had to retreat once again. Among this group of birds was a one-legged gull which had to use its wings as balancers, and to fly back and forth, in the endless rhythm which its fellows accomplished on foot. The crippled bird seemed, nevertheless, to be as well fed and quite as full of *joie de vivre* as any of the others.

The special interest of the Gray Gulls in sandy rather than stony beaches was explained by their stomach contents, for the great bulk of their food proved to be made up of the sand-bug or hippa (*Emerita analoga*), a member of an almost world-wide group of crustaceans which are confined entirely to sandy strands. In Peru, this little creature is known as the "mui-mui" and it is used not only as bait by fishermen but also as human food. In the northern part of the country, particularly, it seems to be a staple article of diet among the local Indians. As many as six of the mui-muis, which are rotund, heart-shaped creatures with lengths up to 25 millimeters, or thereabouts, have been found in the stomach and gullet of a Gray Gull. Other material identified included bones of fishes, the hard jaws of Nereid worms, gravel, and a few feathers.

BELCHER'S GULL

Larus belcheri

Larus Belcheri Vigors, 1829, Zool. Journ., 4, p. 358 (no locality = Peru).

Names: The names "Simeón" and "Gaviota" seem to be the commonest designations of this gull in Peru. It is also known as the South American Lesser Black-backed Gull. Synonyms of the specific name include *melanurus*, *frobeeni* and, through misidentification, *fuliginosus* and *scoresbii*.

Characters: A gull with a heavily red- and black-tipped bill, subterminally banded white tail, wholly black primaries, brownish black mantle, and white head.

Adults in breeding plumage (sexes alike): Head and ventral surface white, with a pale grayish wash on the hind neck and breast; mantle deep brownish black; primaries black, the inner 3 or 4 grayer and with narrow white tips; secondaries and tertials slatier, with white tips 15–20 mm. in breadth; wing coverts like the mantle; tail white, with a subterminal broad black band, succeeded by white tipping 6–10 mm. in breadth. Iris brown; bill basally bright yellow, both mandibles tipped with cherry-red, and with a superior, subterminal black spot on the maxilla; legs and feet bright yellow.

In winter plumage the head is covered with a dull brownish black hood, extending well below the eye which, however, is encircled by a white ring, dusky near the canthi. The flesh colors are somewhat duller than during the breeding season.

6 males: wing, 348–372 (361); tail, 128–143 (135); exposed culmen, 50–52 (51.3); tarsus, 63–66 (64.1); middle toe without claw, 47–52 (49.3) mm.

8 females: wing, 330–352 (340.6); tail, 124–143 (135.7); exposed culmen, 46–51 (47.8); tarsus, 55–60 (58.1); middle toe without claw, 43–47 (45) mm. (Dwight, 1925, 159).

The wing-spread of a male was 1235 mm. The average weight of a male and a female shot at the Chincha Islands, October 24, 1919, was 670 grams.

In younger examples the mantle is brownish slate, the rump pale gray, becoming white on the upper tail coverts; the head extensively slaty brown, with faint whitish edgings on the forehead; the white ventral surface duskily flecked and almost solid dusky on the jugulum; the breast pale gray, merging with the whiter abdomen and crissum. The color of the wings is browner than in adults, the tipping of the inner primaries brownish, the tail dusky, often mottled with whitish.

In juvenal plumage the back and mantle are pale clove-brown, the feathers subterminally darker and very broadly edged with pale buff, which fades toward whitish; head blackish clove-brown, faintly edged with buff, the hind neck richly sepia in contrast with the back; forehead paler because of wider pale edgings; no obvious hood, the occiput fusing with the brown nape and this in turn with the back; eye-ring whitish, with dusky speckling; eye-crescent dusky; ventral surface brown, the feathers of breast and sides whitish basally with deep brown subterminal bands and buffy white edgings; the chin dull white, obscurely streaked and spotted; abdomen, flanks, and crissum dull white; under tail coverts subterminally with sparse dusky barring or spotting; primaries dull black, the inner quills with whitish or buffy edgings; secondaries, tertials, and greater coverts narrowly edged with whitish or brownish; wing-lining pale clove-brown, edged with buff; alula and primary coverts dull black; tail dull black, with inconspicuous white or "fogged" areas basally, increasing outwards and most marked on the distal rectrices, in which the outer webs and three-quarters of the inner are mostly white, all the quills with narrow whitish tips, the central pair dusky to base. Bill pale greenish yellow, more or less flesh-colored basally, and with a subterminal black band on the greater part of the area which is cherry-red in the adult. The tip of the maxilla is orange-red. The legs and feet are pale greenish or grayish yellow.

The natal down is extraordinarily pale. The dorsal surface is prevailingly grayish white, sparsely lined or mottled with pale clove-brown; the head is whiter, with a few bold dark spots arranged in irregular lines; the ventral surface is grayish white, very faintly buff, and practically unmarked save for small black spots at the side of the chin, and an obscure dusky speckling caudad.

I collected the first known eggs in 1919. A set of three, slightly incubated, from San Pedro Islet, Pescadores group, Peru, December 13, are ovate, somewhat attenuated and pointed at the smaller end, one of the three slightly blunter and more abruptly rounded at the larger end than the others. The ground color is deep olive buffy, the spotting very evenly distributed over the entire shell and comprising irregular masses of pigment up to 8 or 9 mm. in diameter which, wherever it lies at the surface, is of a blackish brown hue. Underlying spots appear grayer or lilaceous. In one example most of the pigment is more or less buried, giving the whole egg a milky cast. The dimensions of the three are 63.7 x 45.9, 63.7 x 45, and 64.3 x 44 mm.

A fresh egg, alone in a nest on La Huaca Islet, Pescadores, December 14, has a somewhat darker or almost buffy brown ground color, with a heavier surface blotching of a richer and more reddish brown. It measures 60.7 x 45.2 mm.

Distribution: Coasts of Peru and Chile, from Lobos de Tierra Island (6° 25′ S.) southward to Coquimbo. (Fuegian and Falkland Island records are erroneous.)

The distribution of the "Simeón," as this gull is called along the coast of Peru, has evidently been subject to considerable misunderstanding. Several recent works, including such authoritative books as those of Dwight (1925, 158) and Alexander (1928, 129), state that the species occurs at the Falkland Islands, and along the west coast of South America from Cape Horn northward. Such statements are due merely to the repetition of error, for the Simeón is, as a matter of fact, an endemic species of the Humboldt Current littoral, found only along the prevailingly desert shores between the neighborhood of Sechura Bay, Peru, and Coquimbo, Chile. Hellmayr (1932, 409) correctly says that the

species is of relatively rare occurrence in Chile. The southernmost record appears to be based upon an example collected by Admiral Markham at Coquimbo, during the month of November, and now in the British Museum (Saunders, 1896, 227).

Allegations regarding the occurrence of the Simeón in Magellanic South America are based upon sight records and resulting misidentification. That such mistakes are hard to avoid is indicated by references in Beck's journal to supposed Belcher's Gulls feeding off Ancúd, Chiloé Island, during April, 1914, and to others observed at Ushuaia and Magallanes, during the same month and also in July. No specimens from these parts of the coast exist, however, in his collections, and the mystery is apparently solved by an examination of skins of *Leucophaeus scoresbii* in juvenal garb. Young Dolphin Gulls in the plumage of the first winter are very gray and have a broad subterminal band on their tails. For these and other reasons they bear an extraordinary superficial resemblance to *Larus belcheri*, the differences relating only to such scarcely perceptible details as the slightly larger size of the latter species, and the shapes of the bills. No doubt this close resemblance is responsible for the many published records of Belcher's Gull from Patagonia and the Falklands.

The Simeón belongs to the subgenus *Adelarus*, as recognized by Dwight, and its affinities are with the three gray species inhabiting, respectively, the coasts of Peru, the Galápagos Islands, and the west coast of North America; besides this, it shows indications of relationship with several Old-World species, including *Larus crassirostris* of the Pacific coast of Asia. Such ties are indicated by morphological details, and more particularly by the pattern of plumage in both adult and immature stages. *Larus crassirostris*, *modestus*, and *belcheri*, the last two of which belong to the west coast of South America, are the only members of their genus which retain banded tails in the adult stage of plumage.

In the course of the Brewster-Sanford Expedition, Mr. Beck collected an excellent series of young and adult specimens of this gull at Ancón, Peru, during April and May, 1913. There was no example in breeding state at this season, and the post-nuptial moult of the quills was in full progress. Among some examples the entire wing is made up of short primaries which have not completed their growth, while in others one or two exceedingly worn outer quills remain. Six weeks after Beck's work at Ancón, or about July 1, his notes from the Pisco Bay region state that the Belcher's Gulls were then beginning to show the white heads which heralded the coming of the nesting season.

During my own two periods of field work along the coast of Peru, I encountered the Simeón at many localities between Lobos de Tierra Island in the north and the port of Islay in southern Peru. I discovered also that it nests on islets off the coast, always in low situations, close to the breaking waves. The three eggs are laid during November or December, and nests containing eggs or very young downy chicks were found at the smaller islets of the Pescadores group, off Ancón, during the middle of December, 1919. None of the nests was more than about 3 meters above mean sea level. The walls of gorges of small islets which had split in half were favorite sites, and on one islet known

as Pantacabra a number of nests, lined with a few feathers, were so close together that the aggregation made a sort of small colony.

The southernmost nesting locality I found was at Vieja and Santa Rosa Islands, at Independencia Bay where, during the middle of November, 1919, these gulls were extremely abundant. At San Gallán, the Chinchas, and other islands in Pisco Bay, at Asia Island, at Mazorca and its neighbors of the Huaura group, the Simeón was pestiferously in evidence in colonies of the guano birds during the entire period of my field work between October and January. In its depredations it showed a clear preference for the eggs of newly hatched chicks of the Peruvian Cormorant or Guanay. At Lobos de Afuera and Lobos de Tierra in January, I found it in relatively small numbers as compared with those of the larger Kelp Gull (*dominicanus*). The fishermen at this island called *belcheri* the "Gaviota," which means merely gull, to distinguish it from its larger cousin, the "Cleo." True to its habit of preying chiefly upon the Guanays, Belcher's Gull was in special concentration at the Canevaro Peninsula of Lobos de Tierra, which was the site of the only extensive cormorant colony at the time of my visit. Here numbers of the gulls were always engaged in their nefarious plotting to steal eggs, while the Cleos were dividing their equally destructive attention indifferently among cormorants, pelicans, and the two species of boobies. Throughout the guano islands of Peru, the Simeón is generally regarded as the most serious enemy of the guano-producing birds. The Administration maintains at most of these islands a corps of sharpshooters, and I was informed that during February and March of the year 1917 more than 5000 predacious gulls, the vast majority of which was undoubtedly of this species, had been shot at the islands between Pachacamác and Santa Rosa. In view of this, the following analysis of stomach contents of *Larus belcheri*, as determined through the courtesy of the United States Bureau of Biological Survey, will be of interest. All of these represent birds shot by the Indian guardians at South Chincha Island during the afternoons of October 12 and 13, 1919, and at Santa Rosa Island during the early morning of November 15, 1919.

STOMACHS FROM SANTA ROSA ISLAND

½ full. Percentage of animal matter, 100. Contents: Fish flesh, bones, eye-lenses, 88 °/°; several feathers of cormorant, apparently *P. bougainvillii* and 1 of penguin (*Spheniscus humboldti*), 11 °/°; bits of squid mandible, 1 °/°.

$\frac{1}{10}$ full. Percentage of animal matter, 100. Contents: Remains of young cormorant, 88 °/°; bones and eye-lenses of small fishes, 12 °/°.

$\frac{1}{10}$ full. Percentage of animal matter, 100. Contents: Slight remains of cormorant, 65 °/°; a few bits of fish bones, 10 °/°; 2 crab chelae (*Cycloxanthops sexdecimdentatus*), 15 °/°; pieces of Chitonid, 10 °/°.

STOMACHS FROM SOUTH CHINCHA ISLAND

⅔ full. Percentage of animal matter, 100. Contents: Remains of sea-urchin, 6 °/°; ground up Engraulidae, 92 °/°; a few feathers, probably of *Phalacrocorax*, 2 °/°; skin of small fruit, trace.

⅓ full. Percentage of animal matter, 100; of gravel etc., 4. Contents: Feathers, etc., of *Phalacrocorax*, 40 °/°; remains of small fishes, 60 °/°.

Full. Percentage of animal matter, 100. Contents: Remains of eggs and young of *Phalacrocorax*, 100 °/°.

¼ full. Percentage of animal matter, 26; of vegetable, 74. Contents: Fragments of a sea-urchin, 20 °/°; bits of an immature bivalve, trace; otolith and a few vertebrae and scales of fishes, 4 °/°; cormorant feathers, 2 °/°; vegetable débris, 74 °/°.

¼ full. Condition of gullet, nearly empty. Percentage of animal matter, 100; of gravel, etc., 10. Contents: 8 Bird flies (*Pseudolfersia* sp.), 30 °/°; a few feathers, apparently *Phalacrocorax*, 30 °/°; bits of fish bones, 40 °/°; small univalve, trace.

Full. Percentage of animal matter, 100; of gravel, etc., 1. Contents: Several feathers of *Pelecanoides garnotii;* remains of bird egg, probably of same species, 96 °/°; slight remains of small fishes, 4 °/°.

⅔ full. Percentage of animal matter, 100; of gravel, etc., 1. Contents: Several feathers, apparently of *Pelecanoides*, 30 °/°; remains of bird eggs (yolk), 60 °/°; slight remains of small fishes, 10 °/°

Full. Percentage of animal matter, 100. Contents: A few feathers, apparently of *Phalacrocorax*, 4 °/°; remains of fishes, 96 °/°.

Full. Condition of gullet, full. Percentage of animal matter, 100. Contents: Remains of an egg of *Phalacrocorax*, also a nestling of same genus, to which were attached (on the thighs) 3 Mallophaga (*Tetrophthalmus incompositus*).

¼ full. Percentage of animal matter, 100; of gravel, etc., 8. Contents: Remains of a bivalve with large quantity of byssal threads, 58 °/°; a few eye-lenses and vertebrae of small fishes, 36 °/°; traces of *Phalacrocorax* feathers, 2 °/°; bits of squid mandibles, 4 °/°.

¾ full. Percentage of animal matter, 100. Contents: a few feathers, apparently of *Phalacrocorax*, 20 °/°; fish bones, in part Clupeidae, 80 °/°; bulk of flesh, etc., is estimated arbitrarily and distributed to the foregoing items.

Full. Condition of gullet, ½ full. Percentage of animal matter, 100; of gravel, etc., 1. Contents: 2 eggs, containing embryos; color of shell and size indicate them to be those of *Phalacrocorax*.

Full. Percentage of animal matter, 100. Contents: Remains of young *Pelecanoides garnotii*, 65 °/°; bit of egg (*Phalacrocorax*), trace; of a Clupeid and another fish, 35 °/°; 1 Mallophagan of the genus *Tetrophthalmus*.

Nearly empty. Percentage of animal matter, 100; of gravel, etc., 10. Contents: Otoliths, vertebrae, etc., of 3 or more fishes, including at least 1 Engraulid, 60 °/°; feathers, etc., of *Pelecanoides garnotii*, 40 °/°.

Full. Condition of gullet, ½ full. Percentage of animal matter, 100. Contents: Fish remains, 99 °/°; a few cormorant feathers, 1 °/°.

Full. Percentage of animal matter, 98; of vegetable, 2. Contents: Remains of Clupeidae, 80°/°; a few feathers, 9 °/°; 2 *Pseudolfersia* sp., 1 °/°; fragments of echinoderm, (echinoid), 6 °/°; barnacle, 2 °/°; algae, 2 °/°.

Full. Percentage of animal matter, 100. Contents: Remains of Clupeidae, 98 °/°; a few feathers, in part at least from *Phalacrocorax*, 2 °/°.

Nearly empty. Percentage of animal matter, 100. Contents: A few feathers, apparently of *Pelecanoides*, 40 °/°; slight remains of fishes, 60 °/°.

Also the following entire fishes which dropped out of the gullets of several of the gulls:
2 *Trachinotus paloma*, 1 *Engraulis ringens*, 1 Sciaenid.

The contents of these stomachs consist, in brief, of remains of the Peruvian Cormorant, Diving Petrel, and Penguin, the eggs, young or feathers of the first-named being in excess of traces of any other species. They show also, however, that even gulls shot in the neighborhood of a colony of cormorants had done a great deal of food-hunting for themselves, since bodies of many species of fishes, together with sea-urchins, chitons, crabs, mollusks, and other animal matter, figure even more strongly than birds.

Not infrequently I observed the Simeón Gulls fishing on their own account, and I found that they were quick to take advantage of a concentration of Inca Terns, which is always a sign of the presence of food. Off one of the Chincha

Islands on November 25, I saw two of the gulls resting together on the water close to a sea-lion, about the head of which Inca Terns were hovering. Suddenly the seal swung toward one of the gulls, snapping its jaws as it reached for it. The bird, however, had leaped up too quickly, and it at once alighted beside and grasped a herring which the sea-lion had dropped.

While the Simeón is often seen in company with the Kelp Gull, I have never observed it following in the wake of vessels as the larger species does everywhere along the Peruvian coast. At the islands, the two birds are often much in company, and their behavior has many similarities. Both, for example, go through certain vocal gestures in exactly the same manner. On one occasion at Santa Rosa Island three or four birds of each species were standing near me on the guano-covered plateau, and apparently resenting my presence in territory that they regarded as their own. They would put their bills between their legs and begin to scream in this backward-looking and upside-down attitude, and would then raise the head, open the mouth wide, and scream still louder, sometimes permitting me to approach within 25 to 30 paces before they took flight, still protesting. On this occasion, as I inspected the birds at leisure through field glasses, the differences between adults in full breeding plumage were impressed upon me, and I made the following record of them in my field notebook:

Larus dominicanus—	*Larus belcheri*—
Pure white on nape and under surface.	A pearly gray tinge on these areas.
Primaries white-tipped, and with a spot on the outermost.	Primaries entirely dark.
Inner side of wing white.	Gray.
Bill horn-yellow; lower mandible with subterminal red blotch.	Bill rich yellow; both mandibles red-tipped; maxilla with superior subterminal black patch.
Eyelid orange, bare.	Eyelid yellow, feathered except at the canthi.
Iris grayish yellow, reticulated; encircled by a darker ring.	Iris brown.
Feet and legs olivaceous.	Feet and legs bright yellow.
Tail white, with a few faint gray marks.	Tail broadly banded with black; white-edged.
Tongue and inside of mouth pale yellow.	Tongue and inside of mouth bright orange.
Back and wings slaty black.	Back and wings brownish black.

This gull apparently lives well in captivity. Although I could obtain no exact data, I was told that examples at the Zoölogical Park of Lima had thriven for periods of years. Schlegel (1863, 9) states that one brought to Europe from a Peruvian guano island lived for five years in the Zoölogical Garden at Amsterdam.

KELP GULL

Larus dominicanus

Larus dominicanus Lichtenstein, 1823, Verzeichn. Doubl., 2, p. 82 (coast of Brazil).

Names: Southern Black-backed or Dominican Gull; Big Gull at the Falklands; "Gaivotão" in Brazil; "Gaviota Cocinera" in southern South America; "Cau-cau," the Araucanian Indian name, imitative of the notes, is also a native name in Peru where, however, this gull is usually

called "Cleo." In early literature the species was listed under *marinus* and other specific names of the Black-backed Gull of the northern hemisphere. True synonyms of the name *dominicanus* are very numerous and include *fuscus*, *flavipes*, *littoreus*, *antipodus*, *pelagicus*, *vetula*, *vociferus*, *verreauxii*, *fritzei*, *azarae*, *antarcticus*, and *pacificus*.

Characters: The only large black-backed and wholly white-tailed gull in the southern hemisphere. Its mantle, moreover, is darker than that of any other gull.

Adults (sexes alike): Mantle slaty to sooty black; head, neck, rump, tail, and ventral surface, including lining of wings, white; wings generally of color of mantle, the scapulars and all of the secondaries with broad white tips, which together form a conspicuous alar bar; primaries black, with white apical spots, the outermost with a rather small subapical mirror of variable size and shape; a light tongue, indicated on the fourth from the outermost primary, becoming more pronounced along the series inward. Iris straw-yellow or gray; eyelid carmine; bill amber, the tip of the lower mandible carmine; legs and feet greenish yellow.

10 males from South America, the Falklands, South Georgia, and the South Sandwich Islands: wing, 403–422 (412); tail, 168–185 (174.5); exposed culmen, 46–57 (51.8); tarsus, 63–69 (65.9); middle toe without claw, 52–56 (53.9) mm.

6 females: wing, 372–404 (389.5); tail, 152–165 (157.4); exposed culmen, 46–53 (49.2); tarsus, 56–70 (63); middle toe without claw, 45–53 (49.7) mm.

The above dimensions are from Dwight (1925, 224), who has studied our entire American Museum material. Discussion regarding measurements that transcend these limits will be found in the text below.

The wing-spread of a male from the South Orkneys was 143 cm.; those of four males and females from Rio de Janeiro ranged between 128 and 142 cm.

The Kelp Gull does not attain its adult non-nuptial plumage until the fourth winter of its life. The sequences, which resemble those of other large gulls, have been reported upon in beautiful detail by Dwight, and are summarized upon the basis of South Georgian specimens by Matthews (1929, 581), as follows:

In the first winter the plumage is grey-brown with buff specklings; the bill with white tip; legs, brown, feet grey, darker toward the edge of the web; claws black. The iris is dark brown and the feet grey. The second winter the grey-brown plumage is heavily spotted with buff and white and the mantle is brown. The base and tip of the bill are yellow and the center is black. The iris is light brown and the eyelids are dull red. The feet and legs are green-grey, the webs grey at their margins. . . . The third winter the mantle and wings are black, and the rest of the plumage is white, except for some scattered dark feathers in the head, neck, breast and tail. The bill is yellow, the mandible with an orange-red spot and a few small black streaks above the angle of the gonys. The eyelid is red and the iris light yellow. The feet and legs are yellowish green. . . . In the fourth year, when the bird breeds, the wings and mantle are black, the rest of the plumage being white.

The natal down is darker than that of the Herring Gull (*Larus argentatus*), with more buffiness, and finer and fewer markings on the back; the spots on the head are clearer, smaller, and more abundant. Back and proximal half of wing grayish buff, obscurely lined and spotted with dull clove-brown; rest of wing dull white; head creamy buff with dull black linear spots, median only on the forehead, in four broken lines on crown, and curving laterally on the nape, lores, and about eye; ventral surface grayish buff, more buffy on throat and crissum, the breast and chin decidedly white, with one or two black spots on the sides of the chin (Dwight).

Valette records the body temperature of Kelp Gulls at the South Orkneys as 40.7° C. He gives the length of the intestines as 143 cm.

The eggs of this gull are highly variable. Werth (1925, 364) once found three of totally different color in the same nest. Three is the commonest number in a set, but many complete clutches have only two, and more than two young birds are rarely reared. Bullock found several sets of four eggs at Mocha Island on November 24, 1932. The shells are thin and relatively tender, and the yolk is very dark reddish. Gibson (1920, 77) found the average dimensions of large series from the Province of Buenos Aires to be 71 x 51 mm.

During the Brewster-Sanford Expedition, Beck collected 6 sets of eggs as follows: Peyron

Island, Chile, December 19, 1914, 3 eggs, incubation begun; nest of dry grass, well built, on rocky point of island; the nest of a Black Oyster-catcher only 6 meters away. Five sets from East Island, Falklands, December 10, 1915. At the latter locality the Kelp Gulls had nests of dry grass, kelp, and other seaweed, on a small rocky islet. Cormorants, Cassin's Terns, and Pink-breasted Gulls were nesting on neighboring islands, and Black Oyster-catchers on the same islet with the Kelp Gulls, and sometimes only a few steps away. All the Kelp Gull eggs were fresh. The sets, no doubt selected for their variation, are made up of rather uniform-looking eggs within each clutch, with a ground color varying between olive-buff or a slightly greener hue and buffy brown. The overlying markings are brown, of variable size and pattern, and mostly well distributed instead of being markedly concentrated near the larger end. Some eggs have relatively fine speckling, while in others many of the blotches measure up to 10 mm. in diameter. Measurements of the 6 sets are as follows:

Peyron Island, 71.8 x 50, 73.7 x 50, 69.6 x 59.1 mm.

East Island, Falklands: 72.2 x 51.9, 68.6 x 51.8, 72.6 x 52.2; 70.6 x 50.5, 73.6 x 50.1; 77.3 x 50.4, 71.9 x 48.1, 74.1 x 50.7; 72.8 x 52.1, 73.4 x 51.4; 74.4 x 51.3, 72.8 x 51.9 mm.

Eggs from northern Peru, and many other parts of South America, bear a close general resemblance to these. The average dimensions of 22 eggs in sets of three and two, collected by myself at points from Vieja Island to Lobos de Tierra Island, Peru, between November, 1919, and January, 1920, are 70.7 x 48.5 mm. Extreme examples in this series measure 70.1 x 47.5, 75.4 x 48.7, 70.3 x 59, and 66.7 x 48.8 mm.

Distribution: Circumpolar in the southern hemisphere and breeding at practically all of the sub-antarctic islands, including Gough and the Tristan da Cunha group; also at the islands of the Scotia Arc, and southward into the West Antarctic Archipelago. The species nests likewise in New Zealand, along the southern coasts of Africa, and on those of South America from Cape Horn northward to the vicinity of Cape Frio on the Atlantic side, and to the island of Lobos de Tierra, Peru, on the west, from where it strays casually northward to the coast of Ecuador.

This handsome black-backed gull, the largest member of its family in South America, has one of the most extensive ranges among sea birds. Not only does it encircle the globe throughout a broad sub-antarctic belt, but it also nests in the American region from the vicinity of Marguerite Bay, in the Antarctic Archipelago (Gain, 1914, 185), northward through successive climatic zones to Lobos de Tierra Island, just off the burning shores of the northern Peruvian desert. The length of this breeding range amounts to approximately 60 degrees of latitude, which is almost or quite without parallel, and is all the more noteworthy because the entire distance lies on the same side of the equator. True, Fleming (1924, 139) has described the Kelp Gull of the South Shetlands as a distinct race from the bird breeding in South America. After examining a very large series from many localities, however, I am compelled to agree with Dwight (1925, 223) and Wetmore (1926, 131) in concluding that the alleged differences have not yet been shown to be constant. Moreover, if there are two subspecies, there are equally likely to be others and, pending a revision of the Kelp Gulls from all parts of the southern hemisphere, I prefer to treat them as an undifferentiated unit.

Wetmore has pointed out the very close similarity in color and structure between this gull and *Larus marinus* of the North Atlantic. He regards the two as representative of each other, and even considers the propriety of grouping them as subspecies. Dwight, on the other hand, emphasizes the relation of the Kelp Gull with the *Larus fuscus* assemblage of the northern hemisphere, the fundamental kinship showing in immature no less than in adult stages of

plumage. Considering such implied differences of opinion, it is clear that much work remains to be done on problems concerned with the intricate valences within the gull family, a condition apparently produced through respectively accelerated and retarded rates of evolution of color, pattern, and plumage sequence in the different phyla of these birds. The situation also points out the folly of attempting to indicate the finer degrees of relationship by means of zoölogical nomenclature in advance of more thorough study than has yet been carried through.

The American Museum possesses a very large series of South American Kelp Gulls, obtained during the Brewster-Sanford Expedition, during my own field work at South Georgia and along the Peruvian coast, and from many other sources. This material is listed below in geographic order, beginning in Brazil, working southward to the Antarctic Archipelago, and thence northward along the Pacific coast of the continent.

Brazil: Rio de Janeiro, 4 specimens, June (Cleveland Museum Expedition). These are presumably to be regarded as topotypes of the species, especially since this gull nests or formerly nested at the islets of Raza and Redonda, at the entrance to the harbor of Rio de Janeiro (Wied, 1833, 850).

Argentina: Mar del Plata, immature and sub-adult stages, September and October; Río Gallegos, August and September; Ushuaia, July (all collected by Beck).

Falkland Islands and political dependencies: Port Stanley, Port Louis, and other localities, breeding birds and younger stages, November, December, and January (Beck); South Georgia, representative series, December and January (Murphy and Correia); Deception Island, South Shetlands, 6 specimens, young and adults, December and February (Bennett).

Chile: Hoste Island, December; Magallanes (Punta Arenas), a series, February and July; Chiloé Island, a series, May and June; Corral, flying birds of all ages, September (Beck); Mocha Island and Temuco, Cautín, several specimens, November (Bullock); Tofo, several specimens, February (Hallinan).

Peru: Independencia Bay, one breeding male, November (Murphy); Ancón, adults and young, May (Beck); Lobos de Tierra Island, January (Murphy); Talara, full-plumaged adults, January (Murphy and Heilner).

Ecuador: El Muerto Island; adult male, February (Murphy and Heilner); Puná Island, July (Chapman).

These birds, considering the great series of adults as a whole, show an individual range in the color and form of the bill beyond anything that I can correlate with locality, age, or the well-marked differences of size between the sexes. Irrespective of any of these qualifications, many birds show, for example, an extremely pronounced gonydeal angle, which results in a bill form approaching that of the Dolphin Gull (*Leucophaeus*), or even of *Gabianus pacificus* of the Australian region. Wetmore has called attention to the sporadic appearance of this character in Kelp Gulls from both Kerguelen Island and South America. I find that in several birds from Peru and from South Georgia the feature is very strongly marked, and yet is not shared by other examples taken at the same

places and dates. A drawing of a specimen of this type is reproduced herewith. The condition indicates, I judge, that a deep mandible and pronounced angle are inherent traits among certain gulls of the *Larus* group, attaining maximum development and fixity in such forms as *Gabianus*.

It is possible that a true geographic variation may be shown by the color of the iris in adult Kelp Gulls. In the field I recorded the hue among South American birds as "stone-gray," and some of Beck's labels bear the notation "whitish." Among a number of antarctic specimens, however, the iris is recorded as "light yellow."

Dimensions of specimens are confusing, because individual variation is so great that it makes one cautious about drawing geographic conclusions. Measurements less than or greater than those shown among the sixteen specimens selected by Dwight crop out among birds from various localities. Thus a male from Nightingale Island, Tristan da Cunha, has an extremely long wing (447 millimeters), all its other measurements, however, falling close to the averages given above. Two males from Rio de Janeiro have wings slightly shorter than Dwight's minimum, namely, 395 millimeters. An extraordinary bird is a huge-billed male shot by myself at Talara, Peru. It was in breeding condition and generally resembles other males from the same region, though both its bill and tarsus are of unmatched size. I append its measurements, compared with those of two males from other localities. Abundant correlated material indicates, nevertheless, that these differences are individual rather than geographic.

Fig. 78. Bill of Kelp Gull, ♂, Wollaston Island, near Cape Horn; to illustrate the deep gonydeal angle occasionally exhibited by this species.

	Culmen	Bill from gape	Width of maxilla	Tarsus	Middle toe and claw
♂, Deception Island, December 15 . .	53.7	66.6	19.7	66.2	55.8 mm.
♂, Chiloé Island, January 20	58.8	72	22.9	71.2	61
♂, Talara, December 15	61.5	81.3	26.1	77	68.6

While the specimens listed above give a skeleton of the South American range of the Kelp Gull, there are, of course, innumerable records which piece out and slightly extend the distribution. The species is recorded from many localities on the coast of Brazil, and Friedmann (1927, 164) found that in late August his steamer was never without an escort of Kelp Gulls during the voyage between Rio de Janeiro and Buenos Aires. According to Álvarez (1933, 8), this gull is common all the year along the Uruguayan coast, nesting during September and October on Flores and Gull Islands. In Argentina it occurs far inland as well as at the seashore, particularly during the winter season when Wetmore observed examples nearly 200 kilometers from the ocean. Probably the presence of stockyards and killing-pens had been an inducement to draw

Kelp Gulls away from salt water, although they doubtless bred round the shores of some of the Andean lakes in western Patagonia even before the settlement of the country. Breeding stations about fresh water are, in fact, not uncommon throughout the southern portion of the continental range, as testified by a colony Peters (1923, 292) found on a rocky island in Lake Nahuel Huapi, and another recently discovered by Reynolds (1934, 352) near a cormorant colony on Lake Yewin, Tierra del Fuego. Beck saw many Kelp Gulls on December 20, 1914, high up under Diadem Mountain, Tierra del Fuego, about a small lake, where some were bathing in puddles on the ice. At Deceit Island, near Cape Horn, he found eight pairs nesting on two islets in a pond on flat land, below the breeding ground of the Sooty Shearwaters. The Kelp Gull is, in fact, indifferent to the nature of available water, whether salt or fresh, and is equally at home in regions of constant rain and snow or at sun-baked Peruvian islands which receive not a drop of precipitation for years on end.

Along all coasts of South America the breeding range of the Kelp Gull seems nowhere to be continuous, but to be particularly dependent upon a combination of local conditions, as determined by the accessibility of a food supply, or by a site which offers the nesting gulls full protection from their natural enemies. On the great mud flats of the Rincones, near Cape San Antonio, Argentina, for example, these gulls find a sufficiently inaccessible retreat on the mainland, in a district honeycombed by the burrows of crabs and overgrown with patches of glasswort. On one side are the dunes of the Atlantic coast, and on the other the treacherous and unfrequented shallows of the Plata estuary. It is the mud of the "cangrejales," however, which here offers the best protection to the birds. High continental headlands, islets in steep-cut estuaries, shores protected by cliffs and close to water of sufficiently low temperature to support growths of giant kelp, also make favorite nesting localities. Along the west coast of South America the gulls themselves are to be seen almost everywhere, and yet their nesting stations may be far apart. Mocha Island, which is well off the Chilean coast, Santa María Island in the Bay of Arauco, and Quiriquina in the Bay of Talcaguano, all offer such safe havens as I have described, and are all occupied by at least a few pairs of Kelp Gulls, which nest in close proximity to each other even though they may not form a true "colony." The high landward slope of Vieja Island at Independencia Bay, Peru, likewise furnishes a favorable environment, and here on a spit of shingle, with a bulwark of kelp growing only a short distance offshore, I found nests during November, 1919. San Gallán Island, and San Lorenzo, the shelter of which creates the roadstead of Callao, are also constant breeding grounds. I found no nests at any of the very small Peruvian guano islands, but the large yet low Lobos Islands are overrun with the Kelp Gulls, particularly Lobos de Tierra, which appears to be one of the world's centers of abundance of the species.

In view of the vast environmental differences in the habitats of Kelp Gulls within the South American region, I have thought best to treat separately the life history of the species at the tropical Lobos Islands, before continuing the general account of the birds occupying the pan-antarctic zone.

At Lobos de Afuera, on January 5, 1920, I found the Cleo, as it is here called, extremely abundant, to the great detriment of the guano birds, upon the eggs and chicks of which the gulls pounced as soon as they were uncovered. At this island and at Lobos de Tierra, where I subsequently made a longer stay, I was impressed at once by the fact that in a region of all-year-round nesting, the gulls had become largely parasitic creatures, the subsistence of which was gained at the expense of cormorants, boobies, and pelicans. The gulls had altogether departed, moreover, from their sub-antarctic régime, and had themselves adopted a more or less continuous breeding season, so that they were enabled to feed their own offspring throughout the year upon the produce of despoiled nests. Wherever I walked on the Lobos Islands I was invariably followed by a host of gabbling, screaming Cleos, which became even more vociferous when their young ones were approached. They all behaved as though perfectly aware of the fact that sooner or later I would unwittingly startle an unfortunate guano bird from its nest. The eggs of boobies they would carry away to devour, sometimes swallowing them entire, while those of pelicans they would break upon the ground. Even the eggs of their own kind were not immune; they would carry them off as soon as an incubating gull was flushed and, when I threw some heavily incubated Cleo eggs on the sand, cracking them, the cannibalistic old birds flew down and gobbled up the embryos.

At Lobos de Tierra the Kelp Gull breeds, like its abused neighbor the Blue-footed Booby, in every part of the island, from just above high watermark to the slopes and summits of all the little hills. The nests are attractive structures, made of several species of marine algae, most of them red, yellow, purple, or of other bright colors. The exquisite black and white gulls sitting upon them are conspicuous from afar, and it may be in direct correlation with this fact that they flee the nest at once upon the approach of a human being.

I found nests on the sand of the beach, in the seaweed of the higher drift lines, inside an old basket, on the pebbly pampa of the interior, in the talus of steep banks, and on the sharp ridges of stony outcrops far back from the water. Some of them had neither eggs nor chicks, but most contained one, two, or three, sets of the last number being in every stage of development. Downy chicks, and young birds of all ages up to full-grown gray-brown fledglings, were about as numerous as eggs. Chicks of whatever size left their nests when a man approached, but some of them, when watched from a distance, were seen to return to them later, provided they escaped the savage lunges that every nesting booby would make toward them. The chicks had one trick never attempted by their parents, namely, that of squatting down among the stones, or "freezing," thus taking full advantage of their obliterative pattern. It is an interesting biological fact, concerned no doubt with the rigors of natural selection, that such reactions become eliminated from the behavior of a bird at an age when they would cease to be effective. If the young Kelp Gulls were surprised when near the beach, they would at once take to the open ocean—even the tiniest downy chicks—and swim out, to remain afloat until the fancied danger had passed.

The adult Cleos gathered in droves along the sandy beaches close to the Indian fishing stations at Lobos de Tierra, and every evening clouds of them rose into the air and hovered about the returning sloops and schooners of the fishermen, eager to pick up scraps from the cleaning of the day's catch. I believe, also, that the gulls undertook more or less fishing for themselves as a variation from their diet of eggs and nestlings, because I frequently encountered them singly, or in loose flocks, far out over the ocean, scouring about and occasionally descending to ruffled patches of surface that indicated a concentration of fishes or swimming crustaceans.

I had no way of estimating the numbers of Cleos at Lobos de Tierra and Lobos de Afuera, but I judge that the islands had fully as many of these gulls as they were capable of supporting, and that there is perhaps no other area of equal size that is the home of so many.

Migratory movements of the Kelp Gull seem to be largely dependent upon latitude. Throughout the milder portions of the range, particularly where, as in northern Peru, the nesting period of the species as a whole is continuous, the migration is doubtless irregular and sporadic, and likely to lead the wandering birds in either direction along the coast. For this reason, no doubt, I saw numbers of the gulls at El Muerto and Puná Islands, and even on exposed mud flats opposite the water front of Guayaquil, during January, 1925. A month later I observed others in the Bay of Santa Elena, north of latitude 2° S. Chapman (1926, 189) reports the species on the Jambelí coast and elsewhere in the Gulf of Guayaquil at the opposite season of the year, or during July, August, and the first half of September. At the Falklands, according to Abbott (1861, 165), a good proportion of the Kelp Gulls depart during the winter. We have no indication, however, as to whether these birds migrate to sea or go to swell the half-terrestrial winter population on the continent. At South Georgia the majority of the Kelp Gulls certainly remain in residence throughout the year, and at all times the species obviously clings to the bays and the coast rather than venturing far out to sea. One rarely or never finds a gull on the offshore whaling banks, where skuas and petrels are so abundant. But in the polar lands of West Antarctica the species is definitely migratory, although it is not certain whether it travels into distant parts of the open sea or merely clings to the northerly border of the pack-ice. According to Gain (1914, 102), most of the gulls go north after April, but a few single birds always remain in the ice. Members of the Swedish Antarctic Expedition saw no Kelp Gulls at Snow Hill Island between March 4 and September 21, although at Paulet Island and in Hope Bay examples appeared several times during the winter. At the South Orkneys, Valette (1906, 55) also found that one or two of these birds might occasionally put in an appearance during the winter, but at the South Shetlands, according to Lester (1923, 174), the gulls absent themselves completely during the dark and frigid season of the year, returning shortly after the homeward migration of the Gentoo Penguins and in advance of the skuas. The point appears to be that the Kelp Gull is a generally sedentary species at isolated islands, such as South Georgia and Macquarie (Ainsworth, 1915, 195), or wher-

ever the climatic conditions permit. At the Falklands the birds probably dwell close enough to the continent to find their way to regions of richer forage, while at the polar islands they necessarily move away for a part of each year. It is possibly because of such enforced migration in the Atlantic that the species originally reached such far-away spots as Gough and Tristan da Cunha, from where Verrill (1895, 450) and Wilkins (1923, 499) have recorded it. Although this gull is not common about the Tristan group, the 'Quest' party obtained a specimen in juvenal plumage at Inaccessible Island, on May 21, and saw many others, all of which were larger, and of an older and lighter phase, than those obtained at South Georgia. In the British Museum I have examined examples from Nightingale Island.

Despite the fact that the Kelp Gull has reached such remote islands as those just named, it is noteworthy that it has never been recorded from Juan Fernández in the Pacific. That the latter islands would make a suitable environment is indicated by the presence of the Magellanic Penguin and other sub-antarctic birds, and by the fact that Mas Atierra is visited at times by such Fuegian coastal species as the Black Oyster-catcher. Juan Fernández, however, lies to windward of the continent, in addition to which the Kelp Gulls of the opposite mainland shores occupy an environment from which they are never forced by inclemency of weather to migrate. The most distant land from the west coast of South America at which they have been observed appears to be the little islets of Hormigas de Afuera, off central Peru.

At South Georgia the Kelp Gulls were already breeding and were very active and noisy, when I arrived at the island in late November, 1912. They frequented both the seacoasts and the pond-dotted, grassy valleys beyond the heads of the fiords. They were much shyer than most of the native birds, making, in this respect, a particularly strong contrast with the skuas, for at the approach of a man most of them would fly to the screes of the surrounding slopes and watch until the trespassers among their lakes had passed by. Nest-building had started in October, the Kelp Gulls probably being among the earliest breeders at South Georgia (Matthews, 1929, 581). I found nests with well-incubated eggs or newly hatched chicks during late November and the first half of December. These were in a wide variety of sites, including promontories above the sea, glacial moraines, back beaches, and particularly on grassy islands offshore, such as those at the Bay of Isles.

At South Georgia the gulls usually congregate in colonies of several dozen pairs. The nest is made of tussock grass, moss, dried kelp, bits of whalebone, and a few feathers, and is situated on the ground amid grass or in bare places, usually on a rise or on top of a boulder. Most eggs, according to Matthews, are laid soon after the beginning of November, although others appear well into the next month.

On December 3, I found many young downy chicks, and all the eggs examined were advanced in incubation. A month later, fledglings were everywhere, all able to swim strongly, but not yet capable of flying far. They were wary, and were very skilful in keeping the width of a pond between themselves and a

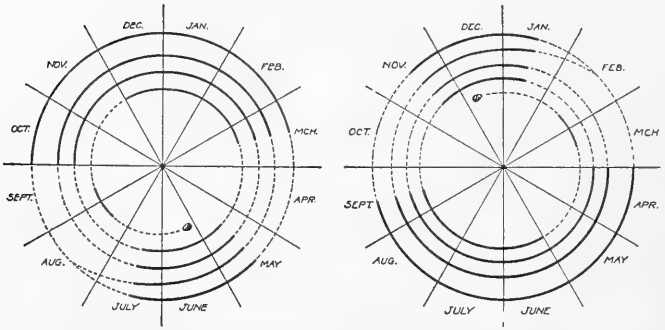


FIG. 79. *Left*, the four-year plumage cycle of any large gull that breeds in the northern hemisphere, *e. g. Larus argentatus*. *Right*, the same cycle of any large gull that breeds in the southern hemisphere, where the seasons are reversed, *e. g. Larus dominicanus*. Solid lines represent periods of stable plumage, broken lines periods of moult.

From Dwight (1925).

pursuer. I found that all the Kelp Gulls of a colony seemed to take a proprietary interest in every young bird. Whenever I approached one of the latter, the adults would circle overhead, screaming until the fledgling took wing, but, although they made a great deal of noise, they did not attempt actively to protect their offspring, as the skua does with so much determination and abandon. The outcry of the adults is one of protest rather than of effective defense. As Hall (1900, 10) says, "The young crouch on the rocks for evasion when a human being passes, and the whole flock call from above as if they had the melancholies." At this stage, as well as earlier, while they are still in the nest, the chicks need constant protection from the skua. They have a piping, trilling whistle, very snipe-like and quite unlike the voice of the old birds. They are quick to give the note of alarm, to which the old gulls as promptly respond, making a great commotion when a skua actually flies over their occupied ground. Curiously enough, however, they pay no attention, as Vallentin (1924, 302) points out, to an enemy that has passed out of their territorial zone, even though it may be engaged in tearing to pieces and eating a young gull within plain sight. On one occasion, at South Georgia, I saw a skua badly worsted by the gulls. The marauder flew over a pond close to where two chicks were swimming, whereupon first three and then four old gulls pitched into it, knocked it down to the water, and then piled upon it and continued to peck and pound it vigorously. It was some time before the skua could collect itself, beat off its enemies, and fly away. On another occasion I saw a skua high in the air flying ignominiously before a pair of gulls, which swooped down upon it repeatedly until the foe finally outdistanced both.

I noted the first youngster in flight on January 11, and by January 29, flying fledglings were common. As soon as the chicks have reached this stage, the

gulls gather in flocks, mostly spending the nights afloat on the surface of ponds, and standing about during the daytime in groups of forty or fifty on the glaciers, cliffs, or beaches, always with their breasts turned toward the wind. South Georgia is a region of sudden meteorological changes, and the gulls make excellent weather vanes, for as the wind veers, whether gradually or rapidly, the gulls, too, change their direction. They sometimes fly very high, especially during a tempest, and have been seen at an altitude of 1500 meters (Gain, 1914, 106). As violent puffs begin to blow, the birds often leave the beaches to settle on the water in the lee of the long lines of growing kelp, which serve them as a breakwater. Sometimes they stand on the kelp itself, the weight of their bodies causing the strands to sink until the feathers of their bellies touch the surface.

The growth of the fledgling to full strength appears to be very gradual. Up to the end of the South Georgian summer period, at least, the birds in the youthful gray plumage seldom if ever accompany their elders on foraging flights to the middle of the great fiords, or over the snow-covered glaciers and headlands to distant inlets of the coast; rather, they cling closely to the place of their nativity and lie low when the gales break. At this stage the young have a peculiarly long-legged appearance and they can cover the ground very rapidly.

Distrustfulness seems to be a strongly marked temperamental character of the Kelp Gull. Whenever at South Georgia I was bent upon stalking a sleeping albatross or seal with a camera, and was at the point of accomplishing my object, a self-appointed sentinel in the form of a gull would be almost certain to fly by and to warn my prospective subject with its annoying cackle. But while the gulls would render me no assistance, they were always ready to profit from the slaughter of sea-elephants by members of the crew of the brig 'Daisy.' Even at such times, however, their reactions would be very different from those of the skuas, which gathered with them, for the gulls would sit about at a distance, waiting for the coast to clear, while the skuas would hustle forward and, as the skipper of my vessel expressed it, "take a hand with the men in a bit of skinning." Later, when gulls and skuas were none too amicably sharing the remains, the latter would stay calmly on the job if I rejoined their party, while the gulls would retreat to the nearest rise of ground, or to the kelp fields a stone's throw out from the beach. Matthews states that the gulls become very much less wary about the whaling stations during the long South Georgian winter, when the meadows and beaches are deeply buried under snow.

At the Falklands the Big Gull, as it is called, usually breeds in large rookeries, a habit which offers some protection against the skua; nevertheless, solitary nests are also known there. The location of the colonies is either inland, among the diddle-dee, or on the beaches. If the latter, the lee of a log of drift-wood or a whale's bone is often used as a protection against the grit-bearing winds. Sheep's wool, gleaned from the shrubbery, often enters into the material of Falkland nests, which are composed mainly of grass and seaweed (Cobb,

1910, 69). The groundsel, *Senecio vulgaris*, grows luxuriantly about the gull colonies, probably resulting from the natural sowing of seeds which had adhered to the gull feathers (Vallentin, 1924, 302). At the Falklands the eggs are collected for human food in December, and as many as possible of those not taken are smashed, because of the injury this gull does to the sheep industry. The thin and relatively tender shells of Kelp Gull eggs make them difficult to transport. Furthermore, the dark reddish color of the yolk is somewhat prejudicial to their appearance, though they are good to eat, whether boiled, fried, or cooked in flapjacks (Cobb, 1910, 68; 1934, 41).

At the South Shetlands, as at South Georgia and the South Orkneys, the breeding season is somewhat earlier than at the Falklands. Bennett (1920, 26) states that November 10 is about the earliest date for completion of the sets of eggs, and that if these are taken, the birds will promptly replace them. By the end of September the gulls come in numbers to the South Orkneys (Valette, 1906, 55); birds have been seen pairing on November 3 and the earliest eggs are recorded on November 15 (Clarke, 1913, 242), the sets of three all being completed by the middle of December. Clarke states that fresh eggs marked on December 3 were found chipped on December 28, indicating an incubation period of 25 days. The nests are sometimes simple depressions in the ground, without lining. Because the shells of Kelp Gull eggs are so delicate, they are not infrequently dented or cracked by the roughness of the stones on which they are laid. Nevertheless, that young birds hatch from these broken eggs has been many times observed (Bennett, 1920, 26). Bennett (1930, 13) also speaks of the Kelp Gull as the "gardener of the antarctic." The nucleus of every patch of grass in West Antarctica, he states, was once a gull's nest. In constructing the nests, the gulls pull up wisps of grass by the roots. Some of this survives, and benefits not only from the manuring but also from the bodily heat of the sitting bird, and such stalks as take root on the outer wall of the nest undergo more than the ordinary amount of growth. The gulls breed, however, well to the southward of the limit of vascular vegetation in West Antarctica, and at Trinity and Valdivia Islands nests built of moss have been found upon a foundation of snow. Gain (1914, 102) saw similar nests south of the antarctic circle, constructed of mosses, lichens, and feathers, and containing either two or three eggs. In these high latitudes, nest-building begins before the middle of November and the first eggs have been reported on November 20. At the South Shetlands well-grown young have been found by Bennett as early as December 20.

At Kerguelen, Kidder (1875, 13) noticed that at the beginning of the mating season there was a tendency for these gulls to congregate and fly about high in the air, making considerable outcry. On November 19, Werth (1925, 564) several times saw that, in a large group, one bird appeared to be following another, possibly in courtship.

The voice of the Kelp Gull has a considerable range of expression. The birds utter a variety of cackling and laughing notes, reminiscent of those of many other species. While standing quietly but watchfully on the rocks, they utter

a conversational note of low pitch, which sounded to me like the words "Katy-did" and "Katy-didn't," or even more like the sounds produced by the orthopterous insect called katydid. Frequently calls that begin as a rapid cackle change to long-drawn "tortured" screams; this is particularly true when the birds are on the ground, thus permitting their outcries to be accompanied by appropriate gestures. For instance, they sometimes begin their song with the bill pointing toward the ground between their legs, the head then being lifted in a succession of jerky movements as the sounds are heightened and prolonged, the final ear-splitting outcry coming from a widely opened mouth which points upwards. Gibson (1920, 77), whose observations were made near the mouth of the Río de la Plata, writes, "The cries also are typical of the species, clamour of long hoarse calls to each other, loud chorus of inhuman laughter as they wrangle over their feast, and a high and sad double-note recalling great oceans and wandering sea-fowl. *Sui generis!*" Buller (1888, 47), in mentioning two albinos, both pet birds, states that he found that captives of this species responded to the music of a piano, and that sometimes they would begin a chorus of screams as if in accompaniment. Incidentally, Kelp Gulls have been kept for very long periods in captivity, and one female is known to have constructed her first nest and laid three infertile eggs after leading the life of a lonely pet for nineteen years (Buller, 1905, 168).

The Kelp Gull has feeding habits of the most diverse kind, its staples depending very largely upon place and circumstance. Its old mode of life in many places has been changed by human activities, such as those of shore whaling stations and plants for the slaughtering of sheep or cattle. For such reasons, the Kelp Gull is no doubt now vastly more of a scavenger than it was in primitive times. Beck, for example, saw many thousands of these gulls about the "frigorífica" at Río Gallegos, Argentina, where more than 300,000 sheep had been slaughtered and rendered during the three months preceding his visit in June, 1915. Everywhere in southern South America, the gulls gather about the killing-pens to share blood and offal with Turkey Vultures and other birds of prey. The flesh that attracts them most of all, according to many observers, is that of a horse. Such a carcass, with the hide stripped off, is sure to draw a large force of Kelp Gulls, whereas a dead cow or sheep might lure only one or two. Under such circumstances, these birds may remain in possession for a week, keeping off all other carrion-feeders, and retiring to some near-by pool only at dusk (Gibson, 1920, 77). In the same way they take advantage of modern whaling and sealing in the Antarctic; I have seen them alighting upon inflated whale carcasses straight from sea, as these were being towed into Cumberland Bay, South Georgia. Whalemen and ranchers alike believe that the Kelp Gull has a keenly developed sense of smell, because it gathers so quickly at the spilling of blood. This was also credited by Dr. Gain, but I know of no trustworthy data bearing upon the subject.

Carrion-feeding is only one step removed from the eating of live stock, and in Patagonia and the Falklands the Kelp Gull is roundly hated because of its attacks upon young lambs. Even dogs and cats go in terror of it about ranch

stations. In carrying off eggs or the young of various birds, it is almost as adept as the skua; in some parts of the range, as at the Peruvian guano islands, a large proportion of the food is, as already noted, made up of eggs and young birds. Gain states that during late winter in West Antarctica, when the carcasses of all the seals that had been killed were deeply covered by snow, the few Kelp Gulls which had lingered about the human winter quarters took to hunting the Snow Petrels, although most of the latter proved too quick for them. The Kelp Gulls are, of course, noted for keeping close to coastwise ships in search of refuse. From Cape Blanco, in northern Peru, they regularly follow the steamers southward, often alighting on the superstructure and enjoying a free passage until garbage appears in the wake. They confine their attention entirely to coastwise vessels, however, quickly leaving one which heads out toward the warm high sea. Sharpe (1879, 109) states that the Kelp Gulls soon become conditioned to such regular phenomena as the striking of eight bells at noon on board an expedition vessel anchored for a long time in one locality, this sound always presaging the emptying into the sea of table refuse.

The Kelp Gulls are, however, quite capable of capturing active food for themselves. Stomachs I examined in the Humboldt Current region contained fish bones, and in Beagle Channel near Ushuaia, on April 30, 1915, Mr. Beck saw many of these gulls in pursuit of small leaping fishes which his notes call sardines. These the birds were capturing easily, picking them from the top of the water or even seizing them in mid-air. When the gulls fish in this way, they strike the surface smartly with both feet together, thereby giving themselves a forward impulse that launches them again into flight. Frequently, however, they feed while afloat, tipping up the tail as the head goes beneath, or even diving with half-spread wings after a short forward leap, so that every part of them except the ends of the long primaries is completely submerged. Buller (1888, 47) saw one capture a flounder as large as a man's hand, though it was unable to swallow it.

To judge by the habits of the Kelp Gulls observed in parts of South Georgia remote from the whaling stations, the bulk of their natural food—dating from before the days of human shambles and city dumps—comprises mollusks and other invertebrates found on the rocks and beaches or in the tangled and barely submerged surface of the kelp fields. Limpets of the genus *Patella* hold a high place in their diet. Every coastal hilltop at South Georgia is more or less covered with layers and heaps of the perforated limpet shells, as a result of the gulls' habit of flying over and over again to the same place to ingest a meal. Many other invertebrates, including mussels, chitons, sea-urchins, and crabs, mostly obtained in the intertidal zone, also furnish them with food. The gulls seem always to be on the alert for the turn of the tide, which will expose their feeding grounds. Hard-shelled creatures, such as they cannot readily break with their bills, they drop from a height in the usual gull manner. Oldham (1930, 239) has published exact observations on the shell-smashing habit of gulls in general. He found, for example, that the ordinary procedure of Herring Gulls with whelk shells containing hermit-crabs was for the birds to fly from

the intertidal zone to the higher beach, then to run a few steps and rise almost perpendicularly to a height of six or seven meters, drop the prey, descend, and tear at it vigorously. If the crash had not broken the shell, the gulls would go through the same maneuver again. Oldham saw one bird repeat it eight times, and another ten times. The gulls make no discrimination, however, as to the type of shore on which they drop their prey. That is, they do not select adjacent areas of flat rock or hard shingle in preference to soft sand, as is so commonly believed. Yet they do distinguish between water and land, only rarely making the mistake of using the former. However, I have seen gulls dropping mollusks on ice, and have noted that they occasionally erred or miscalculated enough to permit the shell to fall into adjacent water and be lost. An altitude of between 5 and 8 to 9 meters seems to be fixed by practical considerations, if the bearer of the prey is itself to become the beneficiary because, as Oldham writes, "gulls make no clear distinction between *meum* and *tuum*."

LAUGHING GULL

Larus atricilla

Larus Atricilla Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 136 (America = Bahama Islands).

Names: A native name at islands off the coast of Venezuela is "Guanaguanare." Synonyms of the specific name include *plumbiceps*, *wilsonii*, *atricapillus*, *macroptera*, *minor*, *catshaei* and *megalopterus*.

Characters: One of the two largest of South American "black-hooded" gulls, the other being *L. serranus*, from which the Laughing Gull differs in its much darker mantle and almost wholly black primaries.

Adults in breeding plumage (sexes alike): Head completely hooded in dark sooty gray, save for a conspicuous white eye-ring; nape, lower neck, upper tail coverts, tail, and ventral surface white, the breast sometimes suffused with delicate pink; mantle and rump deep neutral gray; outer primaries black, all but the outermost sometimes with small white apical spots, increasing in size inwards and forming a broad white terminal band on the tips of the proximal feathers; the fourth from outermost quill usually with a tongue on both webs, making the feather about half grayish; the inner quills increasingly grayish forming, with the primary coverts, a wing-patch which is bounded by the black outer webs of three primaries, the tips of two, and the white edging of the secondaries; primary coverts and alula usually somewhat dusky, or with blackish shaft streaks; lining of wing gray, the axillars white. Iris brown, eyelid dull red, bill dark brownish red, the terminal third of gonys carmine; legs and feet dark red. Adults in winter differ chiefly in the absence of the hood, the head and neck being white, the occipital and auricular regions spotted or mottled with brownish gray, the eye more or less surrounded by a dark crescent.

16 males: wing, 308–330 (321); tail, 113–133 (122.6); exposed culmen, 37–44 (40.2); tarsus, 50–54 (51.6); middle toe without claw, 33–36 (34.2) mm.

10 females: wing, 295–326 (312.3); tail, 115–123 (118.5); exposed culmen, 35–41 (38.9); tarsus, 46–55 (49.7); middle toe without claw, 31–36 (32.7) mm. (Dwight, 1925, 262).

Younger birds have an imperfect black hood during the breeding season; the mantle is deep neutral gray but a little browner than in adults; the head in winter plumage is white, with the occiput spotted or streaked with grayish brown, which forms a partial collar on the nape extending to the sides of the neck; auriculars, an eye-crescent, and the outer canthus of the eye black, with a partial white eye-ring posteriorly on each lid. The hind neck is gray, paler than the back. The white under parts show an inconspicuous dusky gray band on the throat and sides, and an occasional clouding on the breast. The skin of the eyelid is black, rather than reddish.

In juvenal plumage the mantle is pale clove-brown, with buffy feather edgings which are broadest and palest on the tertials and scapulars, the feathers otherwise being brown nearly to their

bases; rump grayer, tail coverts white, concealing the dark gray basal portion of the tail; head solidly grayish brown; hind neck browner and darker, merging with the back; forehead, lores, and malar region slightly paler; partial eye-ring gray; ventral surface dingy white, with clouding, whitest on chin and tail coverts; a broad, ill-defined pectoral band merging into the whitish of breast; sides of chin distinctly white, usually flecked with brown; primaries black, a faint white tipping increasing inward, the inner five with dingy gray on the outer webs; secondaries black, conspicuously white-edged; tertials brown like the back; primary coverts and alula black, faintly edged with buffy gray, the greater coverts clove-brown with buffy gray edgings; median coverts more gray; lesser coverts like the back; wing-lining and axillars grayish brown, faintly edged with buffy gray; tail largely basally gray on outer, and white on inner, webs, with a very broad terminal blackish band narrowly tipped with buffy white; outermost rectrices with a narrower band, and outer web often gray to tips.

In natal down the back and wings are dingy buff, with clove-brown markings in distinct, rather narrow lines; on the head the brown markings are broken up into numerous small spots; the ventral surface is paler but with obscure dusky fleckings on the sides, and clearer dull black spots and lines on the upper throat and chin; buffy lower throat and paler abdomen, immaculate.

Eggs: Usually three but not infrequently four; highly variable in shape but most commonly ovate. The ground color varies from cream-buff to wood-brown, more prevailing types of eggs being olive buffy or rarely olive-green. The markings consist of spots and blotches or sometimes of irregular scrawls, variously distributed, and intermingled with the usual underlying marks of olive-gray. Measurements of 69 examples average 53.5 x 38.5, those showing the four extremes measuring 62 x 37, 52 x 42, 48.5 x 37, and 52 x 30.5 mm. (Bent, 1921, 158).

Distribution: Breeds from the Caribbean coast of Central America and the Lesser Antilles northward to southern California and Maine; recorded in summer from the coast of Venezuela and the islands of Curaçao, Aruba, and Bonaire; winters from the South Atlantic and Gulf coasts of the United States to Brazil and northern Peru.

On the Atlantic coast of South America the Laughing Gull moves southward through the warm littoral waters at least as far as the mouth of the Amazon. According to Léotaud (1866, 533), who calls the species *Larus ridibundus*, the name of the European Brown-headed Gull, it is common at Trinidad between July and October. Cherrie (1916, 374) found it to be a conspicuous species at certain seasons in the Gulf of Paria and about the various mouths of the Orinoco. It is well known in the Guianas, and Snethlage (1914, 81) records three winter specimens from Marajó Island. The vicinity of Pará apparently marks the southeastern limit of the range on this coast of South America (Goeldi, 1894, 585).

Along the Pacific coast, the Laughing Gull is one of the birds which serve as more or less of an index to the temperature, and perhaps to other physical attributes, of the coastal water. Its range terminates short of the region in which cool upwelling becomes pronounced, and occasional southward inroads of the species down the coast of Peru appear always to synchronize with periods in which the ordinary Humboldt Current phenomena have been pushed back or obscured by a strong development of the warm current known as El Niño. Other conspicuous species with which the Laughing Gulls become associated at such times include the Royal Tern, Caribbean Man-o'-war Bird, Masked Booby, and Red-billed Tropic-bird.

No doubt the Laughing Gull is a common resident during the northern-hemisphere winter along the shores between Panama and the Gulf of Guayaquil. To southward of the latter point it appears only sporadically, under the special

conditions noted above. On January 24, 1925, I saw a number of the birds on bars inside the mouth of the Chira River, just north of latitude 5° S. At this time El Niño was running southward with extraordinary force, and both the meteorological and the oceanographic régime were of a sort unprecedented during the preceding 30 years or longer. Under such circumstances the Laughing Gulls might well wander farther southward, but there seems to be no justification for the often repeated statement that its winter range extends to Chile.

I judge from hearsay accounts that this is the species of gull which at times comes up from the sea in flocks to the neighborhood of Guayaquil, in order to feast upon the recurring plagues of crickets. Between January and March, 1925, Laughing Gulls were common along the lower stretches of the Guayas River, in Ecuador, as well as on the outer coast near Point Santa Elena. On February 14 I saw many standing on current-borne flotsam from the north in Santa Elena Bay, close to the small bare island called Pelado. Examples in winter plumage and in worn post-juvenal plumage were collected at this time and place by Mr. Heilner and myself. During the Brewster-Sanford Expedition the species was not encountered until Mr. Beck neared the end of his long voyage, when he collected a series of adults in process of change from black-hooded to winter plumage at islets near St. Thomas, West Indies, during August and September, 1916.

Dwight (1925, 266) points out that the alleged differences between the resident Antillean Laughing Gulls and those of the North American continental coast are too slight and inconstant to warrant the taxonomic recognition which has been proposed for them. It seems still to be questionable whether the Laughing Gull belongs to the actual breeding avifauna of South America. At Margarita Island and adjacent parts of the Venezuelan mainland, it has been found between March and July as well as during the winter season, as recorded by Cory (1909, 233) and previous observers cited by him. So far as I can learn, however, nests and eggs are unknown from any part of this Leeward Island chain. In any event, the breeding range approaches as close to the continent as the island of Grenada, where the habits of the Laughing Gull have been studied by Wells (1902, 239), from whose report the following account is abridged.

At Carriacou the Laughing Gull or "Mauve" is plentiful throughout the year. Large flocks are to be seen sitting upon the water, keeping an eye upon the movements of pelicans. The gulls seldom fail to demand a share of each pelican's catch, literally taking food from the mouth of the larger bird, all the while uttering their laughing cry which, according to the local fishermen, is "half-half-half."

The breeding season, which is practically the same here as on the coast of Massachusetts, comes during the months of May and June, when the gulls can be found nesting on the small islets, of which one known as Ile-de-Large is the favorite. The three or four eggs are laid in little depressions among tufts of grass or bare rocks, the sites being so close together that one has difficulty in walking without treading upon the eggs. The period of incubation is about

20 days and, after the hatching of the young, the parents noisily depart at a very early hour of the morning for their feeding grounds, which are chiefly off the western coasts of the various islands. Between four o'clock in the afternoon and dusk, they are uninterruptedly returning, laughing and calling to each other as they make their way across the water.

These gulls apparently do not dive, but depend for such food as they capture themselves upon the shoals of fry and small species of fishes that come to the surface. They have been known, however, to bite at the backs of fish far too large for them to capture. When heavy rainfall covers the island pastures with numerous pools and puddles, the Laughing Gulls resort to these in order to feed upon earthworms which issue at such times from the ground.

GRAY-HOODED GULL

Larus cirrocephalus cirrocephalus

Larus cirrocephalus Vieillot, 1818, Nouv. Dict. Hist. Nat., 21, p. 502 (Brazil).

Names: "Gaviota de Capucho Gris." Synonyms of the specific name include *poliocephalus*, *plumbiceps*, *major*, *minor*, and *polionotus*. The species has frequently been reported upon under the name *maculipennis*. This gull is also a bird of the African continent, and various other specific names have been used for the branch of the population now recognized as a distinct subspecies.

Characters: The pale gray hood, which darkens toward the posterior margin, the pattern of white subapical spots on the two outer primaries, and tongues of white with more or less square ends on the median primaries, are diagnostic of this gull.

Adults in breeding plumage (sexes alike): Hooded head very pale gray, almost white on forehead and chin and darker all around toward the caudad margin; mantle light neutral gray or darker with a faint purplish tinge; primaries brownish black, with white subapical mirrors on the two outer quills and small apical spots on all the others; these quills basally white, which hardly shows on the two outermost; the more proximal primaries show more or less square-ended white areas on the outer webs, and gray tongues of increasing size on the inner webs; secondaries, tertials, and coverts gray; primary coverts, alula, and small adjacent coverts white; wing-lining gray like the mantle; tail white, sometimes dusky on the shafts or even on the webs; ventral surface white, with a rosy bloom. Iris napthalene yellow; eyelids, tarsus, and toes dragon's-blood red; bill madder brown, becoming diamine brown at base; claws black (flesh colors from Wetmore, 1926, 136). Beck's labels describe the bill as "dark crimson."

In winter adults the flesh colors are duller, and the head is white with a pale gray occipital area or half hood, and a dark auricular spot and eye-crescent; anterior half of eye-ring white; hind neck gray, slightly paler than the back, the feathers being white basally and narrowly edged.

12 males: wing, 308–338 (325); tail, 121–133 (127.7); exposed culmen, 38–42 (40.3); tarsus, 50–60 (54.7); middle toe without claw, 35–43 (40.2) mm.

10 females: wing, 305–323 (314.9); tail, 120–134 (127.7); exposed culmen, 35–41 (37.4); tarsus, 48–54 (51); middle toe without claw, 34–42 (37.2) mm. (Dwight, 1925, 271).

Younger birds resemble adults except that the back is usually browner, the feathers showing faint brownish edgings, and the sides of the throat are usually buffy; an imperfect gray hood is assumed in first nuptial plumage.

In juvenal plumage the mantle is wood-brown or pale snuff, with rather narrow paler edgings, passing into neutral gray on the rump; upper tail coverts grayish white, the basal parts of the feathers being entirely gray; head brownish mouse-gray, the color extending to below the eye, with darker auriculars; hind neck with an ill-defined grayish white collar; forehead, lores, and a large post-ocular spot lighter; ventral surface white, tinged with brown on the sides of the breast; wing quills generally grayer, and the coverts much more brown than in adults; tail white, with a

band of brownish black 20–25 mm. in width, succeeded by narrow whitish tipping; this tail band is widest on the central rectrices, reducing outward. Iris brown; bill, legs and feet dull yellow.

Examples in natal down are buffy on the dorsal surface, marbled with white and spotted with pale clove-brown, the head being generally whiter and with darker spotting. The ventral surface is paler, especially on the breast, obscurely spotted, and with a dingy band across the throat.

Eggs of the South American subspecies are perhaps unknown.

Distribution: Breeds from southern Brazil to the Province of Buenos Aires, and ranges up the Paraná and Paraguay Rivers to Paraguay and Matto Grosso, perhaps only casually reaching the Pacific coast in central and northern Peru.

This extraordinarily interesting gull occurs on the continents of both South America and Africa, its breeding range in the latter being confined chiefly to the central region of equatorial lakes. Most students have been unable to recognize even subspecific differences between birds from opposite sides of the South Atlantic. Saunders (1896, 199) saw reasons for believing that the species had crossed from Africa to America during comparatively recent times, and its somewhat peculiar distribution in the New World appeared to him to be more extraordinary than its hurdling of the oceanic barrier. Recently, Wetmore (1926, 135) expressed himself as unable to recognize appreciable differences between the South American and African birds, but Dwight (1925, 275) has shown that there are three distinct though overlapping characters which distinguish Old-World and New-World races. In a study of 50 specimens, he found that African examples are definitely darker in the shade of the mantle, and that South American birds are slightly larger and have decidedly more extensive mirrors on their wing quills.

As regards distribution in South America, great caution must be used in accepting or interpreting published information because of the frequency with which the Gray-hooded Gull has been confused with other species, particularly with *Larus maculipennis*. Dwight states that *cirrocephalus* breeds in the river-marshes and on some of the lakes of Argentina, Paraguay, and southern Brazil, and that in the non-breeding season it ranges along the southeastern coast of Brazil as well as the coasts of Argentina, Chile, and Peru. He adds that the birds probably reach the Pacific side of the continent by way of the Strait of Magellan. Hellmayr (1932, 412), however, has been unable to accept any report of the occurrence of this species in Chile, and has shown that records under its name refer in reality to *Larus maculipennis*. Furthermore, the few records from the coast of Peru, such as that of MacFarlane (1887, 208) of an example taken off Paita in July, and those of Saunders (1896, 200) of specimens from Callao and Paita collected during December and January, refer, as will be seen, to captures during the height of the breeding season no less than during the southern-hemisphere winter. Without implying a questioning of the identification, it would be well for some ornithologist to reëxamine in the British Museum the skins and labels upon which the Peruvian records are based. Finally, with reference to the general account of breeding habits given by Dwight, it is of interest to note Gibson's (1920, 82) comment that the South American nesting grounds of the Gray-hooded Gull are still unknown. The only first-hand description of its breeding I have been able to find is an unsatis-

factory one by Venturi, who states that during the month of November, 1926, he found many nests and eggs of both *Larus cirrocephalus* and *L. maculipennis* in the great marshes near Bahía Blanca, Argentina (Hartert and Venturi, 1909, 254).

At any rate, observers agree that in the lands about the Río de la Plata the Gray-hooded and Brown-hooded Gulls consort closely, even if they do not actually mingle, during the months of the year that come between the breeding seasons. Curiously, the Gray-hooded species was nowhere encountered by Beck during the course of the Brewster-Sanford Expedition, nor does it seem to have been collected by members of any other American Museum party in South America. Our only specimens, obtained in exchange, were taken at the Estancia los Yngleses, near Lavalle, Buenos Aires, during April, 1909. At this same locality Wetmore became acquainted with the birds during November, 1920.

Owing to the frequent confusion of the Gray-hooded and Brown-hooded Gulls, the following summary of their distinctive characteristics, as drawn from the observations of Dwight, Wetmore, Gibson, Friedmann (1927, 164), Durnford (1877, 201), and Aplin (1894, 211), may be of interest:

Larus cirrocephalus—	*Larus maculipennis*—
Hood pale gray (lighter in winter), darkening at the posterior margin.	Hood dark brown in summer; head white with dusky auriculars and eye-crescent in winter.
Iris yellow.	Iris brown.
Primaries with never more than small subterminal white spots on the two outer quills.	Primaries largely white-tipped, or with much more extensive spots, except in first-year plumage.
Call rather long drawn out, a strange *caw-caw* similar to that of a crow and quite ungull-like.	Notes sharp, staccato, and vehement.
Flight steady and direct, with rapid wing-strokes.	Wing-strokes slow and deliberate, suggesting those of Franklin's Gull.

Wetmore found that the Gray-hooded Gull, like the other Argentine species, frequents the vicinity of the slaughtering pens in search of waste scraps of meat. Durnford gives us the following account of the species as he observed it to northward of the city of Buenos Aires between the months of March and July:

> Unlike *Larus maculipennis*, it never wanders inland, but frequents the shallow shores of the La Plata, feeding on dead fish or offal, and flocking round the fishermen when they are hauling their nets to get a share of the spoil. As a rule, this species does not mix with *Larus maculipennis*, though now and then they are seen together; but all the flocks or parties I have observed when flying from one spot to another have always been composed of birds of its own kind. Adults, after once attaining their pearl-grey hood, never lose it, though in winter it becomes rather lighter, and those with white heads are immature birds, which do not attain their full plumage till after their second moult. I have seen many birds throughout May and June of the present year with well-defined dark grey hoods. Some specimens, when first killed, have a delicate faint pink tinge on their underparts, also observed in *L. maculipennis*, which, however, quickly fades after death. The colour of the iris varies a good deal in different examples, being pale grey, grey with a tinge of yellow, and grey with a tinge of light wood-brown. This is probably attributable to age.

MOUNTAIN GULL

Larus serranus

Larus serranus Tschudi, 1844, Wiegm. Arch. für. Naturg., 10, pt. 1, p. 314 (Peru = Puna region of Junín).

Names: Andean Gull, Tschudi's Gull. In Peru the species is known as the "Serranita"; recorded names in Chile are "Chelli" and "Quiulla." A synonym of the specific name is *personatus*, besides which *cirrocephalus*, *glaucotes*, and *bonapartii* have been used through confusion with other species.

Characters: Larger than other dark-hooded gulls confined to South America, and distinguishable from the Laughing Gull by its mantle of much paler gray.

Adults in breeding plumage (sexes alike): A complete hood of brownish black; mantle pallid neutral gray; primaries black, with large mirrors on the outer three and white stripes or tongues along the shafts of all; small apical spots, beginning usually on the second or third from the outermost, increase in size inwards; primary coverts and adjacent small coverts mostly white; secondaries and lesser coverts gray; wing-lining gray, with the edge and the axillars white; alula dusky, with white on the outer webs of the feathers, these and the adjacent coverts forming a large wing-patch; tail white; ventral surface white with a rosy tint. Iris brown; bill, legs and feet dark reddish.

In winter plumage the head and neck are pure white, which blends into the gray of the back; a black eye-crescent nearly surrounds the broad white eye-ring, which is narrowly black at its junction with the eyelid.

15 males: wing, 348–370 (363); tail, 140–158 (150.2); exposed culmen, 37–42 (39); tarsus, 54–61 (56.6); middle toe without claw, 39–43 (41.1) mm.

7 females: wing, 336–358 (349.7); tail, 138–149 (144.3); exposed culmen, 33–37 (35.4); tarsus, 51–54 (53.1); middle toe without claw, 37–40 (38.4) mm. (Dwight, 1925, 277).

In juvenal plumage the mantle is wood-brown, with whitish feather edgings, mixed with much pale gray of the exposed basal parts of the feathers; rump gray, paling to white on upper tail coverts; head grayish wood-brown, paler on the crown, the forehead, lores, a broad eye-ring, post-ocular stripe, and cervical collar grayish white; large eye-crescent and margin of eye-ring black; auriculars deep brown; hind neck paler than the back, the feathers merely tipped with dark wood-brown; ventral surface white, the throat, breast, and flanks faintly washed with wood-brown; the wings are similar to the adult stage, except that the white mirrors and tongues are smaller and narrower, and the gray secondaries and lesser coverts more dusky and brown, respectively; the tail is chiefly white, with a subterminal band of brownish black, 20–30 mm. in breadth, which diminishes to a shaft-line or a smudge on the next to the outermost rectrices, the outer pair being white; the tips of the central rectrices are pale wood-brown, which becomes lighter on successive feathers outward. Bill and feet blackish.

The natal down is undescribed. At Lake Junín, Peru, on March 13, Beck collected a fledgling with traces of down still clinging to the juvenal plumage.

The eggs are apparently unknown.

Distribution: Breeds about high Andean lakes, from Ecuador to northern Chile and northwestern Argentina; descends sporadically to salt water along the coast of Peru.

The "Serranita" is essentially an inland gull, belonging to the high plateaus of the Andes, where the greater part of the population apparently remains throughout the year. According to Dwight (1925, 279), the species is a member of a widely distributed group of continental and river gulls having representatives in South America, Africa, India, and Australia. These comprise the subgenus *Cirrhocephala*, birds which vary as regards the presence or absence of a dark hood, but resemble each other closely in the shape of the bill, the pattern of the wing markings, and other fundamental characters.

Great uncertainty seems to be current regarding the place of this species as

an oceanic bird. It is said by many authorities, including Peters (1934, 322), to descend from the mountains to the coast of Peru during the non-breeding period. Others, such as Dwight and Alexander (1928, 135), credit it with occurring likewise along the coasts of Ecuador and Chile. I can, however, discover nothing to substantiate its presence at sea level in Ecuador, while Hellmayr (1932, 411) finds that it has not yet been found anywhere near the ocean in Chile. Furthermore, it appears that a large proportion of the published records from the Peruvian coast are based upon sight identification, while even these are by no means confined to the season of southern winter. Finally, Mr. Beck's collections show that the species is abundant at its lofty mountain breeding grounds during the midwinter period, thus proving that there is no regular or general migration to lower levels at this season.

We have two coastal specimens, one of which I shot at Paracas Bay on November 10, 1919. This was a female, the only one of its kind seen; its stomach was empty except for a few feathers which were probably its own. The second coastal specimen, taken by Beck at Ancón on May 8, 1913, was an adult male still in full winter plumage, with a nearly all-white head, a black anterior eye-crescent, and a dark spot well behind the eye. Additional examples taken at or near Callao and Islay, Peru, during the months of September and October, are recorded by Saunders (1896, 190). MacFarlane (1887, 204) states that the species was common in Callao Bay during both April and August, 1883, though he seems not to have confirmed his identification by the collection of specimens. A small flock flying offshore at evening was observed by Beck near Salaverry, January 5, 1913. Sight records of my own include a number over the ocean offshore from Asia Island, December 5, 1919; several hundred filing southward against the coastal mountains above Mollendo on December 19, 1924; and a number of black-headed adults resting on the water off Point Pariñas, in northern Peru, on January 21, 1925. In these several instances I was satisfied as to the identity of the species, but it should be borne in mind that along the coast of Peru the presence of migrant Franklin's Gulls and Laughing Gulls, in addition to the native coastal species, tend to make sight identification unsatisfactory except when the birds can be observed at close range and in company with other species suitable for comparison. At Pisco, in February, 1935, Dr. Chapin saw several Mountain Gulls under good conditions for positive determination.

During Beck's several periods of mountain field work in Peru, he collected excellent series of the Andean Gull at Lake Junín between March 13 and 31, 1913, and at Lake Titicaca between the last week of July and the third of August of the same year. One of the March birds is a fledgling with considerable down still clinging to the tips of its plumage. All of the adults had, of course, long passed their breeding state, but the nuptial plumage, with the black hood and new wing and tail quills, is represented by August specimens from Lake Titicaca (altitude 3840 meters). In the Museum collection there are also specimens in breeding plumage from Antisana, Ecuador, and from the highlands of Bolivia, all taken during June and July. Apparently the breeding season begins in October or November.

FRANKLIN'S GULL

Larus pipixcan

Larus Pipixcan Wagler, 1831, Isis, von Oken, col. 515 (Mexico).

Names: Called in Peru "Pardela," a word applied also to other species of sea birds; "Cagüil" in Chile. Synonyms of the specific name include *franklini*, *cucullatus*, *kitlitzii*, and *cinereo-caudatus*, besides which accounts of the species have been published under the names of such other gulls as *L. terranus* and *L. atricilla*.

Characters: Mantle darker than in any other American dark-hooded gull except the Laughing Gull, from which it may be distinguished by its smaller size and the white tips to the outer primaries. The very dark half-hood of the winter plumage is also diagnostic, since it is unlike that of any other species except certain much larger gulls, such as *Larus belcheri*.

Adults in breeding plumage (sexes alike): Head with complete deep black hood; a broad eye-ring, white posteriorly, divided by a black line, the anterior quadrant being black like the hood; mantle deep neutral gray, paler than in *L. atricilla;* ventral surface white, tinted with a rosy hue except on the throat along the margin of the hood; primaries white, with broad black bands on the five outer quills, the outermost having also a black outer web; apical white areas large, the whole tip of the outermost primary being white for 15 mm.; these quills are basally deep gray, paling to white on the inner webs and terminally; tail white, the central quills basally grayish. Iris brown; bill maroon, with a blackish bar or spot toward the tip, which is dragon's-blood red; gape crimson; legs and feet bay or burnt sienna.

In winter plumage a dull black half-hood, with white-edged feathers, extends from forehead and crown to the level of the eye; remainder of head white; hues of bill and feet duller than in summer.

14 males: wing, 263–286 (277.2); tail, 98–111 (103.9); exposed culmen, 29–34 (30.7); tarsus, 41–45 (42.5); middle toe without claw, 30–33 (31.5) mm.

12 females: wing, 262–283 (273.2); tail, 97–107 (100.7); exposed culmen, 27–33 (29.2); tarsus, 39–44 (41.4); middle toe without claw, 30–35 (31.1) mm. (Dwight, 1925, 289).

In younger stages and juvenal plumage the mantle is grayish sepia-brown, with narrow buffy edgings on the feathers, which are basally grayish white, deepening to the subterminal dusky brown area; the rump is neutral gray, paling toward white on the upper tail coverts, which nearly conceal the gray of the rectrices; head and nape darker than the back, with a dusky half-hood which includes the crown, occiput, upper neck, and sides of head; auriculars more dusky; forehead, lores, and a broad interrupted eye-ring, which includes only the posterior half of the eye, rather dingy white, eye-crescent brownish black; nape white, washed with pale gray; ventral surface white, with a slight buffy or dusky clouding at the sides of the throat; primaries dull black, with small white apical spots, increasing in size inward, the inner webs of these quills paling toward gray; tail pale neutral gray, with a subterminal black band 15–25 mm. in breadth, and a narrow buffy or grayish white terminal edge, the outer rectrices being usually white, with only a shaft streak or a dusky spot. Bill olive-drab, blackish toward the tip; legs and feet olive-drab.

Since this species does not breed in South America, descriptions of the natal down and eggs are omitted.

Distribution: Breeds in the interior of western North America, east of the Rocky Mountains, and migrates southward to winter in the Gulf of Mexico and along the west coast of South America between Ecuador and the middle part of the Chilean coast.

Franklin's Gull is a northern-hemisphere winter resident along the entire desert stretch of the west coast of South America, between the Gulf of Guayaquil, where I observed a large flock on December 6, 1924, and the south-central part of the coast of Chile. As noted by Hellmayr (1932, 411), the species has been taken at Mocha Island, which seems to be the southern outpost of its known range. It has been found abundantly at the Galápagos Islands during

February and March (Gifford, 1913, 42). Between the latter part of October and the middle of May, one is likely to see from shipboard, at almost any point along the steep and arid coast of Peru, enormous flocks made up mostly of gulls of this species, though sometimes mixed with such birds as *Larus modestus*, *belcheri*, and *dominicanus*. The Franklin's Gulls, however, are much more given to mounting into higher regions of the atmosphere than are any of the native species.

In our northern autumn *i.e.* the southern-hemisphere spring, Franklin's Gull becomes common in northern Peru at a time when few or none are yet to be found along the southern shores of the republic. In 1918 I saw them appear suddenly in the Bay of Callao, during the first week in November; but the southward migration must, on occasion, be very much earlier, for Hellmayr has cited a number of September records for central Chile. Nicoll (1904, 50) found them abundant in the harbor of Valparaiso during the middle part of February. West coast dates late enough to be of interest are as follows: Valparaiso, March 16 (Beck); Callao Bay, common throughout April (MacFarlane, 1887, 204); Ancón, Peru, May 12 (Beck). It is, of course, to be expected that non-breeding examples may remain south of the equator throughout the year.

The small size and the wing-pattern (very like that of *ichthyaetus*) distinguish this gull in all plumages, and when adult the two central tail feathers are gray basally unlike any other species. The very dark half-hood of the winter plumage is a good deal like that of *belcheri* and is different from the gray partial hoods of any of the other species. The juvenal plumage might be mistaken for that of *atricilla* but the latter is uniformly browner especially about the head and does not have the white of *pipixcan* that contrasts with the half-hood. The tail-band too is very much narrower and does not reach the outer rectrix, and the primaries are white-tipped.

The complete moult occurring at the prenuptial season is a feature unknown in other gulls, but the evidence of its occurrence is conclusive. It may perhaps be linked with the origin of the species, as *pipixcan* is the only species that regularly breeds in the Northern Hemisphere and then migrates to south of the equator.

If we suppose that, like *maculipennis*, it nested and moulted at one time only south of the equator and, as it extended its range, climatic conditions necessitated a change in the breeding season, why does it not breed south today? And why the double complete moult? It is a matter for speculation and the case of *pipixcan* is unique among the gulls. If the colonies had breeding peaks at widely different times of the year, it would be easy to explain the moult but no evidence has been produced to show that the species breeds anywhere except at the northern fringe of its range and only during the months of July and August (Dwight, 1925, 292).

The American Museum Collection contains Franklin's Gulls taken at Chorrillos and Ancón, Peru, between February and May, 1913; a series from Valparaiso taken during March, 1914, and seven adults from Pacasmayo collected on January 3, 1920. Many of Beck's Valparaiso specimens still show the rich pink suffusion on the white feathers of the breast. These birds are in winter plumage, but a female shot at Ancón, Peru, on April 24, is in full breeding plumage and the eggs in the ovary were distinctly enlarged. It is also of interest that I saw a black-hooded bird, still in full breeding plumage, as late as December 4, 1919. This was at Asia Island, Peru, when the gull flew low over a cormorant colony. I have no evidence, however, that Franklin's Gulls are interested in egg-stealing, as their larger relatives are.

Toward evening, when the sun over the western ocean peeps below the prevailing blanket of cloud that extends offshore from middle heights of the Peruvian coastal ranges, the yellow rays will sometimes illumine the breasts of thousands of Franklin's Gulls moving northward or southward, well behind the shore, against the lofty, plantless slopes. The notes of Mr. Jaques state that while he was on shipboard and at anchor in the harbor of Salaverry, a blast of the steamer's whistle about four o'clock in the afternoon startled several thousand Franklin's Gulls into concerted flight. The birds congregated into a dense flock, then circled to a great height above the water, and finally formed into long lines and moved eastward toward the mountains. In the roadstead of Huarmey I saw a flock of these birds feeding at evening and filling the air, like a swarm of gleaming midges, along a line fully 3½ kilometers in length. The body of birds as a whole was facing up-wind, and those in the rear of the column were continuously flying forward over the van, to descend again to the surface of the water and so maintain contact with the shoal of anchovies that was the center of their united interest. Perhaps these gulls are most active in early morning and at evening, for during the middle part of the day I frequently saw them standing in droves on sandy shores, sometimes with one dainty foot lifted from the ground and with the bill tucked among the feathers of the back. The sandy beaches of Lobos de Tierra Island were favorite resting places for large numbers, in December, 1920, and in the same month I saw more than a thousand standing along the edge of a white bar on the mainland coast, north of Pacasmayo, with their pink breasts perfectly reflected in a shallow pool. A passing Indian informed me that the name of the bird was "Pardela," the same term by which I had already heard it called at Pisco.

Jaques observed numbers of Franklin's Gulls not only in the harbor of Callao, but also in the cultivated fields of the lower Rimac valley in February. During his visit to Ancón in the same month, Franklin's Gulls vastly exceeded the Gray Gulls (*modestus*) in numbers. The Gray Gulls, however, were hunting actively along the wash of the waves, whereas Franklin's Gulls were resting on the beach, but never feeding there. The presence of Franklin's Gulls in the rich irrigated fields between Callao and Lima shows that, although they live mostly upon fishes and crustaceans during their winter sojourn, they do not entirely forget the insect-eating proclivities which make them the "Prairie Pigeons" of North America.

Stomachs of eight specimens shot on the beach near Pacasmayo, January 3, 1920, at about eleven o'clock in the morning, varied between being practically empty and about half-filled with food. The one with the greatest quantity held about 300 small crustaceans, representing the megalops stage of a crab, together with an equal amount of bones of the fishes known as silversides or pejerreyes (Atherinidae), and finally, a tiny fragment of an alga. The other seven stomachs contained gravel or fragments of Bryozoans, probably taken as gravel rather than as food, as well as bits of barnacle (*Balanus*), fish bones, fragments of a mollusk, and a few feathers. All but two specimens showed traces of fishes, which seemed to be either silversides or anchovies.

BROWN-HOODED GULL

Larus maculipennis

Larus maculipennis Lichtenstein, 1823, Verzeichn. Doubl., 2, p. 83 (Montevideo, Uruguay).

Names: Spot-winged, Pink-breasted, Pink-bellied, or Black-headed Gull; "Gaviotina," "Gaviota de Capucho Café," "Gaviota de Cabeza Parda"; "Cagüil" at Chiloé Island. The most important synonyms of the specific name are *glaucodes* or *glaucotes;* the bird has also been described as *albipennis* and *roseiventris*, besides which it has been confused in the literature with *Larus ridibundus*, the Brown-headed Gull of Europe, with *L. serranus*, and more particularly with *L. cirrocephalus*, a South American Gray-headed Gull of about the same size and of overlapping range.

Characters: Distinguishable from *Larus cirrocephalus*, the only South American gull of partly similar range, by its dark brown hood and pale gray under wing coverts; and from all other gulls of similar size by the wholly white-tipped outer primaries of the fully adult stage.

Adults in breeding plumage (sexes alike): Hood deep brown, darkest at its junction with the neck, and interrupted by a broad white horseshoe-shaped eye-ring around the posterior two-thirds of the lids; mantle gray; ventral surface white, with a rosy tinge; primaries white (tipped or spotted with black on the inner webs only in not quite mature plumage, or in younger stages); the subsequent condition is somewhat variable, the two outer quills usually having very long white tips, the median occasionally showing small spots of black, the inner four or five being almost wholly gray; the outer web of the outermost is always black basally; the rest may or may not have a dash of black, while succeeding feathers inward are white on the outer web, until replaced by the almost entirely deep gray quills of the inner series; secondaries and tertials gray, like rest of mantle; alula, axillars, edge of wing, and adjacent coverts white; under wing coverts pale gray; tail white. Iris brown; margin of eyelids dull Brazil red; bill, tarsus and toes Vandyke red; claws dull black (flesh colors from Wetmore, 1926, 133).

In winter plumage the head is white, with a slight gray clouding on the occiput, the nape somewhat grayer where it blends with the back. Bill and feet duller than in summer.

11 males: wing, 280–310 (292.1); tail, 113–127 (120); exposed culmen, 34–39 (36); tarsus, 45–51 (46.4); middle toe without claw, 34–37 (35.3) mm.

7 females: wing, 271–292 (284.6); tail, 111–119 (114.9); exposed culmen, 32–37 (33.6); tarsus, 44–46 (45); middle toe without claw, 33–35 (34.1) mm. (Dwight, 1925, 296).

In younger birds the black subterminal markings curve across the tip of the wing in half or full bars, such marks being lost progressively with age from the outer quills inward. A nearly or quite terminal tail band, which involves all but the outermost rectrices, is worn until the moult of the first-year plumage.

In juvenal plumage the mantle is bister-brown, with snuff-brown or paler feather edgings; crown and auriculars drab or dusky snuff-brown, with indistinct paler edgings; eye-crescent black; rest of head white; hind neck brown like the back, from which it is separated by a whitish collar; ventral surface white, the sides of neck, throat, breast, and flanks tinged with buff, which sometimes crosses the breast; primaries black, white-tipped and with elongate mirrors of variable size on the outer two, which have little or no white at the base; succeeding primaries, however, usually have the outer web grayish white nearly to the tip, but terminally restricted more or less to the shaft by a black edging beginning about halfway between the ends of the primary coverts and the tip; inner primaries decidedly grayer, with black subterminal bands and pale gray apical spots; primary coverts and alula white, occasionally with dusky edgings; secondaries brownish black or clove-brown, with broad gray margins and tips; tertials similar, but the inner feathers with brown edgings like the back; greater coverts clear gray, as in adult plumage, but faintly brownish at the tips; median coverts gray basally, with rather narrow snuff-brown terminal areas, edged with paler brown; lesser coverts brown, like the back, the marginals gray; edge of wings and axillars white, and wing-lining grayish white; tail white with a rather narrow dull black or brownish subterminal band, which is widest on the central rectrices, reducing outward and often absent from the outer pair of quills. Bill brownish, with a blackish tip; legs and feet brownish flesh color.

In natal down the dorsal surface is rich buff, heavily marked with black lines or spots, which are clearest on the head; the ventral surface is paler buff and unmarked. Bill, legs, and feet yellowish brown.

Saunders (1891, 373) notes that the eggs of this species are similar in character to those of other marsh-breeding brown-hooded gulls in other parts of the world. Examples collected by Beck at East Island of the Falklands, December 10, 1915, vary in ground color from pale olive greenish to a buffy or *café au lait* hue. Their brown markings include spots, blotches, and vermiform splashes, some of those on the surface being very dark and those within the texture of the shell pale. Most of the eggs are rather uniformly marked, with only a slight tendency toward heightened pigmentation near the larger end. In size and shape, however, they are considerably more variable than in color and markings. In one set of three, the ground color of one is quite different from that of the other two. In the other four instances, the eggs in the respective sets look more like pairs or trios. Five sets measure as follows: 54.1 x 41.2, 52.7 x 39.5, 52.7 x 38.2; 53.1 x 38.9, 54.5 x 38.3, 55.8 x 37.8; 54.6 x 38.4, 57.7 x 38, 57.5 x 38; 53.2 x 38.6, 54.8 x 38.9; 48.6 x 37, 48.6 x 36.3 mm.

The nesting season is apparently similar throughout the range. Germain (1860, 314) writes that the Brown-hooded Gulls congregate at Chiloé Island for breeding in late November.

Distribution: Breeds in southern South America, from islets along the coast of eastern Uruguay and from the vicinity of Valdivia, Chile, southward to the Falkland Islands and Tierra del Fuego; ranges northward to Alagoas, Brazil (latitude 10° S.), and to Tarapacá, Chile (latitude 20° S.). The alleged presence of the species along the Peruvian coast requires verification.

The literature relating to the Brown-hooded Gull of southern South America is for two reasons difficult to interpret. In the first place, the name and identity of this bird have been confused with those of a Gray-hooded Gull (*Larus cirrocephalus*) of about the same size. Although the range of the latter is somewhat more northerly, the two species overlap in lands around the Río de la Plata. Furthermore, the progressive change in wing-pattern as Brown-hooded Gulls advance toward maturity has led many ornithologists to the conclusion that birds with "spot-wings" and those with "white-wings" represent two species which have, indeed, long passed current under the respective names *maculipennis* and *glaucodes*. The large series of specimens obtained during the Brewster-Sanford Expedition has fortunately enabled Dwight (1925, 298) to determine that differences in primary markings are due entirely to age and individual development. There is but one species of Brown-hooded Gull in South America, of which the fully adult bird represents the "*glaucodes*" type, while a retarded or reversionary second-year plumage represents the "*maculipennis*" type. Since the latter name has priority, it must be accepted as that of the species.

The American Museum possesses specimens of this gull from Rio Grande do Sul, Brazil, and the Province of San Juan, Argentina, taken in July, and both young and adults collected in Cautín, Chile, during the months of January, February, September, and December. In addition to these, Mr. Beck obtained a large series, as follows:

Chile: Valparaiso, March; Corral, September and October; Ancúd and neighboring parts of Chiloé, April and May; Magallanes and other parts of the Strait of Magellan, February.

Argentina: Ushuaia, July; Río Gallegos, August; Río Santa Cruz, May; Mar del Plata, September and October.

Falkland Islands: November.

At the Falklands he also collected eggs and fledglings, while other youthful stages are represented by specimens from Magallanes and elsewhere.

This is the species which Cordova found in the Strait of Magellan, and which is thus quaintly described in the English translation of his book (1820, 81):

> The sea-gulls also are here in prodigious numbers, and of many different sorts. The most beautiful is one not bigger than a large turtle; its head is black, the whole body and wings of a dazzling whiteness, mixed with a few light black strokes; diamonds and rubies themselves do not equal the brilliancy of its eyes, round the pupils of which is a circle coloured like carmine, which adds infinitely to the beauty of this animal.

Dwight has fully described the moult and the plumage vagaries of this gull, which had puzzled many earlier students. "Laggards" in moult tend to give the population a heterogeneous appearance. Thus three adult females taken by Beck at Ushuaia on July 19, 1915, represent three completely different stages, one being brown-headed, one in full winter plumage, and the third exactly intermediate, with a mottled head and a white forehead and chin. During August and September the normal assumption of breeding dress takes place, with a corresponding heightening in the carmine of the eyelids. Examples collected by Beck in the Falklands on November 4, 1915, still show the pink breasts clearly. According to Cobb (1933, 33), this suffusion is hardly noticeable under the summer sun, but on calm bright days of winter it is extraordinarily conspicuous, the rosy hue being reflected from still waters as brilliantly as it shows through the air.

This Patagonian gull is so closely related to the Brown-headed Gull of Europe (*Larus ridibundus*) that Hellmayr (1932, 412) believes the relationship between the two might possibly be regarded as subspecific. Aplin (1894, 211) states, furthermore, that in voice and actions the Argentine bird is much like *ridibundus*, a fact that had also been noted by Darwin. Both species resort largely to inland marshes to breed, and neither is restricted to foraging over water but is given to spending much time in fields and meadows. The Patagonian Brown-hooded Gull, like its European relative, congregates in great numbers about tilled grounds, filling a new-made furrow until it appears like a white line, hovering in a cloud above the plowman's head and following at his heels, fighting, screaming, buffeting, in a compact crowd. These words are those of Hudson, and on page 183 I have already quoted this naturalist's description of the manner in which the "Gaviotas" gather along the shores of the Río de la Plata after duststorms on the pampas, and of how their flocks take advantage of the destructive swarms of grasshoppers. For the latter reason, according to Wetmore (1926, 134), the government of Uruguay furnishes absolute protection to these gulls and their eggs. Unfortunately, in Argentina they are still killed in numbers as game, being decoyed within range by means of white objects waved in the air by the gunners.

The Brown-hooded Gulls breed abundantly on rocky islets along the coast of the Department of Rocha in Uruguay, and from here southward through Argentina all the way to Tierra del Fuego. Throughout most parts of this region, they are the commonest of gulls on the open pampas as well as along

the coast. The northward limit of the breeding range on the Pacific coast, according to Hellmayr, probably does not extend much beyond Valdivia. Wanderers have been recorded from Peru, even as far northward as Callao, although most of our information seems to be based upon sight records and should be regarded as unsatisfactory until specimens have been obtained. The same may be said concerning the reputed abundance of the species about lakes in the interior of Brazil during the winter, because the collections of the Brewster-Sanford Expedition show clearly that it is sedentary even as far south as Ushuaia and the islets near Cape Horn. Its winter migration appears to consist of a local dispersal of the birds over a larger extent of territory, rather than of a definitive movement toward zones of different climate.

Wetmore found these gulls common in the eastern part of the Province of Buenos Aires during October and November, which was the beginning of their breeding period. At this season adults were found in pairs, circling over pools of water on the pampa, and flying forward to examine an intruder while uttering a scolding *kek-kek-kek*. The call-notes as well as the slow flapping flight were strongly suggestive of Franklin's Gull. Friedmann (1927, 164) speaks of the deliberate strokes of Brown-hooded Gulls, as contrasting with the more rapid wing action of its neighbor, *Larus cirrocephalus*.

The nesting habits seem to be similar throughout the range of the species, the Brown-hooded Gulls assembling in flocks during November and early December at lakes or marshes not far back from the sea, or to sluggish stretches of river courses about which there is a good growth of grass and reeds. They make bulky nests and lay three or rarely four eggs which are "a great delicacy, resembling those of the Plover in taste and appearance and are consequently much sought after" (Sclater and Hudson, 1889, 199). Several hundred nests are sometimes spaced close together, and at daybreak the breeding gulls rise overhead and hover in a cloud, producing a noise which can be heard at a long distance.

From the Falkland Islands, there may be a partial autumn movement of these gulls toward the continent, as is true of certain other species, for Abbott (1861, 166) speaks of Brown-hooded Gulls returning to the islands annually about July 25, "almost to the day." The species is not now particularly abundant at the Falklands, although there are a number of rookeries on isolated tussock islets, and also about the borders of lakes and ponds on certain of the larger islands, sometimes as far as 5 to 6 kilometers back from the sea. Vallentin (1924, 302) records colonies at the Jason Islands and elsewhere in West Falkland, especially in the neighborhood of penguin centers. Beck found the species beginning to lay in East Falkland on December 10, 1914, the nests being placed on somewhat trampled tussock hummocks which grew on a small islet in a pond. South American Terns (*Sterna hirundinacea*) were nesting about the borders of this colony, and at a neighboring islet the Kelp Gulls were engaged in the same process. At this date, various Brown-hooded Gulls' nests contained two or three eggs each, all of which were fresh. Many of the eggs, as has been pointed out by others, resembled those of the South American Tern, being only slightly larger.

The grasshoppers and the grubs of earth-boring beetles, which the gulls capture themselves or steal from the lapwings, and also the diet that they seek nowadays about the slaughterhouses and the garbage dumps of ranches, pertain alike chiefly to the non-breeding season, when these birds are distributed far and wide over the pampas. At such times, as Peters (1923, 291) has said, they will come to feed not only upon the offal of slaughtered sheep, but will pick up kitchen scraps and even eat the bodies of birds tossed out to them by an ornithological collector. At their breeding grounds, however, they feed much more extensively upon live fish, displaying with the terns great excitement when schools approach the shore. Like most of the other gulls they are always ready to steal the eggs or young of such birds as moor-hens, and they have been observed hawking about in the air after winged-ants (Gibson, 1920, 81). At the Falklands, according to Cobb (1933, 33), they rifle the night herons' nests, although the bulk of their hunting is done along the beaches. Here they hover and scramble at the edge of the washed-up kelp, pretending not to like wetting their feet, screaming and jumping clear whenever a wave runs up, like a crowd of paddling girls.

SWALLOW-TAILED GULL

Creagrus furcatus

Larus furcatus Néboux, 1846, Voy. 'Venus,' Atlas, Zool., Ois., pl. 10 ("Monterey" = Galápagos Archipelago).

Names: There appear to be no synonyms of the specific name.

Characters: The only gull with a pronouncedly forked tail; distinguishable also by the large and conspicuous triangular white patch on the wings, the great length of the wings, and the slender pointed bill, all of which give this species a somewhat tern-like aspect.

Adults in breeding plumage (sexes alike): Head and neck covered with a dark gray hood, broken by a white stripe on each side of the forehead; mantle neutral gray, the wing coverts darker, the scapulars and tertials with narrow white edgings which enclose the back within a white line; rump darker gray, the upper tail coverts abruptly white; ventral surface white, the throat and breast with a pronounced rosy tinge; primaries sharply pointed, dull black, with conspicuous white tongues covering the greater part of the inner webs, the median series of these quills with whitish apical spots, the inner series mostly or wholly white or gray; primary coverts dusky on inner webs, but gray to white on outer; secondaries pale gray, becoming white on the proximal quills; tertials gray, narrowly edged with white; greater and median coverts white, with pale gray edgings; tail white. Iris brown; eyelid crimson; bill basally black, bluish or greenish distally, beyond the nostril; rictus crimson; skin of interramal space salmon color; tarsus and toes peach-blossom-pink; webs geranium-pink, shaded with black at the edges.

In non-breeding plumage the head is white, obscurely streaked on the occiput with gray, which passes into an ill-defined collar contrasting with the paler neck; a slight auricular spot is dusky, and the eye is surrounded by a broad spectacle of grayish black; the throat is more or less clouded with pale gray, its sides markedly so; the bill is much darker than at breeding time, being prevailingly black except toward the tip; the legs are dull reddish ochre, with the feet more distinctly red.

8 males: wing, 405–433 (414.8); tail, 184–202 (191.1); exposed culmen, 47–55 (52); tarsus, 45–55 (52.1); middle toe without claw, 44–52 (48.5) mm.

8 females: wing, 393–414 (404.1); tail, 181–197 (189.7); exposed culmen, 49–52 (50.9); tarsus, 47–54 (51); middle toe without claw, 44–50 (47.1) mm. (Dwight, 1925, 325).

Length in the flesh: 5 males, 571–606; 3 females, 550–573 mm. Wing-expanse: 5 males, 1362–1392; 3 females, 1241–1330 mm. (Gifford, 1913, 417).

In juvenal plumage the mantle is clove-brown, with broad white feather edgings; the feathers of back largely white basally, with irregular subterminal bars; rump and upper tail coverts grayish,

marked with brown; head white, with pale brown edgings on the occiput, the neck becoming gradually pale clove-brown, which merges into the darker back; auriculars and eye-crescent dusky, the lores partly brown; ventral surface white; primaries similar to those of adult plumage, but with less extensive white tongues; secondaries and alula white, the greater coverts with pale gray edgings, the median coverts and tertials darker gray; primary coverts dull black; lesser coverts brown like the back, and similarly edged with white; tail white, with a terminal dull black band 20–30 mm. in width, the rectrices narrowly white-tipped, the outer pair with only one or two slight smudges or spots. Bill dull black, the mandible basally brownish flesh color; feet grayish white.

Natal down not seen, but Dwight (1925, 377) refers to "the white and speckled" pattern as it shows in photographs. Gifford (1913, 40) states that there are both protoptyle and mesoptyle generations of down in this gull, and that the second series is brownish gray on the dorsal surface, ventrally chiefly white, shading to pale gray on the throat and chin.

Eggs generally resemble those of other gulls, and vary in a similar manner. They are more or less regularly ovate. Most specimens are very light greenish or bluish white, with large, bold spots, patches of dark brown, and underlying grayish mauve spots. The spots may be either spread all over the egg, or accumulated near the larger end in a patch or an irregular ring. In some eggs the ground color is of a brownish or light reddish, but all appear light sea-green when held against the light. Examples measure 64 x 47.5, 66 x 46.5, 66 x 46, 60 x 44.5 mm. (Rothschild and Hartert, 1899, 190). Gifford records the average dimensions of 36 as 66.3 x 45.9 mm.

Distribution: Breeding at the Galápagos Islands and probably at Malpelo Island, and migrating to the west coast of South America between Ecuador and southern Peru.

The handsome Swallow-tailed Gull, which can be readily distinguished at sea because of the large triangular white patch on its long wings, is a surprisingly common and conspicuous bird in waters well out from shore along the coast of Peru. Unlike the Dusky Gull of the Galápagos, it makes a lengthy annual migration away from its nesting ground. The movement seems to be individual or sporadic rather than seasonal, however, for Swallow-tailed Gulls have been observed and collected off Peru at many different seasons of the year. This is doubtless the type of migration to be expected of a species having a breeding season of the continuous, tropical-island type.

Streets (1912, 233) calls attention to the fact that the Swallow-tailed Gull is not in the usual sense a littoral bird, like most of its relatives, but is to a certain extent pelagic even during the breeding period. On a voyage between Callao and Acapulco, this author passed within sight of Chatham Island, the easternmost of the Galápagos, and up to distances of 500 kilometers or more from the island, both when approaching and departing, he observed gulls of this species over the high sea, on lines of flight proceeding away from the archipelago in the morning and toward it at evening. Throughout three days' sail this phenomenon was observed. Gifford also speaks of the powerful flight of the Swallow-tailed Gull, and of the fact that the California Academy party observed it at sea upwards of 250 kilometers to southwestward of Albemarle in June, and almost as far to eastward of Chatham in September.

The nesting grounds are at many if not all islands of the Galápagos, and were formerly supposed to be confined to the archipelago. Townsend (1895, 121), however, obtained specimens of this gull at the little island of Malpelo, which lies in latitude 4° N., close to a line drawn between the Galápagos and Panama. Townsend concluded that the species is "doubtless abundant there." Swarth (1931, 66) states that one or more stragglers have been taken at Panama,

which is not surprising in view of Streets' notes on the long reach of the daily flight.

The American Museum possesses several Galápagos specimens of this gull obtained through exchange with the California Academy of Sciences, as well as a female collected by Beck on the ocean about 16 kilometers west of Pisco, Peru, on June 28, 1913, and a male taken by myself 13 kilometers west of Talara, Peru, on January 20, 1925. The latter two birds were in non-breeding condition, as might be expected. Beck's specimen is one of a group of three which he saw in the Pisco Bay region. His notebook also mentions others sighted south of Salaverry on January 5, outside the Bay of Callao on January 6, and off Ancón on May 12, 1913. Jaques reports groups off Salaverry, Callao, and Pisco during February and March, 1925, while in the course of my own field work I saw the species as follows:

Off the Bay of Ferrol, December 31, 1919, 50 or more together; between the islands of Lobos de Afuera and Lobos de Tierra, January 6, 1920, several flocks; off the Gulf of Guayaquil, January and February, 1925, several small groups; in the harbor of Callao, December 8, 1924, several birds; far offshore from Mollendo, January 19, 1925, a number.

According to Gifford, the Swallow-tailed Gull is common at the Galápagos throughout the year. Its nesting period is also continuous, for eggs have been taken during eight different months, and chicks in one nest are often found close to fresh eggs in others. Only one egg is laid, the site rarely being more than a slight scrape or depression lined with fragments of stone.

In flight, these gulls have a pulsating upward and downward movement of the body with each stroke of the wings. They usually travel singly or in small flocks. At times they soar high in the air, their descent to the water from such altitudes being a series of swooping spirals, like those of the man-o'-war birds. Streets calls attention to the shyness or indifference of the birds on the high sea. They neither hovered about his vessel, nor showed the slightest interest in it. During my own work along the coast of Peru, I was constantly impressed by the strange wariness of these gulls, which are so utterly fearless when ashore at their breeding grounds. Ordinarily a migrant flock on the water will take flight when a small boat is still at a great distance.

The man-o'-war bird seems to be the principal enemy of the adult Swallow-tailed Gulls, often pursuing them through complicated aërial evolutions in order to make them disgorge, and not hesitating to torture as well as to frighten. Gifford saw one of a team of two pirating man-o'-war birds seize the foot of a fleeing Swallow-tailed Gull, apparently dislocating its leg, which afterwards hung down limply. The young gulls are not infrequent victims of the Galápagos hawks.

The principal food of the species consists of squids, examples of which are commonly disgorged by both young and adults. The California Academy party also saw these gulls pursuing schools of surface fish, while the stomachs of specimens taken at sea contained remains of pteropods and of marine water-striders (Hydrometridae).

BLACK TERN

Chlidonias nigra surinamensis

Sterna surinamensis Gmelin, 1789, Syst. Nat., 1, pt. 2, p. 604 (Surinam).

Names: The American Black Tern has appeared in the literature under several other names, including *plumbea*, *exilis*, *frenata*, *fissipes*, and *lariformis*.

Characters: A small, short-billed, generally dark-bodied tern, with a short and only slightly forked tail, the head, neck, and breast black in breeding plumage but gray and white at other seasons.

Adults in summer (sexes alike): Head, neck, and under parts, except under tail coverts and anal region, uniform sooty black or grayish black (blackish fuscous or fuscous black to chaetura black, varying, rarely, to deep purple-gray); under tail coverts and anal region immaculate white; back and scapulars, rump, upper tail coverts, tail, and wings deep neutral gray or purple-gray, the wings somewhat lighter (neutral gray); edge of wing, from body to carpometacarpal joint, white; axillars and under wing coverts light neutral gray; bill black, the rictus purplish red (in life); interior of mouth lavender-pink (in life); iris dark brown; legs and feet dusky livid purplish (in life).

Adults in northern-hemisphere winter: Head, neck, and under parts white, the orbital and auricular regions dusky, the crown and occiput dark grayish, the feathers margined with paler; upper parts (except as described) as in summer.

10 adult males: wing, 192–213 (203.2); tail, 73–87.5 (79.8); exposed culmen, 26–29.5 (27); tarsus, 14.5–16 (15.4); middle toe [without claw], 15–16 (15.6) mm.

10 adult females: wing, 191–215 (199.6); tail, 73.5–82 (77.8); exposed culmen, 25.5–27 (26.2); tarsus, 14–16.5 (15.6); middle toe [without claw], 14.5–16.5 (15.5) mm.

Young: Similar to winter adults, but scapulars, interscapulars, and tertials tipped with light buffy brownish, anterior lesser wing coverts dusky, crown, occiput, and nape dusky, and sides and flanks washed or tinged with gray (Ridgway, 1919, 532).

Distribution: Breeds in northern North America, southward to California, Kansas, northern Tennessee, Ohio, and western New York. Migrates southward over Mexico and Central America and winters in South America, from Dutch Guiana to Peru and Chile.

Except for scattered captures of individual examples, little seems to be known about the Black Tern throughout its extensive winter range in South America. It was not encountered by Mr. Beck during the course of the Brewster-Sanford Expedition, but one of Dr. Chapman's parties collected a male on the coast of Manaví, Ecuador, on February 13, 1913. I suspect that I saw a large flock of Black Terns off the Chanduy coast of the Gulf of Guayaquil, just before dawn of February 11, 1925. The visibility was, however, very poor, and I obtained no specimens in the region. Rendahl (1920, 27) found the species at the Pearl Islands, Gulf of Panama, during April. In the British Museum is an example from Callao, Peru, and Hellmayr (1932, 408) records this tern as an occasional winter visitor to Chile.

The Black Tern is a bird of inland marsh regions, apparently approaching the sea only during migration. It does not nest close to salt water. In keeping with its generally terrestrial habits, it feeds largely upon insects, and is capable of capturing moths and even dragon flies upon the wing. During the parts of the year in which it follows the coast or crosses arms of the sea, it associates commonly with other terns, and at such times plunges for small fishes and crustaceans in the usual manner.

LARGE-BILLED TERN

Phaetusa simplex

This fluviatile tern comprises two subspecies (*P. s. simplex* and *P. s. chloropòda*), the first of which is found in the river basins of northern South America while the second seems to be confined to the Paraguaý-Paraná drainage (Wetmore, 1926, 141). The original citations of each are as follows:

Sterna simplex Gmelin, 1789, Syst. Nat., 1, pt. 2, p. 606 (Cayenne).
Sterna chloropoda Vieillot, 1819, Nouv. Dict. Hist. Nat., 32, p. 171 (Paraguay).

Names: In Argentina and certain other parts of Spanish-speaking South America this tern is known as the "Atí," "Gaviotín," or "Martín Pescador"; in Brazil it is called "Andorinha do Mar." The commonest synonym for the specific name is *magnirostris;* other names that have appeared in the literature are *speculifera* and *albifrons*.

Characters: A large, exceedingly heavy-billed tern, with a relatively very short tail.

Adults in breeding plumage (sexes alike): Pileum, nape, and auricular region uniform black, this descending to anterior angle of eye and extending along median line of hind neck; back, scapulars, proximal wing coverts, tertials, rump, upper tail coverts, and tail plain deep neutral gray; distal smaller wing coverts, secondaries, greater wing coverts, lores (sometimes anterior margin of forehead, narrowly), and under parts immaculate white, the sides and flanks more or less strongly tinged with pale or pallid neutral gray, the sides of neck deeper gray; primary coverts and primaries dull black, the innermost primaries with inner webs more grayish and margined terminally with white; inner webs of primaries with an extensive white "wedge," especially the outermost; bill yellow, more or less tinged with grayish or horn-color basally; legs and feet grayish dusky (said to be olive, with yellow webs, in life) (Ridgway, 1919, 541).

The above applies to the northern South American race. In *Phaetusa simplex chloropoda*, from Paraguay and northern Argentina, the hind neck, back, scapulars, lesser wing coverts and tail are definitely lighter gray than in the typical race. The flesh colors, according to Wetmore (1926, 140), are: bill lemon-chrome, becoming light cadmium at base of culmen; tongue and inside of bill lemon-chrome, becoming cress-green toward the fauces; iris fuscous; tarsus and toes primuline yellow; claws dull black at tip, changing at base to gray.

7 adults (of both sexes) from Ecuador, Colombia, Venezuela, and Brazil: wing, 296–314 (303.3); tail, 105.5–119.3 (112.7); culmen, 61.5–70.2 (65.3); depth of bill at base, 18–21 (19.3); tarsus, 24–27 (25.8); middle toe and claw, 29–31.2 (29.8) mm.

Immature: Essentially like adults but pileum light gray, deepening into black on auricular region and near anterior angle of eye; back, etc., pale gray (between light neutral gray and light mouse-gray); secondaries more extensively gray than in adults; white of distal wing coverts tinged with gray and metacarpal region mostly gray; primary coverts and primaries duller or more brownish black, and bill duller yellow and more tinged with horn-color or olive.

Young: Similar to the immature plumage, but feathers of pileum broadly tipped with vinaceous-buff or pale ochraceous, and with mesial streaks of black; interscapulars and anterior scapulars (sometimes proximal wing coverts also) more or less distinctly margined terminally with vinaceous-buff or pale avellaneous, the posterior scapulars very broadly tipped with the same, the tertials tipped or terminally margined with pale buff or buffy white; feathers of rump, upper tail coverts, and tail tipped with dull vinaceous buff or pale avellaneous; white of lores and blackish postocular area tinged or suffused with pale avellaneous (Ridgway, 1919, 541).

Eggs of the southern form of the Large-billed Tern taken on sandbanks opposite Bellavista on the Río Paraná numbered two or three. They were of a yellowish ground color overlaid with large ash-colored blotches and upon these smaller spots of reddish brown. Measurements of an unstated number showed lengths varying between 46 and 51.5 mm. and breadths between 35 and 37 mm. (Hartert and Venturi, 1909, 253).

Distribution:

Phaetusa simplex simplex: Coasts and larger rivers of northern and eastern South America from

Ecuador, Colombia, Venezuela, the Guianas, and the northeastern coast of Brazil, southward to Amazonian Peru.

Phaetusa simplex chloropoda: Estuaries and larger rivers of southern South America from eastern Bolivia, Matto Grosso, and São Paulo, south to northern Argentina.

The Large-billed Tern is far more a bird of broad streams than of the coasts, and the two well-marked subspecies divide the great drainage basins of the continent between them, apparently ascending well toward the headwaters. The preference of the birds runs toward rivers of considerable size and depth, which is doubtless the reason why they have never invaded to any great extent the South American waters of Pacific drainage. MacFarlane (1887, 209) reports these terns as flying over the River Guayas, off Guayaquil, during evenings of May and June, and Peters (1934, 329) remarks that they have been "recorded from western Ecuador." All such specific records are, however, scarce, whereas along the lower stretches of the Río Magdalena, and other streams flowing toward the Caribbean, the bird is abundant (Chapman, 1917, 221). Along the Caribbean coast the Large-billed Tern has been recorded at Margarita and other outlying islands (Cory, 1909, 233), although it is much more in evidence about the mouths of rivers on the mainland coasts, as at Cumaná, Venezuela, where it often swarms among the flocks of pelicans (Robinson, 1895, 653). Beebe (1909, 74) reports it in the delta of the Orinoco, perching occasionally on the mangrove snags and then resuming its flight and headlong plunges. Both Schomburgk (1848, 76) and Young (1928, 765) state that it is common along the whole sea front of British Guiana throughout most of the year, although it nests only on sandbanks far up the streams between May and August. Along this coast of mingled muddy streams and turbid sea, the Large-billed Terns appear indifferent as to the salinity, or even the translucency, of the water in which they contrive to find their prey. They scout about at a good height above the surface, then plunge, and subsequently carry their catch high into the air to swallow it while on the wing. Their activities are greatest about sunrise, when flocks of the birds pursue the shoals of small fish.

The Large-billed Tern is recorded from many localities along the Brazilian coast, between the waters about Mexiana Island, in the mouth of the Amazon, and the Uruguayan border, but the point at which the northern and southern races come into contact, if they do, is still to be determined.

In the Province of Buenos Aires, Argentina, where the southern subspecies of the Large-billed Tern reaches the seacoast, it appears to remain an almost exclusively fresh-water bird, limiting its range in the estuary of the Río de la Plata to a point inside the line of blue water. The southern race is thus even less marine than that of tropical coasts.

Wetmore (1926, 140) calls attention to the peculiarly robust appearance that these birds have in the air, owing to their huge bills. He states that they frequently swing up toward an intruder to examine him curiously, or to scold with harsh, raucous calls. At such times the yellow bill is especially prominent. Durnford (1877, 200) states that the ordinary note of the Large-billed Tern is much like the cry of the Tero-tero or Argentine Lapwing.

GULL-BILLED TERN

Gelochelidon nilotica

Sterna nilotica Gmelin, 1789, Syst. Nat., 1, pt. 2, p. 606 (Egypt).

At least three forms of the Gull-billed Tern have been described from America, among which Wilson's name has priority. Specimens are not available for an adequate revision, and Peters (1934, 330) was unable to decide to which of several alleged forms various South American records pertained. Following are three citations of original descriptions, any or all of which may refer to South American examples of this tern.

Sterna aranea Wilson, 1814, Amer. Orn., 8, p. 143, pl. 72, fig. 6 (Cape May, New Jersey).
Gelochelidon nilotica grönvoldi Mathews, 1912, Birds Australia, 2, p. 331 (South America).
Gelochelidon nilotica vanrossemi Bancroft, 1929, Trans. San Diego Soc. Nat. Hist., 5, p. 284 (Salton Sea, Imperial County, California).

Names: In South American writings this tern is sometimes called "Gaviotín de Pico Negro." Common synonyms for the specific name are *anglica*, *aranea*, *affinis*, *meridionalis*, *macrotarsa*, and *palustris*.

Characters: The short and stout black bill distinguishes this tern from any other within our region; another peculiarity is the long tarsus which considerably exceeds in length the middle toe with claw.

Adults in breeding season (sexes alike): Pileum, nape, and upper half of lores uniform deep black; rest of upper parts, including rump, upper tail coverts, and tail, uniform pale gray (between gull gray and pallid neutral gray); entire under parts, including sides of head up to and including auricular and suborbital regions and lower half of lores, together with axillars and under wing coverts, immaculate pure white; bill wholly deep black; inside of mouth flesh color (in life); iris dark brown; legs and feet dark reddish brown (dark walnut-brown) in life, the soles of toes pinkish brown.

Adults in northern-hemisphere winter: Head and neck white, the hind neck tinged with pale gray, the auricular region and a crescentic space immediately in front of eye dusky grayish; otherwise as in summer (Ridgway, 1919, 479).

Measurements of 3 males and 2 females from the Gulf of Guayaquil, Ecuador, and Mar del Plata, Argentina, agree well with those of 20 specimens from both Old- and New-World localities recorded by Ridgway, and are as follows: wing, 295–306 (304.6); tail, 115–121 (117.8); exposed culmen, 37.3–39.6 (38.6); tarsus, 30–33.1 (31.5); middle toe and claw, 28–30.8 (29.2) mm.

Young: Upper parts pale gray, the feathers more or less tipped with pale clay color or dull buff, this sometimes nearly uniform on back and scapulars, where the gray is mostly concealed, the pileum and hind neck, as well as back and scapulars, sometimes streaked with dusky, but oftener immaculate; a blackish crescentic spot immediately in front of eye, and a dusky grayish suffusion on upper portion of auricular region, forming a more or less distinct post-ocular stripe; rump, upper tail coverts, tail, and wings nearly uniform pale gray; remiges deeper, more silvery, gray, the secondaries and proximal primaries tipped or terminally margined with white; rectrices darker gray subterminally and tipped with white or buffy; under parts immaculate white; bill dusky brownish, the mandible dull brownish orange, dusky terminally; legs and feet varying from dull reddish brown to dusky brown (in life), the soles more reddish.

Downy young: Upper parts light grayish buff with several large and tolerably well-defined dusky irregular spots on posterior half of head, a distinct dusky stripe down each side of hind neck and upper back, the wings, rump, and flanks with rather distinct large spots of dusky; under parts white, tinged with grayish on sides of throat; bill brownish inclining to orange (in life) on mandible; legs and feet brownish orange (in life) (Ridgway, 1919, 480).

Eggs: Bent (1921, 199) writes as follows regarding the eggs of this tern: the Gull-billed Tern raises but one brood in a season and lays ordinarily two or three eggs; sets of four eggs are occasion-

ally laid, but they are uncommon. The eggs are characteristic and are easily recognized by their size and shape. In general appearance they are rounder and lighter colored than the eggs of any of the medium-sized terns. In shape they are usually ovate or short-ovate, well rounded at the small end. The ground color varies from "warm buff" or "pinkish buff" in the darkest eggs to "cartridge-buff" or "ivory-yellow" in the lightest eggs; the prevailing colors are the lighter shades of buff. The markings consist of spots and blotches of various sizes and shapes scattered irregularly over the egg in varying amounts, but the majority of the eggs are not very heavily marked. The underlying spots show all five shades of "brownish drab," and the heavier markings are in various shades of the darker browns, such as "Vandyke brown," "bister," and "sepia." The measurements of 47 eggs in the United States National Museum average 47 x 34 mm.; the eggs showing the four extremes measure 51 x 35.5, 49 x 36, 44 x 33.5, and 46 x 32.5 mm.

Distribution: Of nearly cosmopolitan range but absent from the colder regions. In America the species breeds from the Atlantic and Gulf coasts of the United States and southern California southward presumably to Ecuador or northern Peru and to southern Brazil or beyond.

As will be seen from the discussion of names above, the distribution and races of the Gull-billed Tern in South America can hardly be determined until additional study has been preceded by more extensive collecting. Mathews's highly casual statement that his proposed race, *grönvoldi*, from "South America," has a longer bill than North American specimens, proves not to hold among the skins I have examined.

According to Peters (1934, 330), the subspecies recently described from southern California winters on the west coast of America, southward to Ecuador. However, the Gull-billed Tern is in all probability a resident bird, as well as a migrant, in Peru and Ecuador, which indicates that the existing subspecific names have been created far in advance of any adequate study of the facts.

In the course of my work in the Gulf of Guayaquil, I observed examples of this well-marked tern off the southern coast of Puná Island on February 26, 1925. This date is in the middle of the northern winter, but Chapman (1926, 185) records specimens from Jambelí Island, taken during July, 1922, when the testes of the males were slightly enlarged, and from Vaqueria, Ecuador, during September of the same year. An additional specimen was collected in the Gulf of Guayaquil during November, 1921.

On the east coast of South America, Mexiana Island, at the mouth of the Amazon, and various localities along the southwestern coast of Brazil, are alleged to be breeding stations (Peters, 1934, 330). Dabbene (1918, 136) implies that the birds encountered on the coast of Argentina, between the Río de la Plata and Bahía Blanca, are migrants from more northerly nesting grounds.

Wetmore (1926, 136) encountered this tern in small numbers near Bahía Blanca during December, 1920, and again near Carrasco, Uruguay, during the following month, when several were seen in company with Royal Terns. At Ingeniero White, in the Province of Buenos Aires, he watched Gull-billed Terns feeding over shallow bays, or resting on muddy points. They circled about, with chattering calls, and frequently dived for small fishes in the tidal channels. One flew over his head, carrying one of the common crabs of the "cangrejales" (*Chasmagnathus granulata*) in its bill; after alighting in shallow water it pulled off the creature's claws and then swallowed it.

During the Brewster-Sanford Expedition, Mr. Beck took a male and a female of this species, each with much enlarged gonads, at a pond north of Mar del Plata, Argentina, on October 27, 1914. These, and the Ecuadorian birds referred to above, are the only South American specimens in the American Museum Collection.

In North America the Gull-billed Tern is much of a marsh bird and, like the Black Tern, is said to feed largely upon insects. In its breeding habits, however, it chooses either grassy territory or shell-strewn sea beaches and, under the latter condition, it may build a large pile of jetsam for a nest. Sometimes it breeds in small groups of its own kind, but perhaps more frequently the nests of Gull-billed Terns are distributed among those of other species. Thus at an island colony on the Texas coast, the Gull-bill was but one of seven different terns, ranging in size between the Least Tern and the Caspian, all closely associated within a relatively small space.

SOUTH AMERICAN TERN

Sterna hirundinacea

Sterna hirundinacea "Cuv." Lesson, 1831, Traité d'Orn., livr. 8, p. 621 (coast of Brazil, *i.e.* State of Santa Catharina).

Names: Cassin's Tern; Fork-tailed or Swallow-tailed "Gull" in the Falkland Islands; "Terrecle" in Peru, and "Chibrillo," "Chiliuta," "Golondrina de Mar," "Corbinero," or "Gaviotín" in other parts of Spanish-speaking South America; "Trinta Reis" applies in Brazil to this or almost any other tern. The name Terrecle is imitative of the notes, and is curiously like the term "terrick" of Scotland and "carrick" of the British West Indies, both of which are applied to terns. In scientific literature the South American Tern has been listed under the specific names *acutirostris*, *antarctica*, *meridionalis*, and *cassinii*.

Characters: Larger than any of its near relatives, and with a long, somewhat curved bill. While the species evidently has certain affinities with *Sterna vittata*, the breadth of the band on the upper wing coverts of immature birds indicates, according to Saunders (1896, 53), a relationship with the northern-hemisphere *S. hirundo*.

Adults in breeding plumage (sexes alike): Pileum, greater part of lores, and nape black, bordered by an inferior white streak running caudad from the gape; neck, mantle, throat, and breast pale pearl-gray, passing into white toward the vent, the secondaries and inner primaries broadly margined with white; rump and tail white, with a gray tinge on the outer webs of the rectrices. Iris brown; bill, legs, and feet vermilion.

Adults in winter: Plumage generally lighter than in summer, especially ventrally; forehead and crown mottled black and white; bill and feet of duller red. Among most examples an active moult begins in April.

21 males from Peru, central Chile, the Magellanic region, the Falkland Islands, northern Argentina, and Brazil: wing, 284–315 (296.2); tail, 161.5–219 (183); maximum fork of tail, 143.4; exposed culmen, 40–44 (42.1); tarsus, 19–23 (21.6); middle toe and claw, 24.1–28.5 (27) mm.

8 females from Chile, the Magellanic region, Falkland Islands, northern Argentina, and Brazil: wing, 291–305 (298); tail, 172.5–185.4 (181); exposed culmen, 39.5–42.4 (40.6); tarsus, 20.9–22.1 (21.5); middle toe and claw, 26–29.5 (27.5) mm.

Measurements in the flesh of two specimens from Rio de Janeiro were: male, length 432, wing-spread 832; female, length 444, wing-spread 775 mm.

In immature examples, the gray tinge is heavier throughout. Younger birds retain a somewhat plover-like plumage, with strongly barred, buffy and blackish feathers, a streaked pileum, and buffy flecked and speckled breast and flanks, even longer than the young of *vittata*. Birds which

have been flying for several weeks still remain relatively dark. The bill is blackish, and the legs and feet dull orange.

In nestlings the dorsal surface is olive-brown, with darker brown mottling, the throat blackish, and the remainder of the ventral surface dirty whitish.

Eggs are extraordinarily variable in ground color, as are those of most terns, this ranging between pale greenish or buffy white and a rich olive-brown. The overlying spots and blotches vary from relatively fine speckling to solid irregular marks 20 mm. or more in diameter. The markings are prevailingly brown, the density of the color depending upon whether the pigment lies directly on the surface or somewhat beneath it. When two eggs constitute a set, these generally tend to resemble each other in the type of outer marking. The shape of the eggs is likewise variable, ranging between ovate and short-ovate, with an occasional pyriform example.

Sets of two from East Falkland, collected December 10, 1915, measure as follows: 45.9 x 33.6 and 44.5 x 33.5; 41.4 x 33.7 and 42.2 x 33.7; 44.7 x 33.7 and 47 x 33.7; 47 x 34.9 and 45.8 x 34.9; 46.2 x 34.7 and 45.9 x 34.3; 45.8 x 35.6 and 46.5 x 34 mm. A set of two from Pouchet Island, Chile, December 1, 1914, measures 46.8 x 35.4 and 45.4 x 35.7 mm. Among sets of single eggs from Pouchet and other islets in the Cape Horn region, the extreme measurements are as follows: 49.4 x 34.8, 47.1 x 30, 45 x 41 (pyriform), 45.2 x 33.8 mm.

Distribution: Breeds on both coasts of central and southerly South America, from San Gallán Island (and probably northward), Peru, and from the neighborhood of Cape Frio, Brazil, southward to the Falkland Islands, Tierra del Fuego, and Cape Horn. Wanders northward to northern Peru (Pacasmayo) and to Bahia, Brazil. Records of this tern from the South Orkney and South Shetland Islands, and other localities in the American Antarctic, prove to be erroneous, and are based upon another species (*Sterna vittata*).

This handsome red-billed tern, the largest member of its group within the genus *Sterna*, may with particular appropriateness be known as the South American Tern, a name perhaps first bestowed upon it by Alexander (1928, 166), for it is a species confined entirely to the South American continental coasts and to such closely adjacent islands as the Falklands. Its reputed residence at the South Shetlands and South Orkney Islands now proves to be due to confusion with another species (*Sterna vittata*) which, in the form of two or more geographic races, is the only tern inhabiting islands within the Antarctic Zone of surface water in the American quadrant of the south polar regions.

The Brewster-Sanford Expedition, and other South American field work on behalf of the American Museum of Natural History, have yielded a large series of these terns from many parts of the continental coast and the Falkland Islands. Mr. Beck's specimens include adults in full summer plumage, and in breeding condition, taken at Ancón and San Gallán Island, Peru, during May and July, 1913, and many adults with enlarged gonads, as well as several young birds, taken at Valparaiso and Corral, Chile, during September, October, and March of the same year. Later, Beck collected a large series of birds in all stages of growth at the following localities: Ancúd, Chiloé Island, April and May; Magallanes and elsewhere in the Strait of Magellan, Caroline Island, and Cape Horn, November, December, February, and March; the Falkland Islands, November and January; Mar del Plata, Argentina, September and October; Rio de Janeiro, May. In addition, the Museum possesses specimens taken at Tofo, Chile, in June by Mr. Thomas Hallinan, and others collected at Rio de Janeiro in June and July during the South Atlantic Expedition of the Cleveland Museum of Natural History.

Throughout the cool-water littoral of South America, this tern fills a zoögeographic rôle similar to that of the Kelp Gull, although the northern limit of its breeding range on either coast is less accurately known. In any event, its distribution practically supplements that of such pan-tropical sea fowl as the man-o'-war birds. The ranges of *Sterna hirundinacea* and of *Fregata magnificens* may be said to meet, but scarcely to overlap, on both the Atlantic and Pacific sides of the continent, the former bird being a symbol of cool upwelling water as the latter is of tropical surface water (*cf.* Fig. 23, p. 165).

For such reasons the northernmost breeding outposts of the South American Tern in Brazil and Peru are of critical interest, and further information is needed concerning them. The species is reported as a common winter visitor to São Paulo (von Ihering, 1907, 40) and even northward to Bahia (Dabbene, 1917, 138). It probably nests near Rio de Janeiro or Cape Frio (Bennett, 1920, 25), though the records of Aplin (1894, 210) and Álvarez (1933, 7) for islets off the Banda Oriental and the eastern coast of Uruguay are suggestive rather than fully satisfactory.

In the Humboldt Current region this tern is abundant at all seasons of the year, and it seems extraordinary that Peruvian breeding records are so scarce. I found the birds in large numbers in the roadstead of Pacasmayo, Peru, on January 2, 1920, while in the harbors of Chimbote, Salaverry, Callao, Pisco, etc., it is a common experience to see them fishing close to passenger steamers, or being chased about by marauding jaegers on winter migration from the northern hemisphere. At Independencia Bay, and the little island of Santa Rosa, Mr. Jaques found this tern to outnumber all other birds during the latter part of February, 1926. This locality, by the way, is a definitely established breeding station, for here Coker (1919, 459) found the South American Terns nesting during the winter season. He writes:

> The terrecle is very common in the southern region particularly. The principal breeding places observed were San Gallan (June 25) and the Islas de Santa Rosa at the Bay of Independencia (July 18, 1907). This was in midwinter. Of the south Santa Rosa, a relatively low, flat-topped island, the nests lay so thickly on the ground, and the eggs were so inconspicuous among the small stones, that, despite great watchfulness, one could not walk about without crushing the eggs. The young birds, however, stood in little danger, since even in the fledgling stage they were wary and exceedingly active; they would run quickly away even to a distance and become almost invisible beside a small bit of gravel. No other birds of the islands were observed to be either so active or so successful in concealment.

In the Magellanic region, the records of the South American Tern are, of course, exceedingly numerous. Cunningham (1871, 74), Nicoll (1904, 43), Crawshay (1907, 128), and many other naturalists tell of observations on the great flocks that gather at low tide on the famous sandy spit close to the town of "Punta Arenas" or Magallanes. Here they fly in a vociferous cloud above the head of an intruder, and may be lured within close range by clicking two flints sharply together and thus producing a sound that excites their curiosity. Here Beck collected specimens during February and March, 1915.

During subsequent field work, Beck also obtained a considerable series of eggs of this tern, which show wide variety in shape, ground color, and

markings. In December, 1914, he visited terneries at a precipitous islet off Caroline Island and at Pouchet and Thiéry Islets, the latter two of which lie just south of the Hardy Peninsula of Hoste Island, and not far from Cape Horn. At these places the crews of passing sloops and schooners stopped to gather bucketfuls of the eggs for food. In January, 1915, the Indians at the Río Douglas Mission, on Navarino Island, also laid up a huge supply of tern eggs from a colony on Vauverland Island in the Gulf of Nassau. Of eleven sets personally taken by Beck at Pouchet Islet, on December 21, one is composed of two eggs and the remainder of but one. It is probable, however, that many sets had not been completed at this date. Beck found that most of the terns here had formed slight nests by picking wisps of grass that grew close to the sites.

A second series of eggs is from East Island, Falklands, taken on December 10. In this instance six of seven sets are made up of two eggs, the other of one. The nests were on the gravelly beach of a tiny islet in a fresh-water pond, close to a colony of Brown-hooded Gulls, and were composed of strands of tussock grass.

Cobb (1933, 31) writes that at the Falkland Islands three eggs in a set are not infrequent, and that in some nests on sloping tussock land he has found four or five, but in such instances he judged that two or more of them were extra eggs which had rolled down from above. Bennett (1920, 25) infers that the breeding season is relatively long at the Falklands, and that fresh eggs and well-grown chicks may be observed in many colonies on the same date.

At Tombo Point, on the coast of Patagonia, Durnford (1878, 404) reports one, two, or three eggs, and "no two alike," in nests which were mere hollows in the gravel of an enormous ternery. Here in December he found an average of three nests to each square meter of surface over a space 150 meters square, to the somewhat staggering total of 67,500 nests or 135,000 adult birds. Hartert and Venturi (1909, 253) refer to a colony on the Isla de Leones at the mouth of the Río Santa Cruz.

A wide variety of small fishes and other organisms enter into the diet of this species. Along the Peruvian coast the terns appear to follow the same shoals of silversides and anchovies upon which the guano birds subsist. At Corral, Beck found them plunging for crustaceans which he calls "young shrimp." In the coastal waters of Chiloé Island, he saw them diving into the dark surface of the kelp beds, apparently in search of arthropods of some sort. Frequently the terns would settle in flocks to rest upon the long strands of the kelp itself. This species shares a habit common in its family, namely that of exchanging food with the mate, particularly during incubation. Whether it is only the male which passes food to a brooding female is not known.

Throughout the Humboldt Current the South American Tern is a favorite victim of the Parasitic Jaeger. On several occasions, however, I have seen the terns recapture their own disgorged fish in the air, before the jaeger could reach the prize. It looked as though the tern were merely teasing its pursuer.

COMMON TERN

Sterna hirundo hirundo

Sterna hirundo Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 137 (Europe = Sweden).

Names: Wilson's Tern; in Brazil this and other terns are called "Trinta Reis." Synonyms of the specific name include *fluviatilis*, *wilsoni*, *senegalensis*, and *macroptera*.

Characters: This species, the type of the genus *Sterna*, is difficult to distinguish, particularly when in immature plumage, from some of the other medium-sized, black-capped, gray terns. Keys by Ridgway and others distinguish the species from its nearest relatives by the relatively long tarsus, lesser amount of forking in the tail, and the vermilion or orange-red coloration of the bill and feet in adults.

Adults in summer (sexes alike): Pileum and nape, including upper half of lores, uniform black; rest of upper parts pale neutral gray, the edge of wing, tips of secondaries, lower part of rump, upper tail coverts, and greater part of tail immaculate pure white; under parts of body uniform pallid neutral gray to grayish white, fading into white on under and lateral portions of head, the under tail coverts, axillars, and under wing coverts pure white; outer web of outermost rectrix gray, becoming darker terminally, in abrupt contrast with the pure white of inner web, the outer webs of remaining rectrices (except middle pair) pale gray; outer web of outermost primary blackish slate, of the other primaries pale silvery gray; inner webs of distal primaries for the most part white but with a stripe of grayish next to shaft, this stripe abruptly defined on outer five quills but becoming gradually broader and paler toward the fifth, and extending round tip of web and returning toward base as a sub-edging, the edge itself white; five inner (proximal) primaries with inner webs pale silvery gray edged with white; bill vermilion-red, blackish terminally, except on tomia; inside of mouth orange-vermilion; edges of eyelids black, iris dark brown; legs and feet orange-vermilion.

Adults in northern-hemisphere winter: Similar to summer adults, but forehead, crown, and anterior part of lores white, the crown intermixed with black; only the occiput and nape uniform black; under parts pure white (Ridgway, 1919, 494).

Measurements of 12 specimens of both sexes from Bahia, Brazil, and the east coast of Patagonia agree well with Ridgway's figures for 32 specimens from North America and Europe, and are as follows: wing, 261–267 (264.5); tail, 123–142 (132.5); exposed culmen, 34.4–38.2 (36.3); tarsus, 18.3–19.6 (18.9); middle toe and claw, 24.7–26 (25.3) mm.

Young: Orbital region, occiput, and nape black; crown mixed black and grayish white; forehead, loral region, sides of head (below orbital region), entire under parts, upper tail coverts, inner webs of rectrices, and tips of secondaries, white; upper parts (except as described) pale gray, the scapulars, interscapulars, and tertials tipped with pale buff and marked with a subterminal lunule of dusky brown or grayish brown; anterior lesser wing coverts dusky, forming a broad bar across anterior portion of wing; primaries much as in adults, but darker; larger wing coverts pale gray, indistinctly edged with white; outer webs of rectrices grayish, much darker on outermost pair; bill dusky brownish, the mandible paler and more reddish basally; legs and feet pale yellowish in dried skins (flesh color in life ?) (Ridgway, 1919, 494).

Distribution: Breeds in North America, Europe, and eastern Asia, from the Canadian provinces, the British Isles, Scandinavia, and the White Sea, southward locally to the Gulf of Mexico, the Florida Keys, Bahamas, islands off the coast of Venezuela (breeding?), the Azores, Madeira, Canary Islands, and northern Africa. Winters from Florida and the coast of Mexico, southward through the Caribbean, and the tropical Pacific as far as Ecuador, and along the Atlantic coast of South America to the latitude of the Falkland Islands and the Strait of Magellan.

Although the Common Tern winters in the Caribbean Sea, and northward throughout the West Indies as far as the southern coast of the United States, certain examples of the species make far more extensive migrations into the southern hemisphere than has hitherto been realized.

Brazilian records are not uncommon, and it is therefore by no means surprising that Mr. Beck should have found this species over the ocean off Bahia, where he collected twenty-five or more specimens between April 15 and June 30, 1916. All of these have more or less white on the forehead, although a few with the pileum practically all black were taken at the end of April. According to Witherby (1924, 709) and Forbush (1928, 108), the spring pre-nuptial moult of the Common Tern is a protracted process in the species as a whole, taking place between February and June. A number of Mr. Beck's Bahia specimens are apparently yearling birds, with dark epaulettes at the bend of the wing, and relatively small bills. The bills of all, young and old, are described as brownish, more or less flesh-colored toward the base of the mandible, and yellowish at the extreme tip. The feet were reddish.

During October, 1914, and September and October, 1915, Mr. Beck collected a number of Common Terns which represent a great extension of known range for this species, the localities lying between the coast of the Province of Buenos Aires, the Falkland Islands, and southern Patagonia. The specimens deserve listing with their catalogue numbers in the Brewster-Sanford Collection.

4768—female, Mar del Plata, Argentina, October 27, 1914.

4245 and 4248—2 females, latitude 51° S., longitude 68° W., September 10, 1915. The locality is off the coast of Patagonia, between the Strait of Magellan and Puerto Santa Cruz.

4246—male, latitude 48° 27′ S., longitude 65° 36′ W., September 15, 1915. This station is a little south of Puerto Deseado.

4247—female, latitude 51° 37′ S., longitude 66° 20′ W., October 1, 1915.

Several, if not all, of these Patagonian specimens are birds of the year, with dusky bills and reddish legs and feet.

During Dr. Chapman's investigations in the Gulf of Guayaquil, Ecuador, adults of this tern, with the sexual organs not enlarged, were taken on November 1 and July 20. Chapman (1926, 186) subsequently wrote of the latter:

> This species has not before been recorded from Ecuador, and although it is said to have bred on Aruba and Bonaire Is., off the coast of Venezuela (Bent, Bull. No. 113, U. S. Nat. Mus.), I believe that these July Ecuadorian specimens, like the northern breeding shore-birds we found there in July, are barren birds which have lacked the physiological impulse to migrate.

Since it is doubtful whether the Common Tern nests anywhere within the South American region, I have omitted the descriptions of the eggs and youngest stages.

ARCTIC TERN

Sterna paradisaea

Sterna paradisaea Pontoppidan, 1763, Danske Atlas, 1, p. 622 (no type locality = Christiansoë, Denmark).

Names: In the ornithological literature this tern has been listed under many specific names, including *hirundo*, *macrura*, *arctica*, *argentata*, *brachytarsa*, *brachypus*, *longipennis*, and *portlandica*.

Characters: In comparison with other terns of approximately the same size that enter the South American region, the bill is short, slender, and acute; tarsus short (13.5–17 mm.); feet very small; tail forked for usually more than 102 mm., when the rectrices are full grown.

Adults in summer (sexes alike): Pileum and nape, including upper two-thirds of lores, uniform

deep black; rest of upper parts mostly plain light gray (between light and pale neutral gray), the tips of secondaries and tertials, upper tail coverts, and greater part of tail (including whole of inner webs) white; elongated lateral rectrix with outer web deep gray, growing darker terminally, in strong and abrupt contrast with pure white of inner web, the outer web of next rectrix pale gray; outermost primary with outer web dark gray or slate color; inner webs of all the primaries mostly white, with a stripe of silvery gray next to shaft, this gray stripe growing gradually wider toward inner primaries, on which it extends across tip of inner web and runs anteriorly near edge for a greater or less distance, the three or four innermost primaries, however, with inner webs light silvery gray edged with white; under tail coverts, axillars, and under wing coverts immaculate pure white; rest of under parts plain light gray (pale neutral gray, slightly paler than color of upper parts), fading into still paler gray on throat and chin, and into white on sides of head, next to black of pileum and lores; bill carmine or nopal-red, usually tipped with blackish; iris dark brown; legs and feet intense red.

Adults in northern-hemisphere winter: Similar to summer adults, but forehead, crown, and anterior portion of lores white, the crown streaked with black, only the occiput, nape, and posterior portion of lores uniform black; under parts white, sometimes slightly tinged with gray (Ridgway, 1919, 499).

Measurements based upon 17 specimens taken off the coasts of Peru and Chile and at Mar del Plata, Argentina, substantially agree with the published data for North American and European examples, except that the wings and tails, owing to the state of the plumage, average considerably shorter. They are as follows:

9 males: wing, 245–264 (254.1); tail, 138–145 (142.3); exposed culmen, 29.8–33.2 (31.6); tarsus, 14.6–16.8 (15.7); middle toe and claw, 20.5–23.2 (22.1) mm.

8 females: wing, 246–268 (254.9); tail, 136–153 (145); exposed culmen, 29–31.6 (30.2); tarsus, 15–16 (15.5); middle toe and claw, 22–23.3 (22.6) mm.

Young in first winter plumage: Very similar to winter adult but with juvenal wings and tail.

Young in juvenal plumage: Like juvenal Wilson's Tern, but *rump and tail coverts white* without gray tinge and tail with more white; forehead and crown grayish, latter mottled with black which increases over ears and on hind head to practically clear black; back and wings "deep gull-gray," feathers of back, scapulars and wing coverts edged pale buffy, each with subterminal dusky band and fine dusky sprinkling; markings most conspicuous on scapulars; tertials, secondaries and inner primaries edged broadly white; considerable dusky and some pale buff near ends of tail feathers; below white, washed pale brownish on sides, throat, and breast; feet reddish orange; juvenal plumage worn apparently until birds begin to migrate in September, but probably partially moulted in autumn to produce first winter plumage (Forbush, 1928, 116).

Distribution: Breeds in circumpolar arctic lands and southward to the British Isles, Baltic coasts, Massachusetts, British Columbia, and the Aleutian and Commander Islands. South in winter through the Atlantic and Pacific Oceans, along both coasts of South America to southern Argentina and Chile, and sometimes to waters beyond the antarctic circle.

The Brewster-Sanford Expedition has thrown much light upon the winter range of the Arctic Tern. The previous slight claim that this species has had to a place in the Chilean avifauna is indicated by the investigations of Hellmayr (1932, 406), who came to the conclusion that there were but two rather unsatisfactory records, one being of an adult taken at Valdivia, and the other MacFarlane's (1887, 203) report of a specimen found exhausted on shipboard in the Bay of Arica, on October 4, 1883. The latter, however, is still preserved in the British Museum.

Beck's laconic notebook teems with references to Arctic Terns, seen at distances up to 300 kilometers from the coast of central Peru, during his offshore cruise of June, 1913. On June 6, 9, 12, 13, 16, 21, 23, and 27, he logged these migrants repeatedly in the latitudes of Huacho, Ancón, Callao, Cañete, and

Chilca, at points within sight of the continent as well as at distances of three or four days' sail to westward. He speaks of the terns as passing singly, in groups of six or seven, or as "common." On June 9, 16, and 26, he collected a number of specimens at oceanic positions between 30 and 80 kilometers from the coast.

Later in the same year, while on the voyage from Valparaiso to the Juan Fernández Islands, Beck once again encountered Arctic Terns in considerable numbers, and collected specimens between Valparaiso harbor and a point about 175 kilometers offshore on November 4, 14, 19, and December 3.

The majority of these Pacific coast specimens appear to be young birds, but several are adults in winter plumage or in worn breeding plumage. One male taken at Valparaiso on November 14 retains an entirely black pileum and a pronouncedly gray ventral surface, although its quills are exceedingly worn. A few of the other Chilean examples also show a considerable residuum of the summer plumage. Most of the rest from both Peru and Chile are in typical winter plumage, with white foreheads and white ventral surfaces, but a single female shot off Cañete, Peru, on June 26, is in the condition of assuming nuptial dress, with black feathers replacing the white ones on the head, gray sprinkled throughout the breast and belly, and new quills appearing in the wings and tail. Among the November and December specimens, the bills were blackish, the feet dark reddish. In the June birds taken off the Peruvian coast, the bills were in various transitional stages between dark and red.

On the Atlantic side of the continent, Beck collected a single male Arctic Tern off Mar del Plata, Argentina, on October 21, 1914. On the same day he saw others, all working southward, and about a week earlier he had noted the presence of hundreds, presumably of this same species. Another American Museum specimen from the South Atlantic is a female shot by myself on November 9, 1912, in latitude 36° 46′ S., longitude 46° 29′ W. This position is far out on the ocean, but is almost due east of the estuary of the Río de la Plata. Paessler (1913, 43) has recorded Arctic Terns on the course between the Strait of Magellan and Buenos Aires during July, but he does not indicate that specimens were obtained to certify the identification, while the season suggests a far greater likelihood of migrant Antarctic Terns (*Sterna vittata*), which he could have hardly distinguished in the field from *Sterna paradisaea*.

This brings me to a consideration of the legend which may yet prove to be a far-reaching ornithological illusion, namely, that the Arctic Tern on its annual migration regularly crosses the antarctic circle, enters the pack-ice zone, and attains latitudes as high as 74° S. The currently accepted version of this migration is succinctly summarized by Forbush (1925, 117) in the following words:

> The Arctic Tern is one of the most remarkable birds of the world. It is the long-distance champion of avian migration. It nests at least as far north as the most northern Eskimos live, while in winter its tireless pinions beat along the distant shores of unexplored lands of the Antarctic continent. It sees more hours of daylight and of sunlight than any other creature on earth. On the arrival of the species at its northernmost nesting-site the midnight sun is shining and it never sets during the tern's stay; while for two months of its Antarctic sojourn the bird sees no sunset. For about eight months of the year it has twenty-four hours of daylight, and during the other four

months more daylight than darkness. Says W. Eagle Clarke: "It has the most extensive latitudinal range to be found among vertebrate animals."

According to Professor Cooke the Arctic Tern makes a round trip of 22,000 miles between its farthest north and farthest south, and he says that no man knows its pathway on the journey. When it disappears from New England, it seems to be lost in the vast immensity of the Atlantic; but within about 70 days its flocks are seen in the Antarctic Ocean.

A footnote accompanying Forbush's account refers to Cooke's (1915, 10) paper on bird migration, from which he had, indeed, drawn most of his information. But Cooke's report, with the much-republished chart showing the summer and winter ranges of the Arctic Tern—at opposite ends of the earth—is entirely undocumented, and so the subject becomes more and more elusive. It is not without significance, perhaps, that the area in Weddell Sea, marked as the northern-hemisphere winter range of *paradisaea*, is incidentally the southern-summer or breeding range of *vittata*.

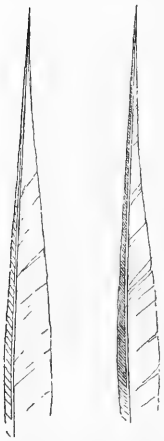


FIG. 80. Outermost rectrix of *Sterna vittata georgiae* (left) and *Sterna paradisaea*. In the latter species the outer vane is of a darker gray and the inner vane is narrower and more attenuated.

There are, as a matter of fact, examples of the Arctic Tern from relatively high southern latitudes. Two such, in the British Museum, are said to have been taken in latitude 66° S., longitude 157° W. (off Ross Sea), during March. Others, now in Edinburgh, were collected by the 'Scotia' party in Weddell Sea, across the antarctic continent from the former locality. Two of the latter I have had the privilege of examining, through the courtesy of the authorities at the Royal Scottish Museum, and they prove, indeed, to be Arctic Terns, as previously reported in the literature. One of these (No. 269, ♀) is a bird in excellent plumage and with an all-black pileum, collected in latitude 68° 32′ S., longitude 12° 49′ W., on March 23, 1904. The second (No. 4, ♂) has the forehead, lores, and a good part of the crown white, with a few blackish speckles caudad; it is in the midst of quill moult, the wing-length being only 216 millimeters. It was captured in latitude 64° 38′ S., longitude 35° 13′ W., on February 25, 1904. Both localities are in the outer part of Weddell Sea, one of them being not very far to southeastward of the South Orkneys.

These two specimens agree in appearance and dimensions with comparable Arctic Terns from the northern hemisphere, and differ from the resident terns of West Antarctica (*Sterna vittata*) in their short tarsi and in their narrow, gradually attenuated long rectrices, the dark outer webs of which form a pronounced contrast with the white inner webs. Furthermore, the sharply defined white inner edgings of their inner primaries are unlike the condition in *vittata*.

Thus the presence of Arctic Terns in Weddell Sea has been definitely established by the activities of the 'Scotia' naturalists. It does not follow, however,

that all of the field notes credited to this species actually apply to it. Clarke (1913, 268) testifies, in brief, that certain terns collected in Weddell Sea, during the 'Scotia' cruise, were identified as Arctic Terns. Birds assumed to be of the same species were logged "by thousands" on March 5, 1904, in latitude 72° 31′ S., and others were seen a few days later off Coats Land, latitude 74° 1′ S., longitude 22° W. Here they were observed in company with skuas and Antarctic and Snowy Petrels, while the 'Scotia' was locked in the pack. Clarke adds the comments that the tern observed by the Scottish naturalists certainly does not breed around Weddell Sea, "nor is any other tern, so far as we know, a native of the antarctic continent." Neither of these latter statements has stood the test of time, for the French Expedition has shown that *Sterna vittata* nests abundantly on coasts just to westward which, although insular, are antarctic and closely connected with the continent. Furthermore, there is now abundant evidence that a native tern does breed on other antarctic continental shores.

In order to trace the tradition of the Arctic Tern in many parts of the south polar seas still further toward its source, we must go back to the cruises of the 'Gauss' and the 'Valdivia,' and to the pertinent ornithological reports of Reichenow (1904, 350) and Vanhöffen (1901, 321; 1905, 507). Reichenow states that the Arctic Tern was encountered by the German Expedition southward to the Wilkes Land coast, whither the birds had probably been driven by storms! In another paper of the same year (1904, 47), however, he described from the Gaussberg, in latitude 66° S., longitude 91° E., on the coast of the antarctic continent, a supposed resident race of the Arctic Tern, to which he gave the subspecific name *antistropha*. The description is very sketchy but, so far as it goes, fits the characteristics of the widely distributed Antarctic Tern (*Sterna vittata*), which appears to be, indeed, so closely allied to *Sterna paradisaea* that one may conceivably have been originally derived from the other. The fact that Reichenow also lists antarctic eggs of this bird clinches the matter of its identity with *vittata* rather than with *paradisaea*.

It is true that on the same page with the description of his supposed "antarctic subspecies" of *paradisaea*, Reichenow likewise described as new the small form of *Sterna vittata* confined to the island of South Georgia. He compared his South Georgia specimens, however, not with topotypes of *Sterna vittata* from Kerguelen Island, but with examples of this species from West Antarctica. Without having examined Reichenow's terns from the Gaussberg region, I can, of course, come to no final taxonomic conclusion. It is perfectly patent, however, that his "*Sterna macrura antistropha*" is in reality *Sterna vittata*, which will probably prove to be of circumpolar distribution along all suitable shores of the antarctic continent.

By the same token, I infer that a good proportion of the extreme southern records for the Arctic Tern are likewise based upon *Sterna vittata*, and that birds of the latter species have been quite generally masquerading in the literature under an incorrect name. Such a supposition is strengthened by Vanhöffen's (1901, 321) statement that the supposedly antarctic representatives of *Sterna paradisaea* have not much endurance in the face of the south polar gales, and

do not go far from shore! On one December day, he continues, an example completely exhausted, and with an empty stomach, fell on board the 'Gauss.' Such testimony hardly fits the reputation of the tireless flier as justly described above by Forbush. Additional notes upon this matter will be found in the biography of the Antarctic Tern.

Regardless of the ultimate resolution of the doubts expressed, the Arctic Tern does penetrate southward as far as the Antarctic Zone of surface water, and certain facts about its migration route have recently been learned by Austin (1928, 121), Wynne-Edwards (1935, 324), and others. The former presents convincing data to indicate that the Arctic Terns of North America first migrate eastward across the North Atlantic, before turning southward toward their winter range. The observations are based in part upon banding recoveries, and in part upon birds observed and collected during late August in the North Atlantic, along the 51st parallel. Austin also writes as follows with reference to the subsequent and more problematical stage of the migration:

> Our knowledge of the winter range of the species is more hazy and indefinite as it lies for the most part in seas that are comparatively unfrequented by man. It is usually given as those waters lying between Brazil and Argentina and West Africa, and south to some undetermined point below the Antarctic Circle. The Pacific migrants seem to winter off the west of South America, and it is possible that the two flights may meet somewhere south of the Horn, but concerning this there are practically no data.

Wynne-Edwards was so fortunate as to witness a definite and prolonged movement of these terns from west to east, while on a trans-Atlantic voyage in August–September. His general comments (326) are of great interest:

> At sea terns travel singly or in small parties up to about a dozen or occasionally twenty together. In clear weather they fly between one and five hundred feet from the surface, but when beating to windward they often keep close to the wave crests. They are so light that in a breeze they cannot keep a straight course, and even in a calm they often change direction and circle round at frequent intervals. There is no indication of that intent arrowlike flight of shore birds such as the Golden Plover, seen at sea, which travel unwaveringly like a bee or a migrant hummingbird, as if they were racing the devil himself. Terns are like their inevitable companions the jaegers and take their journey easily. All the same, they stop to feed only on the rarest occasions (once seen), and never by any chance settle on the water. They seem to dislike swimming at all times, ... They often rest, however, on floating wreckage, and it is a common sight in mid-ocean to see a tern holding a precarious foothold on some jettisoned spar or wooden case, or even on a gasoline can. I have seen terns so resting sixteen times, . . . But never did I detect a single migrant sitting on the water.

The use of flotsam by terns I have myself witnessed several times on the high sea. On the morning of December 4, 1924, just off the Gulf of Panama, but out of sight of land, the distant semblance of a boat full of men almost caused the captain of the steamer on which I was travelling to turn off his course in order to effect a rescue. The objects proved to be terns crowded along a small log, but for a long while they were puzzling, even when viewed through glasses. When they raised their wings, they looked extraordinarily like castaways waving their shirts.

Wynne-Edwards, in concluding his observations on the Arctic Tern (328),

boldly champions the much-decried "sense of direction" in trenchant words which have a bearing upon many of the species of birds discussed in this book:

> Any observations of birds in the act of migrating across great tracts of water must be taken into consideration by those who would solve the problem of orientation. It seems not insignificant that these terns, crossing such an unusually wide expanse of ocean, where there is not a vestige of a landmark of any description for two thousand miles, where the wind sometimes changes direction in a few hours and the sky is often completely overcast for days at a time, pursue such a careless and irregular path. One might expect them to be more intent on the matter in hand for fear they were diverted from their course and got lost. This is no place for a discussion of this intricate question, which would in any case be profitless at the present time, but it may be observed that their sense of direction must be absolute, like that of the compass, without reference to objects they have left behind; and that the faculties by which it is regulated can be called into play at any time in the course of their flight.

ANTARCTIC TERN

Sterna vittata, and its subspecies

One of the interesting results of my work with the Museum's incomparable series of sea birds from American Antarctica is the discovery that the tern of the Antarctic Archipelago has been persistently misidentified. In most of the recent and current literature, the South American Tern (*Sterna hirundinacea*) is recorded as a resident of the South Orkney and South Shetland Islands, etc. No examples have appeared in our collections from these regions but, on the other hand, the Antarctic Tern (*Sterna vittata*) proves to be a common and widely distributed bird throughout most of the islands of the Scotia Arc. It appears that the range of *hirundinacea* is much more restricted than has been generally believed; the species is, in fact, confined to the continental littoral, its most distant outpost being the Falkland Islands. At no point does it pass poleward of the Sub-Antarctic Zone of surface water, and all of the records listed under its name for the lands to southward of Cape Horn refer, in reality, to *Sterna vittata*.

The latter antarctic species, represented by several local geographic races, is much in need of systematic revision. The necessary specimens for such a study are not at present available to me, but I can at least describe the two forms which are found, respectively, at the South Shetlands and at South Georgia.

Among the authorities who have repeatedly reported the presence of *Sterna hirundinacea* at the South Shetlands and other islands of the Antarctic Zone is that keen student of birds of the far south, Mr. A. G. Bennett. At my request, Mr. Bennett has kindly sent to the American Museum four adult breeding males of the resident tern of Deception Island. These were collected on December 1, 1921. The collector had labeled them "*hirundinacea*," but they all prove to be examples of *vittata!*

While this discovery will make necessary a considerable emendation of references in the literature, it should be noted that Gain (1914, 90) long since came to the correct conclusion regarding the identity of the breeding terns in West Antarctica. His careful descriptions and measurements, as well as the

series of plumages illustrated in Plate 11 of his volume, leave no doubt as to the matter.

Reichenow (1904, 47), when describing the resident tern of South Georgia as *Sterna vittata georgiae*, must also have been cognizant of the presence of the same species in the "Graham Land" region, because he compared his type specimen from South Georgia with examples from West Antarctica, although the type locality of the typical race is not in that part of the world at all, but rather at Kerguelen Island in the southern Indian Ocean. By way of illustrating the present unsatisfactory state of our knowledge regarding the forms and distribution of *Sterna vittata*, I quote below the citations and ranges of all the subspecies which Peters (1934, 333) has seen fit to recognize. The ranges, as here stated, are in part erroneous, particularly that ascribed to the typical race:

1. Sterna vittata vittata Gmelin.

Sterna vittata Gmelin, Syst. Nat., 1, pt. 2, 1789, p. 609. ("Insula Nativitatis Christi" = Christmas Harbor, Kerguelen Island).

Breeds on Ascension, St. Helena, Tristan da Cunha, Gough, St. Paul, Amsterdam and Kerguelen Islands, ranging to the coasts of South Africa (largely erroneous).

2. Sterna vittata georgiae Reichenow.

Sterna vittata georgiae Reichenow, Orn. Monatsb., 12, 1904, p. 47 (South Georgia).

Breeds on South Georgia and the South Orkneys, ranging to the east coast of southern South America (partly erroneous).

3. Sterna vittata bethunei Buller.

Sterna bethunei "Travers" Buller, Trans. and Proc. New Zealand Inst., 28, 1895 (1896), p. 348 (Bounty Islands).

Sterna vittata bollonsi Mathews and Iredale, Ibis, 1913, p. 244 (Sub-antarctic Islands of New Zealand).

Breeds on the Bounty Islands, occurs and probably breeds on Snares, Antipodes, Auckland, Campbell and Macquarie Islands.

Only the first two of these three subspecies concern us at present. As will be seen, the form of West Antarctica is left without a subspecific name unless it should prove to be identical with the resident bird of Kerguelen Island, which seems unlikely. Furthermore, as I have already shown in Part I (p. 154), no form of *Sterna vittata* has ever occurred either at St. Helena or Ascension, and the records from these islands are due to error. I may add that the form inhabiting Tristan da Cunha is not likely to be identical with that of Kerguelen, and that the evidence for the occurrence of the South Georgian subspecies at the South Orkney Islands (Dabbene, 1918, 138) is highly inconclusive.

Let us consider first the resident terns of West Antarctica. The four examples collected by Bennett at Deception Island closely resemble specimens of the South Georgian race, except for their considerably larger size. The measurements of the four males are as follows: length in the flesh, average, 377; wing, 278–285 (280.7); tail, 122.9–154 (141.3); exposed culmen, 35–37.1 (36.4); tarsus, 18–19.1 (18.6); middle toe and claw, 23–24.5 (23.7) millimeters. It should be noted how closely these figures, particularly the length of bill and tarsus, agree with specimens from Booth-Wandel and Petermann Islands as recorded on page 88 of the French Antarctic Expedition report. Measurements of South Georgia birds are strikingly smaller, as shown by the following averages based

upon ten males: wing, 253.7; tail, 129.5; exposed culmen, 30.9; tarsus, 16.9; middle toe and claw, 21.4 millimeters.

Our four Deception Island specimens are characteristically of a darker gray than any examples of *Sterna hirundinacea*, the tern with which they have been so often confused. The difference in shade is particularly noticeable on the ventral surface. They are also definitely smaller in certain measurements, and have particularly tiny feet in comparison with their other appendages. The average lengths of the tarsus and middle toe in 17 males of *Sterna hirundinacea* from South America are 21.6 and 27 millimeters, respectively, as against 18.6 and 23.7 millimeters for the same units in the four males of *Sterna vittata* from Deception Island.

Coues long ago pointed out the close apparent relationship between *vittata* and the Arctic Tern, stating that the former might be regarded as a representative of *Sterna paradisaea* (Kidder, 1875, 17). It is, of course, quite possible that the extensive migratory flights of the Arctic Tern ultimately led to the development of a form confined to the far south, although there are no exact data relating to the spread of species by such means.

In 1904 Reichenow described from the Gaussberg, latitude 66° S., longitude 91° E., a supposed subspecies of the Arctic Tern which he designated *Sterna macrura antistropha*. The type locality is on the shores of the antarctic continent, a long distance southward and a little eastward of Heard and Kerguelen Islands. Although this race has been synonymized with *Sterna paradisaea* by Peters (1934, 333), I believe that it is almost certainly a resident race of *Sterna vittata*. Its head was subsequently figured in color (Reichenow, 1908, 463), in connection with which the describer also stated that four eggs and several young of the species were collected at Gaussberg on February 18, 1903. These facts are sufficient to prove that *antistropha* is not synonymous with *paradisaea*. Furthermore, Gain (1914, 93) writes of an adult specimen from Booth-Wandel Island in West Antarctica:

> Il présente exactement les caractères que Reichenow a donnés dans sa description du *Sterna antistropha*. La figure en couleur qui représente la tête et la patte de cette espèce coincide exactement avec les caractères du *S. vittata* adulte, et nous ne voyons aucune utilité à faire une espèce distincte des Sternes qui nichent dans les régions glacées antarctiques.

Somewhat later Gain concludes that a short description by Valette (1906, 54) demonstrates that the bird nesting at the South Orkney Islands is not *Sterna hirundinacea*, but a member of the same species which occupies South Georgia and the Antarctic Archipelago, namely *Sterna vittata*.

It is well known that whereas many specific groups of organisms belonging to the Sub-Antarctic Zone, or even to the outer latitudes of the true Antarctic, break up into geographic races corresponding with various segments of the far south, the forms of plants and animals inhabiting the deep Antarctic, namely such as occur along the coasts of the antarctic mainland and in adjacent seas, are usually circumpolar in their ranges (Murphy, 1928, 369). From this it appears quite possible that the Antarctic Tern described by Reichenow from Gaussberg, in Kaiser Wilhelm II Land, may turn out to be the same as the form

inhabiting the west antarctic region. If subsequent comparison of specimens proves the truth of this, the name *antistropha* may be applicable to a subspecies of *Sterna vittata* occupying suitable stretches of coast around the outline of the whole antarctic continent, as well as the colder outlying islands. For the present, I propose no subspecific name for the South Shetland Tern, but will point out that it exactly resembles the South Georgian Tern except for its much larger size, as noted above. These two races furnish, by the way, an exact illustration of Bergmann's law of the geographic relation between bulk and thermal economy.

Many records of unidentified terns appear in the literature of south polar exploration, a recent instance being a note by Wilson of two terns with "black heads, white rump and tail, and darkish-grey wings and back," seen between the Balleny Islands and Oates Land during the cruise of the 'Terra Nova' in March, 1911 (Lowe and Kinnear, 1930, 112). No doubt all such records refer to this species, and very probably to a single race of the species.

During the voyage of the 'Pourquoi Pas?,' the French naturalists encountered the Antarctic Tern not only at three islands of the South Shetlands, but also all along the west coast of the Antarctic Archipelago, at the islands of Wiencke, Doumer, Booth-Wandel, Petermann, Argentina, Berthelot, and Léonie, the last being inside the antarctic circle. Many examples were also seen along the border of the pack-ice, as far as latitude 70° S., longitude 120° W.

On September 5 the first returning migrants appeared at Petermann Island, the last birds reaching this breeding ground by October 22. During early November the terns prepared their nests, which are merely slight scrapes in the ground, sometimes decorated with bits of shell from the old hatched-out eggs of other birds such as Kelp Gulls. The first egg was recorded on November 14. On January 10, in a colony of from 150 to 200 birds near the southern point of Petermann Island, most of the nests contained either two or three eggs, or one or two chicks in various stages of growth. The number of eggs is confirmed by other observers, and seems remarkable in view of the fact that terns of the South Georgian race are not known to lay more than one. By February the chicks at Petermann Island were advanced in growth, and during March the nesting sites were abandoned and the young swam about more or less in the channels and coves. Although they lost their down only gradually, within three months after hatching they had attained the size of their parents. In May all of the birds, young and adult, disappeared completely.

Menegaux (1907, 36) records the beginning of nest-building at Booth-Wandel Island in October. Most of the groups comprised not more than from six to ten birds which nested on rocks near the shore, close to each other and often near nesting Kelp Gulls. Either two or three eggs were observed in each nest.

At the South Orkney Islands, according to Valette (1906, 54), these terns arrive during October and leave about the end of April, the egg-laying season extending from late November through January. The slight hollows of the nests are rarely less than about 12 meters apart, indicating relatively large

territory requirements, and they extend from sea level to an altitude of 200 meters or thereabouts. The fondness of the birds for nesting in the terminal moraines of glaciers (Bennett, 1920, 25) is reminiscent of the habits of their close relatives at South Georgia. Shells and pebbles are often gathered and placed around the nest by the incubating bird. Valette records the temperature of nesting terns as 42.2° C., and Gain as 39.4° C., the discrepancy being unsatisfactorily great.

The observations of the Scottish naturalists on this tern at the South Orkney Islands are reported upon by Clarke under the erroneous name *Sterna hirundinacea*. The last bird of the autumn was seen at Saddle Island on March 25, 1903, and the first spring migrant was observed on October 21, though it is possible that some had been heard two or three days earlier. Clarke's (1913, 241) account continues as follows:

> The nests were mere hollows, lined with a few small fragments of stone, on the tops of small rocks, or on raised beaches and small screes, and were always quite close to the shore. The nests in the colonies were placed fairly close together, and often in proximity to those of *Larus dominicanus*. When not surprised on their nests, these birds usually betrayed the whereabouts of their treasures by hovering over them and screeching loudly.
>
> The eggs were one or two in number. The first were found on November 14th, and from that date onwards they were observed until January 15th. In 1904 Mr. Mossman records the first eggs observed on November 27th.
>
> The earliest chicks were obtained on December 25th, and by February 7th young were noted as having lost all their down.
>
> A few adult specimens and a chick are included in the collections; also a number of eggs, averaging 4.73 cm. by 3.34 cm.

Further notes on the eggs are given on p. 1110 in comparison with those of the South Georgian subspecies.

The food of the Antarctic Tern is known to include small fishes and many sorts of crustaceans. The commonest of the antarctic opossum-shrimps (*Euphausia superba*), which is the principal food of whales and of many sea birds, is known to make up a large part of the tern's diet both at the South Orkneys and South Shetlands (Valette, 1906, 54; Gain, 1914, 95). They obtain their food both by diving and by swooping down to seize the prey at the surface without submerging themselves.

SOUTH GEORGIAN TERN

Sterna vittata georgiae

Sterna vittata georgiae Reichenow, 1904, Orn. Monatsb., 12, p. 47 (South Georgia).

Names: Wreathed Tern; Kingbird, a name applied by the sealers and whalemen at Tristan da Cunha, has been given to the representatives of this species at various pan-antarctic islands.

Characters: Closely similar to the Arctic Tern (*Sterna paradisaea*), differing chiefly in the following particulars: adults in nuptial plumage of a slightly darker and less pearly gray, which approaches pale mouse-gray or even smoky gray (the winter plumage is lighter); tail shorter and less deeply forked, the outer rectrices very much broader basally than those of *paradisaea*, and tapering more abruptly toward the tip; furthermore, the outer web of the outermost rectrix is not so dark as to make a pronounced contrast with the inner web—it is, on the contrary, such a pale gray that the entire tail looks practically white; the tarsus, moreover, is slightly longer than in

paradisaea, all other dimensions, except those of the tail, being practically identical in the two species. The winter plumage also parallels that of the Arctic Tern. Iris brown; bill red with a black tip; feet dull red, tarsus lighter.

9 males: wing, 246–261 (254); tail, 123.7–137.5 (129.5); fork of tail averaging about 70; exposed culmen, 30–31.8 (30.9); bill from gape averaging about 42.2; tarsus, 16.2–17.8 (16.9); middle toe and claw, 20.1–22.8 (21.5) mm.

5 females: wing, 255–266 (261); tail, 117–141 (129.5); exposed culmen, 28.7–30.5 (29.5); tarsus, 15.9–17.5 (16.6); middle toe and claw, 21.2–23.9 (22) mm.

Adults of the Deception Island race exactly resemble South Georgia birds except for their notably greater size, as shown by the measurements on pp. 1106, 1107.

In the downy and juvenal plumages the South Georgian Tern resembles the Arctic Tern much less than in the mature stage, and exhibits rather an affinity with *Sterna hirundinacea*. Both the latter species and *vittata* retain the presumably primitive barred pattern much longer than does *paradisaea*. From the speckled buffy down in which it hatches, the young of *vittata* comes into a barred and streaked buff and blackish plumage, with the white of the ventral surface heavily overlaid with specklings. The whole cast of the dorsal surface is then somewhat "golden," like the winter plumage of a Black-bellied Plover (*Charadrius*). The buffy bars fade rapidly, so that by the stage of flight, when gray feathers are intermingled over the back, the general effect of the remaining bars is black and white, but throat and breast are still heavily speckled.

Eggs from South Georgia have a ground color varying between light yellowish olive and dull citrine. This is overlaid with spots and blotches of brown, some of the markings being as rich as clove-brown. Some eggs are rather evenly marked; others have a solid cap of color at the larger end, while still others are more or less wreathed with spots at this end. Two taken at the Bay of Isles in January measure 44.4 x 31.2 and 44.5 x 31.4 mm. Lönnberg records a third measuring 48.5 x 30.5 mm.

It is curious that the larger race of *vittata* inhabiting the Antarctic Archipelago has eggs which are no larger than those of the South Georgian subspecies. Examples of ten collected at Booth-Wandel, Petermann, and Deception Islands between November and January measure 43 x 34, 47.5 x 32, 45 x 31, and 48 x 35 mm. (Gain, 1914, 96). The average length of ten is 45.45, as against 45.6 for three eggs from South Georgia. The weights of four eggs from Petermann Island vary from 27–35 and average 30.2 grams.

A number of eggs from South Orkney Islands, as recorded by Clarke (1913, 241), average 47.3 x 33.4 mm.

Distribution: South Georgia, where it is probably endemic and sedentary. Evidence for the presence of this subspecies at the South Orkneys (Dabbene, 1918, 138) is inconclusive.

My first acquaintance with this attractive little tern came on November 24, 1912, while we were idling in the brig 'Daisy' along the rugged coast of South Georgia, driven before eddying and uncertain winds. The terns were feeding here and there over the open ocean, but their numbers increased greatly as we entered Cumberland Bay. After this I saw the birds daily along various parts of the northeasterly coast of the island, until the departure of our vessel in the middle of March. They were observed over the coastal waters and in all of the bays, as well as up the valleys and into the heart of the mountains at altitudes as high as 300 to 400 meters. It is not impossible, as Will (1884, 140) suggests, that they may feed in part among the upland swamps of South Georgia, using their sharp bills to extract tiny organisms from the moss. Undoubtedly, however, they obtain the greater part of their prey by diving into sea water kept quiet by the gently heaving kelp; in such places I constantly saw the terns not only during the hours of daylight but also continuing to plunge by the light of the moon, well into the night.

Offshore on the whaling banks, at a distance of 25 or more kilometers from the coast, I never saw a single example of the tern among the millions of petrels, albatrosses, penguins, etc., that were always about. For such reasons it seems probable that the tern is sedentary and not given to long flights across the ocean either in search of food or in migration. Like other members of its species, it avoids contests with the raging gales of the far south. According to Szielasko (1907, 597), the South Georgian Terns collect in massed flocks on the beaches at the first gusts of blizzards and williwaws, each bird scraping its way into the sand by squatting and turning about until it has formed a sheltering dugout.

Evidence in the literature is not quite conclusive as to whether all of the terns remain at South Georgia throughout the winter months, but I am inclined to believe that they do, and there are numerous records of their presence between April and October. As Lönnberg (1906, 64) notes, they keep to the littoral during the winter, the land being then deeply buried under snow. I do not know the authority for Peters's (1934, 333) statement that some examples range to the east coast of South America. The breeding bird of the South Shetlands belongs, as I have shown, to a distinct and larger subspecies. When it becomes possible to compare representatives from the South Sandwich, South Orkney, and Tristan groups with those from South Georgia, we shall know much more about relationships and distribution within the species.

The breeding sites of the tern at South Georgia are highly various, some of them being far up among the hills on steep slopes, or about the shores of tarns, and others on flats close to sea. At the Bay of Isles, for example, I found the birds nesting upon sharp chips of stone in the terminal moraine of Grace Glacier, and also on a steep bank of crumbling shale near the summit of Albatross Island, about a hundred meters above the sea. In the latter colony, on January 2, I found eggs laid in the mossy depressions between stones, in some instances with a few wisps of dried grass by way of nest-lining. The eggs and young examined here, together with other eggs noted at Cumberland Bay on December 3, show that a single egg constitutes the full set. This agrees with records made by members of the German Expedition on Mount Krokisius at Royal Bay. I have noted above that the larger race of *Sterna vittata* inhabiting the Antarctic Archipelago lays two or even three eggs, but that these are no larger than the egg of the South Georgian Tern. There is a suggestion of some sort of biological compensation in this curious relation between size of egg and size of clutch.

The breeding season is evidently rather more prolonged than that of most South Georgian birds. Members of the German Expedition of 1881 observed the mating of the terns on November 29 (von den Steinen, 1890, 265), and Szielasko found an egg as early as November 23. Matthews (1929, 582) also states that the egg is usually laid in the second half of November. I found numerous eggs after New Year, and von den Steinen reports freshly laid examples in early February. The skua may be largely responsible for such prolongation of the nesting season, for it is probable that this enemy occasionally makes second layings necessary. Furthermore, these terns are by no means averse to

stealing and eating the eggs of their own kind, particularly when a colony of the birds has been thrown into excitement by the incursion of a skua.

The presence of a breeding group is usually betrayed by the terns themselves, for they come out of their way to attack an intruder, hovering about with harsh screams and darting at one's head. It was in this way that I discovered the Albatross Island colony referred to above, for I had not expected to find the birds nesting on this tussock grass-grown islet. There proved to be about thirty to forty pairs here and, among the pebbles, lichens, and moss, eggs and tiny chicks were equally difficult to see, for the latter remained quite as motionless as the former. I quickly discovered that the best way to find them—and to avoid stepping upon them—was to withdraw a few paces, whereupon the solicitous but very unintelligent parents would at once flutter down, still scolding, to their respective nests. Sometimes, however, a bird would have a prior and evil interest in another's nest. Right under my nose I saw several crack eggs and carry away pink and dripping embryos, before the rightful parents could prevent such cannibalism. The frequent but unsuccessful attempts of other terns to express the same unsocial behavior was evidence that the custom was not novel to them.

Five of the terns' eggs collected on this date, January 2, were fresh-laid, a sixth was almost ready to hatch, and I judge that no chick was more than a few days old. All of the latter remained "frozen" throughout the disturbance. Matthews (1929, 582) states that very early in life they begin to leave the nests and to crouch among the stones near-by.

On a moraine behind the beach at the Bay of Isles, I found these terns occupying more scattered nests, which they were very unwilling to leave while incubating. There seemed to be a definite relation between weather conditions and the reactions of the birds, because on several occasions when snow was driving down before a high wind I was able to touch the terns before they would spring off the egg. The sitters protested, nevertheless, at my proximity with high-pitched calls which brought their mates to the vicinity, the latter sometimes poising half curiously, half threateningly, close to my face, or alternately dashing at my head and alighting upon a rock close by, chattering all the while. Whenever a skua flew near, however, both terns would forget me, and the sitter would leave the egg to join its mate in pursuit of the more familiar robber. The skua always demonstrated its ability to outdistance the terns, but the latter would pursue it for a long way, trying repeatedly to strike it. On February 1 one pair of terns at this locality was faced with the dilemma of dividing its attention between me, several Kelp Gulls, and two skuas. Their response showed, however, that they regarded the skua as the worst of the evils, and me as the least, for they attacked the three species of encroachers in the order named, devoting all their attention to the skuas and gulls until both had been driven from the neighborhood, even though I was standing directly over their nest all the while. By collecting on two occasions terns which I had been watching closely, I learned that the male is the bolder and more aggressive in the tactics employed against trespassers.

By January 11 I saw a number of young terns so far advanced as to be flying a little, and before the end of the month these became rather abundant. They joined the flocks of adults over the kelp fields, and could be distinguished not only by their appearance but also by their note, which is sweet and mellow.

At Possession Bay, on March 8, I saw very large clouds of terns over the moraines on the west shore of this deep fiord. There were many hundreds together, perhaps flocking because their breeding season was entirely over. About this same season I saw also mixed groups of adults and young perching along the edges of cliffs, from where they would occasionally fly down to pools in the sluggish kelp.

South Georgian Terns collected by myself, and others obtained by Correia, show that the plumage is grayest during November and December, before the strong, even though chary, summer sun has had time to bleach the feathers acquired by a pre-nuptial moult. Such examples also have the longest tail quills, and the lightest tone of red in the bill and feet. By April, a post-nuptial moult of quills and body feathers causes the anterior half of the crown to turn white, and the ventral surface to become very light gray. The broad white stripe just under the black cap is then much less conspicuous than during the breeding season. Young taken as late as July or August still show a trace of the barred feathering.

I find nothing in my notes to distinguish the call of the South Georgian Tern from that of related species elsewhere, such as the Arctic Tern. They are very noisy but probably no more so than most of their kin. Will (1884, 140) records the ordinary cry as "Trr Trr Kriâh." Another common chattering note is like the rattle of pebbles or the gritting of teeth.

The food of the South Georgian Tern comprises crustaceans, such as euphausians and isopods, as well as tiny fish. During January and February I frequently saw birds flying from coves to their nesting grounds carrying silvery fry in their bills. Lönnberg (1906, 64) has identified fish from their stomachs as the young of *Notothenia macrocephala*, a species which abounds in the kelp fields, although full-grown examples are usually to be obtained only toward the bottom, in depths of 10 to 20 meters or more. I found that the terns were always willing to quarrel with the petrels for small scraps of blubber tossed overboard from our anchored brig in the Bay of Isles, and that they would even flutter about the carcasses of newly killed seals ashore, and pick at both the fat and the flesh.

TRISTAN DA CUNHA TERN

Sterna vittata, subspecies

Distribution: Tristan da Cunha group, and Gough Island.

A form of the Antarctic Tern, locally known as the Kingbird, is resident at Gough Island and at all three islands of the Tristan group. Wilkins (1923, 509) found great numbers of both adults and flying young at Gough during his visit at the end of May, and he reports that they rested at night on the ledges of cliffs, as the South Georgian Terns do. Barrow (1910, 275) states that at Tristan

da Cunha the tern is a migrant species, coming back to the island in September and laying its eggs in November. Flying young have been reported in the middle of January. Mathews (1932, 45) describes eggs taken during mid-November at Sandy Point, on the east side of Tristan. Sets of one or two were found on bare sandy ground, with little or no nest-lining. Six examples averaged 46 x 32 millimeters in dimensions, the largest being 47.5 x 33.

This tern was also collected at Inaccessible Island during the 'Challenger' expedition, but I have seen no specimens.

TRUDEAU'S TERN

Sterna trudeaui

Sterna Trudeaui Audubon, 1838, Birds Amer. (folio edit.), 4, pl. 409, fig. 2 (Great Egg Harbor, New Jersey).

Names: In Argentina this species is known as "Gaviotín," the same name applied to other medium-sized terns; in Brazil a published name is "Trinta Reis" which is also applied to other terns. A specimen from Chile has been described under the specific name *frobeenii* and one from Uruguay under the name *sellovii*.

Characters: This species is distinguishable from other terns by its white pileum and nape; the under parts are pale gray like the back, and the bill yellow with a subterminal band of black.

Adults in summer (sexes alike): General color plain pale gray (nearest lilac-gray), paler (nearly white) on rump, upper tail coverts and tail, fading into white on head and upper neck, the primary coverts and greater part of primaries still paler gray or silvery white, the outer web or outermost primary deeper gray than back, etc., the inner (proximal) primaries with inner webs becoming dusky toward edge and margined with white; a spot of black immediately in front of eye, and a less sharply defined post-ocular stripe of the same, occupying upper portion of auricular region; axillars and under wing coverts and broad tips to secondaries, immaculate white; bill yellow with a broad subterminal band or area of black; iris dark brown; legs and feet brownish in dried skins (said to be orange-yellow or dull orange in life) (Ridgway, 1919, 488).

Wetmore (1926, 138) writes of an adult female from Argentina: tip of bill cinnamon-buff, base between zinc-orange and tawny; band across distal third black; iris Vandyke brown; tarsus and toes zinc-orange, the scutes clouded with fuscous; nails blackish.

Adults in winter: Similar to summer adults, but stripe on side of head more grayish, especially the post-ocular portion, and (especially in fresh plumage) the silvery frosting on primaries more pronounced; bill black, tipped with yellowish (Ridgway, 1919, 489).

14 specimens of both sexes from Argentina and Chile: wing, 250–270 (258.1); tail, 104–140 (116.1); exposed culmen, 38–43 (40.8); tarsus, 23.4–26.7 (25.4); middle toe and claw, 27.5–30.2 (29) mm.

Young: The patch before and the streak behind the eye decidedly larger, and there is an indication of a grayish crescent on the nape; the crown grayish white, slightly mottled with brown, as are the feathers of the mantle; tail feathers dark ash-gray with white margins; bill yellowish brown at the base, the rest blackish, with no yellow at the tip; tarsi and toes yellow (Ridgway, 1919, 489).

Eggs from the Province of Buenos Aires, Argentina, are described by Gibson (1920, 76) as often elongate and sometimes pear-shaped, with an olivaceous or yellowish brown color and with spots and blotches of dark ash-gray, red-brown, dark brown and black, and (under the surface) dull lilac areas. Three or four constitute a set, the average measurements of eggs in Gibson's series being 43 x 31 mm. Bent (1921, 228) records a number of sets alleged to have come from San Ambrosio Island, latitude 26° S., far off the coast of Chile, on December 17, 1907, but, as noted elsewhere, the locality is almost certainly incorrect. These, he states, are not distinguishable from certain types of eggs of *Sterna hirundo*. The ground color varies from Isabella to deep olive-buff. Some are uniformly spotted or blotched at the larger end. A number of eggs show underlying spots of drab or lilac. The measurements of 10 average 41.7 x 30.6 mm. The eggs showing

the four extremes measure 46.4 x 30.4, 44.7 x 31, 39 x 30.5, and 39.5 x 30 mm. If these are actually eggs of Trudeau's Tern, which is not improbable from their measurements, they are likely to have come from some mainland locality.

Saunders (1891, 373) has pointed out that the eggs of *Sterna trudeaui* are somewhat intermediate in shape and pattern between those of coast-breeding forms of terns and those of the marsh tern (*Hydrochelidon = Chlidonias*) group.

Distribution: Breeds on the coast and in the interior of the Province of Buenos Aires, Argentina; known to occur on the Atlantic coast of South America from Rio de Janeiro to the Strait of Magellan, and along the Chilean coast between Arica and Corral. Accidental in North America.

On the western coast of South America Trudeau's Tern is known only from a few specimens taken in Chile, one of which has been figured by Philippi (1902, pl. 47, fig. 2). It is therefore of interest to report that the American Museum has two adult males taken by Mr. D. S. Bullock at Penco, Bay of Concepción, on March 4, 1927, and September 21, 1928. The presence of a breeding colony at the little waterless and nearly plantless island of San Ambrosio, as announced by Bent (1921, 228), is open to serious doubt, as noted on page 261. Bent's account, which is highly circumstantial, states that at San Ambrosio in mid-December the nests of this species were found to be mere hollows without lining, placed in the sand among boulders. The birds proved to be close sitters, and they perched about so unguardedly after being flushed from their eggs that one of them was killed by a stone tossed by the collector.

The discovery, if verified, would be an extraordinary one for a species which seems so thoroughly continental in its usual preferences for fresh water over salt. However, the 'Zaca' expedition saw no trace of Trudeau's Tern at San Felix and San Ambrosio in February, at which season fledgling young might have been expected.

In the northern coastal region of Argentina this species has been reported upon by Durnford (1877, 200), Holland (1890, 428), Gibson (1920, 75), and Wetmore (1926, 137).

Durnford observed Trudeau's Tern near Flores Island, at the mouth of the Río de la Plata, during every season except spring. Holland found them nesting in a gullery of *Larus maculipennis* at Estancia Espartilla, Province of Buenos Aires, early in November. The nests were segregated from those of the gulls, and were at a corner of a lagoon, among flooded willow stumps, without sheltering rushes, and surrounded by rather deep water. There were thirty to forty of them close together, each composed of very wet, green water grass, and kept above the surface only by the mass of vegetation underneath. There were three or four eggs in each nest, no two of which seemed to be similar.

Gibson states that Trudeau's Tern is to be found on every interior marsh and lagoon, as well as along the seacoast, of the Cape San Antonio district in the Province of Buenos Aires. Inland the species is usually encountered singly or in pairs, but on the coast large flocks are a daily feature. These birds are bold in defending their nests, and Gibson on one occasion was struck three times in rapid succession by the same individual. He found, during long years of observation, that the beginning of the breeding season varied between October 26 and January 5. Not infrequently the Tern colonies were combined with those

of the Spot-winged Gull, as reported also by Holland. Gibson observed that Trudeau's Terns perched on wire fences, just as the gulls frequently do. Such a habit seemed extraordinary to him in a sea of flooded land, but it matches the familiar North American experience of seeing terns of several species perching upon the fine cordage of fish weirs. That Trudeau's Tern should nest in Argentina, "generally at the side of a swamp . . . the material always soaking wet water weeds, and . . . floating in the same," would be enough to cast doubt upon its breeding in dry sand on the oceanic, semi-arid islet of San Ambrosio.

Wetmore saw very many Trudeau's Terns, both inland and along the coast of Argentina and Uruguay, between the months of October and March. During January they were common at Carrasco, east of Montevideo. This writer's always enlightening notes are as follows:

> Trudeau's tern in flight and general actions is similar to other smooth-headed terns. As the birds beat back and forth with zigzag flight along shallow channels they darted down at intervals to secure small fish that appeared in the water within striking distance. When they were not feeding they gathered in close flocks to rest on some sandy beach or point near water. Below Cape San Antonio parasitic and long-tailed jaegers harried them and made them disgorge. Once or twice I noted hooded gulls in similar attempts, but in each case the tern with seeming ease eluded its less agile pursuer.
>
> The call notes of Trudeau's tern are sharp and explosive and suggest in many ways the sounds emitted by Forster's tern, a species that the present one suggests strongly in life. A usual call was a sharp *tik tik tik*, changed when birds became angry or excited to a drawn out *keh-h-h*. As birds in full plumage approach across the level expanses of the broad marshes or along some open sea beach they appear plain gray, with light head and a prominent dark mark through the eye. In winter the undersurface of the body is entirely white. At times they were wary but were enticed within range by a white bird or a handkerchief waved in the air. Near Lavalle through inquiry I located a small breeding colony of the *gaviotina*, as these terns were known locally, where the birds were associated with gulls, but before I was able to visit it the ternery was raided by boys who sold the eggs to the local baker for use in preparing cakes (Wetmore, 1926, 137).

At Mar del Plata, in October, 1914, during the course of the Brewster-Sanford Expedition, Mr. Beck noted and collected a number of Trudeau's Terns. His journal reports that most of them were seen about ponds and pasture-puddles back from the coast, rather than over salt water. Their stomachs, furthermore, contained small fresh-water fishes. All of the specimens from this locality are in somewhat worn plumage, and are much less gray than a male taken near Buenos Aires on September 21. The gonads are described as minute, and Beck believed that not one of the birds had experienced even the beginning of the physiological changes incident to the breeding season.

ROSEATE TERN

Sterna dougalli dougalli

Sterna Dougalli Montagu, 1813, Orn. Dict. Suppl., not paged; text under Tern, roseate; pl. (Firth of Clyde, Scotland).

Names: Synonyms of the specific name include *bicuspis* (described from Bahia, Brazil) and *gracilis*, besides which the species has frequently been listed under the name *paradisaea*.

Characters: The pink suffusion on the under side of the body distinguishes adults of this species

from other terns, besides which the outer (as well as the inner) web of the outermost rectrix is white; the bill is mostly black during the northern-summer season and not more than basally red at other times.

Adults in summer (sexes alike): Pileum, nape, and upper half of lores uniform deep black; rest of upper parts plain pale gray (pallid neutral gray) passing into silvery white on upper tail coverts and tail; secondaries tipped with white, and inner webs of primaries broadly edged with the same; outermost primary with outer web dark gray or blackish slate, the inner webs of three outer primaries white with a stripe of silvery gray next to shaft, the white extending to the extreme tip; lateral and lower portions of head and neck, lower hind neck, and entire under parts, including axillars and under wing coverts, immaculate white, usually more or less deeply tinted with pink, especially on under parts of body; bill black, usually more or less reddish at extreme base (mostly red in pre-nuptial season); iris dark brown; legs and feet pure vermilion-red or scarlet (in life).

Adults in northern-hemisphere winter: Similar to the summer plumage, but forehead and anterior portion of crown white, the latter shaded with grayish and indistinctly streaked with darker, only the orbital region, occiput, and nape uniform black (Ridgway, 1919, 505).

Measurements of adults of both sexes taken off Bahia, Brazil, in April substantially agree with those of northern-hemisphere birds except for the lesser average length of the tail due, no doubt, to a recent moult of these quills. They are as follows: wing, 220–231 (225.7); tail, 160–169 (164.1); exposed culmen, 32.2–38.3 (35.4); tarsus, 19.1–19.5 (19.3); middle toe and claw, 22–23.9 (23.1) mm.

Young: Pileum and nape pale buffy grayish, finely mottled or stippled with darker, and streaked, especially on crown, with dusky; orbital region and upper portion of auricular region dusky or blackish; remainder of head, lower hind neck, and entire under parts white, the hind neck, and sometimes sides of breast, finely mottled with buffy grayish; back, scapulars, wing coverts, rump, upper tail coverts, and tail pale gray, the back and scapulars overlaid or washed with pale buff, irregularly mottled with dusky, each feather with a subterminal V-shaped mark of dusky; primary coverts and primaries darker gray, edged with paler, the inner webs of the latter broadly edged with white; rectrices each with a subterminal V-shaped mark of dusky and with outer web rather darker grayish; bill brownish dusky; legs and feet dusky (in dried skins).

Downy young: Upper parts pale grayish buffy or buffy grayish, thickly flecked or irregularly streaked with dusky; anterior portion of forehead uniform dusky; throat and lateral portions of head and neck dull grayish; rest of under parts immaculate dull white; bill brownish, tipped with blackish; legs and feet dusky (Ridgway, 1919, 505).

The eggs are described as follows by Bent (1921, 259): The eggs of the Roseate Tern are similar to and often indistinguishable from, those of the other small terns; but when a large series is compared with others the average difference is well marked. They will average a trifle longer and the markings are smaller and more evenly distributed, with fewer of the large bold markings when compared with a series of eggs of the Common Tern. There is less variation in the ground color, which ranges from "cream-buff" to "cartridge-buff" or "pale olive-buff." The darker and richer colors of other terns' eggs are seldom, if ever, seen in this species. A majority of the eggs are evenly sprinkled with small spots or dots over the entire surface, either with or without an occasional larger spot; these spots are seldom large enough to be called blotches and never as large and conspicuous as they are on the eggs of the Common Tern. These markings are in the darker shades of brown from "warm sepia" to "dark clove-brown." There are often numerous spots of various shades of violet, plumbeous or lavender-gray, underlying the darker markings. In shape the eggs vary from ovate to elongate-ovate, usually quite pointed. The shell is smooth, thin, and without lustre. The measurements of 87 eggs, in the United States National Museum, average 42 by 30 mm.; the eggs showing the four extremes measure 45.5 by 31, 43.5 by 32, 38 by 30, and 44 by 27.5 mm.

Distribution: Breeds on both coasts of the North Atlantic Ocean, from Sable Island to Long Island, in Florida, Bermuda, the Bahamas, the Lesser Antilles, and Aruba Island in the Caribbean; in Europe from the British Isles and Denmark, south to North Africa. Winters from the southern United States to Brazil and South Africa.

On April 28, 1916, Mr. Beck collected seven Roseate Terns off Bahia, Brazil. His notes say that they were feeding among Common Terns (*S. hirundo*) and Wilson's Petrels, of each of which he obtained a series on the same date. Both the terns and the petrels were resting on the ocean during dead calm periods of the day, to rise into the air and feed again when light cat's-paws rippled the surface of the water. Other species collected on the same occasion include Noddies and Brown Boobies.

The Bahia Roseate Terns are in winter plumage, with white foreheads, and quills which have not attained full growth. Most of the specimens still retain the pink bloom upon the breast to a far greater extent than those of a series obtained by Beck at St. Thomas, West Indies, during August and September of the next year.

Among the Lesser Antilles, the Roseate Tern breeds at many islands, and is known among English-speaking natives as the "Carrect." At Carriacou, of the Grenadines, two eggs are laid in May, generally on the bare ground but sometimes among tufts of grass. The birds fish in active, noisy flocks, making perpendicular plunges into the sea, and during the middle of the day they usually take a siesta on the rocks (Wells, 1902, 239). The only recorded breeding colony actually within the South American region seems to be that on a coral reef off the island of Aruba, in the Caribbean Sea. Here Hartert (1893, 310) found the birds laying three eggs in June, either on the open sand or among the green beach plants.

The Roseate Tern is single-brooded, and its period of incubation has been established as 21 days. Its life history, including the courtship, nesting, plumage sequences, behavior of young and adults, and food habits, has been learned in considerable detail from studies of the North American and European representatives, but little is yet known about its movements in South America.

BRIDLED TERN

Sterna anaethetus melanoptera

Sterna melanoptera Swainson, 1837, Birds W. Afr., 2, p. 249 (West Africa).

The following name, based upon New-World specimens, is believed to be a synonym:
Melanosterna anaethetus recognita Mathews, 1912, Birds Australia, 2, p. 403 (Bahama Islands).

Names: The Bridled Tern appears in the literature under the specific names *pannaya*, *pannayensis*, *discolor*, and *anaestheta*. Furthermore, six or more subspecies have been described, the status of several of which is uncertain.

Characters: The back scapulars, wings, rump, upper tail coverts, and six to ten middle rectrices are deep brownish gray, paler and grayer toward the hind neck which is white or pale gray; inner webs of primaries wholly dusky.

Adults (sexes alike): Forehead and superciliary region, lower portion of lores, suborbital region, lower portion of auricular region and entire under parts, including axillars and under wing coverts, immaculate pure white; lower hind neck grayish white or very pale gray; crown, occiput, nape, upper hind neck, post-ocular region (including upper portion of auricular region) and broad stripe across lores (from bill to eye) uniform black; back, scapulars, rump, upper tail coverts and eight middle rectrices plain blackish fuscous, becoming more grayish (nearly Quaker drab) on upper back, where fading anteriorly to grayish white on lower hind neck; wings deeper fuscous

black, the primaries darker (more nearly black), the anterior margin of wing, abruptly, pure white; outermost pair of rectrices white, with terminal portion of inner web brownish gray, the next pair similar but with much more gray, this on terminal portion of outer web also; the third pair (from outside) with the dusky grayish general color passing into white basally, more extensively on inner web; inner webs of primaries with an extensive, well-defined "wedge" of white; bill, legs and feet black.

6 males: wing, 251–263 (257); tail, 147.5–164 (155.1); exposed culmen, 39–41 (39.9); tarsus, 19–21 (20.2); middle toe [without claw], 22–23.5 (23) mm.

5 females: wing, 255–263 (258.8); tail, 150.5–174 (162.9); exposed culmen, 38–40.5 (39.2); tarsus, 19.5–20.5 (20); middle toe [without claw], 22–24 (22.9) mm. (Ridgway, 1919, 512).

The length of middle toe and claw in one male and one female is, respectively, 29.2 and 28.2 mm.

Young stages: The downy young Bridled Tern is gray, to match the rocks on which it is born. The color varies from very light gray to dark gray or drab-gray, and it is usually tinged with buff; the under parts are grayish white and the throat is dark gray; the upper parts are more or less mottled with dark brown. The young bird, in the juvenal plumage, has the forehead and the entire under parts pure white. The crown and hind neck are "light gull gray," lightly streaked on the crown and heavily streaked on the cervix with black. The feathers of the back, lesser wing coverts, or scapulars, are edged with pale buff, which fades or wears away during the fall and winter, leaving the back "gull gray," and somewhat mottled. The sequence of plumages to maturity, so far as we can tell from the limited material available, is apparently similar to that of the other small species of the genus *Sterna*. The same is probably true of the moults and plumages of the adult. The adult in winter may be distinguished from the young of the year by having no buffy edgings on the upper parts, but the fresh feathers of the back are broadly tipped with very "pale gull gray," or whitish; and the head is more distinctly marked with black and white, though in a similar pattern to that of the young bird (Bent, 1921, 289).

The eggs are somewhat similar to those of the Sooty Tern, and are nearly as handsome, but they do not show such a wide range of variation and are usually much more finely and evenly spotted, the bold, striking color patterns being seldom seen. The ground color is pinkish white, creamy white, or pure white, which is generally well covered with rather small spots of a great variety of shades of brown, from the darkest shades to bright reddish brown, also various shades of drab, gray, violet, and lavender; occasionally an egg is boldly splashed or blotched with violet-gray or lavender, overlaid with bold markings of brilliant shades of brown, and producing a very pretty effect. The measurements of 20 eggs in the United States National Museum average 46 by 33.2 mm.; the eggs showing the four extremes measure 49.5 by 31.7, 47.5 by 35.5, 40.6 by 31.7 and 43.1 by 31.2 mm. (Bent, 1921, 288).

Distribution: Breeds in the Bahama Islands, and in the West Indies from the Lesser Antilles westward and southward to the coast of British Honduras and to Aruba Island, off the coast of Venezuela.

Tobago and Aruba seem to be the closest breeding stations of the Bridled Tern to the continent of South America, and only the colonies at the latter island bring the species within our region. At Aruba the Bridled Terns have been found nesting in June (Cory, 1909, 195).

During the Brewster-Sanford Expedition this species was encountered only at islets off St. Thomas in the West Indies, where Mr. Beck collected a series of specimens during August, 1916. Here most of these terns had evidently passed their breeding season, for a number of fledglings are included among the specimens. However, Beck found that a few nests at Cockroach and Cricket Islets still contained eggs as late as August 10. The flying young have broad buffy edgings on the feathers of the dorsal surface, which appear to be lost rapidly through wear. Their backs consequently become gradually darker, while their heads tend to become lighter.

At Aruba, Hartert (1893, 310) found the Bridled Terns breeding on a coral reef in late June. The single egg was in every instance more or less hidden under shrubbery or within the shadow of a stone or shell, instead of being laid in the open as were the eggs of Roseate Terns in the neighborhood. This agrees with the reputed régime of the species at Jamaica and the Bahamas, where eggs have been found not only under overhanging ledges of rock but even inside the entrances of abandoned Audubon's Shearwater burrows (Bonhote, 1903, 314). In still further confirmation of the trait, Bowdish (1902, 357) states that on islets off Porto Rico, where the Bridled Terns were just beginning to breed on June 24, the eggs were laid in more concealed spots than those of their neighbor, the Brown Noddy. Wetmore (1918, 338) adds that at Desecheo Island, Porto Rico, he found nest-platforms made of loose pebbles and chips of limestone, with perhaps a feather or two, but always in situations well protected from the rays of the sun.

The Bridled Tern is one of the "egg-birds" of the West Indies, sharing with the Sooty Tern and the Noddy the privilege of having its colonies regularly raided by hungry black men. It associates much with the two last-named terns, although it appears to be a considerably shyer bird, except on the nesting ground where, on the contrary, it is highly pugnacious in attacking. Although credited with being difficult to distinguish from the Sooty Tern, its grayish back, and, even more, its evidently smaller size, makes discrimination in life rather simple, especially if the two species are about together. On the wing, it is swifter and more graceful than the Sooty. Furthermore, the voices of these two birds are very different. In addition, the Bridled Tern frequently sits upon the water in flocks, in this respect being very unlike the Sooty Tern, which goes to any length to avoid swimming.

Its relationship with the Sooty Tern is evidently close, for these two species have been by many authors placed in a distinct genus (*Onychoprion*). However, the generic characters are based in large measure upon the anomalous and untern-like coloration of the young of the Sooty Tern, and Ridgway (1919, 486) has called attention to the fact that the young of *Sterna anaethetus* do not agree with those of *Sterna fuscata* but are, on the contrary, typically tern-like.

A form of this tern, which has been named *Sterna anaethetus nelsoni* by Ridgway, is credited with a range along the west coast of Mexico and Central America. Its breeding grounds are unknown, but Wetmore (1923, 171) has recorded an immature female, taken in the Bay of Panama on September 24, 1922, which brings the supposed race within our region.

SOOTY TERN

Sterna fuscata, and its subspecies

Sterna fuscata Linnaeus, 1766, Syst. Nat., edit. 12, 1, p. 228 (Santo Domingo).

The latest list of forms of the Sooty Tern records six distinct subspecific names (Peters, 1934, 338), with the acknowledgment that the arrangement is purely tentative and that the species *fuscata* is much in need of revision. In the list of Peters, moreover, no provision is made for the form now known to occur in the eastern South Pacific, for this part of the ocean is not even included

within the numerous ranges which he gives. It will be well, therefore, to treat the Sooty Tern mainly as a species, listing also additional names which may prove applicable to the Caribbean, South Atlantic, and South Pacific birds discussed in the text.

Besides the typical or Atlantic subspecies, the following names have been proposed for forms that enter the South American region:

Sterna fuscata crissalis:

Haliplana fuliginosa var. *crissalis* Lawrence, 1872, Proc. Boston Soc. Nat. Hist., 14, p. 285 (Socorro Island, Revilla Gigedo Group, Mexico).

Under parts much less purely white than in *S. f. fuscata*, the gray tinge being stronger and extending forward to the chest. Inner webs of lateral rectrices terminally dusky.

Range: The eastern tropical North Pacific, breeding from the Tres Marías and Revilla Gigedo Islands southward to Culpepper and Wenman Islands, at the northerly tip of the Galápagos Archipelago.

Sterna fuscata luctuosa (?):

Sterna luctuosa Philippi and Landbeck, 1866, Arch. Naturg., 32, p. 126 (Río Valdivia, Chile).

Not a properly defined race, because it has not yet been distinguished from the Sooty Terns of southern Polynesia, for which another name may have priority. It is, however, larger than *S. f. crissalis*, and perhaps even grayer ventrally and more dusky on the rectrices.

Range: Breeding at San Felix Island, Chile, close to the Sub-Tropical Convergence. Known also from waters about the Juan Fernández Islands, and from the coasts of Chile and Peru, which it reaches perhaps only at times of exceptional meteorological or hydrographic conditions.

The following data refer principally to the Atlantic race (*Sterna fuscata fuscata*).

Names: Wideawake; Egg Bird at many islands of the West Indies and at St. Helena; Twa-oo at Dominica and other islands of the Lesser Antilles. Synonyms of the specific name include *fuliginosa*, *spadicea*, and *l'herminieri*. Many subspecific names have been applied to birds inhabiting various parts of the pan-tropical oceans.

Characters: The blackish dorsal surface and white breast serve to distinguish the species from any other tern within the South American region.

Adults (sexes alike): Forehead (including latero-frontal antiae and a lateral extension on each side of crown as far backward as middle of eye), suborbital region, lower half or more of auricular region, and entire under parts, including axillars and under wing coverts, immaculate white, the posterior under parts (especially under tail coverts) very faintly tinged with pale gray; crown, occiput, nape, upper portion of auricular region, and broad stripe on lores (from lower portion of lateral base of maxilla to anterior angle of eye) uniform deep black, this extending narrowly above eye; rest of upper parts, including hind neck, rump, upper tail coverts, and tail plain fuscous black, the remiges with a somewhat grayish cast, the feathers of hind neck white beneath surface; anterior margin of lesser wing covert area, abruptly, white; lateral pair of rectrices white, with distal portion of inner web, more or less extensively, dusky; next pair of rectrices with inner web blackish distally, passing into pale gray or grayish white basally; inner webs of primaries neutral gray with a well-defined stripe of dusky next to shaft, the latter yellowish white; bill, black; iris, dark brown; legs and feet, dusky or blackish (Ridgway, 1919, 513).

Adults in winter: Similar to summer adults but, according to Saunders, "with white flecks on the lores and crown."

For measurements of three subspecies entering the South American region, the table on p. 1123 should be consulted.

Young: Upper parts deep sooty brown (clove-brown to blackish brown or fuscous black), the scapulars, interscapulars, tertials, smaller wing coverts, feathers of rump, and upper tail coverts tipped with white or brownish white, the bars thus formed broadest on posterior scapulars, narrowest on interscapulars, rump, and upper tail coverts; under parts lighter grayish brown (clove-brown to dusky drab), passing into much lighter grayish brown or brownish gray on anal region and under tail coverts, where the feathers are more or less distinctly tipped with a darker or more brownish hue, the abdomen more or less intermixed with white; outermost (and other) rectrices

wholly dusky; remiges as in adults, but darker stripe next to shaft on inner webs less distinct; bill brownish black or dusky brown.

Downy young: Upper parts varying from dark sooty (fuscous black), narrowly streaked with pale grayish buffy or dull buffy whitish, to pale buffy grayish narrowly and indistinctly, but thickly, streaked with dusky; suborbital and malar regions and sides of neck and chest (usually chin and throat also), light brownish gray minutely flecked with paler; rest of under parts immaculate dull white; bill brownish; legs and feet brownish dusky (Ridgway, 1919, 514).

Eggs: Bent (1921, 282) quotes Fisher regarding the highly variable eggs of the Sooty Tern. The ground color is white or cream-buff. One type of marking consists of deep burnt sienna and grayish vinaceous spots, with occasional nearly black scrawls scattered rather evenly over the whole surface. The spots are 1, 2, and 3 mm. in diameter, with occasional larger and smaller ones. Another less-prevalent variation consists of heavy, very deep burnt sienna blotches (5 to 15 mm. in extent), congregated in a zone near the blunt end, and lesser pale grayish vinaceous and deep burnt sienna spots sparsely scattered over the rest of the egg. A very handsome type has the brown laid over the vinaceous, and occasionally the deep burnt sienna or chestnut shading off to one side into light, caused by the spiral twisting of the egg in the oviduct. One specimen shows this to a marked degree, having long chestnut daubs extending spirally from the big end. Still another type has fine brown and grayish vinaceous maculations scattered all over the egg, but more numerous at the blunt end. An abnormal specimen is entirely without markings, being pure white. The shape is ovate, either elongate or thick. An average specimen measures 53 x 35 mm.

The measurements of 76 eggs, in the United States National Museum Collection, average 50 x 35 mm.; the eggs showing the four extremes measure 56 x 36, 54.5 x 37.5, 44.5 x 35, and 48.5 x 33 mm.

The above description may be based in large part upon Pacific specimens, but Witherby's (1923, 718) notes and dimensions referring to eggs of the Atlantic subspecies very closely agree.

Distribution (of the Atlantic race): Breeds from the Bahamas, the Dry Tortugas, and other islands through the West Indies to Caribbean islands off the coast of Venezuela; also at Fernando Noronha, Rocas Reef, Ascension, South Trinidad, Martin Vas, and St. Helena. The subspecies apparently ranges far during the period of its absence from nesting grounds, but of these migratory movements practically nothing is known.

Distribution of the eastern Pacific races has been discussed above.

The Sooty Tern is one of the most abundant sea birds throughout the pantropical oceans, nesting on the sands of countless islands in numbers that beggar description. The manner in which birds of the species hang like canopies of smoke above their breeding grounds—as seen from afar—the harsh clamor of their screaming, snarling voices, their entertaining behavior during courtship, the strange and skilful method by which they capture food, and their ability to find their way unerringly across long stretches of open ocean, have been the subject of many interesting accounts from the time of Audubon to the present. An excellent summary, particularly as pertaining to northern-hemisphere colonies of the Atlantic and Pacific, has been published by Bent (1921, 279). I shall therefore confine what I have to say chiefly to southern-hemisphere representatives of the species, though it will, of course, not be permissible to omit the essential data gathered by Watson during his studies at the Dry Tortugas, off the southern tip of Florida.

Sooty Terns in the collection of the American Museum include many examples from various parts of the West Indian region, together with an excellent series obtained at the South Atlantic islands of Fernando Noronha, Rocas Reef, Ascension, South Trinidad, Martin Vas, and St. Helena by the 'Blossom' expedi-

Table of Measurements of Sooty Terns

	Wing			Tail			Exposed culmen			Tarsus			Middle toe and claw		
	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.
S. fuscata fuscata															
7 males from Arcas Keys, Yucatan	272	300	286.6	130	162	149	40	47	44.1	22	25	23.1	(Ridgway, 1919, 515.)		
9 males from Bahamas, Fernando Noronha, Rocas Reef, South Trinidad, and St. Helena	285	310	300	162	177	168.8	42	47.6	44.5	22.1	25.2	23.6	24.7	28	26.7 mm.
13 males from Ascension	285	299	292.1	157.5	182	169	42	48	44.4	21.3	24	23.1	23.3	28.2	26.1
6 females from Bahamas, Fernando Noronha, South Trinidad, and St. Helena	292	306	297.1	152	185.5	171.3	41.2	43	42.3	22	24	23	26	27.3	26.8
8 females from Ascension	278	302	290.8	158	195	168.1	40.5	44	42.5	21.4	23.3	22.1	25	28.2	26.1
S. fuscata crissalis															
2 males and 2 females from Clipperton Island	284	302	291.8	173.2	191	183.1	40.3	41.6	40.9	21.2	23.2	22.2	24.2	27.2	26
S. fuscata luctuosa (?)															
2 males and 2 females from off Valparaiso, Chile	306	320	311.8	174.2	187.5	181.4	43.5	47.1	45.3	21.4	25.4	23.4	24.9	29	26.9
1 male and 2 females from San Felix Island	314	327	320.3	162.3	184.5	173.8	41.6	48.3	44.6	22.2	25.1	23.9	25.9	29.2	27.4

tion of the Cleveland Museum of Natural History. Furthermore, we have a small series from the eastern tropical Pacific (*S. f. crissalis*), received in exchange from the California Academy of Sciences, as well as two males and two females shot by Mr. Beck, during the Brewster-Sanford Expedition, in latitude 33° S., longitude 74° W., on December 5, 1913. The last position is due west of Valparaiso, Chile, about one-third of the distance between the continental coast and the Juan Fernández Islands. The gonads of these four eastern South Pacific specimens indicated that the birds were at the height of their breeding season. Since their measurements, particularly in length of wing, average considerably larger than those of *Sterna fuscata crissalis*, as recorded by Snodgrass and Heller (1902, 505), Gifford (1913, 19), Ridgway (1919, 519), McLellan (1926, 284), and other authors, I am listing the Chilean specimens provisionally under the subspecific name *luctuosa*, of Philippi and Landbeck, at the same time admitting that this is not yet a properly defined race.

The probable breeding source of Beck's specimens became for the first time revealed during the recent cruise of the yacht 'Zaca,' when three adult and three fledgling Sooty Terns were collected by Mr. Templeton Crocker and Dr. Chapin at San Felix Island, on February 18, 1935.

With seven adult specimens from the eastern South Pacific in our possession, it might be supposed that their taxonomic status could be at once determined. The matter is complicated, however, by the fact that these birds appear to resemble very closely Sooty Terns from the Tuamotu Archipelago, the Marquesas Islands, and other parts of Polynesia, to which one or more subspecific names older than *luctuosa* may be applicable. They are of large size, very gray on belly and crissum, with dusky inner webs on the long rectrices. For the present, I merely wish to point out that they seem to be racially different from *crissalis* of the equatorial and north tropical eastern Pacific, leaving final systematic treatment until such time as the large series of Sooty Terns obtained by the Whitney South Sea Expedition can be compared as a whole. All recent authorities, including Witherby (1923, 718) and Peters (1934, 338), have emphasized that an understanding of the subspecific relationships among Sooty Terns must await a thorough revision.

Further reference to the accompanying table of measurements confirms the deduction to be drawn from plumage comparisons that the Atlantic birds from all breeding localities between the Bahamas and the island of St. Helena represent one race, and that the sexes do not differ appreciably in size except that females have, on the average, slightly shorter bills than males. The total length of specimens measured in the flesh proves highly various because of the pronounced discrepancies in the length of the longest tail feathers, due to moult and wear. However, this dimension in 14 males from Ascension averaged 429 millimeters. The average expanse of the tightly outstretched wings in 14 males measured at Ascension by Mr. G. F. Simmons, leader of the Cleveland Museum Expedition, amounted to 897 millimeters. These figures are not very different from measurements of examples of the eastern tropical Pacific race, as taken by Beck and recorded by Gifford (1913, 23).

Let us consider first the birds of the Atlantic and typical subspecies:

Although accidental records of the Sooty Terns have been made at many extralimital localities between Maine, Europe, and the Falkland Islands, there are extraordinarily few published notes on birds seen in any abundance at a distance from their breeding grounds. This fact was long ago noted by Green (1887, 67) and it is all the more remarkable because the Sooty Terns at every great colony are migratory, disappearing from their nesting territory as soon as the young have been reared. Where they go remains one of the outstanding mysteries of the sea. Unlike the noddies, they seem to have little use for solid supports, flotsam, or the surface of the ocean itself as resting places. So far as yet known, they are almost forever on the wing except for such time as they spend on *terra firma* beside their nests. Burmeister long since pointed out their aversion to swimming and their apparent inability to dive, while the experiments of Watson (1910, 470) show that if they are confined to the surface of sea water for only a few hours they become sadly bedraggled and soon perish by drowning. Brown Noddies, after a whole night of similar treatment, come through dry and unharmed.

The breeding season of the Atlantic Sooty Terns as a whole seems to cover the entire year, differing not only according to latitude, but, at some tropical localities, varying from one year to another in a more or less regular succession. The latter phenomenon has been observed particularly at Ascension. At the Dry Tortugas Islets, off Florida, the Sooty Terns return annually about one week after the noddy population. The early comers appear late in the first week of May, and within four days practically all of the birds have reached their breeding ground, after which eggs may be expected within a week (Thompson, 1903, 82). Farther southward, as on islets off Jamaica, eggs may be laid as early as March. At Aruba and Los Hermanos Islands, off the coast of Venezuela, the birds have been found breeding in large numbers during early February (Cory, 1909, 226). At South Atlantic islands they may appear either between early August or December or at the same season as in the northern hemisphere. Thus Simmons (1927, 71) found hundreds of thousands sitting on their eggs at Rocas Reef, off the coast of Brazil, during April, and at South Trinidad and Martin Vas during December and January. On the occasion of a visit to Fernando Noronha in December, Nicoll (1904, 39) remarked that, although the Sooty Terns were still breeding, he had come too late to find eggs. Meliss (1875, 98) states that at George's and Speery Islets, off St. Helena, the terns normally arrive each year toward the end of December and lay their eggs between January and March, all the birds disappearing as soon as the breeding season has ended. The data as regards scattered localities are, in short, rather confusing. Perhaps each island colony is more or less a law unto itself, and it may be more profitable to consider the sequence at a single station which has been under observation for a long period, such as the famous "Wideawake Fair" at Ascension, which lies close to the eighth parallel of south latitude in the very middle of the Atlantic.

My notes on the Sooty Terns at Ascension are taken from the following

sources: Collingwood (1867, 979), Sperling (1868, 286), Meliss (1875, 98), Gill (1878, 145), Thomson (1878, 227), Moseley (1879, 563), Penrose (1879, 277), Vanhöffen (1905, 511), Brown, Mossmann, and Pirie (1906, 293), Wilkins (1923, 510), and Simmons (1927, 74).

The Wideawake Fair is said to cover "ten or fifteen acres" (Sperling), or "several square miles" (Thomson), not far from the sea, in a valley toward the southwestern part of the island (*cf.* Fig. 21, p. 152). The site is well sheltered from wind by the hills and is very oppressive under the full blaze of the tropical sun, the more so because of an overpowering odor that arises from it during the time that the birds are present. The stench comes not alone from guano, but also from dead bodies of young and adults and innumerable cracked or addled eggs, among which carrion beetles and their larvae swarm. From the slopes of Green Mountain one can see the area as a greenish white patch, looking as though the bed of cinders had been whitened by a light fall of snow, while in the air above the wheeling and hovering terns appear like a pillar of cloud that is never dissipated during the hours of daylight. The tremendous noise, which is so discordant and ear-splitting at close range, blends in the distance to a sound like the murmuring of a vast crowd of human beings.

Besides the special aggregation at Wideawake Fair, there are or formerly were several lesser colonies at Ascension, as well as one on the flat-topped adjacent islet known as Boatswain-bird. The terns of these separate rookeries arrive and depart with those of the Fair, and all observers agree that, on the average, the nesting season begins about three months earlier each successive year, so that instead of nesting once a year the Sooty Terns breed about four times in each three-year period. Wilkins puts the fact in other words when he states that they return to nest about once every nine months. Thus the status of the Ascension colonies at different periods of selected years is approximately as follows:

The months regarded as the summer season run from October to January. This is also the period during which the sea turtles come out of the ocean to deposit their eggs upon the beaches. If we begin by dating the annual arrival of the Sooty Terns from a period which might be regarded as early spring, we can best trace the curious succession of the nesting seasons upon the basis of scattered and incomplete data.

In early August, 1922, Wilkins found that most of the eggs had hatched. Since the period of incubation lasts just under a month, the terns must have arrived during this year some time in June.

Vanhöffen found, during the visit of the 'Gauss,' that the Sooty Terns were breeding by hundreds of thousands on September 12.

Lady Gill, who spent several months in residence at Ascension, recorded in her notes for September that great flights of small black-winged terns had been observed for several days passing inland from the sea, and that at sunset the sky was dark with them. The new outcry that their voices made in the lonely island reminded her of the cawing of great flocks of rooks in England. Every day they continued to pour in until October 5, or later.

Penrose states that in 1877 the first returning Wideawake was observed during the first week of October, and that the numbers continued to increase daily thereafter for about two months, the height of the nesting season coming toward the end of December.

Simmons, in 1925, also found egg-laying in full progress at Wideawake Fair during December, 10,000 dozen eggs a week being collected for human food during this period. Penrose, who refers to heavy egging during a certain February, states that a good market-collector could gather 2000 dozen in a morning's work. It is of incidental interest that this species is also the most important "egg-bird" in the Antilles. At islets off Jamaica the egging season formerly extended from March to May (Gosse, 1847, 433), and large baskets full of eggs from Tortola used to be a familiar sight in the public market of St. Thomas (Taylor, 1864, 172).

Moseley, who visited Ascension in the 'Challenger' between March 27 and April 3, 1876, found a single family of Sooty Terns breeding at this time on Boatswain-bird Islet, and his notes seem to imply that others were to be found at the Fair on the main island during the same period.

It would thus appear that the rhythm of reproduction at an island close to the equator, such as Ascension, is correlated with some other external stimulus than the succession of the seasons. At the Dry Tortugas, where there is a definite seasonal rhythm, the Sooty Terns come back for breeding each year on practically the same date, while at Ascension the reproductive season evidently varies from year to year in a manner highly deserving of further investigation. Both Gill and Penrose write of minor irregularities, due to the collecting of the eggs and the related disturbance of the birds. It is believed locally that a mated pair of adults will persevere in laying again and again after their egg has been taken. This, if it is a fact, might cause a marked and undue prolongation of the breeding season, and tend to obscure the nine-month rhythm which seems to be indicated. Furthermore, a great flood resulting from exceptional rainfall, such as occurred at Ascension in 1876, may have the effect of destroying the vast majority of eggs in the colony, causing the birds to renew courtship and egg-laying, and delaying the whole routine up to the time that young and adults leave the island together. Penrose states that, in the flood-year mentioned, the general exodus of birds was deferred until May, and that by August of the same year the hosts were back again at Ascension for the beginning of another breeding season.

As to their whereabouts during the pelagic interim, scarcely more is certain than was known of bird migration in general throughout the not-distant dark ages when the swallows of Europe were believed to winter in the mud beneath ponds. However considered, it is almost incomprehensible that *millions* of conspicuous, black and white terns, which do not perch, which are incapable of swimming without becoming sodden, which are unresting—flying perhaps for days and days on end—should be almost unreported, swallowed up in the immensity of the Atlantic.

The subsequent account of the habits of the Sooty Tern is abstracted in large

part from Watson's (1908, 187) studies, made at Bird Key, of the Dry Tortugas.

Incessant fighting and screaming accompany the selection of nesting sites by newly returned migrants. Thousands of birds are involved in such turmoil, which represents the defense of family territories, of circular shape and from 30 to 75 centimeters in diameter, against late-comers. Concentration may further reduce the area of the sites, and Dill has reported as many as nine nests within one square meter at a Pacific ternery. Each mated pair assumes full possession of the territory of its choice, and the noise and confusion of combat continue both day and night. Usually a process of bluffing is sufficient to maintain the security of the nesting territory against trespassers. Birds in occupance go through a "walkaround," with heads cocked, wings closed, tail high, and steps dainty, croaking at each other in a manner no doubt intended to be ominous (Iredale, 1914, 436).

Mated birds are frequently lured outside their own charmed circle, however, by the impulse to join in a struggle taking place a few paces away. When there is a lull in the general disturbance, the mated pairs stand comparatively quietly in their own respective territories. It is during such periods that copulation takes place, and this is usually the time chosen for encroachment by neighboring males.

As soon as a claim to a nesting area has been successfully established, the mated terns proceed to form the nest depression by putting the breast to the ground and scraping out the sand from beneath with their feet. The scratching is continued during a complete rotation, birds of both sexes taking part, after which leaves, shells, pebbles, or other decorative objects are sometimes picked up and placed roundabout. On account of the crowding, and the quarrelsome temperament of incubating birds, the exact localization of the nest, and the ability to recognize both nest and mate, become the most important problem in the life of the Sooty Terns.

During late afternoon in the Tortugas colony, Watson observed the female Sooty Terns being fed by males, a process which usually attracted dozens of other birds and precipitated a battle and a deafening outcry. During all this courting season, before the eggs appear, the Sooties are shy and very restless both by night and by day. Sleep is apparently not especially associated with the hours of darkness, but is taken by very brief snatches of dozing at any time. This is the peculiarity which has led to the popular nickname, Wideawake.

The Sooty Tern normally lays one egg. Watson noted 25 nests out of several thousand that contained two, and the results of observers in colonies elsewhere substantially agree (Dill, 1912, 14; Cassin, 1858, 386). In a single instance at Dry Tortugas two chicks were actually hatched and reared within one nest. The eggs are smooth and polished, unlike the dull-surfaced eggs of the noddy. During the heat of the day the Wideawakes commonly stand astride the egg instead of snuggling down upon it, a custom reminiscent of the incubating behavior of the Fairy Tern.

After the egg is laid, the mated Sooty Terns undergo a psychic change, and become relatively bold in the presence of intruders. If driven from the egg, they

will at first flutter and drag their wings in a distracted manner. Their clamor and gyrations make one giddy, and the continual proximity to one's face of sharp bills makes them seem dangerous, even though they may not be. Ordinarily they remain much longer on the egg without relief than do their relatives, the noddies. Watson once spent six hours in observation without seeing a single tern leave its egg, except to make short excursions to drink from the surface of the sea. During the laying and brooding season, the male of each pair commonly remains over the water all day, returning at nightfall to feed his mate or to take a shift at incubation. The change normally takes place every twenty-four hours, but Watson's table of observations shows that sometimes it may not occur oftener than once in forty-eight hours. At the time of the transfer the new arrival from sea pushes its mate off the egg, and the latter, after flitting about for a few moments, is likely to come back and go through the same act, temporarily regaining possession of the nest. This may be repeated several times, and occasionally the previous sitter loses out, so that the wrong bird ultimately joins the groups departing to feed. If the orientation of a returning bird has not been exact, causing it to alight among terns which are not its normal neighbors, it will surely have to run the gantlet of many sharp beaks before finally reaching its own nest. When a returned male bird approaches his mate, he arches the neck, droops the wings, lowers the head slightly, and turns it to one side, and in this attitude struts round and round the female, bowing repeatedly.

The period of incubation is 26 days, and the hatching of the egg produces a further change in the instinctive reactions of the parents. Throughout the first three days after the chick has appeared, the Sooty Tern is reluctant to leave when disturbed, but after this length of time adults fly off at the slightest stimulus, just as during the egg-laying season. Also, after the chick is about three days old it is ready to leave the nest instantly at a note of alarm, and to run to the nearest hiding place, where it remains motionless, thigmotactically pressing its body against any convenient solid object. At a subsequent clucking call of the adult, the chick immediately responds. When the young birds first hatch, the parents do not visually recognize their offspring, but react merely by virtue of its presence in the nest. This Watson determined by exchanging young birds. Within a few days after hatching, however, the chicks are identified with certainty by their respective parents, which strike forcibly at any other young ones. There is, in fact, a mutual recognition between parents and young through both sight and the sound of the voices.

During their first week of life, hundreds of chicks are killed by adults, especially by those which have no young of their own and are still engaged in brooding an egg. When chicks start to crawl back from hiding places toward their nests they are attacked, for example, by every sitting bird they pass. The survivors soon gain agility and experience, however, learning to avoid dangerous spots, and to dart quickly past threatening adults.

Parent Sooty Terns alternately feed the young at intervals varying from four to seven hours. Feeding takes place at any time but is particularly in evidence

at dusk, when the Sooties hurry homeward in great numbers. If a parent bird disgorges more than the nestling can take in, and food accidentally falls to the ground, the parent picks it up and reswallows it. Sometimes the adults appear to tantalize the chick by repeatedly bringing up a piece of fish to the end of the beak and then engulfing it again, while the chirping youngster vainly struggles to obtain the morsel. The mate of a feeding parent has only the rôle of a spectator, except when other terns attempt to approach. Under such circumstances it assumes that aggression is the best defense.

After an age of 20 days or thereabouts, the young terns often wander from the nest which still serves, however, as a localizing influence because the parents continue to alight beside or near it when returning from their fishing. When the chick has reached this age, the process of supplying sufficient food is evidently exhausting to the parents, for they usually become somewhat emaciated and dishevelled.

Watson's experiments in coloring eggs of the Sooty Tern, and in daubing certain feathers of mated birds with unfamiliar pigments, showed that visible changes of this kind are immediately noticed. The painted birds created great disturbances, both as regards their mates and the colony as a whole, although within a few hours the harmony of families, at least, became reëstablished. As concerns eggs, it was revealed that the Sooty Tern is not capable of distinguishing between its own and another, but that it is much puzzled and perturbed by unusual egg coloration.

Tests involving removal of nest and egg showed that locality is the important element in recognition, the nest being reacted to by virtue of its position alone. Even when an entire small unit of the landscape, including a tussock of grass, was moved a meter away, the returning Sooties would first alight at the original site of their nest, and would become adjusted to the new position only after periods of half an hour or more. The evidence was not conclusive as to whether conditioning takes place only in terms of vision.

At sunrise the Sooty Terns are spontaneously most noisy. The individual notes have been likened to a sharp staccato laugh, with which longer, more musical tones are occasionally mingled. Soon after the break of day, the free birds leave their island in search of breakfast, often mingling, purely from a community of interest, with noddies, boobies, and other sea fowl over the ocean. They feed without plunging or in any other way touching the water. They capture their food rather by pursuing shoals of small fish, such as herrings and carangids, and doubtless larval flying fish, and deftly picking these out of the air as they leap above the surface. After sufficiently gorging themselves, the Sooties spend much time in sheer aërial maneuvers, and sometimes join the frigate-birds in soaring higher and higher until they are lost to sight.

Watson concluded that the Sooty Terns, like the noddies, do most of their feeding within a short distance of the nesting ground, rarely foraging at points as distant as 25 to 30 kilometers. In other parts of the world, however, they have been observed in large numbers considerably farther from islands at which they were nesting. Wilkins (1923, 510), for example, during the cruise of the

'Quest,' saw many over the sea up to distances of 320 kilometers on either side of Ascension. Beck, too, observed that their daily range may take them away as far as "200 miles." Strictly pelagic records are, as noted above, exceedingly rare, but Green (1887, 67) quotes the great Captain Cook's observations on examples sighted "a hundred leagues" from the nearest land, and in the British Museum, there are specimens collected at the mouth of the Amazon, which is a long way from any nesting station.

In Watson's (1910, 470) homing experiments, four Sooty Terns which had been confined below deck were released at night along the steamship course toward New York, at a distance of 587 kilometers from Bird Key. One returned to its nest at the expiration of four days, and a second after five weeks. The route was certainly unfamiliar to the birds, and the means of orientation is unknown. Brooks (1934, 190) raises the question as to whether the rich feeding grounds along the margin of the Gulf Stream may not have played a part in guiding the terns homeward, though the suggestion hardly offers a satisfying explanation.

At Dominica and other islands of the West Indies, the Sooty Terns or "Twaoos" have the reputation of appearing vagrantly along with squally weather (Lawrence, 1878, 68), or still more during the calms that often precede disastrous cyclonic storms (Ober, 1880, 179). The observation has been made or fancied often enough so that they are sometimes called "hurricane birds."

Turning now to the Pacific, we are concerned with two forms of this species, of which the Socorro Sooty Tern (*crissalis*) nests at certain islands from the Revilla Gigedos southward only to the isolated, northernmost members of the Galápagos Archipelago. It avoids, however, such humid stations as Cocos, as well as all islands close to the South American continental shore. The presence of a colony at Culpepper Island, Galápagos, affords an instructive commentary, in the opinion of Swarth (1934, 221), upon the obscurity of factors governing the distribution of species. Although this tern has bridged the wide gap between the metropolis of its kind, off the coast of Mexico, and the northern tip of the Galápagos group, it has not taken the additional short step toward unlimited nesting space afforded by other islands of the same cluster. At Wenman and Culpepper Islands, just to northward of latitude 1° N., the Socorro Sooty Terns are abundantly established. Doubtless it is the effect of cool Humboldt Current water, of the negative departure between atmospheric and oceanic temperatures (*cf.* p. 297), and a resulting influence upon surface food resources, that bar the birds from the members of the Galápagos group which lie nearer the equator or south of it.

The greater part of the range of the Socorro Sooty Tern is outside the field of this book. Furthermore, its habits seem to agree substantially with those of the Atlantic race, and they have been well described by authors cited at the beginning of this biography.

We may therefore turn our attention to the subspecies of more southerly parts of the eastern South Pacific, which I have provisionally listed under the name *luctuosa*. The region is one from which, until recently, Sooty Terns were

supposed to be absent. Thus Saunders (1896, 110) wrote that the species is "almost unknown on the South American side of the Pacific," a belief further emphasized by Gifford (1913, 19) when he called attention to lack of records off the coasts of Colombia and Ecuador, and in the area extending between the northernmost Galápagos and the well-known breeding grounds of Easter Island, in the heart of the South Pacific. The records which have now changed the accepted status of the bird are as follows:

An adult female, which was emaciated and had probably been transported by storms, was shot in the Río Valdivia, Chile, on August 2, 1855, and was subsequently made the type of "*Sterna luctuosa*" (Philippi, 1902, 101). The capture of four specimens by Beck, west of Valparaiso, on December 5, 1913, has been noted above. On December 7, somewhat nearer the Juan Fernández group, he saw more of these terns fishing with flocks of shearwaters, and not far from Mas Atierra Island, on December 19, his notes refer to others which flew past his sloop from the direction of the island.

At San Felix, on February 18, 1935, Chapin encountered moderate-sized flocks of Sooty Terns at the latter end of their breeding season. Among them were fledglings which had not quite reached the flying stage. The stomachs of adults were empty at ten o'clock in the morning, while those of young contained remains of both small fish and small squids. Lest a reader presume that the cephalopods could have been captured only by diving—behavior to which Sooty Terns are not given—attention should be called to the fact that certain kinds of squids leap into the air, and are capable even of shooting clear across the deck of a ship.

My own notebook contains an observation regarding many Sooty Terns off Independencia Bay, Peru, on January 13, 1925. One or more of them flew close to my vessel, so that I could examine them intimately through binoculars. It should be especially noted that at this particular date the surface waters along the greater part of the Peruvian coast had begun to be warmed through a cessation of upwelling in the Humboldt Current. Within a few days after the sight record, indeed, temperatures of unparalleled warmth characterized this littoral. It is exceedingly interesting and suggestive that Sooty Terns should be among the organisms which serve as accompaniments, or even precursors, of such profound, cyclic oceanographic phenomena as I have attempted to describe in Part I of this book. Under the circumstances, it is hardly possible to guess whether the Sooty Terns which "abnormally" appear along the coast of Peru are immigrants from the equatorial Pacific to northward, or whether they wander toward the continent from San Felix or from central tropical areas of the South Pacific.

YELLOW-BILLED TERN

Sterna superciliaris

Sterna superciliaris Vieillot, 1819, Nouv. Dict. Hist. Nat., 32, p. 176 (Paraguay).

Names: River Tern; "Gaviotín Pequeño" or "Hatí de Ceja Blanca" in Argentina. Synonyms of the specific name include *maculata* and *argentea*.

Characters: The longer wing (exceeding 180 mm.) and the yellow bill without dark tip dis-

tinguish this species from the white-breasted Least Tern of northern South America. The only other very small species, namely *Sterna lorata* of the west coast, has the lower parts gray.

Adults in breeding plumage (sexes alike): Similar to the Least Tern (*Sterna albifrons antillarum*), but larger and stouter, with a shorter tail; black loral streak very narrow; mantle and tail darker gray, with a slightly brown tinge on the inner secondaries; four outer primaries chiefly dusky black, with comparatively narrow white margins to the inner webs of the first two, and very little white on the next two; iris Rood's brown; bill entirely waxen yellow; tarsus and toes olive-ochre; crus yellowish olive.

Adults after the autumn moult differ only in that the crown is flecked with white and the lores are speckled with black.

Measurements of 2 males and a female in the American Museum from Brazil and Bolivia: wing, 185–190; tail, 72.3–82; exposed culmen, 30.2–34.1; tarsus, 15.8–16; middle toe and claw, 18.7–19.4 mm. Wetmore (1926, 139) states that birds from southern South America appear to be slightly larger than those from Colombia and British Guiana.

Immature: Lores and forehead white; crown gray, with blackish streaks which become confluent round the eye and on the nape; primaries with a brownish tinge; bill yellow, with horn-colored tip. Otherwise like the adult.

Young: Lores drab, a very marked whitish superciliary streak, forehead drab; crown darker, flecked with umber; a black patch from behind the eye to the nape; mantle gray, tinged with buff and barred with ash; tail mottled with ash, the ground color grayer than in any of the allied species: bill dull yellow, the maxilla nearly horn-color; tarsi and toes dull yellow. Conspicuously darker than the young of *S. albifrons antillarum* (Saunders, 1896, 125).

According to Oates (1901, 195), the eggs of this tern are similar to many of those of *Sterna albifrons*, the ground color being of a warm buff and the marking rather small and delicate. Eight specimens from branches of the Amazonian river system vary in length from 29.7–31.2 mm., and in breadth from 23.1–24.1 mm.

Distribution: Rivers and coasts of South America, east of the Andes, from Colombia, Venezuela, and the Guianas to Uruguay and eastern Argentina.

This little tern is very similar to the Least Tern except that its much larger bill makes it look almost like a diminutive edition of the other common species of South American rivers, the Great-billed Tern (*Phaetusa*). Young (1928, 766) states, indeed, that these two are frequently seen in company, like big and little brothers, along the coast of British Guiana. Hellmayr (1929, 497) appears to regard *superciliaris* as an exceedingly close relative of the Least Tern, implying that both of them are no more than races of one mainly holarctic species, namely, *Sterna albifrons*. If this be correct, the division of habitat between Least Tern and Yellow-billed Tern is, respectively, that of salt and fresh water, at any rate in South America. *Sterna superciliaris* follows the larger rivers of the continent to points thousands of kilometers from their mouths. In this respect, as well as in appearance, it has become a sort of tiny counterpart of *Phaetusa simplex*.

The Yellow-billed Tern was not taken during the Brewster-Sanford Expedition, nor in the course of any other coastal field work of the American Museum in South America. Wetmore (1916, 139) encountered it in the country around the estuary of the Río de la Plata, and on January 9, 1921, saw two on the sea beach near Carrasco, Uruguay, which behaved as though they were near their nesting grounds. They darted constantly at the intruder's head, with complaining cries, until he had passed beyond their bounds. In the department of Rocha, Uruguay, he saw a number of immature examples beating back and forth over

a lagoon, in company with Trudeau's Terns. The young birds were expert fishermen and were also exceedingly wary. Wetmore noted that in habits and form this species is thoroughly suggestive of the Least Tern in North America, and that it frequents similar localities along large fresh-water streams and sea beaches.

PERUVIAN TERN

Sterna lorata

Sterna lorata Philippi and Landbeck, 1861, Anal. Univ. Chile, 19, p. 612 (Arica, Chile).

Names: In Peru this tern is called the "Churi-churi" from its singing call, and also "Corbinero" because it is said to follow the schools of corvinas and similar fishes. Fishermen also use the term "Pardelito," perhaps failing to distinguish between terns and petrels. In the scientific literature the species has been listed under the names *exilis* and *loricata*.

Characters: From all of the other terns of least size that occur in the South American region this species differs in having the dorsal surface, including the quills of wing and tail, largely gray instead of white or whitish. The ventral surface of the body, likewise, is not white, but is of a gray tinge, although somewhat lighter than the back.

Adults in breeding plumage (sexes alike): Forehead, as far as the middle of the superciliary region, white; upper loral streak black, rather narrow, beneath which is a parallel whitish streak along the cheeks; crown and nape black; mantle slaty gray; primaries white-shafted, the outer web of the outermost black, a smoke-gray line on the inner web, next the shaft, with similar lines of a lighter gray hue on succeeding primaries, the inner portions of the inner webs being white; rump and tail quills slaty gray, the streamers of the lateral rectrices paler; breast, flanks, and abdomen pale gray, passing into white on throat and chin; under wing coverts white. Iris brown; bill yellow, with the culmen and tip blackish, very straight, slender, and prolonged in front of the gonydeal angle; legs and feet yellowish.

Adults in winter: Similar, but with a streaky admixture of white in the crown.

Specimens taken between October and April are in breeding plumage; June birds in full winter plumage.

11 males: wing, 166.7–187 (180.4); tail, 76.3–86.5 (80.7); exposed culmen, 30–34.1 (32.3); tarsus, 13.8–15.4 (14.5); middle toe and claw, 16.6–17.6 (17.2) mm.

3 females: wing, 178–185 (181.7); tail, 77.6–87.4 (83.3); exposed culmen, 29.2–30.5 (29.9); tarsus, 13.3–13.5 (13.4); middle toe and claw, 15.6–16.6 (16) mm.

A chick just emerging from the down, taken at Pacasmayo, Peru, January 2, 1920, is pale buffy above and whitish on the belly, with blackish bars on the feathers of the dorsal surface. The tips of the young primary quills projecting from the sheaths are practically black.

Two sets of two eggs, taken at Pacasmayo on the same date, are of short-ovate form, one in each set being distinctly more pointed than the other. One set was fresh, the second heavily incubated. The ground color is close to deep olive-buff, the outer pigmentation being in the form of rather evenly distributed small spots and blotches of bister, which has a purplish cast wherever it underlies the surface of the shell. Dimensions of the sets are, 30.1 x 22.8 and 29.9 x 23.7; 30.1 x 24.6 and 30.2 x 23.9 mm.

Distribution: Breeds on mainland and islands along the coast of Peru; recorded northward to El Muerto Island in the Gulf of Guayaquil, Ecuador, and southward to the Bay of Arica, Chile.

The little Peruvian Tern is a thoroughgoing member of the Humboldt Current avifauna, confined to the desert section of the west coast of South America. The type specimen, an adult female obtained in the Bay of Arica during September, 1851, appears to constitute the only Chilean record (Hellmayr, 1932, 407). However, the species undoubtedly ranges regularly southward along the desert coast of Chile, because Beck notes the presence of a flock

at Arica on August 25, 1913. During practically the same season of the year, namely in July of 1922, these terns were abundant at the mouth of Jambelí Channel in the Gulf of Guayaquil, Ecuador (Chapman, 1926, 187).

Along the Peruvian coast the "Churi-churi" has been observed at many localities by Mr. Beck and myself during our respective South American work. The following records are from our notebooks:

Paracas Bay, October and November, 1919. Adults in breeding condition collected. During the winter season, June and July, 1913, Beck observed numbers at the same locality, fishing well out from shore and then flying inland with their catches. Coker (1919, 460) also found this tern abundant at Paracas Bay at various seasons of the year.

Chorrillos, February 17, 1913. One collected.

San Lorenzo Island, off Callao, June 3, 1913. Beck found a dozen or more in a valley near the highest summit of the island, the birds behaving as though they were nesting, despite the fact that the season was midwinter. In this same locality, MacFarlane (1887, 204) long ago observed these terns reacting similarly.

At Ancón, a short distance north of Callao, and at the outlying Pescadores Island, both Beck and I found the terns common during April and December, respectively, and I was told that they bred on the sandy plains behind the town.

At Pacasmayo I found them nesting in early January, 1920, as recorded below, and on January 15 I observed numbers fishing off the south point of Lobos de Tierra Island.

Finally on March 6, 1925, during an extraordinary period of strong countercurrent and heavy rains in northern Peru, I saw tens of thousands of the Churi-churis in the harbor of Paita. It was a morning of downpour, and the terns were the only active birds in the port, the pelicans, gulls, and cormorants being mostly perched along the gunwales of lighters, many of them with their bills tucked under the wing coverts. Presently, after the terns had apparently grown tired of fighting the strong north wind, they alighted in little groups on floating branches and other flotsam, of which a great quantity had come down from the northward with the warm current known as El Niño.

Previous to my first visit to Peru, the breeding habits of the Churi-churi were still unknown. I learned that they nest not on the beetling cliffs as had been suspected, but rather on the coastal plain or tablazo, well back from the sea. In November, 1919, at Paracas Bay, I flushed many while crossing the stony desert. They appeared to be nesting, although I found no egg. Early in the morning they would begin to fly inland with food in their bills. On November 13, I followed them back from the bay over the sandy and pebbly wastes behind, and the actions of the terns here left little doubt that this was their nesting ground. Couples were flying roundabout above the pampa, calling loudly to each other. Frequently birds from the bay passed over with small fish carried crosswise in their bills. Two or three times, pairs became much excited because of my presence, and would dash toward me in a characteristic way, attracting other birds, until quite a throng was hovering about me. I hunted a long time for young or eggs, but was unsuccessful. Yet I am sure that

they must have been there, for when I had gone inland somewhat farther I left all the terns behind and, although I occasionally heard their distant calls, I did not come among them again until I passed through the same belt on my return toward the shore. The voice of the Churi-churi, which gives it its common Peruvian name, is very entertaining. The single notes are sweet and mellow, more like those of a sandpiper than of most terns. Occasionally the birds burst into a cadence of cries that continues for perhaps five seconds, so that it constitutes a veritable "song."

At Pacasmayo in northern Peru, on January 2, 1920, I again saw the Churi-churis flying inland over the stony desert, and heard them in lively song, notwithstanding the fact that they were all carrying minnows. Here it was easy to discover their secrets, for, when I had followed the line of flight 2 kilometers back from the beach, small groups of the terns dashed significantly toward my head, chattering in protest. Ignoring these birds, I sat down and quietly scanned the more distant parts of the plain through glasses. Presently I saw a Churi-churi alight about 300 meters away. It stood still and seemed to look all around. Next it preened its feathers in an abstracted manner, and pirouetted several times. After that it trotted straight to a spot ten to twelve paces off and settled down. I glued my eyes upon the bird and started toward it. It soon flew but, without changing my glance, I walked ahead and found its two eggs, which looked like harmonious pebbles on the sunburnt tablazo. By following the same tactics I soon discovered two more eggs, and an equally well-camouflaged chick. In each instance the parent had descended at some distance, and had completed its cautious scouting before approaching the bare site which took the place of a nest.

The food of this little tern includes both fish and crustaceans, as has been learned through examinations of the stomachs of specimens I collected in Peru. Several taken at Paracas Bay during October and November contained anchovies (*Engraulis ringens* and *Stolephorus*), as well as opossum-shrimps (*Euphausia*), the small fishes usually making up between 90 and 100 per cent of the stomach contents. It seems probable that when these terns follow the schools of the "anchobeta" (*Engraulis*), they pick out the tiniest examples, leaving the full-grown fishes to boobies, cormorants, and gulls. Three specimens of the fishes, about 5 centimeters in length or somewhat less than half grown, were found in a single tern's stomach. Incidentally, all but two stomachs among nine examples were crammed with food, and in most instances the entire gullet was filled with the overflow.

LEAST TERN

Sterna albifrons antillarum

Sternula antillarum Lesson, 1847, Compl. Oeuvres Buffon, 20, p. 256 (Guadeloupe, West Indies).

Another subspecies, described from the Pacific coast of North America, is said to migrate southward in winter to Peru, but little or nothing seems to be actually known of its South American status. It was described as:

Sterna antillarum browni Mearns, 1916, Proc. Biol. Soc. Wash., 19, p. 71 (United States-Mexico boundary, south of San Diego, California).

Names: Kill 'em Polly in the English-speaking Antilles. Synonyms of the specific name include *minuta*, *melanorhyncha*, and *frenata*.

Characters: Under parts white or at most very faintly tinged with gray; tail pale gray; wing less than 180 mm.; bill usually tipped with blackish.

Adults in summer (sexes alike): Forehead and sides of crown white; a narrow stripe on lores (from bill to eye); crown, occiput, and upper portion of nape uniform deep black; rest of head and entire under parts, including axillars and under wing coverts, immaculate pure white; upper parts, including hind neck, rump, upper tail coverts, and tail plain pallid neutral gray, slightly deeper gray on back, scapulars, and wings; two outer primaries dusky gray or blackish slate color, their inner webs broadly edged with white, the remaining primaries pallid neutral gray (like coverts, etc.), their inner webs edged with white; bill bright yellow, usually tipped with black; iris dark brown; legs and feet orange-yellow (in life).

Adults in winter: Similar to summer adults but lores, forehead, and crown grayish white (purer white anteriorly), an occipital crescent and a stripe extending from this to and surrounding eye, blackish; bill blackish or dusky; legs and feet dull yellow.

14 males: wing, 163–178 (168.1); tail, 70–93 (81.2); exposed culmen, 26–31 (28.8); tarsus, 14–15.5 (14.5); middle toe [without claw], 11.5–13.5 (12.8) mm.

13 females: wing, 160–167 (162.9); tail, 61–85.5 (72.9); exposed culmen, 25.5–30 (27.5); tarsus, 14–16 (14.7); middle toe [without claw], 11–13 (12.2) mm.

Young: Somewhat like winter adults, but humeral region with a broad space of dusky grayish, scapulars and interscapulars with V- or U-shaped submarginal marking of dusky, crown streaked and occiput mottled with dusky, and primaries darker gray; bill dusky, more brownish basally; legs and feet brownish (in dried skins).

Downy young: Upper parts buffy white to deep pinkish buff, nearly immaculate, but with one or more small irregular black spots on occiput, or on occiput and crown, and a few small and indistinct irregular spots or streaks of dusky on rump; under parts immaculate white or buffy white, the throat usually more buffy; bill pale yellowish brown, tipped with dusky; legs and feet pale yellowish (Ridgway, 1919, 521).

The eggs of the Least Tern are good examples of protective coloration, for they match their surroundings remarkably well and can hardly be distinguished from mottled pebbles. The usual ground color varies from deep rich "cartridge-buff" to very "pale olive-buff," or to a color between "pale olive-buff" and white. This is more or less unevenly sprinkled with small spots, and sometimes with a few large spots or blotches of dark shades of brown, such as "Mars brown," "sepia," or "mummy brown." Most eggs show some spots and many, particularly of the lighter types, show large underlying blotches of "Rood's lavender" or other shades of "lavender gray." Some eggs show very handsome patterns of bold dark markings over lighter shades. The shape varies from ovate to short-ovate and the shell is thin and lustreless. The measurements of 63 eggs, in the United States National Museum, average 31 x 23.5 mm.; the eggs showing the four extremes measure 37 x 24, 28.5 x 23, and 29.5 x 22 mm. (Bent, 1921, 275).

Distribution: Breeds on the Atlantic and Gulf coasts of North America from Massachusetts to Florida and Texas and also on islands in the Mississippi River system; the Bahama Islands, many islands of the West Indies, islands of the Caribbean coast of Central America and northern South America. Winters southward from the Gulf coast of the United States to northeastern Brazil.

The South American status of the Least Tern, along either Pacific, Caribbean, or Atlantic shores of the continent, seems to be highly uncertain. Doubtless its identity has been confused in the ornithological literature with that of *Sterna superciliaris* and other forms. According to the distributional data quoted above from Peters (1934, 341), this bird reaches the coast of Brazil during its winter migration, while the western subspecies is said, on doubtful grounds, to be known from Peru.

At Margarita Island, off the coast of Venezuela, the Least Tern has been

found abundantly in July, and young birds have been taken during the same month at Aruba Island.

Neither the typical West Indian form of the Least Tern, nor the Pacific form (*browni*), appears to be known from western Colombia or Ecuador. Chapman (1926, 187) has identified as *Sterna lorata* the small terns he observed in the Gulf of Guayaquil in the southern-hemisphere winter period.

ROYAL TERN

Thalasseus maximus maximus

Sterna maxima Boddaert, 1783, Table Planches Enlum., p. 58 (Cayenne).

Names: Crickum at Corn Island in the Caribbean; "Gaviotín Real" or "Gaviotín Mayor" in Argentina; "Tijereta" in northern Peru; "Gaivota" in Brazil, the name for all the larger terns. Synonyms of the specific name include *cayanus*, *cayennensis*, *galericulata*, *erythrorhynchos*, *regia*, and *cristatus*.

Characters: The largest American representative of the crested terns, with a wing exceeding 350 mm. in length; bill red.

Adults in breeding plumage (sexes alike): Entire pileum, including occipital crest, nape, and upper half of lores, uniform deep black; rest of head and neck, under parts, rump, upper tail coverts, and edge of wing immaculate pure white; back, scapulars and wings pale gray (pallid neutral gray, sometimes approaching pale neutral gray), the outer web of outermost primary darker gray; inner webs of primaries with a deep or dark gray broad stripe next to shaft, this dark gray continued across tips and for some distance along inner edge, the remainder white; tail grayish white, more or less tinged with pale gray; bill orange or reddish orange; iris dark brown; legs and feet black.

Adults in northern-hemisphere winter: Similar to the post-nuptial (?) plumage, but black of occiput and nape also intermixed, more or less, with white, and bill paler orange (Ridgway, 1919, 467).

Measurements of specimens from Santo Domingo, Panama, Ecuador, and northern Peru agree well with those recorded for North American birds, the relatively shorter wings and tails being doubtless due to the state of the winter plumage.

4 males: wing, 360–376 (367); tail, 153–168 (162.6); exposed culmen, 63–68.1 (65.2); tarsus, 32–35 (33.3); middle toe and claw, 32–34 (33.7) mm.

3 females: wing, 333–345 (339); tail, 132–153 (144.3); exposed culmen, 58.3–62 (59.9); tarsus, 30.8–35.5 (32.4); middle toe and claw, 31.1–36.4 (34.6) mm.

Young: Somewhat like winter adults, but upper parts sparsely spotted with dusky grayish brown, these spots largest on tertials; rectrices deep grayish brown or dusky subterminally; pileum speckled or flecked with white or dusky, the occipital crest but slightly developed (Ridgway, 1919, 468).

Distribution: Breeds in North America on the Pacific coast of Mexico, and on the south Atlantic and Gulf coasts from Virginia to Texas; also in the Bahamas and West Indies. Winters from California to Peru, and from the Gulf coast of the United States southward to Argentina.

Southward bound at the beginning of the Brewster-Sanford Expedition, Mr. Beck saw many Royal Terns in the Pacific off Panama, on December 27, 1912. Records of the species along the northern coasts of South America are so numerous that I shall confine my notes chiefly to observations made close to the southern limits of the range, on both Atlantic and Pacific coasts.

During my own work in Ecuador and northern Peru, I found the Royal Tern to be a common species between Cape San Lorenzo and Paita. In this region the native name by which the bird is known to all the coastal Indians is the diminutive term "Tijereta," which distinguishes it from the larger "scissor-tail,"

namely, the "Tijera" or man-o'-war bird. Of great interest is the fact that the Royal Tern is one of the species associated with tropical waters which appears to be most sensitive to temperature changes. Consequently, as I have mentioned in Part I of this book, the extension of its distribution along the littoral near Point Pariñas, the westernmost projection of the South American continent, depends upon prevailing current conditions. So long as a northward movement of waters, accompanied by upwelling, is in progress, the wintering Royal Terns remain mostly to northward of Point Pariñas. As soon, however, as a barometric high near the equator causes a southward flow of the countercurrent called El Niño, the Royal Terns and other warm-water species of birds, together with giant rays, flying fishes, etc., tend to move southward along the Peruvian coast into what is normally the Humboldt Current zone.

Between November, 1924, and March, 1925, I saw many examples of this species between Talara, Peru, and the outer coast of Ecuador, where on February 14 I collected two males in Santa Elena Bay. During the same season it was common not only in all parts of the Gulf of Guayaquil, but even well up the River Guayas, beyond the reach of salt water. At the end of February, after the notable southward advance of the warm countercurrent of that year, the Royal Terns were also abundant in the Bay of Paita, Peru.

Subsequently, Chapman (1926, 186) recorded the species as not uncommon near Jambelí Island, Ecuador, during the middle of the northern-summer period. A male was collected here on July 20, 1922. It was in worn, non-breeding plumage, with a renewal of the wing quills under way. Presumably such examples, like other northern sea birds and shore birds taken in the Gulf of Guayaquil during this same season, had been deterred from migrating toward their usual breeding grounds by a failure of the internal glandular secretions to function normally. Dr. Chapman has noted that the sex organs of all such birds were in a dormant state.

My own specimens from Ecuador and northern Peru are in full winter plumage, with white foreheads and speckled crowns. An example taken at Talara on January 17, 1925, was just completing the moult of the remiges, all of which had been replaced except the outermost primary, which was ragged from wear. In Ecuadorian birds taken a month later, the wing moult had been completed, but the new tail feathers had not yet grown to full length. The bills of all of these birds were orange, the legs and feet black with orange soles. The specimens entirely agree with examples taken by Beck at St. Thomas and Santo Domingo, in the months of August and November, 1916.

The claw on the middle toe of this species shows a breaking down of the flange, which looks like an incipient stage in the development of a pecten. The same phenomenon is even more pronounced in the Inca Tern.

Gibson (1920, 74) reports the Royal Terns along the outer coast of the Province of Buenos Aires during the month of March, sometimes apparently in migration well out at sea, sometimes mingling with Trudeau's Terns and gulls on the sandbars near Cape San Antonio. He states that its clear, shrill, short cry distinguishes it from any other local species.

On November 4, 1920, Wetmore (1926, 139) collected a male on the coast south of Cape San Antonio, and subsequently saw many others along beaches of the outer part of the Gulf of La Plata.

The effect of oceanic circulation upon avian distribution is well illustrated by the above notes from both coasts of South America. Undoubtedly it is Brazil Current influence which carries the Royal Tern to latitude 37° S., or beyond, in Argentina, while the Humboldt Current blocks it at latitude 7° S. in Peru.

In South America, as elsewhere, the food of the Royal Tern appears to consist almost wholly of small fishes. Hallinan (1924, 306) and Gibson (1920, 74) report the stomachs of specimens filled with fish or their scales and bones, in the Bay of Panama and on the Atlantic coast of Buenos Aires, respectively. The bird is often seen fishing in company with Brown Pelicans and other large sea birds. It is said to rob the pelicans to some extent, and in northern Peru I have seen a group pursuing even a man-o'-war bird. The Royal Tern when fishing usually plunges from a much greater height above the sea than do the smaller species of terns. For this reason it has earned the name of "Gannet-striker" along parts of the coast of the United States.

CAYENNE TERN

Thalasseus eurygnatha

Sterna eurygnatha Saunders, 1876, Proc. Zoöl. Soc. London, p. 654, fig. 1 (Santa Catharina, Brazil).

Names: Black-footed Tern. Previous to the date of the description of this species in 1876, and subsequently through erroneous identification, this tern has been listed under the specific names *cayennensis*, *galericulata*, and *elegans*.

Characters: Adults are identical in plumage with *Thalasseus elegans*, but the bill is lemon-yellow, and the angle of the gonys is immediately below or very little in front of the anterior end of the nostril. Total length, 444.5; wing, 307.3; tail, 165.1; exposed culmen, 68.6; tarsus, 27.9; middle toe and claw, 30.5 mm. (Saunders, 1896, 85).

Young: Forehead, crown, and occiput white, the last, together with posterior portion of crown, streaked with dull blackish; nape and post-ocular (supra-auricular) region dull black, the feathers margined, more or less distinctly, with grayish white; hind neck, upper back, rump, and upper tail coverts white, the rump more or less spotted with gray; scapulars and interscapulars pale gray, indistinctly though rather broadly margined terminally with white, the tertials similar but darker gray centrally; anterior lesser wing coverts (except along edge of wing) gray, the feathers darker centrally, forming a well-defined broad stripe across anterior portion of wing; posterior lesser coverts immaculate white; middle and greater coverts white basally, terminally, and along edges, gray centrally; secondaries dark gray (more or less silvery or "frosted"), tipped and distally edged with white, their inner webs mostly white; primaries dark gray, "frosted" with lighter gray, margined terminally with white, their inner webs broadly edged with white, except the longer (distal) quills; primary coverts similar but margined terminally with pale gray; middle pair of rectrices pale gray (more whitish on inner webs), tipped and terminally edged with white; outermost rectrices white to near tip, where gray and blackish, the intermediate rectrices white proximally, gray and dusky distally and margined with white at tips; sides of head (beneath eyes) and entire under parts, together with axillars and whole under surface of wing (except a broad stripe of deep gray along shafts on inner webs of primaries) immaculate white.

Downy young: Grayish white, thinly streaked with dark gray on the crown, behind the eye, and on the upper parts generally; under parts white; bill olivaceous; tarsi and toes brown, claws lighter (Ridgway, 1919, 474).

The eggs seem to be similar to those of *Thalasseus maximus* but slightly smaller, measuring 60–64 x 43 mm. (von Ihering, 1900, 294).

Distribution: Caribbean and Atlantic coasts of South America from Colombia and Venezuela, including the islands of Aruba, Margarita, Trinidad and Tobago, southward to Puerto Deseado, Argentina. Breeds on the coast of Brazil.

The Cayenne Tern has a long range on the Caribbean and Atlantic coasts of South America, but little is known about its habits or the extent of its breeding area. The species was not collected during the Brewster-Sanford Expedition.

Clarke (1902, 258) and Cory (1909, 194) report this tern as common at Margarita and Aruba Islands during May. Von Ihering (1900, 294; 1907, 41) has recorded it from various parts of the Brazilian coast, and has described the eggs.

ELEGANT TERN

Thalasseus elegans

Sterna elegans Gambel, 1849, Proc. Acad. Nat. Sci., Phila., 4, 1848, p. 129 (Mazatlán, Sinaloa, Mexico).

Names: This species has also been listed under the specific name *galericulata*, besides which it has been twice described from Chile, under the names *gayi* and *comata*.

Characters: A small, crested tern with a slender orange-red bill, the gonydeal angle of which is far anterior to the nostril.

Adults in breeding plumage: Pileum, including occipital crest, nape, and upper half of lores, uniform deep black; rest of head and neck, entire under parts, lower rump, upper tail coverts, and tail immaculate pure white, the under parts more or less deeply suffused with eosine pink; back, scapulars, upper rump, and wings plain pallid neutral gray; inner webs of primaries with a sharply defined stripe of dark gray next to shaft, this color extending across tips and for a short distance along edge; bill orange or reddish orange; iris dark brown; legs and feet black.

Adults in post-nuptial plumage: Similar to the above, but forehead and lores white; crown white, spotted with dusky, only the occipital crest, nape, and sides of crown to and in front of eye, uniform black (Ridgway, 1919, 472).

3 males from Lower California and Mazatlán: wing, 313–337 (324.7); tail, 165–178 (171.8); exposed culmen, 59.6–69 (65.3); tarsus, 29.4–30.4 (29.9); middle toe and claw, 29.5–32.4 (30.8) mm.

Young: Pileum dull brownish black, nearly uniform on occiput (where the feathers are not elongated nor lanceolate, but short and blended), the whole crown streaked with white; forehead and lores white, finely streaked with blackish; hind neck, upper tail coverts, and under parts white, the lower portion of the first with a few roundish spots of dusky; back, scapulars, and wing coverts dull whitish, coarsely and irregularly spotted with dusky grayish brown, this forming an almost uniform area on lesser wing covert region, the anterior border of which is white; secondaries dusky, margined terminally with white; primaries dark hoary gray, narrowly margined with white, their inner webs mostly white but with a broad stripe along shaft and around tip dusky gray; rectrices deep brownish gray becoming paler gray basally, their tips margined with white; bill dull reddish or brownish; legs and feet dusky (Ridgway, 1919, 472).

Distribution: Breeds in Lower California and on islands in the Gulf of California. Winters off the west coast of South America southward to Valdivia.

Except for two specimens taken at Callao and Chorrillos, Peru (Saunders, 1896, 85), nothing seems to be known about the Elegant Tern between its nesting grounds in North America and its winter range along the coast of Chile. Even as regards information from breeding stations at islands off both coasts of Lower California, indeed, this beautiful bird is one of the least known of terns. Little seems to have been learned about its habits, and the downy stage of its plumage has apparently not yet been described.

In Chile specimens have been collected at Arica, Iquique, Coquimbo, Valparaiso, and Corral, between the months of September and February. Hellmayr (1932, 407) reports that birds in the white-fronted winter garb have been found to be fairly common in the Bay of Corral, between November and February, and that immature examples have been taken at Corral, and at Viña del Mar, near Valparaiso.

CABOT'S TERN

Thalasseus sandvicensis acuflavidus

Sterna acuflavida Cabot, 1848, Proc. Boston Soc. Nat. Hist., 2, 1847, p. 257 (Tancah, Yucatan).

Names: Also called Sandwich Tern; other specific names under which the species has been listed are *cantiacus* and *boysii*.

Characters: The only American crested tern with a black bill, which is usually tipped with yellowish or whitish.

Adults in breeding plumage: Pileum, including occipital crest, nape, and upper half of lores uniform deep black; upper parts pallid neutral gray to nearly pale neutral gray, the outer webs of primaries slightly darker, with a silvery or hoary cast; inner webs of primaries mostly white, with a broad stripe of dark gray along shafts; hind neck, entire under parts (including axillars and under wing coverts), rump, upper tail coverts, and tail immaculate pure white; bill black, tipped more or less extensively with yellow or whitish; iris dark brown; legs and feet black.

Adults in northern-hemisphere winter: Similar to the breeding (?) plumage but forehead and lores white, the crown streaked with black and white, and black occipital feathers faintly tipped with white (Ridgway, 1919, 476).

4 males and females from the coast of Brazil: wing, 276–294 (282.5); tail, 106.9–119.5 (113.7); exposed culmen, 47.5–53.5 (50.9); tarsus, 25.3–27.3 (26.1); middle toe and claw, 26–28.1 (27.4) mm.

Young: Pileum, nape, and upper half of lores dull blackish or dusky, irregularly intermixed with dull whitish, especially on crown, which is coarsely spotted; occipital feathers short and blended; rest of upper parts, including rump, upper tail coverts, and tail pale gray, coarsely and irregularly spotted with dull blackish or brownish black; wings, except smaller coverts, as in adults; rectrices becoming darker gray terminally, where irregularly spotted, or with hastate spots, of dusky or blackish; under parts immaculate white; bill dusky or dull blackish, scarcely or at least not abruptly, paler at tip (Ridgway, 1919, 476).

Distribution: Breeds from the southern Atlantic and Gulf coasts of the United States to the Bahamas, West Indies, and the coast of British Honduras. Winters from Florida and the Bahamas to the Caribbean and Atlantic coasts of South America between Colombia and Brazil.

South of Middle America, Cabot's Tern appears to belong exclusively to the Atlantic coast of the New World, where it has been taken as far southward as São Paulo and Iguapé, Brazil (von Ihering, 1907, 40). A few are said to remain on the Brazilian coast throughout the northern summer, and an example has been recorded from Rio de Janeiro in August (Bent, 1921, 227). A male and two females collected with other terns off Bahia, on June 30, 1916, by Mr. Beck, were apparently birds which were not bound back toward their breeding grounds, for the gonads of all three were undeveloped. In these specimens the bills were black with a yellow tip, and the feet black with yellow soles. One of the females may have been a yearling, for its bill is smaller than those of birds in comparable plumage from Florida and Texas.

Cabot's Tern is a highly gregarious bird, mingling not only with its own kind but also with other species such as the larger Royal Tern. At Alacrán Reef,

in the Gulf of Mexico, it has been found in late May among great numbers of Sooty Terns (Kennedy, 1914, 42).

So little is known about the longevity of sea birds that a recent note relating to *Thalasseus sandvicensis sandvicensis*, the Old-World representative of Cabot's Tern, is of interest. A bird of this race banded in Cumberland, England, in June, 1917, was recovered in southwestern Africa nearly fourteen years later (Flower, 1931, 48).

INCA TERN

Larosterna inca

Sterna Inca Lesson, Voy. da la 'Coquille,' Zoöl., Atlas, livr. 3, pl. 47 (Callao, Peru).

Names: Generally known in Peru as "Zarcillo" but on some parts of the coast called "Aromito"; a common name in Chile is "Monja." The Inca Tern has been described under the specific name *mystacalis* and through misidentification has been listed also under the specific name *stolida*.

Characters: The moustache-like tufts of feathers projecting from the angle of the mouth in this gray-bodied, red-billed tern distinguish it from all other species. The tufts are white in adult birds and gray in fledgling young.

Adults in breeding plumage: Dark bluish slate color, lighter on the throat and under wing coverts; primaries and outer rectrices brownish black; the four outermost primaries edged with white; secondaries mostly broadly tipped with white; a white moustachial stripe from the angle of the mouth terminating in a tuft of about ten slender plumes which cling together and curve backward, downward and outward from the cheek to a length of 50 mm. or more; wing much more rounded than in most terns; tail moderately forked, the outermost rectrix being only slightly longer than the second; iris brown; fleshy wattles at the angle of the mouth bright yellow; bill dragon's-blood red; legs and feet red of a slightly paler hue.

8 males from coast of Peru: wing, 271–291 (281.3); tail, 129.4–133.8 (132.2); exposed culmen, 43.4–49.2 (45.6); tarsus, 22.5–24.8 (23.5); middle toe and claw, 29.2–32.4 (30.7) mm.

5 females from coast of Peru: wing, 263–280 (270.6); tail, 117.5–138.5 (128.3); exposed culmen, 42–47.5 (44); tarsus, 21.9–23.3 (22.8); middle toe and claw, 29.1–31.1 (28.9) mm.

Immature: Browner than adults, with a bill of blackish horn-color, which gradually changes to red, and with pale feet; the plumes of the moustache and the stripe from the bill are of the same ashy brown color as the surrounding plumage. In fledgling birds the moustache is indicated only by a faint gray line, with very short free terminal plumes.

A downy chick from San Gallán Island, Peru, July 2, is covered with rather nondescript purplish gray down, somewhat lighter on the belly than on the dorsal surface. Only on the head are there a few dark spots reminiscent of the general pattern of gull and tern plumage.

Eggs: One or two in a set, usually ovate or elongate-ovate and exceedingly variable in color; a common ground color is light buff, this being overlaid with heavy splashes and blotches of mummy-brown and other shades of brown; the concentration of markings is usually heaviest around the larger end where it sometimes forms a ring; occasionally eggs have a ground color of pale blue with or without superimposed spots and blotches. In all of these respects they are typically tern-like. Measurements of two sets of one egg and one of two obtained on islands off the coast of central Peru during June and July are as follows: 51 x 36.8; 58.1 x 37.2; 52.2 x 38.1 and 53.5 x 37.2 mm.

Distribution: Coasts of Peru and Chile, from Lobos de Tierra Island and Point Aguja southward to Coquimbo and casually to Valparaiso and Corral. The breeding range probably extends from the Lobos Islands southward to Pelican Rock off Coquimbo.

The coral-billed Inca Tern is the most outstanding example of an endemic bird in the Humboldt Current region. So distinct is it from its closest relatives elsewhere that no one knows just what these may be. It is present in enormous numbers on rocky shores and islets throughout the length of the desert littoral

of Peru and northern Chile. Not only is it familiar to visitors to lonely islands, but equally so to residents of the busiest seaports. Its commonest names refer to characteristics of its striking plumage: thus "Zarcillo" likens the white, corkscrewed plumes to pendent earrings, and "Monja" connotes a fancied resemblance to a gray-robed nun with starched white linen at her throat; the meaning of "Aromito" I have never learned.

> It is altogether a most pleasing bird in its grace of form and movement, as well as in its strikingly neat and even dandified appearance. The soft dark blue of the plumage is effectively varied by the crimson of bill and feet, the white margin of the wings, the yellow flaps at the gape of jaws, and the showy "earrings" (Coker, 1919, 460).

In general, the Inca Tern inhabits the same kind of rocky coasts as the sea-lion, and the two are very frequently seen together. During the Brewster-Sanford Expedition and the course of my own field work in Peru, the species was observed, apparently in residence at Salaverry, the Guañape Islands, Palominos Rocks, Mazorca Island, Pescadores Islands, Ancón, Callao, San Lorenzo Island, Fronton Island, Asia Island, the Chincha Islands, San Gallán Island, Santa Rosa, Vieja and other islands in Independencia Bay, and at Mollendo. Hellmayr (1932, 404) alleges that it breeds as far north as Macabí Island. Furthermore, Beck observed one just off Hormigas de Afuera, 67 kilometers west of Callao, where MacFarlane (1887, 207) long ago recorded it as nesting. This is perhaps the most seaward record for a species which is confined entirely to the zone of cool, upwelling waters of the Humboldt Current.

Centers of particular abundance of these terns, as noted during the field work of Mr. Beck and myself, include the Pescadores Islands during December, April, and May; Asia Island, the Chinchas, and San Gallán. Movements of the birds seem to be more or less sporadic, and are doubtless determined by conditions in the Humboldt Current that affect their food resources. MacFarlane and other observers have attributed the sudden appearance of great numbers of Inca Terns in the harbor of Callao or elsewhere as due to completion of the breeding season and a consequent migratory trek. We know now, however, that egg-deposition and the rearing of the young go on throughout the year. There may well be a peak of productiveness during the southern-hemisphere spring, but a large proportion of the birds have eggs and young chicks in June and July, which is midwinter. I believe, therefore, that the sudden appearance of flocks in bays or roadsteads, where none had been observed during preceding days, is due to a concentration of birds from neighboring islands in pursuit of food. For example, on October 25, 1919, I saw about 500 Inca Terns attracted very quickly when Peruvian Indian fishermen were engaged in illegal dynamiting of fish along the cliffy coasts of North Chincha Island. During late April, 1913, Beck observed aggregations, which he estimated to contain 5000 or more of these birds, in the vicinity of some of the islets off Ancón. My own notes, added to those of Messrs. Beck and Jaques, lead me to the conclusion that the Inca Terns may be more abundant at the Pescadores Islands than on almost any other part of the Peruvian coast.

At North Chincha Island I obtained eggs during December, 1919. Beck

collected several at Fronton, off Callao, on June 3, and others at San Gallán, off Pisco, in July. At the last island he found eggs and young in all stages of development. On December 28, 1919, at Palominos Rocks, full-fledged young made up more than half the local population of these birds, although there were still fresh eggs in some of the rock caverns.

The Inca Terns nest in niches, hollows, or burrows, some of which they make or enlarge themselves. More often, however, interstices in a scree, a natural hollow in a guano-covered slope, or the burrow of such a bird as a diving petrel, furnish the necessary site. At San Gallán Island, for example, Beck located eggs and chicks both in rock heaps close to the shore and in diving petrel burrows at a considerable distance inland. At Independencia Bay I found that the Inca Terns even made use of the entrances to penguin burrows, scratching out a little chamber for themselves just inside the threshold of the dwelling of their hosts.

The presence or abundance of Turkey Vultures at any Peruvian guano island appears to have more or less to do with the degree to which the Inca Tern nests are concealed, for the vultures are inveterate nest-robbers and quickly gobble up eggs left within sight or within easy reach. Furthermore, the Inca Terns sometimes meet with insufferable competition from the Guanays or Peruvian Cormorants. When the latter cover a hillside in their wonted manner, the terns are forced to abandon the territory, since the constant treading and milling about of the larger birds tends to break down the entrances to the tern nests, besides which they become filled up with guano. At Asia Island I noted particularly that the Inca Terns inhabited all the slopes that were not occupied by the Guanays, and also the steep sides of a gloomy chasm which cleaves the island well toward its center. Some of the tern burrows were deep and complicated, while in others the eggs could be seen lying within 20 to 30 centimeters of the entrance. At Asia Island, as at the Pescadores, I should say that the Zarcillo population was large enough to make the species of appreciable importance as a guano bird.

Coker's (1919, 461) remarks on the nesting of the species are as follows:

> The breeding places of zarcillos are found on many islands; generally they were observed to use the trenches or other places where the surface crust had been broken away in guano extraction, and where the nests could readily be concealed by excavating little tunnels in the bank. Nests with all stages of eggs and young were observed at the Chincha Islands (North Island) in June, 1907. One of the most populous breeding places was the Isla Asia visited in August of the same year. I have no record of nests observed in the summer season although doubtless there is little interruption of the breeding season.

As a result of Beck's field work, and of my own, the American Museum has an excellent series of Inca Terns, illustrating all states of growth. The downy stage of the young is followed by a nearly uniform plumage, dusky brown on the dorsal surface and dusky gray below, the scapulars and lesser coverts being tipped with white. In their later stages, young birds resemble immature examples of the Sooty Tern (*Sterna fuscata*), although their wing-linings are dark instead of whitish, and moustache-like plumes are present even though

inconspicuously gray in color. The slaty plumage of the adult type is acquired by a post-juvenal moult which involves all the feathers except the quills of wing and tail.

On the claw of the middle toe, I find, the Inca Tern has a flange which resembles a pecten in rudiment. This organ, well known in herons, frigate-birds, etc., has not been reported among the Laridae. The flange of the Inca Tern is irregularly serrate toward its base, while on the distal half the processes take on the form of teeth of variable width. Most specimens show ten or twelve of these, and in the interstices there are usually fine fragments of feathers resulting from the scratching and combing for which the structure is used.

The Inca Terns are very inquisitive creatures, circling rapidly about, now and then making startling dashes toward one's head, swerving aside just before they strike. Coker suggests that this habit is correlated with the pursuit of other birds, perhaps causing the latter to drop their food, which the alert terns can then appropriate. At any rate, they are quick to take advantage of the spoils of any predator. Several times, near various guano islands, I have seen Turkey Vultures, their guano-spattered backs showing where they had been feeding, shot at by the government guardians. If such vultures were not killed instantly, they would disgorge into the water, whereupon flocks of Inca Terns seemed always at hand to scurry to the surface below in quest of what the vulture had unloaded. Moreover, the Inca Terns seem always to be hovering about the head of a rising sea-lion. When the animal appears, mouthing and tossing its fish, the terns are like a cloud of flies, sometimes dropping almost into the seal's jaws for morsels. I have seen them fluttering in the same manner above rising humpback whales in the Humboldt Current.

The Inca Tern's mode of flight has little in common with that of most of its relatives, for its wing-beats are rapid and fluttering, and it usually hovers near the surface of the water before stooping or making shallow dives. Flocks of the birds show a very strong tendency toward simultaneous action. I have seen groups sitting on rocks beneath the cliffs launch suddenly into flight and, after a short period of circling, return to the same spot, only to repeat the performance a few moments later. Coker writes:

> In flight it apparently delights in sharp curves, quick reverses of direction, or sudden drops with webbed feet outspread. The forked tail presents a variety of forms in these maneuvers, now widespread and fan-shaped losing all trace of the fork, now closed in swallow-tail effect, or, again, so snugly closed as to obscure the forked form entirely.

The call of the Inca Tern is plaintive and petulant, without the harsh tone in the cry of the "Terrecle" (*Sterna hirundinacea*). Coker likened it to the voice of a young kitten.

The food for which the Inca Tern plunges, if it cannot obtain it in scraps from the banquets of other organisms, consists of small fish. The alimentary tracts of two examples I collected at the Chincha Islands during October were well filled with remains of anchovies (Engraulidae). One of them contained six or more of the latter, and the other a few feathers and a bird-tick (*Ornithodorus*).

The Pacific Ternlets or Gray Noddies

The latest list of these exquisite and diminutive terns is that of Peters (1934, 345) who treats them as seven subspecies of the typical form, *Procelsterna cerulea*, which was described from Christmas Island, 2° north of the equator in mid-Pacific. In an accompanying footnote Peters states that the forms of this allegedly monotypic genus are much in need of revision and that his arrangement is merely tentative.

Disregarding for the moment the several subspecific names, it is apparent that the ternlets, from whatever source in the Pacific, are divisible at sight into two groups, of which one is made up of birds that may be called "blue," and the other of birds that are "gray." I find, furthermore, that this distinction is correlated with a zonal type of distribution, all of the blue birds inhabiting tropical islands to northward of about latitude 25° S., while the gray birds belong to islands south of the 25th parallel and close to the Sub-Tropical Convergence. Finally, the Gray Ternlets are of uniformly larger size than the Blue Ternlets, the relationship presenting another good illustration of Bergmann's law (*cf.* p. 358).

For such reasons I hold that the Blue and the Gray Ternlets constitute distinct species, each of which breaks up into a number of subspecies. The former is *Procelsterna cerulea*, of the Tropical Zone of surface water, with representatives at the Line Islands, the Phoenix and Ellice groups, the Samoan, Society, Marquesas, and Tuamotu Archipelagoes, and other mid-Pacific localities. The second species is *Procelsterna albivitta*, of the Sub-Tropical Zone. It was originally described from Lord Howe Island, and it is represented at Norfolk Island, the Kermadec group, the Australs, Henderson, Ducie, Easter, San Felix, and San Ambrosio Islands, all of which are far on the polar side of the Tropical Convergence. It is only at San Felix and San Ambrosio that the Gray Ternlets enter the field of this book. The resident form has been described somewhat inadequately by Mathews. Final determination of its status must await the working up of its relatives from many South Pacific islands, but for the present I shall make use of Mathews's subspecific name, and point out the slight average difference in size between the ternlets of San Felix and those of the least distant islands of southern Polynesia. The form inhabiting Easter Island has already been given the subspecific name *skottsbergii* by Lönnberg (1921, 20), but its taxonomic relationships cannot be said to be more than sketchily known.

The two sexes of the Gray Ternlet seem to be of approximately the same size. The following table compares the average dimensions of San Felix birds with those of ternlets from southeastern Polynesia.

	Wing	Tail	Exposed culmen	Tarsus	Middle toe and claw
6♂ and 3♀ from San Felix Island	204.4	101.9	27.2	26.4	35.5 mm.
8♂ and 3♀ from the islands of Henderson, Ducie, Easter, Ravaivai, Rapa, and Bass Rocks	200.5	100.5	26.3	25	33.5

SAN AMBROSIO GRAY TERNLET

Procelsterna albivitta imitatrix

Procelsterna cerulea imitatrix Mathews, 1912, Birds Australia, 2, p. 431 (San Ambrosio Island, Chile).

The typical race of this species is as follows:

Procelsterna albivitta Bonaparte, 1856, Compt. Rend. Acad. Sci. Paris. 42, p. 773 (Lord Howe Island).

Names: Gray Noddy. The species appears in the literature under the names *pelecanoides*, *cinereus*, and also under various synonyms for the species *cerulea*, which include *parvulus*, *plumbeus*, *teretirostris*, and *tephrodes*.

Characters: A small, long-legged tern with large feet, gray back, wings, and tail, and grayish white head and ventral surface.

Adults (sexes alike): Head and under parts gray-white, a ring of black feathers around the anterior part of the eye, the hinder part of both lids being covered with white feathers; back and scapulars pale or light neutral gray, the wings and tail somewhat darker, tending toward deep neutral gray at their tips; lesser coverts and tertials broadly edged with white, particularly on the outer webs of the feathers; inner webs of two outermost primaries whitish on their inner halves; shafts of quills brownish dorsally, and white in ventral aspect. Iris brown; bill black; legs and feet brownish black with the webs flesh color or yellowish. Inside of mouth yellow.

3 males: wing, 202–210 (207); tail, 98–109 (104.7); exposed culmen, 26.9–28.5 (27.6); tarsus, 25.4–27.5 (26.8); middle toe and claw, 33.9–37 (35.6) mm.

6 females: wing, 195–211 (203); tail, 95.6–106.3 (100.8); exposed culmen, 26.6–27.5 (27); tarsus, 24.8–27.9 (26.2); middle toe and claw, 34.4–37.5 (35.5) mm.

Young birds (from Rapa Island, Austral group) differ from adults in being slightly brownish on the back, and in having the pileum, chin, and throat streaked with dusky feathers. Downy young are smoky gray, lightest in hue on the cheeks, nape, and ventral surface.

Eggs of the San Felix-San Ambrosio race have not been taken. Mathews describes an example, presumably from Norfolk Island, as "ground-colour stone, with underlying spots of grey sparingly distributed, and fewer spots of chestnut-brown; axis 42 mm., diameter 30."

Distribution: The subspecies, if valid, is presumably confined to the islands of San Felix and San Ambrosio. The species *albivitta* is a bird of the southern Pacific Sub-Tropical Zone, occupying islands lying between the tropic of Capricorn and latitude 32° S.

The first specimen of the Gray Ternlet of San Felix and San Ambrosio to be described was collected by Lieutenant Gunn, of the Royal Navy, during 1880, and was reported upon by Tristram (1881, 177). During the cruise of the 'Alerte,' however, Coppinger had already obtained an example at San Ambrosio in July, 1879, and this subsequently found its way into the British Museum (Saunders, 1896, 136).

On the occasion of the visit of the yacht 'Zaca' to these islands, the ternlets were found to be common, and on February 18, 1935, Chapin collected a series of nine non-breeding adults for the American Museum. The birds were observed flying in flocks about the bases of the cliffs, perching on low, projecting rocks, and resting on the surface of the water. They were in process of moult, and several of our specimens show a mixture of old and new wing and tail quills. Their stomachs were mostly filled with small shrimp-like crustaceans about 10 millimeters in length. One female is marked as having contained "hundreds" of these. Gray Ternlets shot at Rapa, Ducie, and Easter Islands, earlier during the course of the same cruise, contained small cephalopod mandibles, remains of crustaceans, and tiny fish with silvery eyes, resembling larval eels.

On islands in the easterly part of the range of the species as a whole, this little tern is described as laying its single very thin-shelled and delicate egg on bare rocky ledges, at altitudes between sea level and 600 meters or more. The birds are not migratory, but remain at their breeding grounds throughout the year. In nesting behavior they are not essentially colonial, though the nature of the required sites sometimes leads to a high concentration of breeding birds. The season of reproduction is in the southern spring, between September and January. In this respect the Gray Ternlet differs characteristically from the smaller and darker tropical species (*Procelsterna cerulea*), which seems to have an all-year breeding season.

Cheeseman (1891, 222) states that at Meyer Island of the Kermadec group, where the eggs of the Gray Ternlet are laid in October,

> . . . almost every ledge on the cliffs near the landing-place was occupied by these birds, which watched our proceedings with the greatest curiosity. Small flocks of them would every now and then leave their resting-places, fly backwards and forwards over our heads, noisily screaming all the time, and then return to their quarters, to be quickly imitated by another party. They were quite tame, allowing us to approach within a few feet.

The Noddy Terns, Genus Anoüs

The noddies are of two types, one brown-plumaged, the other smaller and black-plumaged. The brown bird is *Anoüs stolidus*, which has a number of subspecies in different oceans. Of the black noddies there are two species, of which *Anoüs minutus*, sometimes known by the generic names *Micranoüs* or *Megalopterus*, has Atlantic and Pacific races in the South American region, and others elsewhere.

Both the species of noddies within our field are of pan-tropical distribution, but both reach the border of sub-antarctic surface water at the Tristan da Cunha group in the South Atlantic. They thus have a zonally broader range than either the Fairy Terns (*Gygis*) or the Sooty Terns (*Sterna fuscata*). Like both the latter, however, they reach considerably higher latitudes in the equable middle zones of the southern or water hemisphere than they do in the northern or continental hemisphere.

It is very interesting to note that the noddies have access to Tristan da Cunha, so to speak, because their annual migration to and fro is correlated with seasonal changes in the temperature of the surface waters about these islands. Along the west coast of South America, however, to southward of the equator, the Humboldt Current interposes between the continent and the warm outlying water a low-temperature barrier that does not greatly fluctuate with either season or latitude. It is for such reasons that noddies and Fairy Terns are unknown along the so-called tropical Pacific coast of South America to southward of the Galápagos Islands. Neither do Sooty Terns breed within the area, although they have been known errantly to fly into it. Just outside this zone, in waters close to the rather indefinite Sub-Tropical Convergence of the eastern South Pacific, the Brown Noddy has established itself as a resident at the little island of San Felix.

BROWN NODDY

Anoüs stolidus stolidus

Sterna stolida Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 137 ("Americae pelago" = West Indies).

Names: Noddy Tern; Wood Pigeon at Tristan da Cunha. In the bulk of the literature the species is listed under its correct specific name, but synonyms include *niger*, *leucoceps*, and *superciliosus*.

Characters: A tern of uniform dusky or brownish coloration, the forehead sometimes whitish.

Adults (sexes alike): General color plain deep sooty brown (nearly clove-brown), the under parts somewhat lighter (nearly sepia), paler and more grayish on hind neck, where passing, anteriorly, through pale gray into white or grayish white on forehead and superciliary region; a bar or narrow crescent of white on lower eyelid; lores and narrow space immediately above eye black or sooty black, in abrupt and strong contrast with the white or grayish white of forehead and superciliary region; the sides of head and neck, chin, and throat sooty brownish but of a more grayish cast (sometimes nearly dark plumbeous, especially in fresh plumage) than the general color; remiges and primary coverts darker sooty brown, the primaries and their coverts approaching sooty black; axillars and under wing coverts deep brownish gray; bill black; iris dark brown; legs and feet brownish (said to be dull brownish red or reddish brown, with ochraceous webs, in life) (Ridgway, 1919, 546).

12 males from the West Indies, Fernando Noronha, Bahia (Brazil), Ascension, South Trinidad and St. Helena: wing, 261–297 (269.8); tail, 130–154.4 (138.6); exposed culmen, 38.8–47.2 (43.2); tarsus, 24.3–27 (25.8); middle toe and claw, 35.1–39.1 (37.2) mm.

8 females from the West Indies, Bahia, Fernando Noronha and Ascension: wing, 261–275 (266.8); tail, 121.5–146.2 (136.7); exposed culmen, 39.7–44.2 (42.4); tarsus, 24.2–25.3 (24.7); middle toe and claw, 35–38.7 (36.6) mm.

Measurements in the flesh of a dozen specimens of both sexes from Fernando Noronha, South Trinidad, and St. Helena, were: length, 419–457; wing-spread, 815–876, average 838 mm.

Young: Essentially like adults but general color lighter sooty brown and pileum much less distinctly gray, with white, or very pale gray restricted to a narrow superciliary line, sometimes continued around lateral and anterior edges of forehead.

Downy young: Immaculate dull grayish white to pale brownish gray or even sooty brown, paler (sometimes dull white) on abdomen (Ridgway, 1919, 546).

Eggs: The single egg is ovate or slightly elliptical-ovate in shape. The shell is thin, smooth, and without lustre. The ground color varies but slightly, from "pale-pinkish buff" to "cartridge buff." It is sparingly spotted with small spots or dots, usually more thickly at the larger end, with at least two distinct colors. The underlying spots are of various pale shades of lilac or lavender and the overlying, more conspicuous, spots are of bright shades of deep reddish brown. Some of the brown spots seem to be superimposed over the lilac spots or blended with them. The eggs can be readily distinguished from those of the Sooty Tern by being much less heavily spotted. The measurements of 44 eggs, in the United States National Museum, average 52 x 35 mm.; the eggs showing the four extremes measure 58 x 37, 54 x 37.5, 49.5 x 35.5, and 51 x 33 mm. (Bent, 1921, 306).

Distribution: Breeds on small islands from the Bahamas and Florida Keys, southward through the Gulf of Mexico and the Caribbean Sea and the tropical and sub-tropical Atlantic; breeding stations in the latter ocean include St. Paul Rocks, Fernando Noronha, Rocas Reef, Ascension, St. Helena, South Trinidad, and the three islands of the Tristan da Cunha group; it is recorded as at least a visitor to Gough Island.

The distribution of the Brown Noddy in the Atlantic is highly remarkable, for the bird breeds at all suitable islands from the Bahamas, and the northernmost West India islands, southward to those of the Tristan da Cunha group, beyond the 37th parallel of south latitude. Both the Brown and the Black Noddy (*Anoüs minutus*) are, in fact, found together at Tristan, and I suspect that the two have been much confused by visitors who have written about

them. Only the Black Noddy is here given to nesting in trees, and probably it is this smaller species which is the true "Wood Pigeon" of Tristan. The Brown Noddy breeds rather on bare rocks, such as those called the Hardies, just off the coast of Tristan da Cunha, from where Mathews (1932, 45) has recently reported eggs, taken during November of three different years, which agree in measurements and appearance with those of the same species from the West Indies.

Saunders (1881, 137) writes of a Brown Noddy shot on Inaccessible Island, on October 16, 1873, which he found to be absolutely identical with birds from the Dry Tortugas, Florida. He distinguished this specimen, of course, from examples of the Black Noddy taken at the same island, on the same date, by members of the 'Challenger' expedition. Campbell (1877, 72) also observed noddies swarming inside a large cave on Nightingale Island, although he saw no nests.

There can be no doubt about Captain Comer's record of the Brown Noddy from Gough Island, for he not only brought home one skin but observed many of the birds (Verrill, 1895, 452). Wilkins (1923, 496) has more recently reported seeing at Gough a tern resembling this species. The same author says that at Tristan da Cunha the migrating noddies arrive in September, lay their eggs in November, but leave the islands altogether for the winter season. According to Barrow (1910, 275), the extreme absolute temperatures at sea level on Tristan da Cunha, during the years 1908 and 1909, were 3.8° C. (August 16) and 25.4° C. (March 14). Since the noddies arrive soon after the period of lowest temperatures for the year, we may doubtless take the first of these thermometer readings as approximately the minimum which Brown Noddies will tolerate at a breeding station.

Regarding the status of this species at other South Atlantic islands, Meliss (1875, 98) states that it is one of the most abundant birds at St. Helena, where it inhabits principally the ledges of outlying islands such as Egg Islet. At Ascension it breeds on numerous rocky holms off the coast (Penrose, 1879, 280), and Wilkins (1923, 510) found it nesting side by side with the boobies on Boatswain-bird Island, on August 3, 1922, at which time the noddies had eggs but no young. Moseley (1879, 563) reports it breeding at Ascension during March and April, but the nature of his remarks leads me to suspect that he may be referring to the Black Noddy. Simmons (1927, 72) discovered about 1200 pairs nesting at New Moon Cay, Rocas Reef, during April, while many visitors to Fernando Noronha have found it a common resident.

I judge that at South Trinidad the Brown Noddy is migratory, more or less as it is at Tristan da Cunha. On April 8, 1914, I found enormous numbers in the waters about South Trinidad, and even captured by hand, and banded, four of the birds as they hovered curiously about our whaleboat or alighted upon our heads and shoulders. Nicoll (1906, 670) also found these terns abundant and breeding on the occasion of his landing in January, 1906. Since none was collected during the visits of earlier expeditions in August, and since the 'Discovery' naturalists found noddies scarce in September, I conclude that the

species is to be found at South Trinidad chiefly during the season of southern summer. It is not unlikely that a migration takes the birds to distant parts of the sea between the months of May and December. The further inference is that only the noddies of sub-tropical, or even cooler, regions make a collective, universal, exodus migration, a matter concerning which I shall give additional data below.

Since noddies from all the sub-tropical South Atlantic islands, as well as those from the Tortugas and the West Indies, are known to migrate away from their nesting grounds for a part of each year, the dearth of pelagic records seems very extraordinary. Indeed, the whereabouts of errant noddy and Sooty Terns is one of the great unsolved mysteries of the sea, the more so because it is certain that these birds rarely swim or rest upon the surface. Of pelagic records in the Atlantic I find, however, a few. Peale (1848, 284), who remarks that the presence of the noddy is no indication of the vicinity of land, captured a bird which was attracted on board his ship at night, during the United States Exploring Expedition, on the equator in longitude 17° 44′ W., a point about equally far from Ascension, St. Paul Rocks and the coast of Africa. During the cruise of the 'Novara,' large numbers of noddies were seen, and a female was captured, on July 18, 1857, in latitude 7° 18′ N., longitude 29° 50′ W., which is almost equidistant from St. Paul Rocks and the Cape Verde Islands (Pelzeln, 1869, 155). Buller (1905, 162) reports another that came on shipboard on March 24, in latitude 29° 25′ S., longitude 45° 53′ W., a point southwest of Santa Catharina Island, Brazil; and Goeldi (1894, 585) records the species as a not infrequent visitor to the coasts between Rio Grande do Sul and Maranhão. During the course of the Brewster-Sanford Expedition, Beck, in fact, collected many examples off Bahia during April, 1916. On April 15, when they were first reported in his journal, he observed 200 or more among terns of other species inside Barra Point; all the birds were following shoals of fish which were entering the bay with the rising tide. Most of Beck's Bahia specimens appear to be immature, with slender bills and with whitish feathers just coming into the crown. Adult examples are in non-breeding or "winter" plumage, with a moult of wing and tail feathers under way, the new quills contrasting with the worn and faded body plumage. In other respects they do not differ from birds collected by Beck in the West Indies during August of the same year.

As inferred above, there are tropical localities at which the Brown Noddies may be found breeding during every month in the year. Even under such circumstances, however, it is likely that there is at any one time a division of the population into birds at home and birds away at sea. A parallel might be drawn between this type of migration and the shedding of the leaves by many trees of the humid tropics. Thus the simultaneous seasonal departure of all the noddies from the Dry Tortugas, and the seasonal stripping of deciduous trees in the temperate zone, are both conspicuous phenomena. But the same respective processes go on, though continuously and less obviously, among the tropical noddies and trees. Certainly at St. Paul Rocks the available surface would be

insufficient to accommodate all the noddies that nest there at one time or another each year. At this tiny haven, which projects barely above the surface of the Atlantic, eggs and chicks have been found in February by the 'Beagle' party, in May and December by the 'Terror,' in August by the 'Challenger,' in November by the 'Quest,' and in December by the 'Valhalla.' There can, therefore, be no doubt that the breeding season is constant and uninterrupted.

A number of visitors, including even Darwin, have confused the Brown and Black Noddies at St. Paul Rocks, attributing the specific difference in the nesting habits of these two kinds of terns to a competitive struggle for nesting sites among the members of a single species. The Black Noddy makes a bracket-like nest against a sloping or upright surface, while the Brown Noddy, according to Nicoll (1904, 36), mostly lays its egg upon the bare rock at this locality. Elsewhere, the Brown Noddies may in some instances build fairly elaborate nest structures and may even select trees, as well as shrubs, as sites; but in any event they use little or no wet seaweed, the favorite nest material of *Anoüs minutus*. The principal colony of the Brown Noddies of St. Paul Rocks is at the base of Booby Hill, the high point of the islets. I suspect that even Wilkins (1923, 475) confused the nests of the two species at this locality for, although he clearly describes the Brown Noddy, and states that eggs and young were found in slight depressions among the broken rocks, without any nest-lining beneath them, he refers also to large, built-up nests of guano and seaweed, which doubtless belonged to the lesser species. Wilkins reports, too, that the abundant land crabs were constantly crawling within touching distance of the young noddies without molesting them, nor were the birds showing any concern. Probably the greater part of the normal food of these crustaceans comprises such offal as fish discarded by the noddies.

As soon as we transfer the field of our attention to the belt of ocean between 10° and 25° of north latitude, a zone in which there are definite seasons of temperature, rainfall, trade-wind rhythm, or all three, we find that the physiological cycle of the resident noddies likewise becomes rhythmic, in tune with the meteorology. Within this zone, furthermore, the breeding range of the noddy and of other tropical terns becomes shifted entirely to the Antillean side of the Atlantic. The birds are absent, for example, from the Cape Verde Islands which, from a superficial point of view, might seem to be admirably adapted to them. I have shown elsewhere, however, that such distribution can be correlated closely with the course of the Atlantic isotherms of surface water for the northern-hemisphere spring months (Murphy, 1924, 230). The tropical terns nest only to southward of the isotherm of about 26°C. for the month of June, while the northern or holarctic terns nest chiefly to northward of the isotherm of 21° C. for the same month. The West Indies and Bahamas lie equatorward of the first mentioned of these lines, while the Cape Verde Islands, as well as Bermuda, are situated in the neutral zone to northward, and have neither breeding noddies nor other terns of tropical affinities.

Belcher and Smooker (1935, 296) state that the Brown Noddies breed at Soldado Rock, near Trinidad, in April and on rocky islets off the leeward coast

of Tobago during the same month. Like the Sooty Tern, the noddies are said to have a second nesting season at these localities in July.

At Los Hermanos and other islets on the leeward side of the Antilles, the Brown Noddies begin to breed about the first of February (Cory, 1909, 226). To northward and windward they return later in the spring from their migrations, and are at their nesting grounds off Porto Rico, Jamaica, and at the Dry Tortugas, by early April. The farther northward the breeding station, the more closely the calendar dates of successive years seem to coincide with the same stages in the reproductive process. Nesting habits vary considerably, the site in which the eggs are laid including limestone ledges, bare, shelving surfaces of rock or sand, or the flat tops of bushes and shrubs such as grow on windswept, semi-arid islands. Likewise, the nature and quantity of nesting material is highly various, sometimes being only a few pebbles, and again comprising large quantities of twigs, stranded gulf weed, etc. Thus Bonhote (1903, 315) writes that in the Bahamas, where incubation begins early in May, the eggs are deposited indiscriminately upon naked rock, beneath bushes, or in nests built on top of the vegetation.

Burmeister (1856, 453) long ago reported that the noddies voluntarily neither dive nor swim. This was again emphasized in Watson's (1908, 187) classic study, from which many of the following life-history data are drawn. Yet subsequently, Watson (1910, 470) showed experimentally that the noddies can swim well, and that they are capable of floating for many hours on the surface of the ocean without becoming water-soaked, an accomplishment quite beyond the ability of the Sooty Tern. Ordinarily the feathers of the noddies touch the water only when they bathe, a feat accomplished by striking against it without complete immersion. They feed, as do the Sooty and Fairy Terns, by picking small fry from the surface as they poise on beating wings just above it. In their usual foraging, Watson found that the maximum distance from the nesting island to which they go is not more than about 24 kilometers. Beck's notebook, however, indicates that he has seen them feeding regularly as far as 50 kilometers from their homes, while the Sooty Terns, according to his observations, go as far as 300 kilometers. The noddies make free use of every stake, buoy, bit of flotsam, or any other available resting place over the water; they will even perch at times upon the head of a swimming pelican. Furthermore, they will sit for long periods on barely exposed reefs and ledges, perhaps waiting for shoals of fish to appear, perhaps merely preening themselves or dozing in the bright sunlight. They enjoy light, and react strongly to it; on brilliant moonlit nights they are likely to be especially active. As noted above, they seem to avoid swimming, especially during the season of reproduction. Beck, however, saw flocks resting on the calm water off Bahia, and Meliss (1875, 98) reports that on rare occasions he has seen small groups afloat in the roadstead of Jamestown, St. Helena.

Watson's famous experiments show that the noddies display an amazing ability to regain their nesting sites after being transported varying distances away. One of two marked birds released east of Cape Hatteras on June 16

reached its nest on Bird Key of the Dry Tortugas five days later, the distance covered, by direct shore line, being 1739 kilometers. On May 18, 1910, Watson staged an interspecific race between twelve noddies, twelve Sooty Terns and four Caribbean Man-o'-war Birds. These he transported from the Tortugas colony to the harbor of Key West, which is 105 kilometers to eastward. All the noddies returned to their respective nests after intervals varying between 17½ hours and 63 hours, while ten of the Sooty Terns returned at the expiration of from 17½ hours to 11 days. Watson believed that the longer apparent time required by the Sooty Terns was due to the fact that their nesting neighbors objected to the approach of the marked birds to their nests. Two of the four man-o'-war birds likewise returned, but the period required is not recorded. Again, three noddies and four Sooty Terns were released in the Gulf of Mexico at 4.45 A.M. of June 3, after being weakened somewhat by five days of captivity. Two of the three noddies returned to their nests against heavy winds at the end of three days, the distance covered being about 740 kilometers in a straight line, without visual landmarks of any sort. The physiological mechanism of such homing ability is not yet understood. Winds, ocean temperatures in relation to food supply, and many other external influences have been suggested in this connection, when visual stimuli seemed totally inadequate, but we are still obliged to speak chiefly in terms which do not explain. Strong (1911, 619) has inferred that large olfactory lobes, such as those of the fulmar, may serve birds as an organ of orientation. The noddies, however, as well as other species which have shown a highly developed ability to find their way at sea, have relatively small olfactory lobes and associated nerves. At any rate, it is the means, rather than the seat, of the ability which is important.

According to Watson, the noddies arrive at Bird Key of the Dry Tortugas each year during the last week in April, remaining until about the first week in September. It seems likely that courtship and pairing begin before they reach their island, and since they copulate only upon land, it is almost certain that this function is not fulfilled until immediately after arrival. The nodding reaction between birds is closely associated with mating, although it also expresses itself in later relationships. Owing to the latitude, and to the surface of coral sand of Dry Tortugas, the air temperature at ground level during the hottest summer days reaches maxima as high as 61° C. Vegetation is generally scanty, but bay-cedar and cactus are both used by the noddies as nest supports. The nests seem invariably to be placed upon a foundation of stems or grass-clumps, even though subsequently they may press the under-structure quite to the ground. The nest materials consist of branches of bay-cedar, dry seaweed, bits of shell, coral, etc. When shells are used, they are often worked into the inner lining. The nests are loose and shallow, and since they are used year after year, many of them grow to a huge size. In building them, the birds work neither steadily nor rapidly. They steal nest material when they can, looting unguarded nests so that frequent territorial battles result. Watson states that the nest-building instinct is one of the least transitory of the birds' reactions, for they cannot resist the impulse to gather twigs even when they

have young. If a handful of sticks is tossed into the air, all the noddies in the neighborhood will be after them at once. Nest-building is shared in common by the sexes, but subsequently the female guards the nest while the male procures the food for both. The female usually sits close by, inattentive to the advances of other males that flit about, awaiting the return of her own mate with food. When he finally alights at the nest, the female at once approaches and the nodding performance begins. In this reciprocal behavior, the two birds face each other and one bows its head, quickly raises it almost to a vertical position, and then lowers it again. This action is repeated over and over, with great rapidity, and the second bird responds with a similar pantomime. When the performance is connected with mating, the male begins the nodding and the female attempts to extract the fish which he is disgorging by a rhythmic contraction of the throat and body that makes him almost seem as though he were choking to death. The female, while taking food from his mouth, emits a soft nasal purr, a sound to be heard on no other occasion. The feeding is alternated with further nodding, after which the male may fly off and bring a twig. Feeding is best observed toward sunset, when many males are returning from sea. Afterwards, the birds nestle together and nod vigorously, copulation often taking place at this time.

During the nest-building and egg-laying periods the noddies, like so many other birds, are wild, flying both by day and night from intruders. The single egg may be laid as soon as there is sufficient support for it, or not until several weeks after completion of the nest. If an egg is removed from the nest shortly after it appears, the parent birds will apparently produce another, and will continue this repetitive process for a considerable period. At Dry Tortugas Watson found the first eggs on May 4, and by May 25 there were no empty nests. The majority of eggs were laid during the five days between the 11th and 16th of the month. Soon after the egg appears, the parental behavior alters and both mates become active in defense against their own species or other dangers, the tactual and visual impulses aroused by the egg being responsible for this change. Moreover, the male now no longer feeds the female, but each bird takes its turn at brooding and at feeding. The mated birds also give up their close association, and spend almost no time together except at night. At the time of relief, the two may remain on the nest for several minutes, nodding toward each other until the bird about to feed leaves of its own accord or is pushed off by the new arrival. Experiments show that birds may remain on the nest as long as 48 hours if the mate is prevented from returning, but that after about this length of time the sitter will leave its egg unguarded and go in search of food. Incubating noddies occasionally make very brief trips from the nest to wet their breast feathers in the ocean.

The period of incubation is from 32 to 35 days. After the young have hatched the noddies become more pugnacious than ever, and will even attack the frigatebirds by sudden thrusts from beneath. Both parents feed the young at intervals of from two to four hours, the chick being cared for in the nest for about two months or until it is strong enough to flutter to the ground, where it remains

permanently. Thereafter, the returning parents first alight upon or close to the nest, from where they hop to the ground and feed their chick. Recognition, so far as one can tell, is wholly in terms of vision.

The egg of the noddy is dull and granular, characteristics which distinguish it from the egg of the Sooty Tern, the shell of which is smooth or almost polished. The yolk of the noddy's egg is, furthermore, of a pale yellow color, in marked contrast with the bright orange yolk of the Sooty's egg. Watson found that the noddies did not reject artificially colored eggs placed in their nests, although they always appeared more or less disturbed when their mates had been daubed with bright, abnormal hues. He learned, too, that by putting an egg in the nest of a pair that had not yet produced its own, he could upset the ordinary sequence of reactions and change the behavior of the birds from the wary mood of a layer to the fearless and pertinacious mood of a sitter. It is certain that the noddy does not recognize its own egg. Neither does it recognize its nest as such, but the position is so exactly localized that, if the nest be moved even one meter, the returning birds will go first to the old position, fluttering back and forth for some time before conditioning themselves to the new one.

The majority of the downy young noddies at the Dry Tortugas are plain dull black in color, but a few of them have white blotches on the back and wings, and somewhat less than one per cent of them are more or less pure white (Thompson, 1903, 77). Watson found that if white and black chicks are exchanged, no disturbance is shown by the deluded parents, even though the age difference of the respective young may amount to three or four days.

Young noddies can be tamed only if they are reared by hand from the very first day of their lives. Under such circumstances they normally develop no fear, but otherwise they continue to be thrown into a state of absolute panic whenever a man approaches them.

About the first of September the noddies begin to leave the Tortugas colonies in great flocks, to depart, apparently, southward. The entire exodus consumes only two or three days, after which an observer will be able to find only a few cripples left behind.

Aside from the soft, throaty sounds of courtship behavior, the noddies, in the aggregate, make a clamor that reminded Nicoll (1904, 36) of rooks during the breeding season, and Bowdish (1902, 358) of the outcry of young crows. Wetmore (1918, 338) writes that the members of a colony at Desecheo Island, Porto Rico, which were as active by night as by day, uttered a loud harsh guttural *kar-r-rk* and a scolding note resembling *kwok-kwok*.

The noddies drink frequently by skimming the surface of the ocean with open beak. They appear to feed largely by following schools of small fish which are being attacked by larger fish, picking off the former as they skim along or skip above the surface, the birds first hovering over the water then darting downward and poising, at least momentarily, while they snatch the prey. They gather, of course, in groups at centers of feeding, and then disband and scatter when the minnows cease to jump. Ordinarily they leave their island

at the beginning of daylight and continue to fly about until the jumping schools meet their eye. After two hours or thereabouts the fishing noddies return to relieve their mates at the nests, whereupon the latter take roughly a two-hour fishing trip, a régime which is substantially followed during the whole season of incubation and the rearing of the young. Bowdish reports that he found in one noddy stomach the entire body of a flying fish about 10 centimeters in length. Watson learned that a healthy chick in captivity will eat from 12 to 40 minnows a day.

SOCORRO NODDY

Anoüs stolidus ridgwayi

Anoüs stolidus ridgwayi Anthony, 1898, Auk, p. 36 (Socorro Island, Revilla Gigedo group).

Names: A synonym which has been used as a specific name of this noddy is *pileatus*.

Characters: Similar to the typical subspecies but of slightly darker coloration, the pileum darker gray, becoming white only on the anterior margins.

9 males: wing, 261.5–292 (272.6); tail, 142–169 (160.5); exposed culmen, 41–43.5 (41.9); tarsus, 23–26 (24.6); middle toe [without claw], 30–34 (31.3) mm.

18 females: wing, 265–283 (272.6); tail, 141.5–162 (151.1); exposed culmen, 38–43 (40.8); tarsus, 23–26 (24.2); middle toe [without claw], 29–32 (30.8) mm. (Ridgway, 1919, 550).

Distribution: Breeds on islands off the west coast of Mexico and Central America, from the Tres Marías Islands southward to Cocos Island.

The Brown Noddies of the eastern Pacific are generally held to represent two subspecies, of which the present one is alleged to have a relatively extensive range, namely from Cocos Island northward to the mouth of the Gulf of California, while the second is confined to the Galápagos Islands. Regarding the general life history of these two forms, there seems to be little to add to what has been reported of the Atlantic race.

The greater part of the range of the Socorro Noddy is in the northern hemisphere, and outside our field. On one of Beck's earlier expeditions he found large numbers nesting among Sooty Terns on small islets in a lagoon of Clipperton Island. During November, 1898, Snodgrass and Heller (1902, 508) found these terns very abundant on the high rock at the eastern side of Clipperton Island: They obtained an egg, showing that the breeding régime in this part of the Pacific is quite different from that of Brown Noddies at an only slightly higher latitude in the West Indies. McLellan (1926, 284) reports, however, that the birds were breeding at the Revilla Gigedo Islands during April and May, when eggs and also young in various stages were collected. Gifford (1913, 25) found eggs at the Revilla Gigedos at the very end of July, which further indicates a prolonged breeding period of the non-seasonal type, such as we have already encountered in equatorial parts of the Atlantic.

According to Gifford's experience, noddies were not common on the long reaches between the various Pacific islands; they were recorded for the most part within sight of their respective headquarters. During a thirteen-day stay at Cocos Island in September, he found the nesting colonies on small neighboring islets occupied by large numbers of young birds which were, for the most part, nearly ready to fly. The collections studied by Gifford also show that the well-

known dichromatism of the downy young pertains to this Pacific race, as well as to birds of the Atlantic. The dimensions of adult birds, and the pattern, color, and measurements of eggs, show no appreciable differences from the respective characteristics of the typical subspecies.

GALÁPAGOS NODDY

Anoüs stolidus galapagensis

Anoüs galapagensis Sharpe, 1879, Philos. Trans. Roy. Soc. London, 168, p. 469 (Dalrymple Rock, Chatham Island, Galápagos Archipelago).

Characters: Similar to *Anoüs stolidus ridgwayi* but averaging slightly smaller and much darker and less brownish, the head and neck almost slate color, the forehead mouse-gray, often but little lighter or grayer than the occiput, though usually with a more or less distinct supra-loral line of pale gray or hoary gray (Ridgway, 1919, 551).

2 males and 3 females from the Galápagos: wing, 267–284 (273.2); tail, 140–144.2 (141.8); exposed culmen, 39.2–42 (40.5); tarsus, 22.1–25.5 (24.1); middle toe and claw, 35.5–37.3 (36.6) mm.

These figures substantially agree with those given by Ridgway (1919, 551) for a larger series. Gifford (1913, 29) states that Galápagos specimens average somewhat smaller than those from Cocos and Clipperton with which he compared them. He also records the length in the flesh of four Galápagos males as measuring 396–440 mm. and the wing-expanse from 824–855 mm. The corresponding ranges in six females were, length 380–400 mm.; wing-expanse, 784–821 mm.

Eggs appear to be indistinguishable in size and pattern from those of other Brown Noddies.

Distribution: The Galápagos Archipelago; recorded from upwards of twenty islands or islets within the group.

According to Snodgrass and Heller (1904, 329), this Brown Noddy is abundant throughout the Galápagos Archipelago. At Tagus Cove, Albemarle Island, the birds were found nesting in cavities of the high bluffs of tufa facing the ocean. Here they began to mate after the middle of January, and on February 1 eggs were found. Some of the sites were so close to the water that they could be reached from a boat. The nest in all cases was scanty, consisting merely of a few twigs in the bottom of the cavity. That the breeding period is not seasonally rhythmic at the Galápagos Archipelago as a whole is indicated by the fact that Snodgrass and Heller again found noddies nesting at James Island during April. Gifford (1913, 25) later records the months of January, February, March, April, July, and September as periods during which eggs have been found at one island or another. For the same reason his detailed notes on moult reveal little or no seasonal correlation.

Gifford confirms the general nesting habits as recorded above, and states that the birds occupy ledges and crevices, usually not more than 10 meters above the water, and that bones, seaweed, remains of crabs, and feathers enter into the composition of the nests.

Gifford also reports that the Galápagos Noddies accompany Brown Pelicans on their fishing excursions, and that he once saw two noddies perched on the head of a floating pelican which was in the act of swallowing fish. He observed foraging noddies to a distance of about 100 kilometers from the shores of the islands.

The last information brings us to consideration of the very rare pelagic

records of Brown Noddies in the eastern South Pacific. As previously noted, these birds appear to be barred permanently from the littoral waters south of the equator by the unfavorable hydrographic conditions of the Humboldt Current. However, Scouler (1826, 210) reports that early in January, on the course between Juan Fernández and the Galápagos, a number of noddies perched in the rigging of his ship several days' sail to southward of the archipelago, and allowed themselves to be caught in the hand. Paessler (1913, 45) captured a female in latitude 7° N., longitude 84° 8′ W., on July 8. The position is midway between Cocos Island and Panama, and the bird is likely to have been a member of the Socorro race rather than that of the Galápagos.

SAN FELIX NODDY

Anoüs stolidus, subspecies

1 male: wing, 294; tail, 161.2; exposed culmen, 41.6; tarsus, 25.2; middle toe and claw, 39.4 mm.
2 females: wing, 281, 285; tail, 155.5, 155.7; exposed culmen, 39.8, 41.6; tarsus, 24.3, 25; middle toe and claw, 36.5, 36.9 mm.

The discovery of Brown Noddies in residence at San Felix Island adds to the interest of the pelagic records cited in the preceding biography. Scouler's observation, for example, may well refer to birds from this source.

During the visit of the 'Zaca' on February 18, 1935, Dr. Chapin collected a male and two females at San Felix. All three were non-breeding adults undergoing a moult of the quills. The stomachs of two contained remains of small fish.

The wings and tails of these few birds average longer than those of the races inhabiting more northerly parts of the eastern Pacific. Their exact taxonomic status can be determined only by comparison with noddies from other parts of the South Pacific, of which adequate but still unstudied series have been obtained during the long campaign of the Whitney South Sea Expedition. By way of preliminary record, however, I give above the measurements of the San Felix specimens.

ATLANTIC BLACK NODDY

Anoüs minutus atlanticus

Megalopterus minutus atlanticus Mathews, 1912, Birds Australia, 2, p. 423 (Ascension Island).

Names: Atlantic, or Caribbean White-capped Noddy; Tree Noddy; Lesser Noddy; Piccary Noddy in British Honduras: "Mauve Noire" in the French West Indies. Synonyms of the specific name are *tenuirostris*, *melanogenys*, and *leucocapillus*.

Characters: Differs from the greater noddies in its blackish rather than brownish coloration, in having a whitish pileum and nape, and in its smaller size.

Adults (sexes alike): General color plain deep sooty brown, blackish brown, blackish fuscous or sooty black, passing, through a lighter and grayer hue on hind neck, and neutral gray on nape, into immaculate white or grayish white on pileum; lores and space immediately above eyes black (in strong and abrupt contrast with white of forehead and crown), the lower eyelid with a white streak; tail and longer tail coverts (both upper and lower) brownish gray (between mouse-gray and deep Quaker drab); bill black; iris dark brown; legs and feet dusky brownish (Ridgway, 1919, 554).

9 males from Fernando Noronha, Ascension and St. Helena: wing, 225–240 (231.1); tail,

109.6–120 (116.3); exposed culmen, 42.5–48.1 (46); tarsus, 22–23.3 (22.5); middle toe and claw, 31.1–36 (34) mm.

3 females from Fernando Noronha: wing, 228–230 (229); tail, 111.2–117.1 (114.2); exposed culmen, 42.1–44.8 (43.2); tarsus, 21.6; middle toe and claw, 34.3 mm.

Lengths in the flesh of 12 examples of both sexes from Ascension, St. Helena, and Fernando Noronha ranged between 349 and 384 mm.; wing-spreads among the same birds between 663 and 714 mm.

Immature: Forehead and crown white; lores white; neck and nape sooty black, which throws the white crown into strong relief, owing to the absence of any intermediate lead color; mantle, tail, and under parts umber-brown, the primaries blackish.

Young: Forehead and anterior crown white; lores black; upper parts generally umber-brown, with cinnamon borders to the wing coverts and secondaries; primaries blackish; under parts mouse-brown. In an older bird the white is less pure, but extends farther back on the crown, and the plumage has a slightly barred appearance.

Downy young: Forehead and crown dull white, rest of the body sooty black (Ridgway, 1919, 554).

I find no satisfactory description and measurements of the eggs of South Atlantic birds. Oates (1901, 199) states that eggs of this species (but of one or more different subspecies) from the Pacific are broadly oval or elliptical, with a ground color varying from nearly pure white through cream to pale pink. The surface markings, which range in size from specks to huge blotches, are of a deep reddish brown or chocolate-brown intermingled with lines and comma-like dashes. The markings are chiefly confined to the larger end; feebly marked or nearly plain eggs are not uncommon. Examples measure in length from 41.9–49.5 and in breadth from 30.5–33.5 mm.

Distribution: Islands in the tropical and sub-tropical South Atlantic Ocean from St. Paul Rocks and Fernando Noronha to Martin Vas, St. Helena, and Tristan da Cunha, the last being at the edge of the Sub-Antarctic Zone. (A form of this species recognized by Peters (1934, 348) also breeds on islands off the coast of British Honduras, at the western extremity of the Caribbean Sea. Its flight-range may bring it within the South American area, but as to this I have no data.)

In the Atlantic Ocean and its connecting gulfs the White-capped Noddy has a range similar to that of its larger brown cousin, though somewhat less extensive. While it appears in several ways to be more adaptable than the Brown Noddy, particularly as regards the varied nature of its nesting sites, it requires at the same time certain special conditions. These include opportunity to obtain an abundance of seaweed or other fresh, green, and damp material, and also an area, not on flat ground, in which it can construct a bulky nest, preferably in a sheltered and shaded situation. Thus, while it takes freely either to trees or to the walls of cliffs and caverns, it appears to be instinctively conditioned against laying its single egg upon a bare ledge of rock, or a surface of pebbles or sand, such as the Brown Noddy tolerates without difficulty when terrestrial vegetation is wanting.

The Black Noddy inhabits most of the tropical and sub-tropical Atlantic islands between latitudes 1° N. and 37° S. As might be expected, it is not found at the low, flat, and practically treeless and shrubless atoll of Rocas Reef. Its apparent absence as a breeding bird from South Trinidad is more puzzling, especially since it is a regular member of the avifauna at the near-by Martin Vas Rocks, where it was first reported by Nicoll (1906, 673) on January 5, 1906.

When I visited Fernando Noronha in October, 1912, this species seemed to be by far the most abundant bird. Six examples were collected, all of them in a breeding state. The 'Blossom' expedition subsequently found the Black

Noddies nesting at several islets of Fernando Noronha in March, and earlier visitors had made note of reproductive activities during other months.

The nesting habits of the Black Noddy appear to have been most fully observed at the barren St. Paul Rocks, where the species is known from abundant evidence to breed throughout the year. As noted in the biography of the Atlantic Brown Noddy, the explorers of the 'Beagle' and the 'Terror,' as well as certain other visitors, have confused these two related terns. At St. Paul Rocks and other plantless islands, however, the Black Noddy always builds a nest of the only available material, which is green seaweed torn from the rocks by the surf and gathered up by the birds as it floats. Furthermore, the nest is built upon a small rocky projection of a sheer wall or a steep slope, the whole forming a bracket of sopping vegetable matter plastered over with, and more or less cemented together by, the birds' dung. Such nests grow to be 15 to 20 centimeters in height. They appear to be used continuously for, as Wilkins has pointed out, the structure shows no definite horizontal lamination such as would appear if it were added to and occupied only at one definite season each year. Doubtless a new breeding pair of terns is ready to take possession as rapidly as a preceding couple and grown chick relinquish the site.

The Black Noddy nests of St.Paul Rocks have been well described by Moseley (1879, 69) and McCormick (1884, 20), and the former has published a drawing in his narrative of the 'Challenger' voyage. The top of each nest is a sort of platform, or very nearly a plane surface, instead of being hollow.

Similar bracket-nests were seen against the wall of a gloomy cleft in the Martin Vas Islands during the visit of the Cleveland Museum party. Also one Black Noddy was collected here, but the specimen was subsequently lost. Structures of the same sort were noted by Moseley (1879, 563) against the lower part of the cliffs of Boatswain-bird Islet, Ascension, at the end of March, and Penrose (1879, 280) states that these same cliffs were black with the adult birds on January 4, 1878, at which time each pair had one egg resembling that of the Brown Noddy but smaller and more pointed. Nesting Black Noddies were also collected at Boatswain-bird Islet by the 'Blossom' expedition between September and November, and at St. Helena in September.

At the islands of Tristan da Cunha this noddy is a migratory species, which has been observed or captured at all three members of the group between September and February. While perhaps not distinguished by the Tristan folk from the Brown Noddy, it is certainly the black species which, because of its tree-nesting proclivities, deserves the name of "Wood Pigeon." Carmichael (1818, 497) reported that these birds nested abundantly in the buckthorn (*Phylica*) trees early during the nineteenth century, when woods still existed at Tristan. More recently the noddies have been found in the groves of Inaccessible Island, building nests of sticks and leaves (Thomson, 1878, 156), or loitering about the large sea caverns of Nightingale Island.

Both at the borders of the sub-antarctic realm, and in the northeast trade-wind zone of the northern hemisphere, the Black Noddies share a fixed or calendar breeding period which, however, they have lost in greater or less

degree throughout the pan-tropical oceans. Thus at a cay off Belize, British Honduras, Black Noddies (either of the present subspecies or one very closely related to it) nest regularly during the northern spring, though slightly later in the season than the Brown Noddies of the same locality. The nests, of slender twigs and bits of seaweed, are built mostly in the mangroves (Salvin, 1864, 383). No doubt with the destruction of trees at such sub-tropical islands as St. Helena and South Trinidad, the status of the Black Noddy has changed enormously. It is perhaps for such reasons, indeed, that the bird appears no longer to reside at South Trinidad.

The Black Noddy feeds like the other species, not by diving but by making quick stoops to the surface of the ocean and seizing unsuspecting fish as they rise or leap out. Apparently it forages by night fully as much as by day.

Salvin states that this species has a more tern-like call than the cawing note of the Common or Brown Noddy.

COCOS BLACK NODDY

Anoüs minutus diamesus

Micranous diamesus Heller and Snodgrass, Condor, 3, p. 76 (Cocos Island).

Characters: Similar to the preceding subspecies but differing in having a shorter and more slender bill, and in being darker on the shoulders, lower parts, and the sides of the head and neck.

2 males from Cocos and Clipperton Islands: wing, 232–239 (235.5); tail, 122.8–125 (123.9); exposed culmen, 45–45.6 (45.3); tarsus, 21–22.1 (21.5); middle toe and claw, 34.5–35.5 (35) mm.

2 females from Cocos and Clipperton Islands: wing, 224–225 (224.5); tail, 111.5–113.3 (112.4); exposed culmen, 37–41.7 (39.3); tarsus, 20.3–20.4; middle toe and claw, 33.7–34.4 (34) mm.

Heller and Snodgrass (1902, 510) give the following average measurements for 9 birds of both sexes, chiefly females, from Cocos and Clipperton: length in the flesh, 369; wing, 230; tail, 128; exposed culmen, 43.6; depth of bill at base, 8.4; tarsus, 21 mm.

Gifford describes eggs from Clipperton Island as of elliptical-ovate or elongate-ovate form, and in color and markings resembling those of the Brown Noddy. Examples measure 43.7 x 32, 46 x 30.8, and 44.8 x 31.5 mm.

Distribution: The Pacific coast of Central and northern South America, breeding at Cocos and Clipperton Islands.

The distinction between the Atlantic and the eastern Pacific Black Noddies is, perhaps, unduly emphasized above; it may be less marked than was believed by the original describers of the subspecies *diamesus*, and by subsequent reviewers. Certainly the alleged difference in the length of the bill seems to be scarcely perceptible. The comparison of measurements made by Ridgway (1919, 555 and 557) is of no aid, because his figures intended to represent dimensions of *diamesus* are based upon examples of the small noddies of the British Honduras coast, which have since been recognized as still another subspecies, called *americanus*. As I have examined only four specimens of the Cocos Black Noddy, I am unable to settle the taxonomic status of the bird to my own satisfaction.

Heller and Snodgrass state that the Cocos Black Noddy is intermediate between Atlantic birds and the form occurring at the Hawaiian Islands. They found this tern abundant in July, at Cocos Island, where it was nesting inland in tall trees, closely associated with the white Fairy Tern. Gifford (1913, 30)

encountered the Black Noddy at sea, about 50 kilometers south of Cocos Island, on September 1, 1905, a date when young birds on the wing appeared to be more numerous than adults.

At Clipperton Island, during August, Gifford found these noddies nesting on little juttings of rock from the walls of cliffs and caves, building their nests of soaking wet algae from the lagoon, and obviously using old nests as a foundation. The birds showed no timidity, and numbers were caught by hand.

The Fairy Terns, Genus Gygis

These white terns are birds of tropical and sub-tropical oceans, inhabiting remote islands rather than those near continental coasts. They appear to be most abundant just outside the zone of tropical surface water, either close to the borders of pronounced current movements, or where the submarine slopes of small oceanic islands tend to cause a concentration of life at the surface.

Two subspecies come within the South American region. The Atlantic birds constitute the typical race. The affinities of the Cocos Island form are with birds occupying other parts of the Pacific, but its exact status has not yet been settled.

ATLANTIC FAIRY TERN

Gygis alba alba

Sterna alba Sparrman, 1786, Mus. Carls., fasc. 1, no. 11 (East Indies, Cape of Good Hope, and islands of the Pacific Ocean = Ascension Island, South Atlantic).

Names: White Noddy; Snow-white Tern; Love Bird; Holy Ghost Bird. Spanish names include "Paloma de Mar" and "Quía-quía." The commonest synonym of the specific name is *candida;* the Atlantic form has also been described as *crawfordi.*

Characters: Birds of this genus are the only terns with pure white plumage.

Adults (sexes alike): Plumage white, except for a narrow ring of black feathers around the eyelids; shafts of primaries and rectrices sometimes dusky or brownish even in apparently mature birds. Iris brown; bill black; legs and toes slaty blue, the webs white or yellowish.

8 males from Fernando Noronha, Ascension, South Trinidad, and St. Helena: wing, 239–250 (249.1); tail, 92–105.5 (98.6); exposed culmen, 39.2–43.8 (41.7); tarsus, 13.5–15 (14.2); middle toe and claw, 25.5–28.8 (27.5) mm.

8 females from the same localities: wing, 240–268 (250.1); tail, 90–115 (102.8); exposed culmen, 38.6–41.5 (40); tarsus, 13.2–15.4 (14.1); middle toe and claw, 27–29 (27.9) mm.

The total wing-spread of 18 specimens of both sexes from the South Atlantic islands ranged between 698.5 and 870 mm., the average being 739 mm.

Immature birds have a post-ocular blackish spot and dark quill shafts, while the feathers of the nape and back, as well as some of the quills, are tipped with rusty brown. The downy nestling is grayish brown with two broad blackish stripes on the back and a black patch on the crown; the short bill is plumbeous, the feet relatively very large, and the stout toes strongly clawed.

Eggs are described as more uniformly elliptical in shape than those of most terns, being decidedly blunt at both ends. The ground color is usually creamy, though varying between dull white and pale buff. The markings, of widely varying shades of brown, consist of scrolls, lines, specks and blotches spread thickly over the surface and forming a very handsome pattern. Underlying markings beneath the surface of the shell appear as pale purple. I find no measurements of South Atlantic eggs. Three from the Kermadec Islands, in the South Pacific, measure: 44.5 x 32.5, 42.5 x 34, and 41.5 x 30.5 mm.

Distribution: Breeds at Fernando Noronha, South Trinidad, Martin Vas Rocks, Ascension and St. Helena, South Atlantic Ocean.

Most ethereal of sea birds are the delicate and gentle Fairy Terns. Their plumage is white, but with subtle ivory or creamy tones and with a barely perceptible reddish gleam visible in certain lights on the feathers of the belly. The last is all but illusory, and yet I find that most persons can see it if they are asked whether the ventral surfaces of specimens show a bloom of any sort. In the air these terns are ghostly creatures, their exceptionally large black-rimmed eyes sometimes seeming like empty sockets. Moreover, when they fly overhead against the brilliant tropical sky, only the bones and flesh of their filmy wings fully obstruct the light. At such times the Fairy Terns resemble tiny flying skeletons, except that their lightness and grace are more suggestive of disembodied spirits than of dry bones. It is curious that under their rather thin and loose white plumage they have a skin which is black and shiny, like that of a newly hatched naked cormorant. No doubt the dermal melanin of the Fairy Tern bears the same relation to the absorption of the sun's rays, or to the retention of bodily heat, as does the dark plumage pigment of its neighbor, the noddy, which has a white skin.

My first experience with the Fairy Terns came on October 16, 1912, when I landed from the brig 'Daisy' for one day at the island of Fernando Noronha. Here this species proved rare in comparison with many of the other sea birds, for not more than twenty Fairy Terns were observed, most of them in pairs flying from shelf to shelf of the cliffs or sitting affectionately side by side across the boughs of trees. Later during the same voyage, on April 8, 1913, I found the species to be far more abundant at South Trinidad Island. Here, again, the terns seemed to associate in devoted family groups of two, whether flying over the ocean or resting in niches of the rocks. This habit has been noted by other observers, and Thomson (1878, 109) says that in the flying pairs one bird follows very closely all the motions of the other. According to Penrose (1879, 279), who made his observations at Ascension, the breeding pairs seldom flock with others of their own kind, and they likewise tend to keep apart from the noddies and larger birds.

The curiosity of the Fairy Terns is notable, and Meliss (1875, 98) states that they are particularly attracted by white objects. They have a way of fluttering just in front of one's face in a manner that soon becomes disagreeable—not attacking, but merely staring, hovering like overgrown mosquitoes, and wheezing in a way to suggest the buzz of some such noxious insect. McCormick (1884, 25) tells us that during his solitary ramblings about South Trinidad, on the occasion of the visit of the 'Terror' in January, 1840, his only constant companions were the Fairy Terns that never ceased to hover about his head. As I sat in a whaleboat on the heaving swells close against the cliffs of the same island, a succession of these birds fluttered just in front of my nose so that I was able to pick them out of the air by hand. After being captured, they made no resistance except for a very mild and brief struggle, and they did not attempt to use their potentially dangerous bills. Although perfectly willing to shoot specimens at shotgun range, I found that the only thing to do with the big-eyed creatures that nestled unhurt in my hand was to set them free again.

The typical form of the Fairy Tern is confined to the tropical and sub-tropical islands of the South Atlantic. In Part I of this book I have noted as curious the fact that it has never succeeded in jumping the relatively short gap between Fernando Noronha and the Antilles, which lie at no great distance directly to leeward. The presence of Fairy Terns at Cocos and Clipperton Islands, in the tropical Pacific adjacent to the coast of America, might lead to the inference that Atlantic members of the species had at one time "broken through," just as Atlantic types of man-o'-war birds, pelicans, flamingoes, teals, etc., are known to have found their way to the Galápagos Archipelago. However, it can safely be inferred that the Cocos and Clipperton Fairy Terns are not of Atlantic origin, but that their affinities are rather with the forms of the species found in southern Polynesia. At any rate, bills which are relatively deep at the base are shared by representatives from islands in various parts of the tropical Pacific, and are distinguishable at a glance from the slender bills of all South Atlantic birds.

I judge that the Fairy Terns are quite sedentary at the South Atlantic islands. Not only have they been reported at all seasons, but Vanhöffen (1905, 511) states that when the 'Gauss' left St. Helena on September 2, all the terns of this species remained behind after the vessel had gone about 35 kilometers from the land. Among the Pacific representatives, however, there are certain records that suggest a pelagic migration. Thus Oliver (1930, 258) quotes Bell to the effect that White Terns begin to return to the Kermadecs usually about the first week in September, although they are rather irregular from year to year both as to the time of arrival and the date of laying. They come from sea, the observer continues, generally in small groups, and settle at once in the trees in which they later breed. There may be much still to learn about a migratory movement in the South Atlantic. It must be kept in mind, however, that the surface waters about their South Atlantic breeding grounds are relatively poor in food organisms, except in the shore waters of the very islands which are the strongholds of these terns. Moreau (1931, 779) reports a sight identification of a group of Fairy Terns "about 250 miles north of Ascension" on September 30, 1930.

As near as one can judge from the record, the Fairy Tern at Ascension, which is regarded as the type locality of the species, is not particularly abundant and is best known as a nester on Boatswain-bird Islet, where specimens now in the American Museum Collection were obtained in 1925 during the cruise of the Cleveland Museum schooner 'Blossom.' St. Helena and South Trinidad, both of which are sub-tropical rather than tropical, have much larger populations of Fairy Terns. Meliss (1875, 98) reports that at the date of publication of his book the species was certainly one of the most abundant of sea birds at St. Helena, its numbers coming next, perhaps, to those of the noddy. He states that they are often seen flying over the high central part of the island, and that they nest on rocky cliffs or in irregularities in the surface of the standing basaltic dykes, such as the column known as Lot's Wife. Because of such breeding habits, they may be found in apparently intimate association with the tropic-birds. Moreau adds that in 1930 he saw Fairy Terns nesting on the cliffs that

overhang the quay at Jamestown, and one covering an egg above a church door in the main street of the town.

At South Trinidad the Fairy Terns nest not only in rocky situations, but also on the limbs and trunks of the dead Brazilwood forest. A slight hollow or roughened spot, or a level knot from which a branch has long since fallen away, are all that the birds need as a "nest" for their single egg. Wilson (1904, 211) reports eggs and young in various stages of growth at South Trinidad on September 13. Nicoll (1908, 45) also found young not long out of the egg in January. From these and other scattered data it appears that the Fairy Tern may have here a year-long reproductive season, like so many other pan-tropical sea fowl.

From all of the above, it appears that the Fairy Tern is equally at home on stark rocky islands, among forests of trees dead or alive, or in jungles and thickets of shrubbery. Its primitive nesting preference would seem to call for the limbs of trees, or the swaying fronds of palms, but where vegetation does not exist, or has disappeared, the bird takes readily to the rocks and lays its exquisite egg in all sorts of situations, from ledges barely out of reach of the waves to niches in the walls of mountainous valleys far from the sea. In view of the change in the flora of such Atlantic islands as South Trinidad, St. Helena, and Ascension, as described or inferred in the geographic section of this book, it would seem as if the Fairy Terns must have survived through periods of profound alteration. For such reasons, no doubt, their relative abundance has also fluctuated greatly within the historic period.

The egg of the Fairy Tern is so precariously balanced on rock or bark, or even in a slight hollow of a smooth and slender branch, that it has often been wondered why more of them do not come to grief. Mechanically, however, the balance of the egg in its cradle is doubtless less insecure than it appears to be, and the incubating adult seems to stand lightly astride it, rather than snuggling down upon it in the manner of most birds. The adults cling so fixedly to their eggs or young that they may commonly be stroked or picked off; they will even stick to the spot after an egg has been deftly extracted from beneath them! The chicks are particularly adapted to trapeze tactics. With their very strong claws, and also with their bills, they cling tightly to their perches, and are quite capable of hauling themselves back into position after they have been bowled over by the hurried departure of a parent. Wilson compared their tenacity with that of limpets! They are extraordinarily precocious, and they fly about long before they have lost all the down from the tips of their rusty-tinted white feathers.

Like the Sooty Tern and the noddies, the Fairy Tern feeds not by diving but by the amazingly rapid and precise technique of catching little fishes in mid-air as they leap out. Around South Trinidad and other South Atlantic islands there are many halfbeaks (*Hemirhamphus*) in the warm surface water, and doubtless the Fairy Terns capture small examples of these fishes among others, as they are known to in parts of the Pacific (Fisher, 1906, 785). They are capable of catching not only one little fish, but even a second and a third, without

dropping the earlier victims from their bills. They then return to the home site, carrying the prey crosswise, and feed the chick. Small crustaceans have also been found in their stomachs.

COCOS FAIRY TERN

Gygis alba (candida?)

Sterna candida Gmelin, 1789, Syst. Nat., 1, pt. 2, p. 607 (Christmas Island, Pacific Ocean).

Characters: Bill proximally stouter and deeper than in Atlantic birds, and shading from a distal black coloration through purple to indigo-blue at the base.

1 male from Cocos Island and 1 female from Clipperton Island: wing, 245–246 (245.5); tail, 108.1–113.5 (110.8); exposed culmen, 40.5–42.3 (41.4); tarsus, 12.8–13 (12.9); middle toe and claw, 29–30 (29.5) mm. The depth of the bill at the base in the male is 11.5 mm., as against 9.3 mm. for the same dimension in a male from Ascension. Gifford (1913, 34) gives measurements of 20 specimens, which appear not to differ materially from those of Atlantic birds or of birds from the central Pacific.

Distribution: Eastern tropical Pacific, including Cocos, Clipperton, and the Revilla Gigedo Islands; wandering southward to the Galápagos. (The form found in this region may or may not be that of the central Pacific; at present I see no grounds for separating them.)

Recent reviewers, such as Ridgway (1919, 559), Swarth (1931, 66), and Peters (1934, 349), are uncertain as to the correct subspecific name applicable to the form of the White Tern occupying Cocos and Clipperton Islands, and recorded from as far south as the Galápagos. Ridgway tentatively uses the subspecific name *candida* which belongs to birds of the middle tropical Pacific. In this I follow him, pending a study of the unequalled series of Fairy Terns collected in the Pacific by the Whitney South Sea Expedition.

Upon the basis of a comparison of one skin from Cocos and one from Clipperton with a large number of Atlantic and Pacific specimens, these terns are at least divisible according to their respective oceans. In other words, the affinities of the Cocos and Clipperton birds are with those of more distant Pacific islands rather than with the South Atlantic subspecies.

Swarth (1934, 221) speculates as to why the White Tern of the eastern tropical Pacific, which nests abundantly at Cocos Island, occasionally strays southward as far as the Galápagos and yet fails to establish itself there. He suggests, no doubt correctly, that the existence of the species is probably dependent upon a warm current that sweeps southward a little beyond its breeding outpost. The only actual Galápagos record seems to be that of Gifford (1913, 32) of a bird sighted off Tower Island, on September 14, 1906; however, a female was collected "40 miles south of Cocos."

In the same paper Gifford reports upon the resident Fairy Terns of Cocos Island, as observed during the expedition of the California Academy of Sciences. Here they were commonest in the forests, which are very luxuriant on this well-watered island.

> It is in this setting that the terns appear to greatest advantage. As a rule, the first intimation a person gets of their presence is a startling clucking over his head. Upon looking up he will find two or three of these beautiful inhabitants of the forest hovering within a yard of his head. After flying about him four or five times, they will dart away among the trees with a flight as sure as that of any woodland bird.

Over the water their flight was very swift and erratic, and usually at a considerable elevation. None were seen on the water. They paid but little attention to a boat, seldom approaching to examine it. At times they were seen in pursuit of each other, and then their evolutions were the swiftest. One day eight or ten were seen pursuing an Osprey (Gifford, 1913, 33).

The observations of Snodgrass and Heller (1902, 511) regarding the nesting of this species at Cocos were evidently made in error. They seem to have mistaken twig-built structures resembling the nests of crows for the homes of Fairy Terns, whereas it is certain that the species nowhere constructs a nest of any sort.

THE SKIMMERS

FAMILY RYNCHOPIDAE

Skimmers are highly modified tern-like birds, found in both continents of the New World, and in Africa and southern Asia. They all have exceedingly long wings, correlated with a distinctive style of flight, but their outstanding morphological characteristic is the compressed, blade-like bill, in which the lower mandible is much longer than the maxilla. This structure results from differential growth, for young skimmers have mandibles of equal length, with the tips of which they are said to be capable of picking up food from the ground.

In many parts of the world, skimmers belong to great rivers more than to littoral ocean waters. This is true, for example, throughout the eastern drainage systems of South America, where the birds breed mostly or wholly on river-bars exposed during the seasons of low water. Perhaps the reason why the Black Skimmer of southern North America is an almost exclusively coastal bird is connected with the fact that the flood periods of the larger rivers coincide with its breeding season.

The American skimmers are black and white birds, all of a common stamp, though it is possible that they represent two species. The last question can be solved only when the ranges of several forms in the two fairly well-marked groups have been determined with a closer approach to exactitude.

BLACK SKIMMER

Rynchops nigra, and its forms

According to the revisional list of Peters (1934, 349), the American skimmers are represented by four geographic races, but the ranges and status of all of these had not been satisfactorily determined.

Griscom (1935, 544) has more recently reviewed the group, making use of the excellent South American series in the British Museum. He prefaces his account with the following general observations:

"In typical *nigra* and other 'white-tailed' races younger and non-breeding specimens have more grey in the inner webs of the rectrices than breeding adults; thus younger winter specimens of *nigra* cannot be separated from adult breeding *intercedens* on this character. Secondly, size steadily increases southwards; roughly speaking, all North and Middle American Skimmers are smaller and all South American larger. Thirdly, it is by no means definitely proved that the dark-tailed smoky *cinerascens* Spix is not really specifically distinct from *nigra*. Certainly the recently proposed *inter-*

media Rendahl by no means closes the absolute gap between the two series of races. Here the taxonomic treatment is largely a matter of opinion rather than fact."

Disregarding the precise degree of relationship, the five New-World forms of skimmers now recognized are as follows:

Rynchops nigra nigra

Rynchops nigra Linnaeus, 1758, Syst. Nat., edit. 10, 1, p. 138 (coast of South Carolina).

Breeds on the Atlantic and Gulf coasts of the United States, from Long Island to Florida and Mexico; winters southward to northern South America, although, according to Griscom, specimens reported from the coast between Trinidad and northeastern Brazil should be critically redetermined.

Rynchops nigra oblita

Rynchops nigra oblita Griscom, 1935, Ibis, p. 545 (Acapam Lagoon, Pacific coast of Guatemala).

Ranging along the Pacific coast from Guatemala to Tepic.

Rynchops nigra intermedia

Rynchops melanura intermedia Rendahl, 1919, Ark. Zoöl., 12, no. 8, p. 12 (Harbor Head, Río San Juan del Norte, Nicaragua).

Caribbean coast of Central America, off Nicaragua and Yucatan. Also said to be the form of the Pacific coast of South America, from Ecuador to southern Chile.

Only two Caribbean examples of this subspecies are yet known in collections, and Griscom suspects that the birds from the Pacific coast of South America will eventually prove to follow the rule of being of larger size, and will therefore require a new name.

Rynchops nigra cinerascens

Rhynchops cinerascens Spix, 1825, Aves Bras. 2, p. 80, pl. 102 (River Amazon).

Coasts and rivers of northern and northeastern South America, from Colombia (Río Magdalena), Venezuela, the Guianas, and northern Brazil, southward and inland throughout the rivers of Amazonian drainage.

Rynchops nigra intercedens

Rhynchops intercedens Saunders, 1895, Bull. Brit. Orn. Club, 4, p. 26 (São Paulo, Brazil).

Coasts and rivers of eastern and southeastern South America, from Maranhão southward to the estuary of the Río de la Plata and central Argentina.

Griscom notes that the skimmers break up into a "*nigra*" group, with a white under-wing, broadly white-tipped secondaries, and largely white rectrices (in breeding adults); and a "*cinerascens*" group, with a sooty gray under-wing, very narrowly white-tipped secondaries, and a sooty tail. It is these two divisions which, he notes, might be regarded as distinct species. The first would include the races *nigra*, *oblita*, and *intercedens* of the preceding list; the second would comprise the races *cinerascens* and *intermedia*.

I have not seen a sufficient number of specimens of South American skimmers to make an original or fully adequate discrimination of the forms pertaining to that continent, especially since the exact ranges of most of them are still somewhat dubious. The following notes are based upon material in the American Museum and the accounts of Ridgway (1919, 451), Rendahl (1919, 12), Hellmayr (1932, 403), and Griscom.

R. n. nigra. Characterized by small size, together with the white wing-lining and other features noted above. Average dimensions of 10 males: wing, 382; tail, 124; culmen, 68; tarsus, 33; middle toe without claw, 23 mm.

R. n. intercedens. Larger than the preceding race, the inner webs of the lateral rectrices always with more brownish gray. Adults in breeding plumage do not, according to Griscom, show the brownish gray tinge on the wing-lining which is usually credited to this subspecies. Average dimensions of 6 males: wing, 403; tail, 124; culmen, 79; tarsus, 35; middle toe without claw, 24 mm.

R. n. cinerascens. Larger than either of the two preceding members of the "*nigra*" group. Underwing light sooty gray, secondaries much less conspicuously tipped with white, tail deep sooty,

the rectrices (except middle pair) very narrowly edged with white externally. Average dimensions of 3 males: wing, 414; tail, 124; culmen, 87; tarsus, 36; middle toe without claw, 24 mm.

The above three forms are skimmers of Atlantic coasts or Atlantic drainage waters. The only Pacific form coming within our field is the one at present attributed also to the Caribbean coast of southern Middle America, namely:

R. n. intermedia. Apparently smaller than *cinerascens*, its closest relative (*fide* Griscom), and approximating *intercedens* in size. Under-wing smoky gray; rectrices dark umber on the upper surface, their white outer edges about 2 mm. broad; band formed by whitish tips of secondaries narrow and rarely pure white. Measurements are as follows:

	Wing	Tail	Culmen	Gonys	Tarsus	Middle toe with claw
♂, Rendahl's type	405.5	126	80	110	37.5	32.5 mm.
♂, Paracas Bay, Peru, Oct. 19, 1919	406	125	84.4		33.5	26
♀, Paracas Bay, June 30, 1913	370	110.5	66		31	24.5

It will be observed that our Peruvian examples, as measured by myself, do not appear to be larger than the type specimen from the Caribbean coast of Nicaragua, but a direct comparison of more birds from each locality is needed.

Owing to the many uncertainties indicated, I have thought it best to discuss the American skimmers as a unit in the biographical text, describing in detail only the typical race.

Names: Scissor-bill, Razor-bill, Sea-dog, Cutwater, Shearwater; in Spanish-speaking countries "Rayador," "Arador," and "Pico de Tijera" are recorded as vernacular names; in Brazil the skimmer is known as "Magador," "Talha-mar," "Corta-mar" and "Bicorasteiro." Synonyms of the specific or subspecific names include *fulva*, *melanura*, and *brevirostris*.

Characters: A very long-winged, black and white larine bird, with a unique bill, the mandible much longer than the maxilla, both compressed to knife-like thinness except at the base.

Adults of the typical or North American race in summer (sexes alike): Forehead, lores, suborbital and malar regions, and entire under parts (including axillars and under wing coverts), lateral upper tail coverts, and broad tips to secondaries and proximal primaries, immaculate pure white; rest of plumage (except tail), including auricular region, uniform black or sooty black; tail mostly white, the middle pair of rectrices grayish brown edged with white, the remaining rectrices more or less tinged at tips with the same; basal half (approximately) of bill bright vermilion-red (in life), the mandible more scarlet, passing into orange or yellow on tomium, the terminal half black; iris dark brown; legs and feet rich orange-vermilion (in life).

Adults in winter: Similar to summer adults but the black parts duller and more brownish and interrupted by a broad collar of white across lower hind neck.

10 males: wing, 350–401 (381.7); tail, 116–134 (124.3); culmen, 63–72 (68.1); greatest depth of bill, 26.5–29.5 (28.1); tarsus, 31–34.5 (32.9); middle toe [without claw], 22–24 (22.6) mm.

4 females: wing, 338–358 (346); tail, 101.5–110.5 (106.6); culmen, 52–57 (55); greatest depth of bill, 22–24 (22.9); tarsus, 25–29 (27.6); middle toe [without claw], 18–19 (18.4) mm.

Young: Upper parts light buff, each feather with a central spot of blackish, these spots largest on scapulars; lores and suborbital region uniform pale buff, the former, however, with a dusky space immediately in front of eye; greater wing coverts blackish gray or grayish black, tipped with white; secondaries white for most of their exposed portion; primaries blackish, the fourth, fifth, and sixth (from outside) margined terminally with light buff, the four inner (proximal) ones dusky passing into white at tips; under parts entirely immaculate white; bill, legs, and feet dull or dusky reddish.

Downy young: Upper parts pale grayish buff, irregularly and rather sparsely mottled with blackish; under parts immaculate white (Ridgway, 1919, 451).

Data relating to the eggs of the South American forms are scarce and unsatisfactory. Birds of the North American race normally lay a set of four or five boldly marked eggs, which Bent (1921, 314) describes as follows:

The ground color is rarely pure white, but usually pale bluish white or creamy white, varying on the one hand to pale greenish blue, almost a heron's egg color, and on the other hand to deep "cream buff" or "pinkish buff." They are usually heavily marked with various shades of brown, from "tawny olive" and "burnt umber" to "seal-brown" or "clove-brown"; sometimes fairly evenly distributed as small spots, but more often in large irregular blotches or splashes in an endless variety of patterns. Nearly all of the eggs are more or less heavily spotted or blotched, and some are very prettily marked, with various shades of "lilac-gray," "lavender-gray," or "olive-gray." In shape they vary from rounded ovate to elongate-ovate, with a prevailing tendency toward the former shape. The measurements of 58 eggs in the United States National Museum average 45 x 33.5 mm.; the eggs showing the four extremes measure 51 x 32, 45 x 36, 41.5 x 31, and 43 x 30.5 mm.

Distribution: The range of the species as a whole includes the greater part of South America, with the exception of the sub-antarctic south and the west coast to northward of Ecuador; the approximate distribution of the several subspecies has been recorded above.

Around the greater part of the tropical and temperate coasts of South America the Black Skimmer is, or formerly was, a common bird. Curiously, it seems to be wanting along the humid shores between Ecuador and Panama, as well as on much of the Pacific coast of Central America. The same is perhaps true of the Caribbean side of the Isthmus, for no skimmer is listed by Sturgis (1928) among the birds of Panama. Regarding the systematic status and exact distribution of the several subspecies, little is yet known with certainty, and even the tentative conclusions suggested above are in part based upon inadequate series of specimens. Under the circumstances, I have prepared these notes as a general biography of a single American species, rather than as accounts of the separate geographic races.

In South America, which is *par excellence* the continent of great rivers, the skimmer has become much more of an inland bird than is true in any part of its North American range. The three resident subspecies of the southern continent, as at present recognized, may in fact best be divided in accordance with drainage systems. Thus the race *intermedia* belongs primarily to the long seacoast which receives the flow of the Pacific watershed of the Andes; the race *cinerascens* is confined to coasts and basins of Caribbean and Amazonian drainage, throughout which it follows the great rivers to their headwaters; in like manner, the race *intercedens* is a bird of the coasts and basins that receive river waters entering the Atlantic to southward of the eastern shoulder of the continent, including probably the Rio São Francisco as well as the Paraguay-Paraná system. Finally, it appears probable that the typical race of the Black Skimmer, which inhabits North America, migrates southward through the Antilles to various parts of northern South America.

Although skimmers are reported along the Caribbean coast, from the Río Magdalena (Chapman, 1917, 222) to the vicinity of Margarita Island, nothing seems to have been written about the nesting of the birds on the sea beaches of either the mainland or the outlying islands. It is probable that on seacoasts lacking isolated barrier-beaches such as abound in the eastern United States, the skimmers have, for safety's sake, developed a régime of breeding exclusively on the exposed bars of great rivers during the annual seasons of low water. Léotaud (1866, 535) states that the birds come only as migrants to Trinidad,

where they are seen always in flocks. In Guiana and northern Brazil they are abundant in the estuaries and along the coast; according to both Schomburgk (1848, 761) and Young (1928, 767), they retire to certain bars far up such rivers as the Essequibo for their season of reproducton, while at the seashore they are commonest during May and June which, it is noteworthy, is the period just preceding the great floods of the rivers. From eastern Brazil southward skimmers have been recorded from many points along the coast as far as latitude 45° S. in Patagonia, where they were observed by Darwin (Gould, 1841, 143). Throughout this region, however, they are apparently more riparian than littoral birds. On the River Paraguay, according to Gibson (1920, 73), they breed between July and September, which is the low-water period, and thereafter migrate downstream and invade the Gulf of La Plata. Hartert and Venturi (1909, 254), too, write that the skimmers in Argentina and Paraguay nest in the same localities and at the same time as the Great-billed River Tern (*Phaetusa simplex*), which is to say September or the low-water period. Sclater and Hudson (1889, 193) also state that they appear in the neighborhood of Buenos Aires every October, and Gibson observed flocks numbering two hundred or more birds on mud flats at the mouth of the Río Ajo, along the southern coast of the estuary, on November 3. During periods of inundation, such as occurred throughout this region in 1913, skimmers spread out and feed over large areas of what is normally dry land (Daguerre, 1922, 261). In March, which marks the beginning of lowering streams toward the headwaters of the great river system that proceeds from the interior region of summer rainfall and winter drought, the bulk of the skimmer population begins to move again upstream in preparation for the next nesting season.

Gibson, as well as Sclater and Hudson, infers that the skimmers likewise nest on the mud flats and islets near Bahía Blanca, Argentina, and perhaps in the extensive "no man's land" of the Rincones, to westward of Cape San Antonio. While the supposition sounds entirely reasonable to one acquainted with the customs of skimmers along the southeastern coast of North America, it is still not sufficiently supported by evidence to be accepted without further investigation. So far as we yet know, the skimmers of eastern South America are confined, as nesting birds, entirely to the river systems, in which their productive cycle is correlated with the annual rhythm of precipitation and of swelling and falling waters.

Along the west coast of South America the skimmer is a tolerably common bird from the Gulf of Guayaquil to the neighborhood of Chiloé Island. I have never seen it to northward of Point Santa Elena, Ecuador, and there seem to be no records for the Pacific coast of Colombia. Among the wooded channels of southern Chile it is presumably only a wanderer, although casually recorded by Hellmayr (1932, 403) from as far south as the Strait of Magellan. Whether the skimmers described from the high Andean lakes have worked their way thither from the west coast or from Amazonian streams is still uncertain. The only pertinent specimen I have examined was taken on Lake Titicaca, and its age and condition thwart subspecific identification.

About all shores of the Gulf of Guayaquil skimmers are familiar birds. At the beginning of the rainy season I have seen long lines of them quartering the quiet, opaque waters, and on the evening of February 24, 1925, I observed many among a host of other sea fowl on an exposed flat off the southern point of Puná Island. So far as my experience goes, the skimmers do not penetrate the River Guayas far inland, and I noted only a single example well inside the estuary. All of my observations here relate to the rainy months, however, and at other times of year their migrations may take them much farther upstream.

Southward along the Peruvian coast the skimmer is a bird to be expected anywhere, though it is most characteristic of quiet and sheltered regions, such as the Bay of Pisco, or about ports like Ancón and Chorrillos, which are protected by headlands and islands on their windward sides. To southward of the Río Tumbez in northernmost Peru there are, of course, no rivers providing estuaries in which this bird might forage; its habitat along the entire length of the desert coast belongs, therefore, exclusively to salt water. Beck and I both observed it during our field work, though nowhere in large numbers south of the Gulf of Guayaquil.

One of the puzzling facts concerning this bird on the Pacific coast of South America is its apparent great diminution in numbers within the last century or so. I can think of no explanation for this unless it is implied in Delano's (1817, 526) statement that the skimmer is "excellent eating." Whatever the reason may be, both Delano and Morrell (1832, 121) record the bird from the Lobos Islands, while Raimondi and von Tschudi include it as a resident of the Chincha Islands, and the latter author (1844, 46; 1846, 35) states that before the middle of the last century skimmers were abundant in the bays or roadsteads of such ports as Ilo, Islay, Arica, and Iquique, and that large flocks were to be seen in the Bay of Valparaiso. Certainly no such condition holds today. Reed (1896, 211) notes that at the date of his writing skimmers were no longer common in Chile, but were to be found sparingly along most of the coasts and on the more southerly rivers. Hellmayr (1932, 403) also states that while the bird now ranges over the greater part of Chile, it is nowhere common. He cites numerous records from the seashore, the estuaries of rivers, or lagoons behind the beaches, at various localities between Atacama and the island of Chiloé. On April 17, 1914, Beck saw seven or eight skimmers fishing at dusk near the wharf at Ancúd, Chiloé, and on May 6 of the same year he observed a score of the birds standing on floating strands of kelp at the same locality. Since I can find no information regarding the nesting of skimmers along the desert coast or at any of the guano islands, it is possible that the birds of Peru and northern Chile are merely migrants from the river systems to northward and southward. Dabbene (1902, 380) states that the southernmost limit of the recorded range, in the Strait of Magellan, is based upon a purely accidental occurrence.

The skimmer is equally at home in either fresh, brackish, or salt water, provided its hunting ground be reasonably smooth and protected. It is no bird to fight gales, despite its long wings, for it is one of the species most easily beaten down or carried far out of its course by such storms as the tropical hurri-

canes. Darwin noted at Montevideo, Uruguay (Gould, 1841, 144), as I did at Pisco Bay, Peru, that the skimmers often rest at the heads of deep and quiet coves during the daytime, and then fly seaward in a straight line at evening. Many other observations likewise tend to show that these birds are largely nocturnal in their feeding habits, thus taking advantage of the hours during which aquatic organisms approach the surface more abundantly than they do in the daylight. The crepuscular and nocturnal activity of skimmers along the coast of Venezuela has been noted by Robinson and Richmond (1895, 654), and Young refers to their weird and mournful cries as heard in the darkness in Guiana.

Whether or not the cat-like eye of the skimmer has superior powers for collecting light is unknown, but Wetmore (1919, 195) has called attention to the fact that the pupil in this bird contracts to an elongate vertical slit, and that even when it is fully dilated the upper and lower points of the aperture are marked by distinct angles so that the opening is never circular. Darwin surmised that possibly the curious bill of the skimmer was a delicate tactile organ of particular sensory use to the bird during its nocturnal fishing. However, Owen's dissection of materials collected by Darwin indicated that the beak is relatively poorly supplied with nerves, and that as an organ of touch it is not to be compared with the highly innervated bills of certain ducks and waders.

The flight of skimmers, while they are foraging, is graceful in the extreme. The short stroke of their wings and the eerie manner in which the body of the bird seems to bound up and down in the air, give the impression of slow movement, and yet I found in the Gulf of Guayaquil that they easily outdistanced a launch credited with a speed in excess of 25 miles per hour. Gibson (1920, 73) saw a skimmer pursued by several lapwings (*Belonopterus*), as though the latter were attempting to rob it of fish, but the swiftness of flight and agility in turning of the former bird set the lapwings utterly at nought. The black and white livery, the beak formation, and the excited barking voices of the skimmers all combine to make one think of aërial beagles hot on the scent of aërial rabbits. The simile may seem far-fetched, but the skimmers themselves are unreal and unworldly birds, with their impractical looking forward ends, the peculiar lightness of their lilting flight, and the calls that sound like dogs baying in a dream.

There has been considerable recent discussion regarding the function of the "plowing" habit of skimmers, that is, of the manner in which they cut the water with the elongate lower mandible and their "purpose" in so doing. It is this custom which has made the "skimming" of the bird usually thought of as synonymous with feeding. Close observation will show, however, that the skimming or plowing is done frequently, if not invariably, with the bill closed except when the birds snap the mandibles with an audible click or open the mouth to utter their characteristic bark. Furthermore, during the skimming process the bill is not thrust far enough under the surface for food to be swept into the extremely small mouth, even if it were open. The act really amounts

only to a cutting of the water, rather than to "skimming." Bales (1919, 83) calls attention to the fact that the birds have a deeply fixed predilection for barely clearing any sort of surface, so that when they fly for considerable distances over areas of mud and sand, the tip of the lower mandible is held in such close contact that it appears almost to touch. Robinson and Richmond report that they often saw these birds "skimming" over the thin silvery sheet of water spread up over the sand by a breaking wave, under which circumstances it is practically impossible that they could have been feeding. It was doubtless observations related to these that misled Salvin and Godman (1903, 417) into believing that the skimmers "will plow up the mud in search of small molluscs."

The so-called skimming habit is properly to be regarded as a reaction of genetic origin, primarily without purpose or adaptive meaning but, like any other trait of congenital behavior, capable of an adaptive selection. Its fixity, and its lack of obligatory relation to feeding, is emphasized by the discovery of Arthur (1921, 556) that the birds "skim" assiduously when they are disturbed or frightened, as by being driven from their nests, and that at such times they are certainly not engaged in hunting for food but are, on the contrary, altogether distracted from any such aim. Arthur would, in fact, entirely dissociate the skimming habit from its traditional relationship with feeding, for he believes that most of the successful fishing of the birds is done not while they are in flight at all, but while they are standing in shallow water.

The fact may be freely accepted that skimmers sometimes fish from a standing point of vantage; despite their very short legs, they may frequently be seen at rest or walking in water that reaches their feathers, and striking, as better waders such as herons might do, at the minnows which scurry across the shallows. At the same time, the precise evidence that skimmers capture much of their food while they are on the wing is so extensive that it cannot be gainsaid. Darwin, one of the most scrupulous of observers, wrote as follows of observations made in May near Maldonado, Uruguay, where he watched skimmers from the borders of a lake which had been partly drained and which, in consequence, swarmed with small fry.

> I watched many of these birds flying backwards and forwards for hours together, close to its surface. They kept their bills wide open, and with the lower mandible half buried in the water. Thus skimming the surface, generally in small flocks, they ploughed it in their course; the water was quite smooth, and it formed a most curious spectacle, to behold a flock, each bird leaving its narrow wake on the mirror-like surface. In their flight they often twisted about with extreme rapidity, and so dexterously managed, that they ploughed up small fish with their projecting lower mandibles, and secured them with the upper half of their scissor-like bills. This fact I repeatedly witnessed, as, like swallows, they continued to fly backwards and forwards, close before me. Occasionally, when leaving the surface of the water, their flight was wild, irregular, and rapid; they then also uttered loud harsh cries (Gould, 1841, 143).

To this Gibson (1920, 73) adds the following concerning a single bird he observed in the Province of Buenos Aires.

> . . . it skimmed along the surface of the water for about 20 yards with a third of its bill immersed; then rose, circled once or twice, and repeated the surface-glide. For a long time, fascinated, I watched the dexterous and imperceptible use of wings and tail, the reflection of the bird

in the calm sunset-tinted pool, and the tiny furrow ploughed by its bill. And it was almost dark when I rode away and left the Skimmer and its shadow still coming and going in the dusk.

Finally, Stone (1921, 595) watched a flying skimmer at very close range near Atlantic City, New Jersey, while it drove its bill into the water, seized a fish about 8 centimeters in length, and flew off with the prey held transversely. In this instance the unequal mandibles afforded no apparent advantage, for the bird was not "plowing" at the time the fish was caught.

With these several items of testimony my own observations agree and, while watching the birds turn and cut the surface of the water again and again in the same small area during feeding evolutions, I have come to the conclusion that the only practical function of the flattened cutwater is to serve as a lure. Small fishes are doubtless attracted toward the surface either by the sight of the black and red beak moving rapidly along or, more probably, by the tiny surface circulation which it produces. The skimmer thus baits its own trail and, upon wheeling and returning, it takes advantage of the duped victims which have risen to investigate. There is no evidence based upon examination of stomach contents that the birds actually skim minute forms of life from the surface film of the water, and I have shown above that their technique and the structure of their mouths make this highly improbable. Only as an actual attraction to mobile organisms could the elongate cutwater be of advantage to the birds. In other respects, indeed, it is rather a detriment or hazard, for I myself have seen skimmers catch their beaks on submerged twigs or standing oyster-shells, so that their heads were jerked downward and backward, in one instance causing a bird to turn half a somersault and tumble into the water.

The assumed function of the skimmer's beak in creating an attraction to small fish is open to further experimental investigation. In more or less brown, opaque, river or lagoon waters of both Ecuador and the southeastern United States, I have already made the test of cutting an undisturbed surface swiftly with the slender tip of a long switch or bamboo pole. In many such instances small fish, not previously visible, promptly rose from the murky depths, as if in search of an insect which might have been the cause of the scarcely perceptible ripple. The fact that feeding skimmers so frequently "replow" their own furrow tends to make some such explanation of their behavior convincing.

The following account of the breeding habits of the Black Skimmer is based mainly upon the North American race, and is drawn in part from the study made by Bales (1919, 83) during late June in a colony of 4000 pairs on an island off the coast of Virginia. Here, as elsewhere, many of the skimmers nest at such low elevations above mean sea level that spring tides sometimes sweep over them, washing away the eggs or drowning the young birds. Four eggs constitute the usual set, though many nests contain but three, and five are by no means unknown. Drifting sand is a constant menace, for if the birds remain away from the nest for any length of time on windy days, the site is rapidly obscured and the eggs may become completely buried and lost.

All night the nesting skimmers come and go, in strong contrast with their neighbors, the terns, which become permanently quiet as soon as darkness sets

in. When a returning skimmer settles upon its eggs, it utters a liquid, cuddling note, somewhat similar to the cluck of a hen. It next presses the sharp lower edge of the bill on the sand outside the nesting site, an action which accounts for the radiating lines one finds extending in all directions from skimmers' nests. Since the bird always flies up the wind to alight, and invariably faces the wind while incubating, these lines serve as a wind-rose and give a meteorological record sometimes covering many preceding days.

When driven from their nests by the approach of a visitor, skimmers usually exhibit behavior which is sometimes interpreted as a conflict between an impulse to escape and an urge to remain upon the eggs. This, according to the theory just suggested, results in the indecisive and crippled fluster which is anthropomorphically interpreted as a "trick" to lure an intruder away. It is unlikely, however, that such a widely known instinctive response among birds of many groups is to be explained so simply. At any rate, the skimmers stagger and flutter, and beat the sand with their long wings. As soon as they recover from their first emotional debauch, they will alight and repeatedly open and close their bills without making a sound, "as though they were swearing under their breath." When the coast is again clear, so that they are free to react to the pull of the nest, they never alight directly at the site but come down a short distance away, afterwards toddling up on their absurdly small Chinese-lady feet.

Young skimmers exhibit such a characteristic Charadriiform tendency to "freeze" or lie motionless upon the sand which they so much resemble that care is necessary to avoid stepping upon them. When they first hatch, the maxilla and mandible are of the same length, but the latter is already the longer by the time the down gives place to the first contour feathers. During the early part of their lives, the nestlings are fed upon regurgitated food, which is well digested by the parents; before they are quite past the downy stage, however, they begin to receive whole fish. Arthur lists nine species commonly captured by skimmers in Louisiana, and states that the largest example he had seen fed by parent birds to nestlings was 73 millimeters in length. Howell (1932, 275) reports that killifishes and blennies were the common species found in stomachs examined at the United States Biological Survey

BIBLIOGRAPHY

(Since page references, as well as date of publication, are cited in parentheses throughout the text, no additional means have been considered necessary for locating the particular source of information among several papers published during a single year by any one author.)

Aagaard, Bjarne, 1928. The 'Norvegia' expedition and Bouvet Island. Corrected reprint from the Norwegian Journal of Commerce and Shipping, Mar.–Apr., 36 p., 1 fig.

1929. Antarctic whaling and exploration. Scot. Geogr. Mag., **45**:23–34, 65–81, 15 figs.

Abbott, C. C., 1860. The penguins of the Falkland Islands. Ibis, **2**:336–338.

1861. Notes on the birds of the Falkland Islands. Ibis, **3**:149–167.

Acworth, Bernard, 1930. This bondage: a study of the "migration" of birds, insects, etc. London: xxiv + 229 p., 6 figs.

Agassiz, Prof., and Mrs. Louis, 1868. A journey in Brazil. Boston, 540 p.

Agostini, A. M. de, 1924. Zehn Jahre im Feuerland. Leipzig, 308 p., 118 tables, 2 panoramas, 3 maps.

Aikman, C. M., 1892. The nitrate-fields of Chile. Blackwood's Magazine, Edinburgh, **151**:437–445.

Ainsworth, G. F., 1915. Life on Macquarie Island, etc., in: Mawson's "The home of the blizzard." Philadelphia, **2**:167–254.

Alayza y Paz-Soldan, Francisco, 1903. Informe sobre la provincia litoral de Moquequa y el departamento de Tacna. Bol. Cuerpo de Ingenieros de Minas del Perú, no. 3.

Albert, Federico, 1899. Contribución al estudio de las aves chilenas. Anal. Univ. Chile, Santiago, **102–103**:209–255, 445–448, 579–591, 677–690, 829–847.

1900. *Idem*, **105–106**:580–591.

Alexander, W. B., 1921. The Tubinares (petrels and albatrosses) in the Gould collection at Philadelphia. Emu, **20**:224–227.

1922. Observations and records of Australian sea-birds, 1920–21. Emu, **21**:261–272.

1927. Note on Wilson's phalarope in the South Pacific Ocean. Auk, **44**:247–248.

1928. Birds of the ocean. New York, 428 p., illus.

Allee, W. C., and Masure, R. H., 1933. The social order in flocks of the common chicken and pigeon. Bull. Ecol. Soc. Amer., **14**, no. 4, 8th abstract.

Allen, A. A., 1934. A new bird for North America. Univ. of the State of N. Y., Bull. to the Schools, **20**, no. 13:134, 135.

1934. Sex rhythm in the ruffed grouse (*Bonasa umbellus* Linn.) and other birds. Auk, **51**:180–199, 4 pls.

Allen, G. M., 1905. Summer birds in the Bahamas. Auk, **22**:113–133, 1 pl.

Allen, H. T., 1920. Fauna of the dependencies of the Falkland Islands. Report of the Interdepartmental Committee on Research and Development in the dependencies of the Falkland Islands, Command Paper 657, Appendix 18:126–130.

Allen, W. E., 1925. Statistical studies of surface catches of marine diatoms and dinoflagellates made by the yacht 'Ohio' in tropical waters in 1924. Jan. Trans. Amer. Microscop. Soc.:24–30, 1 fig.

1934. The primary food supply of the sea. Quarterly Rev. of Biology, **9**:161–180.

Álvarez, Teodoro, 1933. Observaciones biológicas sobre las aves del Uruguay. Anal. del Mus. de Hist. Nat. de Montevideo, (2) 4:1–50.

Amaral, Afrânio, 1921. Contribuiçao para o conhecimento dos ofídios do Brasil. Anexos Mem. Inst. Butantan, **1**:7–44, 17 pls.

Ambrose, John, 1864. Habits of the storm petrel. Trans. Nova Scotia Inst. Nat. Sci., **1**:34–37.

Ameghino, Florentino, 1901. L'Age des formations sédimentaires de Patagonie. Anal. Soc. Cient. Argentina, **51**:65–91.

American Ornithologists' Union, Check-List of North American birds, 1931. Lancaster, Pa., 4th edit., 526 p.

Amundsen, Roald, 1913. The South Pole. London, **1**:1–392, **2**:1–438, maps.

Andersen, Knud, 1894. *Diomedea melanophrys*, boende paa Færöerne. Videnskab. Meddel. Copenhagen, **6**:241–265, pl. 5.

1895. *Diomedea melanophrys* in the Færöe Islands. Proc. Roy. Phys. Soc. Edinburgh, **13**:91–114, pls. 2, 3.

Andersson, K. A., 1908. Das höhere Tierleben im antarktischen Gebiete. Wissenschaftl. Ergebnisse der Schwedischen Südpolar-Expedition, 1901–3. **5**, Zoologie, I, Vögel: 19–58, 2 maps, pls. 1–10.

André, Eugène, 1904. A naturalist in the Guianas. London, 303 p., 34 illus., map.

Anthony, A. W., 1889. Nesting habits of the California brown pelican. Proc. Calif. Acad. Sci. (2) **2**:83–85.

1898. Two new birds from the Pacific coast of America. Auk, **15**:36–38.

1898. Petrels of southern California. Auk, **15**:140–144.

1898. Avifauna of the Revillagigedo Islands. Auk, **15**:311–318.

1898. The boobys of the Revillagigedo Islands. Osprey, **3**:3–6.

1925. Expedition to Guadalupe Island, Mexico, in 1922. The birds and mammals. Proc. Calif. Acad. Sci. (4) **14**:277–320.

Aplin, O. V., 1894. On the birds of Uruguay. Ibis (6) **6**:149–215, pl. 5.

Archey, Gilbert, 1923. Notes on birds of the sub-antarctic islands of New Zealand. Rec. Canterbury Mus., **2**:117–120.

Archey, Gilbert, and Lindsay, Charles, 1924. Notes on the birds of the Chatham Islands. Rec. Canterbury Mus., **2**:187–201.

Armstrong, W. J. T., 1910. On Albatross Island. Emu, **9**:155–157.

Arribálzaga, E. L., 1924. Nombres vulgares argentinos de las aves silvestres de la república. Hornero, **3**:259–277.

Arthur, St. C., 1921. The feeding habits of the black skimmer. Auk, **38**:566–574.

Austin, O. L., Jr., 1928. Migration-routes of the arctic tern (*Sterna paradisaea* Brünnich). Bull. N. E. Bird-Banding Assoc., **4**:121–125.

Azara, Felix de, 1805. Apuntamientos para la historia natural de los paxaros del Paraguay y Río de La Plata. Madrid, 3.

1809. Voyages dans l'Amérique méridionale . . . 1781–1801. Paris, 4 vols.

Bales, B. R., 1919. Twenty-four hours in a black skimmer colony. Wilson Bull., **31**: 83–87.

Ball, John, 1887. Notes of a naturalist in South America. London, 416 p., map.

Ballén, F., and Gastiaburú, J. C., 1925. La emigración y mortalidad de las aves en el verano de 1925. Memoria de la Compañía Administradora del Guano, **11**:41–45.

Bancroft, Griffing, 1929. A new Pacific race of gull-billed tern. Trans. San Diego Soc. Nat. Hist., **5**, no. 19:283–286.

Bangs, Outram, 1902. The occurrence of boobies in numbers on the east coast of Florida, during a storm. Auk, **19**:395, 396.

Bangs, Outram, and Kennard, F. H., 1920. A list of the birds of Jamaica. Excerpt from: The handbook of Jamaica, 1920.

Bangs, Outram, and Penard, T. E., 1919. Some critical notes on birds. Bull. Mus. Comp. Zoöl., Harvard Coll., **63**, no. 2: 21–40.

Banks, Joseph. See Hooker, 1896.

Bannerman, D. A., 1914. The distribution and nidification of the Tubinares in the North Atlantic islands. Ibis (10) **2**:438–494, map (pl. 7), table on p. 443.

1930. The birds of tropical West Africa. **1**, 376 p., maps, text-figs., and colored plates.

Barbour, Thomas, 1923. The birds of Cuba. Mem. Nuttall Orn. Cl., no. 6, 4 pls.

Barclay, W. S., 1917. Sand-dunes in the Peruvian desert. Geogr. Journ., **49**:53–56, 4 figs.

1926. The land of Magellan. London, 28 illus., 3 maps.

Barrere, Pierre, 1743. Nouvelle relation de la France Equinoxiale, contenant la description des côtes de la Guiane; de l'Isle de Cayenne . . . les moeurs et coûtumes des différens peuples sauvages qui l'habitent. Paris, 250 p.

Barros V., Rafael, 1921. Aves de la cordillera de Aconcagua. Rev. Chil. Hist. Nat., **25**:167–192, 1 pl., 2 figs.

Barrow, K. M., 1910. Three years in Tristan da Cunha. 280 p., 37 illus., map.

Bartlett, A. D., 1879. Remarks upon the habits and change of plumage of Humboldt's penguin. Proc. Zoöl. Soc. London: 6–9, figs. 1, 2.

Bartsch, Paul, 1919. The bird rookeries of the Tortugas. Ann. Rep. Smithson. Inst., 1917:469–500, 38 pls.

Bates, R. W., Lahr, E. L., and Riddle, Oscar, 1935. The gross action of prolactin and follicle-stimulating hormone on the mature ovary and sex accessories of fowl. Amer. Journ. Physiology, **3**, no. 2:361–638.

Baty, R. R. du. See du Baty.

Baur, G., 1879. Birds of the Galápagos Archipelago. A criticism of Mr. Robert Ridgway's paper. Amer. Nat., **31**:777–784.

1891. On the origin of the Galápagos Islands. Amer. Nat., **25**:217–229, 307–326.

Beatty, H. A., 1931. Notes on birds observed at Guanica Lagoon, Puerto Rico. Journ. Dept. Agric. Puerto Rico, **25**, no. 1:19–32.

Beck, R. H., 1902. The wingless cormorant of the Galápagos. Condor, **4**:20, 21.

1904. Bird life among the Galápagos Islands. Condor, **6**:5–11, illus.

1910. Water birds of the vicinity of Point Pinos, California. Proc. Calif. Acad. Sci. (4) **3**:57–72.

1917. Bird photographing on the Falkland Islands. Amer. Mus. Journ., **17**:428–460, 34 illus.

1918. Narrative of a bird quest in the vicinity of Cape Horn. Amer. Mus. Journ., **18**, nos. 1, 2:4–24, 111–119, 32 illus.

1919. Recollections of travel in Peru. Nat. Hist., **19**:183–191.

Beddard, F. E., 1888. Notes on the visceral anatomy of birds. No. 2. On the respiratory organs in certain diving birds. Proc. Zoöl. Soc. London:252–258.

Beebe, C. W., 1907. An ornithological reconnaissance of northeastern Venezuela. Zoologica, **1**:67–114.

1924. Galápagos, world's end. New York, London, 429 p., 24 pls., 83 phots.

1926. The Arcturus adventure. New York, 425 p., 77 illus., maps.

Beebe, M. B., and C. W., 1910. Our search for a wilderness. New York, 408 p.

Beer, G. R. de, 1930. Embryology and evolution. Oxford, 116 p.

Belanske, W. E., 1927. See Vanderbilt, W. K.

Belcher, C. F., 1914. Notes on birds observed in the South Pacific Ocean during a voyage from Sidney to Valparaiso. Ibis (10) **2**: 588–596.

Belcher, Charles, and Smooker, G. D., 1934, 1935. Birds of the colony of Trinidad and Tobago. Ibis, 1934, (13) **4**, no. 3:572–595; 1935, (13) **5**, no. 2:279–297.

Bellin, S., 1743. Déscription géographique de la Guyane. Paris, 294 p.

Bellingshausen, F. von (1831), 1902. Forschungsfahrten im südlichen Eismeer 1819–1821, auf Grund des russischen Originalwerks. Verein für Erdkunde zu Dresden. Leipzig, 203 p.

Bennett, A. G., 1920. Breves notas sobre las aves antárcticas. Hornero, **2**:25–34.

1922. Problemas que presenta la migración en algunas especies de aves sudamericanas. Hornero, **2**:255–258.

1924. Notas sobre el pato vapor *Tachyeres Patachonicus* (King) llamado "Canvas-back Duck" en las Falklands. Hornero, 1923–26, **3**, no. 3:280–282.

1926. A list of the birds of the Falkland Islands and dependencies. Ibis (12) **2**:306–333, pls. 4–6.

1927. The adaptability of subantarctic and antarctic birds to local conditions. Emu, **26**:259–263.

1927. The black-bellied storm petrel, *Fregetta tropica melanogaster*, breeding in South Shetlands. Oöl. Rec., **7**:79–80.

1931. Additional notes on the birds of the Falkland Islands and dependencies. Ibis (13) **1**:12, 13.

1931. Whaling in the antarctic. London, 222 p. ("Creatures of the antarctic,": 174–209).

Bennett, George, 1834. Note on the habits of the king penguin, *Aptenodytes patachonica*. Proc. Zoöl. Soc. London, 1834–36, pt. 1, p. 34.

1834. Note on the nasal gland of the wandering albatross. Proc. Zoöl. Soc. London, 1834–36, pt. 1, p. 151.

1860. Gatherings of a naturalist in Australasia. London, 456 p., illus.

Bent, A. C., 1919. Life histories of North American diving birds. Bull. 107, U. S. Nat. Mus., 245 p., 55 pls.

1921. Life histories of North American gulls and terns. Bull. 113, U. S. Nat. Mus., 345 p., 93 pls.

1922. Life histories of North American petrels and pelicans and their allies. Bull. 121, U. S. Nat. Mus., 343 p., 69 pls.

1927. Life histories of North American shore birds (pt. 1). Bull. 142, U. S. Nat. Mus., 420 p., 55 pls.

1929. Life histories of North American shore birds (pt. 2). Bull. 146, U. S. Nat. Mus., 412 p., 66 pls.

Berg, Karl, 1901. Ornithologisches. Comunicaciones del Museo Nacional de Buenos Aires, **1**:283–287.

Bergmann, A., 1847. Ueber die Verhältnisse der Wärmeökonomie der Thiere zu ihrer Grösse. Göttinger Studien, pt. 1:595–708.

Bergtold, W. H., 1917. A study of the incubation periods of birds. Denver, Colorado: 1–109.

Berlepsch, Hans von, 1908. On the birds of Cayenne. Novit. Zool., **15**:103–164, 261–324.

Berlepsch, Hans von, and Stolzmann, J., 1892. Résultats des recherches ornithologiques faites au Pérou par M. Jean Kalinowski. Proc. Zoöl. Soc. London:371–411.

Bernacchi, Louis, 1901. To the South Polar regions. London, 334 p., illus., map.

Bernsée, F., 1855. Letter from Falkland Islands. Proc. Acad. Nat. Sci. Phila., **7**:287, 288.

Bibra, Freiherr von, 1853. Beiträge zur Naturgeschichte von Chile. Denkschriften der Kaiserlichen Akademie der Wissenschaften, Wien, **5**:73–142, pls. 4–8.

Bigelow, H. B., 1926. Plankton of the offshore waters of the Gulf of Maine. Bull. U. S. Bur. Fisheries, **40**, pt. 2.

1931. Oceanography. New York, 263 p.

Bishop, L. B., 1934. A new petrel for North America. Auk, **51**:77.

Blaauw, F. E., 1912, 1913. Across South America to Tierra del Fuego and back through the Smith-Channel. Notes Leyden Mus., **35**:1–75, 2 pls.

1913. My antarctic goose. Avicultural Magazine, (3) **4**:144–149.

1916. Field-notes on some of the water fowl of the Argentine Republic, Chile, and Tierra del Fuego. Ibis (10) **4**:478–492, pl. 14.

1917. The steamer duck. Ibis (10) **5**:274–276.

1920. On the type specimen of *Chloëphaga inornata* King in the British Museum, and some further notes. Ibis (11) **2**:497–498, pl. 13.

1921. Days with the birds of Tierra del Fuego. Nat. Hist., **21**:51–68, illus.

Blofeld, J. H., 1852. Notes on St. Helena. Proc. Geol. Soc., London:195, 196.

Boase, Henry, 1924. Courting display of the fulmar. Brit. Birds, **18**:45–48.

Boetticher, Hans von, 1932. Vögel ferner Meere. 1. Albatrosse. Vögel ferner Länder, **6**:137–145, fig., map.

Bognoly, J. A., and Espinosa, J. M., 1917. Las islas encantadas ó el archipiélago de Colón. Guayaquil, 172 p.

Bolle, Carl, 1861. Guano Gewinnung auf den Chincha Inseln. Journ. f. Orn., **9**:387–392.

Bond, James, 1928. The distribution and habits of the birds of the Republic of Haiti. On the birds of Dominica, St. Lucia, St. Vincent, and Barbados, B. W. I. Proc. Acad. Nat. Sci. Phila., **80**:483–545.

Bonhote, J. L., 1903. On a collection of birds from the northern islands of the Bahama group. Ibis (8) **3**:273–315.

Borchgrevink, C. E., 1901. First on the antarctic continent. London, 333 p.

Bosworth, T. O., 1922. Geology of the tertiary and quaternary periods in the northwest part of Peru. London.

Boubier, Maurice, 1919. La distribution géographique des Manchots (Sphéniscidés) et son interprétation géophysique. Rev. Franç. d'Ornith., **6**:131–136.

Bougainville, Baron de, 1837. Journal de la navigation autour du globe. Paris, **1**:1–742, **2**:1–351 (also in **2**, Observations astronomiques, 162 p.).

Bowdish, B. S., 1902. Birds of Porto Rico. Auk, **19**:356–366.

Bowman, Isaiah, 1916. The Andes of southern Peru: geographical reconnaissance along the seventy-third meridian. New York, 313 p., maps, illus.

1930. Polar exploration. Science, **72**:439–449.

Boyd, A. J., 1893. Reminiscences of the Chincha Islands. Proc. and Trans. Queensland Branch of Roy. Geogr. Soc. of Australia, **8**:3–12.

Boyson, V. F., 1924. The Falkland Islands. Oxford, 390 p.

Brabourne, Lord, 1913, 1914. Glimpses of South American ornithology. Avicultural Magazine (3) 5:324–330.

Brabourne, Lord, and Chubb, Charles, 1912. The birds of South America. London, 1: 1–443.

Bradlee, T. S., 1906. Audubon's shearwater and Peale's petrel breeding in Bermuda. Auk, 23:217.

Bradlee, T. S., Mowbray, L. L., and Eaton, W. F., 1931. A list of birds recorded from Bermuda. Proc. Boston Soc. Nat. Hist., 39:279–382, pls. 43–45.

Brewster, William, 1912. Notes on the flight of gulls. Auk, 29:85–92.

Broch, O. A., 1927. Gesteine von der Peter I-Insel, West Antarktis. Avhandlinger Norske Videnskaps-Akad., Oslo, 1. Mat.-Nat. Klasse, no. 9.

Bronson, W. S., 1931. Paddlewings, the penguin of the Galápagos. New York, 106 p., illus.

Brooks, C. E. P., 1920. The climate and weather of the Falkland Islands and South Georgia. Geophysical Memoirs, no. 15: 97–146.

Brooks, S. C., 1934. Oceanic currents and the migration of pelagic birds. Condor, 36: 185–190.

Brooks, W. S., 1917. Notes on some Falkland Island birds. Bull. Mus. Comp. Zoöl. Harvard Coll., 61:135–160, pls. 1–3.

Brown, R. N. R., 1905. Diego Álvarez, or Gough Island. Scot. Geogr. Mag., 21: 430–440.

1913. Ornithology of the Scottish National Antarctic Expedition. Sect. 6—The life and habits of penguins. Sci. Res. Scot. Nat. Antarct. Exped., 4:249–253.

Brown, R. N. R., Mossman, R. C., Pirie, J. H. H., 1906. The voyage of the 'Scotia.' Edinburgh, London, 366 p., illus.

Bruce, W. S., 1907. Some ornithological results of the Scottish National Antarctic Expedition. Proc. Fourth Internat. Ornith. Congress, London, Ornis, 14:271–274.

1913. Ornithology of the Scottish National Antarctic Expedition. Sect. 1—Introduction. Sci. Res. Scot. Nat. Antarct. Exp. 4:203–205.

Brüggen, J., 1934. Grundzüge der Geologie und Lagerstättenkunde Chiles. Math. Naturwissenschaftl. Klasse der Heidelberger Akad. Wissensch., 362 p., 76 maps and figs.

Bryant, Henry, 1859. A list of birds seen at the Bahamas, from Jan. 20 to May 14, 1859, with descriptions of new or little-known species. Proc. Boston Soc. Nat. Hist., 7:102–134.

Bryant, W. E., 1886, 1887. Additions to the ornithology of Guadaloupe Island. Bull. Calif. Acad. Sci. 2:269–318.

1887. Description of a new subspecies of petrel from Guadaloupe Island. Bull. Calif. Acad. Sci. 2:450–451.

Bryce, James, 1912. South America, observations and impressions. New York, 611 p., 5 maps.

Bullen, G. E., 1908. Plankton studies in relation to the western mackerel fishery. Jour. Marine Biol. Assn. United Kingdom, (N.S.) 8:269–303.

Buller, W. L., 1873. A history of the birds of New Zealand. London, 384 p., pls.

1888. A history of the birds of New Zealand. London, 2d edit., 1:1–250, 2:1–340.

1893. On the birds observed during a voyage from New Zealand to England. Trans. and Proc. N. Zealand Inst., 26:182–199.

1898. On the ornithology of New Zealand. Trans. and Proc. N. Zealand Inst., 31:1–37.

1905. Supplement to the 'Birds of New Zealand.' London, 1:ix–1, 1–200, 2:1–167.

Bullock, D. S., 1929. Aves observadas en los alrededores de Angol. Rev. Chil. Hist. Nat., 33:171–211.

Burmeister, C. V., 1888. Expedición a Patagonia por encargo del Museo Nacional. Anal. Mus. Nac. Buenos Aires, 3, 1883–1891, Aves:315–321.

Burmeister, Hermann, 1854. Systematische Uebersicht der Thiere Brasiliens. Pt. 2, Vögel:1–466.

1860. Systematisches Verzeichnis der in den La Plata-Staaten beobachteten Vögelarten. Journ. f. Orn., 8:241–268.

1876. Description physique de la République Argentine. Paris, 1 (French edit.).

Burne, R. H., 1908. Note on olfactory gland of *Diomedea exulans*. Proc. Zoöl. Soc. London, 1:66, text-fig. 16 (p. 65).

Burton, Edward, 1822. Observations on the natural history and anatomy of the *Pelecanus Aquilus* of Linnaeus. Trans. Linn. Soc. London, **13**:1–11.

Byron, John, 1748. Narrative of the Hon. John Byron (Commodore in a late expedition round the world) containing an account of the great distresses suffered by himself and his companions on the coast of Patagonia, from the year 1740, till their arrival in England, 1746. London, 2d edit.:i–viii, 1–257.

Cahn, A. R., 1922. Brown pelicans at home. Nat. Hist., **22**:417–429.

Campbell, A. G., and Mattingley, A. H. E., 1907. A rookery of storm-petrels. Emu, **6**:185–192.

Campbell, George, 1877. Log-Letters from 'The Challenger.' London, 2d edit., 504 p., map.

Carcelles, Alberto, 1927. Notas sobre algunas aves antarcticas. Hornero, **4**:82, 83.

1931. Notas sobre algunas aves de la Isla de Sud Georgia. Hornero, **4**:398–401, pl. 13.

Carmichael, Dugald, 1818. Some account of the Island of Tristan da Cunha and of its natural productions. Trans. Linn. Soc. London, **12**:483–513.

Carriker, M. A., Jr., 1910. An annotated list of the birds of Costa Rica including Cocos Island. Ann. Carnegie Mus., **6**:314–915, map.

Carte, Alexander, 1866. On an undescribed species of petrel from the Blue Mountains of Jamaica. Proc. Zoöl. Soc. London:93–95, pl. 10.

Carter, L. C., and Malcolm, John, 1927. Observations on the biochemistry of "mutton bird" oil. Biochemical Journ., **21**:484–493.

Cassin, John, 1856. The U. S. Naval astronomical expedition to the southern hemisphere 1849–1852. **2**, Birds:172–206, 15 pls.

1858. U. S. exploring expedition during the years 1838–1842. Philadelphia, **8**, Mammalogy and Ornithology:5–452.

Castañón, J., Cañas, F., Asencios, F., Eboli, J., Raimondi, A., San Martín, M. J., 1928. Informes de la comisiones encargadas de medir el guano de las Islas de Chincha. (1853.) Bol. de la Compañia Administradora del Guano, **4**:178–187.

Chapman, F. M., 1908. Pelican Island. P. 83–112 in: Camps and cruises of an ornithologist. New York, 415 p., illus.

1908. A contribution to the life-histories of the booby (*Sula leucogastra*) and man-o'-war bird (*Fregata aquila*). Papers from the Tortugas Laboratory of Carnegie Inst. Wash., **2**:139–151, 6 pls.

1917. The distribution of bird-life in Colombia. Bull. Amer. Mus. Nat. Hist., **36**:i–x, 1–729, pls. 1–41.

1919. Notes from a traveler in the tropics. Pt. 3: From Panama to Peru, Pt. 4: Peru. Bird-Lore, **21**:87–91, 157–166.

1924. Brown pelican caught by a sea-lion. Bird-Lore, **26**:328, fig.

1926. Darwin's Chile. Geogr. Journ., **68**: 369–385.

1926. The distribution of bird-life in Ecuador Bull. Amer. Mus. Nat. Hist., **55**:1–784, pls. 1–30, 20 text-figs.

1933. Autobiography of a bird-lover. New York, 385 p., illus., 4 pls.

1934. Descriptions of new birds from Mocha Island, Chile, and the Falkland Islands, with comments on their bird life and that of the Juan Fernández Islands and Chiloé Island, Chile. Amer. Mus. Novit., no. 762:1–8.

Cheeseman, T. F., 1891. On the birds of the Kermadec Islands. Trans. and Proc. N. Zealand Inst., 1890, **23**:216–226.

Cherrie, G. K., 1916. A contribution to the ornithology of the Orinoco region. Brooklyn Mus. Sci. Bull., **2**, no. 6:133a–374.

Cherry-Garrard, Apsley, 1921. The worst journey in the world: Antarctic 1910–1913. London, 1:1–300, 2:301–578, illus.

Chilton, Charles (editor), 1909. The subantarctic islands of New Zealand. Wellington, N. Z., 1:1–388, 2:389–807.

Chubb, Charles, 1916, 1921. The birds of British Guiana. London, 1:1–500, 2:1–589.

Chun, Carl, 1900. Aus den Tiefen des Weltmeeres. Schilderungen von der Deutschen Tiefsee-Expedition. Jena, 390 text-figs., 46 phots.

Clark, A. H., 1902. The birds of Margarita Island, Venezuela. Auk, **19**:258–267.

1903. Notes on the habits of certain Venezuelan birds. Auk, **20**:285–293.

1926. Bird life on Margarita Island, Venezuela. Sci. Monthly, **22**:533–536.

CLARK, JOHN, 1882. The composition of some fossil eggs, from the Peruvian guano deposits. Proc. Philosoph. Soc. of Glasgow, 13:573–575.

CLARKE, W. E., 1905. On the birds of Gough Island, South Atlantic Ocean. Ibis (8) 5:247–268.

1913. Ornithology of the Scottish National Antarctic Expedition. Sect. 5—On the birds of the South Orkney Islands. Sci. Res. Scot. Nat. Antarct. Exped., 4:219–247, pls. 1–4, 6, 7.

1913. Idem. Sect. 7—On the birds of the Weddell and adjacent seas, Antarctic Ocean. Sci. Res. Scot. Nat. Antarct. Exped., 4:255–270.

1913. Idem. Sect. 9—On the birds of Gough Island, South Atlantic Ocean. Sci. Res. Scot. Nat. Antarct. Exped., 4:277–289, pl. 5.

CLAY, C. T., 1911. Some diving notes on cormorants. Condor, 13:138.

CLAYTON, H. H., 1923. World weather. New York, 381 p.

1928. The bearing of polar meteorology on world weather. In: Problems of polar research, spec. publ. no. 7. Amer. Geogr. Soc.:27–37, 9 figs.

1934. World weather records. Smithson. Misc. Coll., 90, 616 p.

CLAYTON, WILLIAM, 1776. An account of Falkland Islands. Philos. Trans., 66:99–108.

CLOWES, A. J., 1933. Influence of the Pacific on the circulation in the south-west Atlantic Ocean. Nature, 131:189–191.

COBB, A. F., 1910. Wild life in the Falkland Islands. London, Gowan's Nature books, 60 phots.

1933. Birds of the Falkland Islands. London, 88 p., 46 phots.

COKER, R. E., 1918. Ocean temperatures off the coast of Peru. Geogr. Rev., 5:127–135.

1919. Habits and economic relations of the guano birds of Peru. Proc. U. S. Nat. Mus., 56:449–511, pls. 53–69.

1920. Peru's wealth-producing birds. Nat. Geogr. Mag.:537–566, illus.

1921. An illustration of practical results from the protection of natural resources. Science, 53:295–298.

1935. The protection of birds made profitable. Science, 82, no. 2114:10–12.

COLLINGWOOD, C., 1867. Ascension: wide-awake fair and the turtle ponds. Zoölogist:979–984.

COLLINS, J. W., 1884. Notes on the habits and methods of capture of various species of sea birds that occur on the fishing banks off the eastern coast of North America, and which are used as bait for catching codfish by New England fishermen. Rep. U. S. Comm. Fish and Fisheries for 1882:311–335, pl. 1.

COLNETT, JAMES, 1798. A voyage to the South Atlantic and round Cape Horn into the Pacific Ocean. London, 179 p., pls. and charts.

COOK, JAMES, 1777. A voyage towards the South Pole and round the world performed in his Majesty's ships the 'Resolution' and 'Adventure' in the years 1772–1775. 1, 378 p.

COOKE, W. W., 1915. Bird migration. Bull. U. S. Dept. Agric.:1–47, 2 figs.

COPELAND, R., 1882. Ein Besuch auf der Insel Trinidad im südatlantischen Ocean. Abhandl. des naturwiss. Vereines zu Bremen, 7:269–280.

COPPINGER, R. W., 1884. Cruise of the 'Alert.' New York, 2d edit., 256 p., illus.

CORDOVA, ANTONIO DE, 1820. A voyage of discovery to the Strait of Magellan. London, 104 p., Eng. trans.

CORY, C. B., 1880. Birds of the Bahama Islands. Boston, 231 p., pls.

1885. The birds of Haiti and San Domingo. Boston, 186 p., pls.

1909. The birds of the Leeward Islands, Caribbean Sea. Field Mus. Nat. Hist., publ. 137, Ornith. ser., 1, no. 5:193–255.

COUES, ELLIOTT, 1864. A critical review of the family Procellaridae: pt. 1, embracing the Procellarieae, or stormy petrels. Proc. Acad. Nat. Sci. Phila., 16:72–91.

1872. Material for a monograph of the Spheniscidae. Proc. Acad. Nat. Sci. Phila., 24:170–212.

1903. Key to North American birds. Boston, 5th edit., 1:1–536, 2:537–1097.

CRADOCK, SIR CHRISTOPHER, 1908. Whispers from the fleet. London, 2d edit., illus.

CRAWSHAY, RICHARD, 1907. The birds of Tierra del Fuego. London, 158 p.

Crisp, Edwards, 1860. On the structure, relative size and use of the tail-glands in birds. Proc. Zoöl. Soc. London:254–260.

Crosthwait, H. L., 1905. A journey to Lake San Martín, Patagonia. Geogr. Journ., 25:286–291.

Cunningham, R. O., 1868. Letters from Rio de Janeiro and Ancúd. Ibis, (N. S.) 4:122–129; 486–495.

1871. Notes on the natural history of the Strait of Magellan and west coast of Patagonia. Edinburgh, 507 p., map and illus.

Cushman, J. A., and Parker, F. L., 1931. Recent foraminifera from the Atlantic coast of South America. Proc. U. S. Nat. Mus., 80, art. 3:1–24, 4 pls.

Dabbene, Roberto, 1902. Mamíferos y aves de la Tierra del Fuego é islas adyacentes. Anal. Mus. Nac. Buenos Aires, (3) 1:343–409.

1910. Ornitología argentina. Catálogo sistemático y descriptivo de las aves de la República Argentina. Anal. Mus. Nac. Buenos Aires, 18:1–513, 87 text-figs., map.

1917–19. Lariformes de la República Argentina. Hornero, 1:49–56, 129–139, 213–220.

1917–19. Notas sobre una colección de aves de la isla de Martin Garcia. Hornero, 1:29–35, 89–96, 160–168, 236–248, map.

1920. Los pingüines de las costas é islas de los mares argentinos. Hornero, 2:1–9.

1921–26. Los petreles y los albatros del Atlántico austral. Hornero, 2:157–179. 1922, 2:241–254. 1923, 3:1–33, 125–158. 1924, 3:227–238. 1926, 3:311–348.

1921. Notas sobre pichón del pingüin. Hornero, 2:226.

1922. Captura del albatros. Hornero 2:272–275.

1923. El albatros de cabeza griz nidifica en la Georgia del Sur. Hornero, 3:198, 199, 1 pl.

1926. The ornithological collection of the Museo Nacional Buenos Aires, its origin, development and present condition. Auk, 43:37–46.

1927. Una nueva especie de albatros y dos especies nuevas para la Argentina. Physis, 8:563.

Daguerre, J. B., 1922. Lista de aves collecionadas y observadas en Rosas, F. C. S. Hornero, 2:259–271.

Daly, A., 1920. A recent worldwide sinking of ocean-level. Geol. Mag., 57:246–261.

Danforth, S. T., 1931. Puerto Rican ornithological records. Journ. Dept. Agric. Puerto Rico, 15, no. 1:33–106, 8 pls.

Darlington, P. J., Jr., 1931. Notes on the birds of Río Frío (near Santa Marta), Magdalena, Colombia. Bull. Mus. Comp. Zoöl. Harvard Coll., 71, no. 6:349–421.

Darwin, Charles, 1839. Journal and remarks, 1832–1836. 3 of King, P. P., "Narrative of the surveying voyages of H. M. ships 'Adventure' and 'Beagle.' " London, 156 p.

1933. Charles Darwin's diary of the voyage of H. M. S. 'Beagle.' Edited from the MS. by Nora Barlow. New York, 451 p.

Davies, R. H., 1846. Some account of the habits and natural history of the sooty petrel (mutton bird). Tasmanian Journ. Nat. Sci., Agric. Statist., 2:13–16.

De Agostini, Alberto M., 1924. See Agostini.

de Beer, G. R., 1930. See Beer.

Deacon, G. E. R., 1933. A general account of the hydrology of the South Atlantic Ocean. Discovery Reports, 7:171–238, pls. 8–10.

1934. Die Nordgrenzen antarktischen und subantarktischen Wassers im Weltmeer. Annal. Hydr. und Marit. Meteorol., Apr.:129–136, 3 text-figs., 1 pl.

Defant, Albert, 1928. Die systematische Erforschung des Weltmeeres. Zeitschr. Gesellschaft für Erdkunde, Berlin, Jubiläums-Sonderband:459–505.

Delano, Amasa, 1817. Narrative of voyages and travels. Boston, 598 p.

Denis, Pierre, 1927. Amérique du Sud. 1:1–210; 2:211–479, pls. and text-figs. In 15 of "Géographie Universelle" publiée sous la direction de P. Vidal de la Blache et L. Gallois, Librairie Armand Colin, Paris.

Devincenzi, G. J., 1929. Aves del Uruguay. Anal. Mus. de Hist. Nat. de Montevideo, (2) 3:3–42.

Dill, H. R., 1912. Report on conditions on the Hawaiian bird reservation with a list of the birds found on Laysan. U. S. Dept. Agric. Biol. Surv. Bull. no. 42:7–24, pls. 1–9.

Dixon, C. C., 1925. The Sargasso Sea. Geogr. Journ., 66:434–442, map.

1933. Some observations on the albatrosses and other birds of the southern oceans. Trans. Roy. Canadian Inst., 19, pt. 1:117–139, pl. 1.

DIXON, JOSEPH, 1927. The surf-bird's secret. Condor, 29:3–16, 9 illus.

DOELLO-JURADO, M., 1917. Sobre aves de Puerto Deseado. Hornero, 1:8–16.

DOERING, D. A., 1881. Observaciones generales sobre la fauna del territorio conquistado. Informe oficial de la Comisión científica agregada al Estado Mayor General de la Expedition al Río Negro. (Patagonia):7–60.

DONALD, C. W., 1894. The penguins of Erebus and Terror Gulf. Proc. Roy. Phys. Soc., Edinburgh, 12:329–335.

DOVE, STUART, 1910. How the penguin fishes. Emu, 9:252–254.

DU BATY, R. R., 1912. 15,000 miles in a ketch. London, 348 p.

DUBOIS, ALPHONSE, 1883. Remarques sur les oiseaux du genre pélican (*Pelecanus*). Bull. Mus. Roy. d'Hist. Nat. de Belgique, Bruxelles, 2:1–11.

DURNFORD, HENRY, 1876. Ornithological notes from the neighbourhood of Buenos Ayres. Ibis (3) 6:157–166.

1877. Notes on some birds observed in the Chuput Valley, Patagonia, and in the neighbouring district. Ibis (4) 1:27–46.

1877, 1878. Notes on birds of the Province of Buenos Aires. Ibis (4) 1:166–203; (4) 2:58–68.

1878. Notes on the birds of central Patagonia. Ibis (4) 2:389–406.

DU TERTRE, J. B., 1667. Histoire générale des Antilles, habitées par les François. Paris, 2.

DWIGHT, JONATHAN, 1925. The gulls of the world. Bull. Amer. Mus. Nat. Hist., 52:63–401, pls. 11–15, 384 text-figs.

EARLE, AUGUSTUS, 1832. Narrative of a residence on the island of Tristan D'Acunha in the South Atlantic Ocean. In: A narrative of nine months' residence in New Zealand in 1827:287–371

EDER, P. J., 1913. Colombia. London, 288 p., 40 illus., 2 maps.

EIGENMANN, C. H., 1927. The fresh-water fishes of Chile. Mem. Nat. Acad. Sci., 22: 1–63, 16 pls.

EIGHTS, JAMES, 1838. A description of the new South Shetland Isles. Pt. 6 in: Fanning's "Voyages to the South Seas, etc.":195–216.

ELWES, ROBERT, 1859. Note on the breeding and mode of capture of the short-tailed petrel, or mutton bird (*Puffinus obscurus*) [the specific name *obscurus* is a misprint for "*brevicaudus*" which is used in the text] in the islands in Bass's Straits. Ibis, 1:397–399.

EWART, J. C., 1881. On the nostrils of the cormorant (*Phalacrocorax carbo*). Journ. Linn. Soc. Zoöl., 15:455, 456.

EWART, J. C., and MACKENZIE, DOROTHY, 1921. The moulting of the king penguin. Trans. Roy. Soc., Edinburgh, 52:115–132, 2 pls.

FALLA, R. A., 1922. Notes on petrels washed ashore, west coast, Auckland Province, N. Z. Emu, 21:206, 207.

1932. New Zealand cormorants in the collection of the Auckland Museum, with notes on field observations. Rec. Auck. Inst. Mus., 1, no. 3:139–154, pls. 25–27.

1934. The distribution and breeding habits of petrels in northern New Zealand. Rec. Auck. Inst. Mus., 1, no. 5:245–260.

FANNING, EDMUND, 1833. Voyages round the world, with selected sketches of voyages to the South Seas, etc. New York, 499 p., 5 pls.

1838. Voyages to the South Seas, Indian and Pacific Oceans, etc., between the years 1830–1837. New York, 2d edit., 324 p.

1924. Voyages and discoveries in the South Seas, 1792–1832. Salem, 355 p., illus. (Reprint.)

FARAGUET, C., 1928. Memoria sobre la cubicación del guano en la isla norte de Chincha. (1853.) Bol. de la Compañia Administradora del Guano, 4:189–194.

FAUVETY, A., 1888. Relación sobre la vida de los pengüines. Anal. Mus. Nac. Buenos Aires, 2, 1883–1891:322–326.

FEILDEN, H. W., 1888. Richardson's skua in the island of Barbados. Zoölogist, p. 350.

1889. On the breeding of *Puffinus Auduboni* in the island of Barbados. Ibis (6) 1:60–63.

1889. On the birds of Barbados. Ibis (6) 1:477–503.

FERGUSON, E. W., 1916. Observations on albatrosses at sea. Emu, 15:243–249, pl. 42.

FERRAR, H. T., 1928. Birds of Ross Dependency. N. Zealand Journ. Sci. and Tech., 9:374–382, map.

Feruglio, Egidio, 1933. I terrazzi marini della Patagonia. Ann. R. Mus. Geol. Bologna, **8** bis:1–285.

Feuillée, Louis, 1714–1725. Journal des observations physiques, mathématiques et botaniques, faites sur les côtes orientales de l'Amérique méridionale, et dans les Indes occidentales, depuis l'année 1707 jusques en 1712. Paris, 3 vols.

1768. Voyage to Magellanica in: Callander, John, 1789, "Terra australis cognita." 3 vols.

Field, G. W., 1894. Notes on the birds of Port Henderson, Jamaica, West Indies. Auk, **11**:117–127.

Filchner, Wilhelm, 1922. Zum Sechsten Erdteil: Die Zweite Deutsche Südpolarexpedition. Berlin, 410 p., maps, illus.

Filhol, M. H., 1882. Observations relatives aux caractères ostéologiques de certaines espèces d'*Eudyptes* et de *Spheniscus*. Bull. Soc. Philom. Paris, (7) **6**:226–248.

Finn, F., 1900. On the form of cormorant inhabiting the Crozette Islands. Journ. Asiatic Soc. of Bengal, **69**, pt. 2:143.

Finsch, O., 1900. Meine Beobachtungen über Fregattvögel (*Fregata aquila* L., *F. ariel* Gould). Anzeigeblatt der Ornithologischen Monatsschrift Deutscher Verein zum Schutze der Vogelwelt, **25**, no. 11:446–452.

Fisher, A. K., and Wetmore, Alexander, 1931. Report on birds recorded by the Pinchot expedition of 1929 to the Caribbean and Pacific. Proc. U. S. Nat. Mus., **79**, art. 10:1–66, pls. 1–10.

Fisher, W. K., 1904. The albatross dance at sea. Condor, **6**:78.

1904. Three boobies interviewed. Condor, **6**:89–94, illus.

1904. On the habits of the Laysan albatross. Auk, **21**:8–20, pls. 2–7.

1904. Albatross pictures. Condor, **6**:151–159, phots.

1906. Birds of Laysan and the Leeward Islands, Hawaiian group. Bull. U. S. Fish Commission, **23**, 1903:769–807, 10 pls., text-figs.

Fitz Roy, Robert, 1839. Proceedings of the Second Expedition, 1831–1836. **2** of King, P. P., "Narrative of the surveying voyages of H. M. ships 'Adventure' and 'Beagle.'"

Fleming, J. H., 1924. A new antarctic form of *Larus dominicanus* Lichtenstein. Proc. Biol. Soc. Wash., **37**:139.

Flower, S. S., 1931. On the longevity of birds. Bull. Brit. Orn. Cl., **52**:45–52.

Forbes, H. O., 1893. A list of the birds inhabiting the Chatham Islands. Ibis (6) **5**:521–546, 2 pls.

1900. Birds in the Derby Museum collected in the antarctic regions. Bull. Liverpool Museums, **2**:48–49.

1914. Notes on Molina's pelican. Ibis (10) **2**:403–420, pl. 13.

Forbes, W. A., 1882. Report on the anatomy of the petrels (Tubinares) collected during the voyage of H. M. S. 'Challenger.' Rep. Sci. Res. 'Challenger,' Zool., **4**:1–64, pls. 1–7.

Forbush, E. H., 1922. Some underwater activities of certain waterfowl. Dept. Bull. of Agric., no. 8, Boston:5–49, illus.

1925. Birds of Massachusetts. 1:481 p., numerous pls. and drawings.

Forster, 1785. Mémoire sur les albatros. Mém. Math. Phys. Paris, **10**:563–572, pls. 13–15.

Franz, Alfred, 1920. Beiträge zur Ozeanographie und Klimatologie der Deutsch-Südwestafrikanischen Küste nach Beobachtungen von S. M. S. 'Möwe.' Archiv der Deutschen Seewarte, **38**, no. 1.

Franze, Bruno, 1927. Die Niederschlagsverhältnisse in Südamerika. Petermanns Mitteilungen, Ergänzungsheft nr. 193. 79 p., 1 pl.

1929. Eine Karte des Temperaturverlaufs in Südamerika. Petermanns Mitteil., Heft 3, 4:62–65, Heft 5, 6:132–135, tafel 6.

Fraser, F. C., 1934. Zoölogical notes from the voyage of Peter Mundy, 1655–56, (b) Sea Elephant on St. Helena. Proc. Linn. Soc., London, Session 1934–35, pt. 2:33–35, pl. 2.

Frauenfeld, G. Ritter von, 1860. Ueber den Aufenthalt in Valparaiso und Ausflüge daselbst, während der Weltfahrt der k. k. Fregatte 'Novara.' Verhandl. Zool. Bot. Gesells. Wien, **10**, Abhandl.:635–640.

Frezier, A. F., 1716. Relation du voyage de la mer du sud aux côtes du Chily et du Pérou. Paris, 291 p., maps.

1717. A voyage to the South-Sea and along the coasts of Chili and Peru. London, 335 p.

FRIEDMANN, HERBERT, 1927. Notes on some Argentine birds. Bull. Mus. Comp. Zoöl., Harvard Coll., **68**:139–236.

FRISTEDT, CONRAD, 1894. List of birds from northern Australia, New Zealand, southern Pacific and southern Atlantic Oceans. Öfversigt af Kongl. Vetenskaps-Akad. Forhandl., **51**, no. 7:325–331.

FROUDE, J. A., 1886. Oceana or England and her colonies. London, new edit., 341 p.

FUENTES, F., 1914. Contribución al estudio de la fauna de la isla de Pascua. Bol. Mus. Nac. Chile, **7**:285–318.

GAIN, LOUIS, 1913. The penguins of the antarctic regions. Ann. Rep. Smithson. Inst. for 1912, Wash.:475–482, pls. 1–9.

1914. Deuxième expédition antarctique française 1908–1910. Oiseaux antarctiques, **2**, 200 p., map, illus.

GAMARRA DULANTO, LUIS, 1934. Los peligros que implica la cria de aves de corral en las islas guaneras. Bol. de la Compañia Administradora del Guano, **10**:43, 44.

1935. El guano del Perú y sus perspectivas futuras en la economía nacional. Bol. de la Compañia Administradora del Guano, **11**:473–486, 6 figs.

GARCILASSO DE LA VEGA, 1609. Los commentarios reales. Lisboa, pt. 1, book 5:100–128.

GARNOT, P., 1826. Remarques sur la zoologie des iles Malouines. Ann. Sci. Nat., **7**: 39–59.

GARRIOTT, E. B., 1900. West Indian hurricanes. Bull. H., Weather Bureau, U. S. Dept. Agric., 69 p., 7 charts.

GAY, CLAUDIO, 1847. Historia física y política de Chile. Zoologica, 1:19–182, Paris.

GERMAIN, M. F., 1860. Notes upon the mode and place of nidification of some of the birds of Chili. Proc. Boston Soc. Nat. Hist., **7**:308–316.

GIBSON, ERNEST, 1880. Ornithological notes from the neighbourhood of Cape San Antonio, Buenos Aires. Ibis, (4), **4**:151–169.

1918–1920. Further ornithological notes from the neighbourhood of Cape San Antonio, province of Buenos Ayres. Ibis (10) **6**:363–415. 1919, (11) **1**:495–537. 1920, (11) **2**:1–97.

GIBSON, JOHN, 1878. On certain birds collected by the late Captain (Rear-Admiral) P. P. King in the Straits of Magellan between the years 1826–27. Proc. Roy. Phys. Soc. Edinburgh, **4**:183–186.

GIFFORD, E. W., 1913. The birds of the Galápagos Islands, with observations on the birds of Cocos and Clipperton Islands (Columbiformes to Pelecaniformes). Proc. Calif. Acad. Sci., (4) **2**, pt. 1:1–132, pls. 1–7.

GIGLIOLI, E. H., 1870. Note intorno alla distribuzione della fauna vertebrata nell' oceano. Firenze, 96 p., 1 map.

GIGLIOLI, H. H., and SALVADORI, THOMAS, 1869. On some new Procellariidae collected during a voyage round the world in 1865–68 by H. I. M's S. 'Magenta.' Ibis, **5**:61–68.

GIGOUX, E. E., and LOOSER, GUALTERIO, 1930. Los tipos de aves conservados en el Museo Nacional de Historia Natural de Santiago. Bol. del Mus. Nac., **13**:5–33.

GILL, ISOBEL S., 1878. Six months in Ascension. London, 285 p., map.

GILLESPIE, T. H., 1919. The breeding of the king penguins. Nature, **104**:314, London.

1932. A book of king penguins. 164 p., 60 illus. from phots.

GODMAN, F. DU CANE, 1907–1910. A monograph of the petrels. London, 367 p., pls.

GOELDI, E. A., 1894–1900. As aves do Brasil. Rio de Janeiro, S. Paulo, 664 p.

1896–97. Eine Naturforscher Fahrt nach dem Littoral des südlichen Guyana zwischen Oyapock und Amazonenstrom. Bericht über die Thätigkeit der St. Gallischen naturwissenschaftlichen Gesellschaft:97–217.

1900–1906. Album de aves amazonicas. Suppl. illustrativo a Aves do Brasil. Zürich.

GOELDI, E. A., and HAGMANN, G., 1902. Aves amazonicas. Bol. Mus. Paraense, **3**:276–327.

GOETSCH, WILHELM, 1933. Die Robinson-Insel Juan Fernández und ihre biogeographischen Probleme. Phoenix, **19**:26–43.

GOLDSCHMIDT, RICHARD, 1933. Some aspects of evolution. Science, **78**, no. 2033:539–547.

GORDON, SETON, 1934. The drinking habits of birds. Nature, **133**:436–437.

GOSS, N. S., 1888. New and rare birds found breeding on the San Pedro Martir Isle. Auk, **5**:240–244.

GOSSE, P. H., 1847. The birds of Jamaica. London, 447 p.

GOULD, JOHN, 1859. List of birds from the Falkland Islands. Proc. Zoöl. Soc. London: 93–98.

1865. Handbook to the birds of Australia. London, **2**:1–583.

GOULD, JOHN, and DARWIN, CHARLES, 1838–1841. The zoölogy of the voyage of H. M. S. 'Beagle.' Pt. 3, Birds. 1838:1–16, 10 pls. 1839:17–32, 10 pls., 33–56, 10 pls., 57–96, 10 pls. 1841:97–164, 10 pls.

GRAN, H. H., 1912. The plankton production of the north European waters in the spring of 1912. Bull. Planktonique 1912:7–138. Conseil Permanent International pour l'Exploration de la Mer, Copenhagen.

GRANDIDIER, ERNEST, 1861. Voyage dans l'Amérique du Sud; Pérou et Bolivie. Paris.

GRANT, C. H. B., 1911. List of birds collected in Argentina, Paraguay, Bolivia, and southern Brazil, with field-notes. Ibis (9) **5**:80–137, 317–350, 459–478.

GRANT, C. H. B., and MACKWORTH-PRAED, C. W., 1933. *Sula nicolli*, sp. nov., White-tailed Red-footed Booby. Bull. Brit. Orn. Cl., **53**, no. 366:118, 119.

1933. The correct type-locality of the red-footed booby, *Sula sula sula* (Linnaeus). Bull. Brit. Orn. Cl., **53**, no. 368:185–187.

GREEN, J. F., 1887. Ocean birds. London, 103 p., 6 pls.

GREGORY, W. K. (discussion by R. C. Murphy), 1935. Remarks on the origins of the Ratites and Penguins. Proc. Linn. Soc., New York, nos. 45 and 46:1–18.

GRINNELL, JOSEPH, 1933. The vulture's fairway. Condor, **35**:164–166, 1 fig.

GRISCOM, LUDLOW, 1935. Critical notes on Central American birds in the British Museum: notes on New World Skimmers. Ibis (13) **5**:544–546.

GROSS, A. O., 1912. Observations on the yellow-billed tropic-bird (*Phaëthon americanus* Grant) at the Bermuda Islands. Auk, **29**: 49–71, pls. 3–11.

GROSS, W. A. O., 1935. The life history cycle of Leach's Petrel (*Oceanodroma leucorhoa leucorhoa*) on the outer sea islands of the Bay of Fundy. Auk, **52**:382–399, pls. 18–21, 1 text-fig.

GUDGER, E. W., 1929. How the laughing gull, the feathered buccaneer of Florida waters, gets its dinner. Sci. Monthly, **29**:435–439, figs. 1–3.

GURNEY, J. H., 1913. The gannet. A bird with a history. London, xvii-li, 1–560, phots., maps.

HAGERUP, O., 1926. Communities of birds. Oecological studies, I. Communities of birds of the northern Atlantic Ocean. Videns. Medd. Dansk Naturhist. Forening i Köbenhavn, **82**:127–151.

HAGMANN, GOTTFRIED, 1908. Die Vogelwelt der Insel Mexiana, Amazonenstrom. Zoolog. Jahrbücher, Jena, **26**:11–62, pls. 2–6.

HALL, ROBERT, 1900. Field notes on the birds of Kerguelen Island. Ibis (7) **6**:1–34, 2 figs.

1910. Occurrence of the king penguin in Tasmania. Emu, **9**:250, 251.

HALLINAN, THOMAS, 1924. Notes on some Panama Canal Zone birds, with special reference to their food. Auk, **41**:304–326.

HAMILTON, A., 1895. Notes on a visit to Macquarie Island. Trans. and Proc. N. Zealand Inst., 1894, **27**:559–579.

HAMILTON, J. E., 1934. The sub-antarctic forms of the great skua (*Catharacta skua skua*). Discovery Reports, **9**:161–174, pl. 1.

HANNA, G. D., 1926. Expedition to the Revillagigedo Islands, Mexico, in 1925. General Report. Proc. Calif. Acad. Sci. (4) **15**:1–113, text-figs. 1–7, pls. 1–10.

HARDY, A. C., 1928. The work of the royal research ship 'Discovery' in the dependencies of the Falkland Islands. Geogr. Journ., **72**:209–234.

HARMER, S. F., 1931. Southern whaling. Proc. Linn. Soc. London, session 142, 1929–30: 85–163.

HART, T. J., 1934. On the phytoplankton of the southwest Atlantic and the Bellingshausen Sea, 1929–31. Discovery Reports, **8**:1–268.

HARTERT, ERNST, 1893. On the birds of the islands of Aruba, Curaçao and Bonaire. Ibis (6) **5**:289–338.

1920. Die Vögel der Paläarktischen Fauna. **2**, pts. 11, 12:1345–1600.

Hartert, Ernst (and Venturi, S.), 1909. Notes sur les oiseaux de la République Argentine. Novit. Zool., **16**:159–267.

Harvey, H. W., 1928. Biological chemistry and physics of sea water. Cambridge, 194 p.

Hatt, R. T., 1934. A manatee collected by the American Museum Congo Expedition, with observations on the recent manatees. Bull. Amer. Mus. Nat. Hist., **46**:533–566.

Hayes, A. A., 1855. Report on a specimen of fossilized egg, from the guano islands, off the coast of Peru. Proc. Boston Soc. Nat. Hist., **5**:165.

Hazard, R. G., 1894. Breeding habits of the king penguin (*Aptenodytes longirostris*). Auk, **11**:280–282, pl. 8.

Heilprin, Angelo, 1906. Impressions of a naturalist in British Guiana. Bull. Amer. Geogr. Soc., **38**:539–553, 7 figs.

Heinroth, O., 1917. Beziehungen von Jahreszeit Alter und Geschlecht zum Federwechsel. Journ. f. Orn., **65**, pt. 2:81–95.

1922. Die Beziehungen Zwischen Vogelgewicht, Eigewicht, Gelegegewicht und Brutdauer. Journ. f. Orn., **70**:172–285.

1924. Lautäusserungen der Vögel. Journ. f. Orn., **72**:223–244.

Hellmayr, C. E., 1907. On a collection of birds from Teffé, Río Salimões, Brazil. Novit. Zool., **14**:40–91.

1929. A contribution to the ornithology of northeastern Brazil. Field Mus. Nat. Hist. Zoöl. ser., publ. 225, **12**:235–501.

1932. The birds of Chile. Field Mus. Nat. Hist., Zoöl. ser., publ. 308, **19**:1–472.

Hentschel, Ernst, 1933. Allgemeine Biologie des südatlantischen Ozeans, Part 1: Das Pelagial der obersten Wasserschicht. Wiss. Ergebn. D. Atlant. Exped. 'Meteor,' **11**: 1–168.

Hildebrandt, Hugo, 1929. Wie sind die Vögel zum Salzwasser eingestellt? Journ. f. Orn., **77**: Ergänzungsband 2:221–229.

Hill, S. S., 1860. Travels in Peru and Mexico. London, 1, 330 p.

H [obley], C. W., 1932. Dominica "Diablotin." Journ. Soc. for Preservation Fauna Empire, New Series, pt. 17:17–20, frontispiece (3 phots.).

Holland, A. H., 1890. On some birds of the Argentine Republic. Ibis (6) **2**:424–428.

1892. Short notes on the birds of the Estancia Espartilla, Argentine Republic. Ibis (6) **4**:193–214.

Holtedahl, Olaf, 1931. Antarctic research by the 'Norvegia' Expedition and others. Geogr. Journ., **78**, no. 5:401–413, 9 figs.

Hooker, J. D. (editor), 1896. Journal of the Right Hon. Sir Joseph Banks—during Captain Cook's first voyage in H. M. S. 'Endeavour' in 1768–1771. London, li + 457 p.

Housse, Rafael, 1924. Apuntes sobre las aves de la isla La Mocha. Rev. Chil. Hist. Nat., **28**:47–54.

1925. Adición a los "Apuntes sobre las aves de la isla La Mocha." Rev. Chil. Hist. Nat., **29**:225–227.

Howard, H. E., 1929. An introduction to the study of bird behavior. Cambridge, 136 p.

Howell, A. B., 1917. Birds of the islands off the coast of southern California. Cooper Ornith. Club, Pacific Coast Avifauna, no. 12, 127 p.

1932. Florida bird life. Fla. Dept. Game and Fresh Water Fish, 579 p., 58 pls., 72 figs.

Hudson, W. H., 1870. Ninth letter upon the ornithology of Buenos Ayres. Proc. Zoöl. Soc. London:798–802.

1871. Tenth letter on the ornithology of Buenos Ayres. Proc. Zoöl. Soc. London: 4–7.

1920. Birds of La Plata. New York, **1**:1–244, **2**:1–240.

Hull, A. F. B., 1918. On the occurrence of the crested penguin (*Eudyptes chrysocome*) in Australia. Records of Australian Mus., **12**:71–80, pls. 10, 11.

Humboldt, Alexander von, 1852. Personal narrative of travels to the equinoctial regions of America, during the years 1799–1804. (Translated by Thomasina Ross.) London, 3 vols.

Hutchinson, T. J., 1873. Two years in Peru. London, **1**:66, 108, 204, 218, **2**:131, 134, 165.

Hutton, F. W., 1865. Notes on some of the birds inhabiting the southern oceans. Ibis, **1**:276–298.

1867. Notes on the birds seen during a voyage from London to New Zealand in 1866. Ibis, **3**:185–193.

1871. On the sailing flight of the albatross. A reply to Mr. J. S. Webb. Trans. and Proc. N. Zealand Inst.:347–350.
1902. Penguins. Emu, **2**:1–9.
1903. Remarks on the flight of albatrosses. Ibis (8) **3**:81–88, 4 figs.

HYATT, ALPHEUS, 1871. Catalogue of the ornithological collection of the Boston Society of Natural History. Spheniscidae. Proc. Boston Soc. Nat. Hist., **14**:237–253.

IDRAC, P., 1925. Le vol sans battement des albatros ou comment volent les albatros. La Nature, premier semestre, 53 année: 241–247.
1926. Le vol des albatros. Rev. Franç. d'Ornith. (2) **10**:38–46, 2 pls., 4 figs.

IHERING, HERMANN VON, 1898. As aves do estado de São Paulo. Rev. Mus. Paulista, **3**:113–476.
1900. Catalogo critico-comparativo dos ninhos e ovos das aves do Brazil. Rev. Mus. Paulista, **4**:191–300.
1904. Aves de São Paulo. Rev. Mus. Paulista, **6**:345–364.

IHERING, HERMANN, and RODOLPHO VON, 1907. As aves do Brazil. Catalogos da Fauna Brazileira, **1**:i–xxxviii, 1–485, 2 pls., São Paulo.

IREDALE, TOM, 1914. The surface breeding petrels of the Kermadec group. Ibis (10) **2**:423–436, pl. 15.
1914. On *Sterna fuscata* Linné. Ibis (10) **2**:436, 437, pl. 16.
1927. The snowy albatross again. Emu, **26**: 282–285, pls. 41, 42.

JACOBI, ARNOLD, 1911. Über Stammesgeschichte und systematische Stellung der Impennes. Verh. V Internat. Ornith.-Kongress in Berlin:216–220.

JAMES, H. B., and SCLATER, P. L., 1892. A new list of Chilian birds. London, 15 p.

JEFFERSON, MARK, 1918. The real temperatures throughout North and South America. Geogr. Rev., **6**:240–267, figs.
1924. New rainfall maps of Brazil. Geogr. Rev., **14**:127–135.
1926. Actual temperatures of South America. Geogr. Rev., **16**:443–466.
1926. A new map of world rainfall. Geogr. Rev., **16**:285–290.

JESPERSEN, P., 1929. On the frequency of birds over the high Atlantic Ocean. Verhandl. VI Internat. Ornith. Kongress, Copenhagen (1926):163–172.
1930. Ornithological observations in the north Atlantic Ocean. Danish 'Dana'-Expeditions 1920–22, Oceanographical Reports, no. 7:1–36, 19 figs.
1930. Distribution of some oceanic birds in the waters east of New Zealand. Nature, **126**:280–282.

JOB, H. K., 1905. Wild wings. Boston and New York, 336 p., illus.

JOHN, D. D., 1934. The South Orkney Islands. Proc. Linn. Soc. London, session 1934–35, pt. 2:29–31.
1934. The second antarctic commission of the R. R. S. 'Discovery II'. Geogr. Journ., **83**:381–398, 9 figs.

JOHNSON, G. R., 1930. Peru from the air (with text and notes by R. R. Platt). Amer. Geogr. Soc., spec. pub. no. 12, 159 p.

JOHNSTON, I. M., 1929. Papers on the flora of northern Chile. Contrib. Gray Herbarium Harvard Univ., **85**:1–172.
1931. The vascular flora of the guano islands of Peru. Contrib. Gray Herbarium Harvard Univ., **95**, no. 2:26–35, pls. 6, 7.
1935. The flora of San Felix Island. Journ. Arnold Arboret., **16**:440–447, pl. 165.

JOHOW, F., 1896. Estudios sobre la flora de las islas de Juan Fernández. Santiago de Chile, **4**, 289 p., 2 maps, 18 pls.

JONES, F. W., 1926. Some observations on the flight of sea-birds. Trans. Roy. Soc. South Australia, **1**:36–44, figs.

JUAN, GEORGE, and DE ULLOA, ANTONIO, 1760. A voyage to South America. London, **1**: 1–498, **2**:1–410, maps.

JULLIEN, JULES, 1882. Remarques sur l'anatomie de l'*Aptenodytes patagonica* Gm. Bull. Soc. Zool. France, **7**:374–383, pls. 8–9.

KAPPLER, A., 1881. Holländisch-Guiana. Stuttgart, 495 p., map.

KEARTON, CHERRY, 1930. The island of penguins. New York:223 p., 90 phots., map.

KELLOGG, V. L., 1914. Mallophaga from birds of the South Atlantic. Brooklyn Mus. Sci. Bull., **2**, no. 1:80–89, pl. 16.

KEMP, STANLEY, and NELSON, A. L., 1931. The South Sandwich Islands. Discovery Reports, 3:133–198, pls. 11–31, text-figs. 1–21.

KENDEIGH, S. C., 1934. The rôle of environment in the life of birds. Ecol. Monogr., 4:299–417.

KENNEDY, R. G. A., 1917. A little-known bird colony in the Gulf of Mexico. Ibis (10) 5:41–43.

KIDDER, J. H., 1875. Contributions to the natural history of Kerguelen Island. Bull. U. S. Nat. Mus., Ornithology, 1, no. 2, 47 p.

1876. Contributions to the natural history of Kerguelen Island. Bull. U. S. Nat. Mus., Oölogy, 2, no. 3:1–20.

KIDDER, J. H., and COUES, ELLIOTT, 1876. A study of *Chionis minor* with reference to its structure and systematic position. Bull. U. S. Nat. Mus., no. 3:85–116.

KING, P. P., 1827. Extracts from a letter addressed by Capt. Philip Parker King, R.N., F.R.S., and L.S., to N. A. Vigors, Esq., on the animals of the Straits of Magellan. Zoöl. Journ., 3:422–432.

1829. *Idem.* 4:91–105.

1831. Characters of new genera and species of birds from the Straits of Magellan. Proc. Comm. Sci. Corr. Zoöl. Soc. London, pt. 1:14–16.

KING, P. P., and others, 1839. Narrative of the surveying voyages of H. M. Ships 'Adventure' and 'Beagle,' between the years 1826 and 1836. London, Birds, 1:532–544.

KINGHORN, J. R., and CAYLEY, N. W., 1922. On the status of several species belonging to the two genera *Fregetta* Bp. and *Fregettornis* Mathews. Emu, 22:81–97, pls. 26–29, and figs.

KINNEAR, N. B., 1934. Zoölogical notes from the voyage of Peter Mundy, 1655–1656, (a) Birds. Proc. Linn. Soc. London, Session 1934–1935, pt. 2:32–33, pl. 2.

KLUTSCHAK, H. W., 1881. Ein Besuch auf Süd-Georgien. Deutsche Rundschau für Geog. und Statist., 3:522–531.

KNIGHT, E. F., 1907. The cruise of the 'Alerte.' London, 328 p., illus.

KOENIGSWALD, GUSTAV, 1896. Ornithologia Paulista. Journ. f. Orn., 44:332–398.

KRUMBACH, THILO, 1926. Humboldtstrom. Corriente del Niño und die Unwetter in Perú. Naturwissenschaften, 14:843–845.

KRÜMMEL, OTTO, 1911. Handbuch der Ozeanographie. Stuttgart, 2d edit., 1:1–526, 2: 1–766.

KÜHN, FRANZ, 1920. Der sogenannte "Südantillen-Bogen" und seine Beziehungen. Zeitschr. Gesell. für Erdkunde zu Berlin: 249–262.

KÜKENTHAL, W., 1907. Die marine Tierwelt des arktischen und antarktischen Gebietes in ihren gegenseitigen Beziehungen. Veröffentl. Inst. für Meereskunde, no. 11:1–28.

KURODA, NAGAMICHI, 1922. Remarks on the Japanese petrels of the genus *Oceanodroma*. Ibis (11) 4:309–314.

LABAT, PÈRE, 1724. Voyages aux isles de l'Amérique. La Haye, 1:1–360, 2:1–520.

LAFRESNAYE, M. F. DE, 1844. Description de quelques oiseaux de la Guadeloupe. Rev. Zool.:167–169.

LAMB, CHESTER, 1910. A glimpse of bird life on the west coast of Mexico. Condor, 12: 74–79.

LAMBRECHT, KÁLMÁN, 1933. Handbuch der Palaeornithologie. Berlin, 1024 p., 209 text-figs., 4 pls.

LANE, A. A., 1897. Field notes on the birds of Chili. Ibis (7) 3:8–51, 177–195, 297–317.

LARREA, C. M., 1924. Geographical notes on Esmeraldas, northwestern Ecuador. Geogr. Rev., 14:373–387, figs. 1–10.

LATASTE, F., 1893. Liste d'oiseaux recueillis par M. le Docteur Federigo Delfin dans le detroit de Magellan et environs. Actes de la Soc. Scientif. du Chili, 3:121–123, pl. 121.

LAUBMANN, ALFRED, 1930. Wissenschaftliche Ergebnisse der deutschen Gran Chaco-Expedition. Vögel. Stuttgart, 321 p., illus.

LAVALLE Y GARCÍA, J. A. DE, 1914. El guano y la agricultura nacional. Lima, 111 p.

1917. Informe preliminar sobre la causa de la mortalidad anormal de las aves ocurida en el mes de marzo de presente año. Memoria de la Compañia Administradora del Guano, Lima, 8:61–88, 4 figs.

1918. Estudio de los factores que influyen sobre la distribución de los nidos de las aves productoras de guano. *Op. cit.*, 9:205–213, map and 10 figs.

1920. Datos para el estudio de la relación entre las épocas de realización de las principales faces de la vida de las aves y las condiciones climatéricas. *Op. cit.*, 11:77–168.

1921. Estudio sobre el aprovechamiento del guano de baja ley existe en el litoral. *Op. cit.*, 12:117–138.

Lawrence, G. N., 1878. Catalogue of the birds of Dominica, from collections made for the Smithsonian Institute by Frederick A. Ober. Proc. U. S. Nat. Mus., 1:48–69.

1889. An account of the breeding habits of *Puffinus auduboni* in the island of Grenada, West Indies, with a note on *Zenaida rubripes*. Auk, 6:19–21.

Layard, E. L., 1862. Notes on the sea-birds observed during a voyage in the Antarctic Ocean. Ibis, 4:97–100.

1867. On birds and eggs from the Crozette Islands. Ibis, (N. S.) 3:457–461.

1872. Letter from Pará. Ibis (3) 2:336–338.

1873. Letter referring to the tropical Atlantic. Ibis (3) 3:331–332.

Lecomte, A. A., 1868. Account of hunting seals and penguins at Falklands. Proc. Zoöl. Soc. London:527–530.

Leigh-Clare, J. L., 1927. A note on the vitamin D content of the stomach oil of the Australian petrel. Biochemical Journ., 21:725–727.

Léotaud, Antoine, 1866. Oiseaux de l'ile de la Trinidad. Port d'Espagne, 560 p.

Le Souëf, D., 1895. Notes on birds found nesting on Albatross Island in Bass Strait, Australia. Ibis (7) 1:413–423.

1902. A young king penguin at the Melbourne Zoo. Emu, 2:26, 27, pls. 2, 3.

Lesson, R. P., and Garnot, P., 1826. Voyage autour du monde sur 'La Coquille.' Zoologie, 1:1–735.

Lester, M. C., 1923. An expedition to Graham Land, 1920–1922. Geogr. Journ., 62:174–194, map.

Levick, G. M., 1914. Antarctic penguins. London, 140 p., illus.

1914, 1916. British Antarctic ('Terra Nova') expedition, 1910. Zoölogy, 1, Natural history of the Adélie penguin:55–84, pls. 1–21.

Lewis, H. F., 1929. The natural history of the double-crested cormorant (*Phalacrocorax auritus auritus* (Lesson)). Ottawa:1–88.

Lister, J. J., 1891. Notes on the birds of the Phoenix Islands. Proc. Zoöl. Soc. London: 289–300.

Littler, F. M., 1910. A handbook of the birds of Tasmania. Launceston, 242 p., illus.

Lloyd, Hoyes, 1921. An aquatic habit of the pigeons. Canadian Field Nat., 35:98, 99.

Lobo, Bruno, 1919. A ilha da Trindade. Arch. do Mus. Nac Rio de Janeiro, 22:107–158, maps, illus.

Lockley, R. M., 1930. On the breeding-habits of the Manx shearwater, with special reference to its incubation- and fledgling-periods. Brit. Birds, 23:202–218.

1931. Further notes on the breeding-habits of the Manx shearwater. Brit. Birds, 24: 202–207.

Loeb, Jacques, 1908. Über den Temperaturkoeffizienten für die Lebensdauer kaltblütiger Thiere und über die Ursache des natürlichen Todes. Pflügers Archiv für die Gesammte Physiol., 124:411–426.

Long, A. S. L., 1929. Note on frigate-bird catching its own food. Emu, 29, pt. 1:77.

Lönnberg, Einar, 1904. On the homologies of the different pieces of the compound rhamphotheca of birds. Arkiv för Zoologi, 1, 1903–04:473–512.

1906. Contributions to the fauna of South Georgia. Kungl. Sv. Vet. Akademiens Handlingar, Band 40, no. 5, 104 p., 12 pls., 7 text-figs.

1908. Wissenschaftl. Ergebnisse der schwedischen Südpolar Expedition 1901–1903; Zoologie I, 5:1–10, Vögel.

1921. The natural history of Juan Fernández and Easter Island. 3, Zoology, pt. 1: The birds of the Juan Fernández Islands:1–24.

Loomis, L. M., 1918. A review of the albatrosses, petrels, and diving petrels. Proc. Calif. Acad. Sci., (4) 2, pt. 2, no. 12:1–187, pls. 1–17.

1919. Variation in the Galápagos albatross. Auk, 36:370–372, pls. 14–16.

1921. Remarks on the migration of southern hemisphere albatrosses and petrels. Auk, 38:527–531.

LORANCHET, J., 1915, 1916. Observations biologiques sur les oiseaux des îles Kerguelen. Rev. Franç. d'Ornith., **4**:113–116, 153–157, 190–192, 207–210, 240–242, 256–259, 305–307, 326–331.

LOWE, P. R., 1909. Notes on some birds collected during a cruise in the Caribbean Sea. Ibis (9) **3**:304–346.

1911. A naturalist on desert islands. London, 300 p., 32 pls., 3 maps.

1916. Notes in relation to the systematic position of the sheathbills (Chionididae). Ibis (10) **4**:122–155, 4 figs.

1923. Notes on some land birds of the Tristan da Cunha group collected by the 'Quest' expedition. Ibis (11) **5**:511–529.

1926. On the classification of the Tubinares or petrels. Proc. Zoöl. Soc. London, pt. 4 (1925):1433–1443, 2 text-figs.

1933. On the primitive characters of the penguins, and their bearing on the phylogeny of birds. Proc. Zoöl. Soc. London, pt. 2:483–538, 6 pls., 16 text-figs.

LOWE, P. R., and KINNEAR, N. B., 1930. British Antarctic ('Terra Nova') expedition 1910. Zoölogy, **4**, no. 5, Birds:103–193, pls. 1–16.

LUCAS, F. A., 1887. Notes of a bird catcher. Auk, **4**, no. 1:1–6.

1890. Scientific results of explorations by the U. S. Fish Commission steamer 'Albatross.' No. 13. Catalogue of skeletons of birds collected at the Abrolhos Islands, Brazil, the Strait of Magellan and the Galápagos Islands, in 1887–1888. Proc. U. S. Nat. Mus., **13**:127–130.

LUEDERWALDT, HERMANN, 1929. Resultados de uma excursão scientifica a Ilha de S. Sebastião em 1925. Rev. Mus. Paulista, **16**:1–80.

MACFARLANE, J. R. H., 1887. Notes on birds in the western [= eastern] Pacific, made in H. M. S. 'Constance,' 1883–1885. Ibis (5) **5**:201–215.

MACKINTOSH, N. A., 1934. Distribution of the macroplankton in the Atlantic sector of the Antarctic. Discovery Reports, **9**:65–160, 48 text-figs.

MACKNIGHT, HUGH, 1921. Studies in albatross flight. Emu, **20**, pl. 13.

MANN, ALEXANDER, 1909. Yachting on the Pacific. London.

MARCUS, ERNST, 1933. Tiergeographie. Handbuch der Geographischen Wissenschaft: 81–166.

MARELLI, C. A., 1924. Elenco sistemático de la fauna de la provincia de Buenos Aires. Aves. Memorias del Ministerio de Obras Públicas, 1922–1923:597–665.

MARMER, H. A., 1930. The Sea. New York, 312 p., illus.

MARRYAT, FREDERICK, 1829. Frank Mildmay or the naval officer. 1st edit.

MARTENS, G. H., 1900. Hamburger Magalhaenische Sammelreise, Vögel. Hamburg: 3–32.

MASURE, R. H., and ALLEE, W. C., 1934. The social order in flocks of the common chicken and the pigeon. Auk, **51**:306–327.

MATHEW, G. F., 1873. Gulls off Valparaiso. Zoölogist (2) **8**:3493, 3494.

1873. Natural-history notes from Coquimbo. Zoölogist (2) **8**:3578, 3579.

MATHEWS, G. M., 1911–1919. Birds of Australia. 1911, 1:271–286. 1912, 2:1–304, 306–479. 1913, 2:480–503. 1915, 4:152–321. 1919, 7:416–430.

1923. Remarks on storm petrels. Emu, **23**: 51–56.

1928. Birds of Norfolk and Lord Howe Islands and the Australian South Polar quadrant. London, 139 p.

1932. The birds of Tristan da Cunha. Novit. Zool., **38**:13–48.

1934. New albatrosses and a new whalebird from the Atlantic Ocean. Bull. Brit. Orn. Cl., no. 369:213, 214.

1934. A new genus of storm-petrel. Bull. Brit. Orn. Cl., no. 376:119.

1934. *Pterodroma mollis* and its subspecies. Bull. Brit. Orn. Cl., no. 379:178, 179.

1934. Remarks on albatrosses and mollymawks. Ibis (13) **4**:807–816.

MATHEWS, G. M., and IREDALE, TOM, 1921. A manual of the birds of Australia. London, 1:i–xxiv, 1–279, pls. 1–36.

MATTHEWS, H. A., 1929. Review of Franze's Niederschlagsverhältnisse in Südamerika. Geogr. Journ. **74**:474–477, map.

MATTHEWS, L. H., 1929. The birds of South Georgia. Discovery Reports, 1:561–592, pls. 45–56.

1931. South Georgia: the British Empire's subantarctic outpost. Bristol, 163 p.

1932. Lobster-krill: anomuran crustacea that are the food of whales. Discovery Rep., 5:467–484, pl. 4.

MATTINGLEY, A. H. E., 1927. Cormorants in relation to fisheries. Condor, 29:182–187.

MAULL, OTTO, 1930. Vom Itatiaya zum Paraguay. Leipzig, 366 p., 80 pls., 30 maps.

MAWSON, DOUGLAS, 1915. The home of the blizzard. Philadelphia, 1:1–349, 2:1–321, illus.

1915. Reproductions of photographs from the work of the Australasian-Antarctic expedition under Sir Douglas Mawson. Nat. Hist., 15:338.

1930. The antarctic cruise of the 'Discovery,' 1929–1930. Geogr. Rev., 20:535–554, 12 figs., map.

MAYNARD, C. J., 1889. Description of a supposed new species of gannet. Contrib. to Science, 1:40–48, 51–57, pl.

1889. Notes on the young of certain species of birds. *Tachypetes aquila*. *Ibid:*140–142, pls. 14, 15.

McBRIDE, G. McC., 1918. The Galápagos Islands. Geogr. Rev., 6:229–239.

McCORMICK, ROBERT, 1884. Voyages of discovery in the Arctic and Antarctic Seas. London, 1:3–432, illus., map.

McEWEN, G. F., 1927. Dynamical oceanography and certain elements of hydrodynamics upon which it is based. Bull. 14 Scripps Inst. of Oceanography, La Jolla, Calif.:3–20.

McLELLAN, M. E., 1926. Expedition to the Revillagigedo Islands, Mexico, in 1925. The birds and mammals. Proc. Calif. Acad. Sci., (4) 15:279–322.

MECKING, LUDWIG, 1928. The Antarctic. In: Geography of the polar regions, spec. publ. no. 8, Amer. Geogr. Soc.:282–325.

MEINERTZHAGEN, R., 1925. The distribution of the phalaropes. Ibis (12) 1:325–344, pls. 8, 9.

MELISS, J. C., 1875. St. Helena. London, 426 p.

MENEGAUX, A., 1907. Expédition antarctique française 1903–1905, commandée par le Dr. Jean Charcot. Paris, Oiseaux, 4:1–75, pls. 1-13.

1908. Sur les embryons, les poussins et les jeunes des oiseaux, des régions australes. Bull. du Mus. Nat. d'Hist., 14:104–107.

1917. Reprise d'un albatros bagué. Rev. Franç. d'Ornith., 5:64.

MICHLER, NATHANIEL, 1861. Report on a survey of an interoceanic ship canal near the Isthmus of Darien. 36th Congress, 2d Session, Executive Document (Senate) no. 9, 457 p.

MILLER, R. C., 1923. A study of the flight of sea gulls. Condor, 25:5–15.

MILNE-EDWARDS, ALPHONSE, 1879–1882. Recherches sur la faune des régions australes. Ann. Sci. Nat., Zool., (6) 9 (1879–80), art. 9:1–82, pls. 17–20, map. 1881, 12, art. 7:1–12, map. 1882, 13, art. 4:1–64, 3 maps.

MITCHELL, C. L., 1924. West Indian hurricanes and other tropical cyclones of the North Atlantic Ocean. Monthly Weather Rev., suppl. no. 24, 47 p., 103 figs.

MITCHELL, P. C., 1911. On longevity and relative viability in mammals and birds; with a note on the theory of longevity. Proc. Zoöl. Soc. London, 1:425–555.

MOBERG, E. G., 1928. The interrelation between diatoms, their chemical environment, and upwelling water in the sea, off the coast of southern California. Proc. Nat. Acad. Sci., 14, no. 7:511–518.

MOGENSEN, JOHAN, 1930. Argentinas Dyr. Köbenhavn, 383 p.

MOLINA, G. I., 1782. Saggio sulla storia naturale del Chili. Bologna.

1810. *Idem*. 2d edit., Bologna, 306 p.

MONTGOMERY, H. H., 1898. On the habits of the mutton-bird of Bass Strait, Australia. Ibis (7) 4:209–216.

MOORE, EDUARDO, 1926. El cormorán (guanay o yeco). Rev. Chil. Hist. Nat. 30:176–183.

MOORE, R. T., 1935. The protection and conservation of the zoological life of the Galápagos Archipelago. Science, 82, no. 2135:519–521.

MOREAU, R. E., 1931. Some birds on a voyage. Ibis (13) 1:778–781.

MORONG, THOMAS, 1892. The Río de la Plata. Bull. Amer. Geogr. Soc., 24:479–509, map.

MORRELL, BENJAMIN, 1832. A narrative of four voyages to the South Sea, etc., from the year 1822–1831. New York, 492 p.

MORTENSON, T., 1933. The 'manatee' of St. Helena. Nature, March 17, 1934, 133, p. 417.

MOSELEY, H. N., 1879. Notes by a naturalist on the 'Challenger.' London, 606 p.

MÜLLER, LORENZ, 1912. Zoologische Ergebnisse einer Reise in das Mündungsgebiet des Amazonas. Abh. d. Königl. Bayr. Akad. d. Wissensch., 26:1–42.

MURPHY, R. C., 1913. A desolate island of the Antarctic. Amer. Mus. Journ., 13, no. 6: 242–259, illus.

1914. A sub-antarctic island. Harper's Mag., 128:165–176, illus.

1914. A report on the South Georgia expedition. Brooklyn Mus. Sci. Bull. 2:41–102, pls. 14–18.

1914. Observations on birds of the South Atlantic. Auk, 31:439–457, pls. 35–39.

1914. Notes on the autumn migration of the parasitic jaeger. Bird-Lore, 16:278.

1914. A flock of Tubinares. Ibis (10) 2: 317–319.

1914. Cruising in the South Atlantic. Brooklyn Mus. Quarterly, 1, no. 2:83–110, 23 phots.

1914. Preliminary description of a new petrel. Auk, 31:12, 13, pl. 2.

1915. Ten hours at Fernando Noronha. Auk, 32:41–50.

1915. The Atlantic range of Leach's petrel (*Oceanodroma leucorhoa* (Vieillot)). Auk, 32:170–173.

1915. The bird life of Trinidad Islet. Auk, 32:332–348, pls. 23–25.

1915. The penguins of South Georgia. Brooklyn Mus. Sci. Bull. 2:103–133, pls. 19–43.

1916. Anatidae of South Georgia. Auk, 33: 270–277, pl. 14.

1916. Notes on American subantarctic cormorants. Bull. Amer. Mus. Nat. Hist., 35, art. 4:31–48, 13 figs. from phots.

1917. A new albatross from the west coast of South America. Bull. Amer. Mus. Nat. Hist., 37:861–864.

1917. Faunal conditions in South Georgia. Science (N. S.) 46:112, 113.

1918. A study of the Atlantic *Oceanites*. Bull. Amer. Mus. Nat. Hist., 38:117–146, pls. 1–3.

1918. Bird life of South Georgia. Amer. Mus. Journ., 18:463–472, 17 phots.

1919. Mollymokes: an observer's account of the monoplanes of the sea. Country Life, (London) 45:37–40.

1922. Notes on Tubinares, including records which affect the A. O. U. Check-List. Auk, 39:58–65.

1922. South Georgia, an outpost of the Antarctic. Nat. Geogr. Mag., 41, no. 4: 409–444, 2 maps, 41 illus.

1923. The oceanography of the Peruvian littoral with reference to the abundance and distribution of marine life. Geogr. Rev., 13:64–85.

1924. The marine ornithology of the Cape Verde Islands, with a list of all the birds of the archipelago. Bull. Amer. Mus. Nat. Hist., 50, art. 3:211–278, 10 text-figs.

1925. Bird Islands of Peru. New York and London:i–xx, 1–362, maps, illus.

1925. Equatorial vignettes. Nat. Hist., 25, no. 5:431–449, map, illus.

1925. Recent oceanic phenomena along the coast of South America. Monthly Weather Rev., 53, no. 3:116, 117.

1925. Notes on certain species and races of oyster-catchers. Amer. Mus. Novit., no. 194:1–15.

1926. Oceanic and climatic phenomena along the west coast of South America during 1925. Geogr. Rev., 16:26–54, 4 maps, 12 illus.

1927. On certain forms of *Puffinus assimilis* and its allies. Amer. Mus. Novit., no. 276:1–15.

1927. The Peruvian guano islands seventy years ago. Nat. Hist., 27:439–447, 11 illus.

1928. Antarctic zoögeography and some of its problems. 355–379 in: "Problems of polar research," by thirty-one authors. Amer. Geogr. Soc., spec. publ. no. 7, 479 p.

1929. Birds collected during the Whitney South Sea expedition. X. Amer. Mus. Novit., no. 370:1–17, 1 fig.

1930. Birds collected during the Whitney South Sea expedition. XI. Amer. Mus. Novit., no. 419:1–15.

1932. The Humboldt and Niño Currents. (Rev. of 2 papers by Gerhard Schott). Geogr. Rev., 22:148–150.

1934. Stray sea birds and Atlantic storm tracks. Geogr. Rev., 24, no. 1:151, 152.

MURPHY, R. C., and HARPER, FRANCIS, 1916. Two new diving petrels. Bull. Amer. Mus. Nat. Hist., **35**:65–67.

1921. A review of the diving petrels. Bull. Amer. Mus. Nat. Hist., **44**, art. 17:495–554, pls. 20–24, 7 text-figs.

MURPHY, R. C., and VOGT, WILLIAM, 1933. The dovekie influx of 1932. Auk, **50**:325–349.

MURRAY, G., 1902. The voyage southward of the 'Discovery'; 2. from Madeira to the Cape. Geogr. Journ., **19**:423–435.

"N", 1860. Notizen über das Küstenland der brasilianischen Provinzen Paraná und São Paulo. Zeitschrift für allgemeine Erdkunde, **9**:327–333.

NELSON, GEORGE, 1911. Notes on Pelican Island. Auk, **28**:393–397, pls. 4–7.

NEWTON, E. T., 1890. Note on the bones of small birds obtained by Professor Nation from below the nitrate-beds of Peru. Proc. Zoöl. Soc. London:375, 376.

NICHOLLS, E. B., 1910. Notes on the crested penguin (*Catarrhactes chrysocome*). Emu, **10**: 41–44.

NICHOLS, J. T., 1907. Around the Horn for petrels. Bird-Lore, **9**:245–248, 4 phots.

1912. Recognition marks in birds. Auk, **29**:44–48.

1913. Notes on offshore birds. Auk, **30**: 505–511.

1914. Size in the avian order Tubinares. Ibis (10) **2**:315–317, 4 text-figs.

1914. An undescribed Galápagos race of *Oceanodroma castro*. Auk, **31**:388–390.

1915. Estimated average age of the herring gull. Condor, **17**:181–183.

1929. At the edge of the antarctic ice. Nat. Hist., **29**:129–142, illus.

NICHOLS, J. T., and MURPHY, R. C., 1914. A review of the genus *Phœbetria*. Auk, **31**: 526–534, pl. 41.

1922. On a collection of marine fishes from Peru. Bull. Amer. Mus. Nat. Hist., **46**: 501–516, pls. 25, 26.

NICHOLSON, E. M., and B. D., 1931. An ornithological transect of the North Atlantic. Brit. Birds, **24**:266–274, pl. 3.

NICOLL, M. J., 1904. Ornithological journal of a voyage round the world in the 'Valhalla.' Ibis (8) **4**:32–67, pl. 1.

1904. On a collection of birds made during the cruise of the 'Valhalla' R. Y. S. in the West Indies (1903–1904). Ibis (8) **4**:555–591, pl. 11.

1908. Three voyages of a naturalist. London, 246 p., illus.

NOBLE, G. K., 1916. The resident birds of Guadeloupe. Bull. Mus. Comp. Zoöl., Harvard Coll., **60**:359–396.

NORDENSKJÖLD, N. O., and ANDERSSON, J. G., 1905. Antarctica, or two years amongst the ice of the South Pole. London, 608 p., maps, illus.

NORDENSKJÖLD, OTTO, and MECKING, LUDWIG, 1928. The geography of the polar regions. Spec. publ. Amer. Geogr. Soc., no. 8, 359 p.

NORTHROP, JOHN T., 1891. The birds of Andros Island, Bahamas. Auk, **8**:64–80.

NORTON, A. H., 1891. Leach's petrel. Ornithologist and Botanist, **1**, no. 7:50, 51.

1921. Our stormy petrels. Maine Naturalist, **1**, no. 1:1–4.

OATES, E. W., 1901, 1902. Catalogue birds' eggs British Museum. **1**, 252 p., 18 pls.; **2**, 400 p., 15 pls.

OBER, F. A., 1880. Camps in the Caribbees. Boston, 366 p.

OBERHOLSER, H. C., 1919. Notes on the names of *Halobaena caerulea* and *Prion vittatus*. Proc. Biol. Soc. Wash., **32**:195–202.

OGILVIE, A. G., 1922. Geography of the central Andes. New York, 240 p.

OGILVIE-GRANT, W. R., 1898. Catalogue of birds of the British Museum. London, **26**: 329–653, 3 pls.

OLDHAM, CHARLES, 1930. The shell-smashing habits of gulls. Ibis (12) **6**:239–243.

OLIVER, W. R. B., 1930. New Zealand birds. Wellington, 541 p., illus.

OLSTAD, O., 1930. Rats and reindeer in the Antarctic. Sci. Res. Norweg. Antarct. Exped. 1927–1928 and 1928–1929, Instituted and Financed by Consul Lars Christensen. No. 4. (Norske Videnskaps-Akad.):3–20, 7 figs.

ORTMANN, A. E., 1896. Grundzüge der Marinen Tiergeographie. Jena, 96 p., map.

OSBECK, PETER, 1771. A voyage to China and the East Indies. (Translated by J. R. Forster.) London, **1**:1–396, **2**:1–367.

Osgood, W. H., 1929. A new rodent from the Galápagos Islands. Field Mus. Nat. Hist., publ. 261, Zoöl. ser. **17**, no. 2:21–24.

Oustalet, E., 1877. Notice sur quelques pélicans nouveaux ou peu connus de l'Amérique méridionale. Bull. Soc. Philomath., Paris (7) 1:208–212.

1891. Oiseaux. In: Mission scient. du Cap Horn 1882–1883. **6**, Zoologie:3–341, pls. 1–6, 2 maps.

Paessler, R., 1909. Beiträge zur Verbreitung der Seevögel. Orn. Monatsb., 17:99–103.

1913. Beiträge zur Verbreitung der Seevögel. Journ. f. Orn., 61:41–51.

1914. *Ibidem*. 62:272–278.

1915. Beiträge zur Verbreitung der Seevögel. Orn. Monatsb., 23:59–61, 71, 72.

1922. In der Umgebung Coronel's (Chile) beobachtete Vögel. Journ. f. Orn., **70**: 430–482.

Pagenstecher, H. A., 1885. Die Vögel Süd-Georgiens nach der Ausbeute der deutschen Polarstation in 1882 und 1883. Jahrb. Wissensch. Anstalt. Hamburg, 2:3–27, 1 pl.

Parkin, T., 1900. On the abundance of bird life in the southern oceans. Ibis (7) 6:675.

Parsons, C. W., 1932. Report on penguin embryos collected during the 'Discovery' investigations. Discovery Reports, 6:139–164, pls. 1–6.

Paul, J. H., 1932. The last cruise of the 'Carnegie.' Baltimore, 131 p.

Peale, T. R., 1848. U. S. exploring expedition during the years 1838–1842. Philadelphia, **8**, Mammalia and Ornithology:5–299.

Pearson, T. G., 1899. Notes on some of the birds of eastern North Carolina. Auk, 16: 246–250.

Pelzeln, August von, 1869. Reise der österr. Freg. 'Novara' um die Erde 1857–1859, **1**, pt. 2, Vögel, 176 p., 6 pls.

1871. Zur Ornithologie Brasiliens, Resultate von Johann Natterers Reisen in den Jahren 1817–1835. Wien, 462 p.

Pemberton, J. R., 1922. A large tern colony in Texas. Condor, 24:37–48, figs.

Penard, E. F., and A. P., 1908–1910. De vogels van Guayana. Paramaribo (Wed. F. P. Penard). 1:1–584, 2:1–550.

Penrose, F. G., 1879. Notes on a collection of birds' skins and eggs made by Mr. D. Gill on Ascension Island. Ibis (4) 3:272–282.

Percy, William, 1934. Steamer ducks. Ibis (13) 4:867, 868.

Peters, J. L., 1917. Birds from the northern coast of the Dominican Republic. Bull. Mus. Comp. Zoöl., Harvard Coll., **61**: 391–426.

1923. Notes on summer birds of northern Patagonia. Bull. Mus. Comp. Zoöl., Harvard Coll., 65:277–337.

1929. Vertebrates from the Corn Islands. Birds. Bull. Mus. Comp. Zoöl., Harvard Coll., 69:130–138.

1929. An ornithological survey in the Caribbean lowlands of Honduras. Bull. Mus. Comp. Zoöl., Harvard Coll., 69:397–478.

1930. Two undescribed races of *Phaëthon aethereus*. Occ. Pap. Boston Soc. Nat. Hist., 5:261–262.

1931. Check-List of birds of the world. Cambridge, **1**, 345 p.

1934. *Idem*. **2**, 401 p.

Petterson, Otto, 1929. Changes in the oceanic circulation and their climatic consequences. Geogr. Rev., 19:121–131.

Philippi, F., 1909. Dos aves nuevas de Chile. Bol. Mus. Nac. Chile, **1**, no. 3:63–65, 1 pl.

Philippi, R. A., 1873. Ueber eine neue Art von *Spheniscus*. Zeits. f. d. gesammten Naturwiss., Neue Folge, 7:121–127, pls. 1, 2.

1879. Über einige neue chilenische Tiere. Arch. f. Nat., **45**, 1:158–164.

1889. Uber *Phalaropus Antarcticus* und *Wilsoni*. Verh. des Deutschen Wissenschaftlichen Vereins. Santiago, 2:266–271, 2 pls.

1895. Ueber Einige Vogelknochen aus dem Guano. Verh. des Deutschen Wissenschaftlichen Vereins. Santiago, **3**, pt. 1: 14–17, 1 pl.

1895. Neue Thiere Chile's. Verh. des Deutschen Wissenschaftlichen Vereins. Santiago, **3**, pt. 1:9–13, 1 pl.

1899. Kritische Bemerkungen über einige Vögel Chiles. Archiv für Naturgeschichte (Jahrg. 65), 1:165–174.

1902. Figuras i descripciones de aves chilenas. Anal. Mus. Nac. Chile, 15:1–114, pls. 1–51.

Philippi, R. A., and Landbeck, L., 1863. Beiträge zur Fauna von Peru. Wiegmann's Arch. für Naturgesch., 29, pt. 1:119–138.

PHILLIPS, J. C., 1923–26. A natural history of the ducks. London, 4 vols., 102 pls., 110 maps.

PIÉROLA, NICOLÁS DE, 1928. Informe sobre el estado del carguío de guano en las Islas de Chincha (1853). Bol. de la Compañia Administradora del Guano, **4**:155–177.

PIKE, O. G., 1914–1915. Feeding habit of red-necked phalarope. Brit. Birds, **8**:292–294.

PLATE, LUDWIG, 1896. Zur Kenntnis der Insel Juan Fernández. Verh. Ges. Erdk. Berlin, **23**:221–229.

PLATH, KARL, 1914. With the tropic-birds in Bermuda. Ibis (10) **2**:552–559, pls. 21–24.

PLATT, R. S., 1934. Pattern of occupance in the Maracaibo Basin. Ann. Assoc. Amer. Geog., **24**:157–173, 17 figs.

PONTING, H. G., 1922. The great white South. New York, 306 p., 164 phots., maps.

PORTENKO, L., 1931. Les ressources productives de l'ornithofaune de la Nouvelle-Zemble (in Russian). Trudy Biogeokhimicheskoi Laboratorii Akad. Nauk, Leningrad, **2**, Supplement, 52 p., 13 figs.

PORTER, C. E., 1912. Bibliografía ornitolójica de Chile. Bol. Mus. Nac., **4**:197–206.

PORTIELJE, A. F. J., 1927. Zur Ethologie bezw. Psychologie von *Phalacrocorax carbo subcormoranus* (Brehm). Ardea, **16**:107–110.

PROBLEMS OF POLAR RESEARCH. By 31 authors. 1928. Amer. Geogr. Soc., spec. publ. no. 7, 479 p.

PYCRAFT, W. P., 1898. Contributions to the osteology of birds. Impennes, pt. 2. Proc. Zoöl. Soc. London:958–989, pls. 59–61.

1899. Contributions to the osteology of birds. Tubinares, pt. 3. Proc. Zoöl. Soc. London:381–411, pls. 22, 23.

1907. On some points in the anatomy of the emperor and Adélie penguins. Brit. Nat. Antarct. Exped. 1901–1904, **2**, Zoöl., pt. 3:1–28, 1 pl., 8 text-figs.

QUELCH, J. J., 1896. Migratory birds in British Guiana. Timehri, (N.S.), **10**:258–279.

RACOVITZA, E. G., 1900. Résultats généraux de l'expédition antarctique belge. La Géographie (Paris), **1**:81–92.

1900. Vers le Pôle Sud. Causeries scient. de la Soc. Zool. de France:175–242.

1900. La vie des animaux et des plantes dans l'Antarctique. Bull. Soc. Roy. Belge Géog., 1899, no. 1:177–230, 3 maps.

RAIMONDI, M. A., 1856. Mémoire sur le huano des îles de Chincha et les oiseaux qui le produisent. C. R. Acad. Sci., **42**:735–738.

RAMSAY, E. P., 1879. Notes on *Puffinus carneipes*. Proc. Linn. Soc. New South Wales, **3**, 1878:406–408.

RAMSEY, L. N. G., 1913. Ornithology of the Scottish National Antarctic Expedition. Sect. 2—St. Paul's Rocks, and the voyages to the Falkland Islands, and to Buenos Aires and back. Sci. Res. Scot. Nat. Antarct. Exped., **4**:207–209.

1913. *Idem*. Sect. 3—The Falkland Islands. Sci. Res. Scot. Nat. Antarct. Exped., **4**: 211–214.

1913. *Idem*. Sect. 4—Voyages between the Falkland Islands and the South Orkneys. Sci. Res. Scot. Nat. Antarct. Exped., **4**: 215–217.

1913. *Idem*. Sect. 8—"Scotia Rise" region: the voyage from the Weddell Sea northward to Gough Island. Sci. Res. Scot. Nat. Antarct. Exped., **4**:271–276.

1913. *Idem*. Sect. 10—South Atlantic, voyage from Gough Island to Cape Town, thence to St. Helena. Sci. Res. Scot. Nat. Antarct. Exped., **4**:291–293.

1913. *Idem*. Sect. 12—St. Helena, Ascension, and between. Sci. Res. Scot. Nat. Antarct. Exped., **4**:299.

1913. *Idem*. Sect. 13—The North Atlantic. Sci. Res. Scot. Nat. Antarct. Exped., **4**: 301, 302.

REED, E. C., 1874. Remarks on the birds of Juan Fernández and Mas-a-fuera. Ibis (3) **4**:81–84.

1896. Catálogo de las aves chilenas. Anales de la Universidad, Santiago, **93–95**:197–213.

1905. Sobre el jénero *Haematopus*. Rev. Chil. Hist. Nat., **9**, nos. 2, 3:49, 50.

REICHENOW, ANTON, 1904. Uebersicht der auf der deutschen Tiefsee-Expedition gesammelten Vögel. Wissensch. Ergebn. Deutsch. Tiefsee-Exped. 1898, 1899, **7**:345–358, pls. 23, 24.

1904. Neue Arten des Südpolargebiets. Orn. Monatsb., **12**:46–47.

1908. Die Vögel des Weltmeeres. Deutsche Südpolar Expedition 1901–1903, **9**:435–565, pls. 45–50, 32 text-figs.

Reiche, Carlos, 1903. La isla de la Mocha. Anal. Mus. Nac. Chile, entrega 16:1–104, 12 pls.

Reid, James, 1835. Anatomical description of Patagonian penguin. Proc. Zoöl. Soc. London, 1834–1836, pt. 2:132–148.

Reid, S. G., 1884. The birds of Bermuda. Bull. U. S. Nat. Mus., no. 25, **1**, pt. 4:165–279.

Reinhardt, J., 1873. Om Vingens anatomiske Bygning hos Stormfugle-Familien (Procellaridae and Tubinares). Videnskabelige Meddelelser 1873. Copenhagen:123–138, table, 1 fig.

1873. Sur la structure anatomique des ailes dans la famille des Pétrels. Videns-kabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn, **5**, 6:38–41.

Reiser, Otmar, 1926. Ergebnisse der zoolog. Expedition der Akad. der Wissenschaften nach Nordostbrasilien im Jahre 1903: Vögel. Denkschriften Akad. Wissensch. Wien, **76**:107–252, 1 pl., 2 maps.

Reithmüller, Eric, 1931. Nesting notes from Willis Island. Emu, **31**:142–146.

Renard, Abel, 1931. Algunas observaciones sobre aves durante un viaje a la ria de Deseado. Hornero, **4**:412–414.

Rendahl, Hjalmar, 1920. A list of the birds of the Pearl Islands, Bay of Panama. Arkiv för Zoologi, **12**, no. 4:1–56, 1 pl.

Reynolds, P. W., 1934. Apuntes sobre aves de Tierra del Fuego. Hornero, **5**:339–353, 9 figs.

1935. Notes on the birds of Cape Horn. Ibis, (13) **5**:65–101, pls. 2–4.

Ribeiro, A. de M., 1919. A fauna vertebrada de Ilha da Trindade. Arch. Mus. Nac. Rio de Janeiro, **22**:171–194 (Aves:179–192, 6 pls.).

Ribera, Emilio, 1904. Nota relativa á una momia de ave "Huanae" procedente de Huanillos (Chile). Bol. Real Soc. Española Hist. Nat., **4**:339–341.

Richards, T. W., 1909. Notes on albatrosses and other pelagic birds in Australian waters. Condor, **11**:5–8.

Richmond, C. W., 1893. On a collection of birds from eastern Nicaragua and Río Frio, Costa Rica. Proc. U. S. Nat. Mus., **16**: 479–532.

Riddle, Oscar, 1917. The theory of sex as stated in terms of results of studies on pigeons. Science, **46**:19–24.

Riddle, Oscar, Bates, R. W., and Lahr, E. L., 1935. Prolactin induces broodiness in fowl. Amer. Journ. Physiology, **3**, no. 2:352–360.

Riddle, Oscar, Lahr, E. L., and Bates, R. W., 1935. Maternal behavior induced in virgin rats by prolactin. Proc. Soc. Exper. Biol. and Med., **32**:730–734.

Ridgway, Robert, 1885. A new petrel for North America. Auk, **2**:386, 387.

1895. Description of 22 new species of birds from the Galápagos Islands. Proc. U. S. Nat. Mus., **17**:357–370.

1897. Birds of the Galápagos Archipelago. Proc. U. S. Nat. Mus., **19**:459–670, pls. 56, 57.

1912. Color standards and color nomenclature. Washington, 53 pls.

1919. The birds of North and Middle America. Bull. 50 U. S. Nat. Mus., **8**, 852 p., 34 pls.

Ridley, H. N., and others, 1890. Notes on the zoölogy of Fernando Noronha. Journ. Linn. Soc., Zool., **20**:473–570.

Riggs, E. S., 1926. Fossil hunting in Patagonia. Nat. Hist., **26**:537–544, illus.

Riiser-Larsen, Hjalmar, 1930. The 'Norvegia' antarctic expedition of 1929–1930. Geogr. Rev., **20**:555–573, 18 figs., map.

Rivero, M. E. de, 1837. Memoria sobre el guano de pájaros y su uso en el Perú. Lima.

Roberts, H. R., 1934. List of Trinidad birds with field notes. Tropical Agriculture, **11**, no. 4:87–99.

Robinson, Wirt, and Lyon, M. W., Jr., 1902. An annotated list of mammals collected in the vicinity of La Guaira, Venezuela. Proc. U. S. Nat. Mus., **24**:135–162.

Robinson, Wirt, and Richmond, C. W., 1895. An annotated list of birds observed on the island of Margarita, and at Guanta and Laguayra, Venezuela. Proc. U. S. Nat. Mus., **18**:649–685, pl. 33.

1901. An annotated list of birds collected in the vicinity of La Guaira, Venezuela. Proc. U. S. Nat. Mus., **24**:163–178.

Rochefort, César de, 1658. Histoire naturelle et morale des Isles Antilles. Rotterdam, 527 p., illus.

ROCKWELL, R. H., 1932. Southward through the doldrums. Nat. Hist., 32:424–436, 15 illus.

ROGERS, R. A., 1928. The lonely island. London, 223 p., 24 illus., map.

ROHL, EDUARDO, 1932. Apuntes para la historia y la bibliografía de la ornitología venezolana. Bol. de la Soc. Venezolana de Ciencias Naturales, no. 6: 201–248.

ROLLIN, C. N., 1929. The walking of the fulmar petrel. Brit. Birds, 23:31–33.

ROSENHEIM, OTTO, and WEBSTER, T. A., 1927. The stomach oil of the fulmar petrel. Biochemical Journ., 21:111–118.

ROSS, J. C., 1847. A voyage of discovery and research in the southern and antarctic regions during the years 1839–1843. London, 1:1–366, 2:1–447, pls., maps.

ROTHSCHILD, WALTER, 1898. On Webster expedition to Galápagos Islands. Bull. Brit. Orn. Cl., 7:51, 52.

1902. On *Sula granti*. Bull. Brit. Orn. Cl., 13:7.

1902. On *Œstrelata wortheni*. Bull. Brit. Orn. Cl., 12:62, 63.

1912. Bird-life on oceanic islands, and insular variation. Trans. Hertfordshire Nat. Hist. Soc., 15, 1911–1914:1–14.

1915. Notes on the genus *Sula*. Bull. Brit. Orn. Cl., 35:41–45.

1915. On the genus *Fregata*. Novit. Zoöl., 22:145–146.

1918. Remarks on a recently described albatross. Bull. Brit. Orn. Cl., 38:39.

1920. Memorandum of interview with the Right Honourable Lord Rothschild. Report of the Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands, Command paper 657, Appendix 9:83–85.

ROTHSCHILD, WALTER, and HARTERT, E., 1899. Review of the ornithology of the Galápagos Islands, with notes on the Webster-Harris expedition. Novit. Zoöl., 6:85–205, pls. 5, 6.

1902. Further notes on the fauna of the Galápagos Islands. Notes on the birds. Novit. Zoöl., 9:381–418, pl. 10, 2 text-figs.

ROUCH, JULES, 1928. The meteorology of the American quadrant of the Antarctic. In: Problems of polar research, spec. publ. no. 7, Amer. Geogr. Soc.:301–313.

R. S. F., 1859. Statistics of guano. Journ. Amer. Geogr. and Statistical Soc., 1:181–189.

RUDOLPH, W. E., 1927. The Rio Loa of northern Chile. Geogr. Rev., 17:553–585, with figs.

1929. The new territorial divisions of Chile with special reference to Chiloé. Geogr. Rev., 19:61–77.

1934. Southern Patagonia as portrayed in recent literature. Geogr. Rev., 24:251–271, map.

RÜE, E. A. DE LA, 1934. Une expédition au Yurumangui et au Naya, fleuves de la cordillère occidentale des Andes de Colombie. La Géographie, 41:17–33, 117–128, 2 maps, 8 figs.

RUSTAD, DITLEF, 1930. Euphausiacea, with notes on their biogeography and development. Sci. Res. Norweg, Antarct. Exped. 1927–1928 and 1928–1929, Instituted and Financed by Consul Lars Christensen—No. 5 (Norske Videnskaps-Akad.):5–83.

SACHSE, WALTER, 1898. Sturmwarnungen durch Seevögel. Orn. Monatsb., 6:105–111.

SALVADORI, TOMMASO, 1900. Contribuzione all' Avifauna dell' America Australe (Patagonia, Terra del Fuoco, Isola degli Stati, Isole Falkland). Annali del Museo Civico di Storia Naturale. Genova, (2) 20:609–634.

1907. On *Fregetta melanoleuca*. Bull. Brit. Orn. Cl., 21:78–80.

1911. Specie apparentemente nuova del genere *Thalassogeron*. Boll. Mus. Zool. ed. Anat. Comp. Torino, 26:1, 2.

1914. Notes on some species of the genus *Thalassogeron*. Ibis (10) 2:503–505, pl. 19.

SALVADORI, T., and FESTA, E., 1900. Viaggio del Dr. Enrico Festa nell' Ecuador. Uccelli, pt. 3, Boll. Mus. Zool. ed Anat. Comp. Torino, 15:1–54.

SALVIN, F. H., 1891. Letter on the position of the cormorant's wings in diving. Ibis (6) 3:150, 151.

SALVIN, OSBERT, 1864. A fortnight amongst the sea-birds of British Honduras. Ibis, 6:372–387.

1875. Additional notes on the birds of Masafuera and Juan Fernández. Ibis (3) 5:370–377.

1876. Critical notes on Procellariidae. Rowley's Ornith. Misc., 1:223–238, 249–257, 5 pls.

1877. On the avifauna of the Galápagos Archipelago. Trans. Zoöl. Soc. London, 9:447–510, 6 pls.

1878. Reports on the collections of birds made during the voyage of H. M. S. 'Challenger.' No. 12. The Procellariidae. Proc. Zoöl. Soc. London:735–740.

1881. On the Procellariidae collected during the expedition. Rep. Sci. Res. Voy. 'Challenger,' Zoöl., 2:140–149.

1888. Critical notes on the Procellariidae. Ibis (5) 6:351–360.

1896. Tubinares. Cat. Birds Brit. Mus., 25:340–455, pls. 2–8.

SALVIN, OSBERT, and GODMAN, F. D., 1897–1904. Biologia Centrali-Americana. 3, Aves, text:1–459; 4, Aves, pls.

SAUNDERS, HOWARD, 1866. On birds of the southern ocean. Ibis (N.S.) 2:124–126.

1876. On the Stercorariinae or skua gulls. Proc. Zoöl. Soc. London:317–332, pl. 24.

1879. On the geographical distribution of the gulls and terns. Journ. Linn. Soc., 14, Zoöl.:390–406.

1880. On the sea-birds obtained during the voyage of Lord Lindsay's yacht 'Venus' from Plymouth to Mauritius in 1874. Proc. Zoöl. Soc. London:161–165.

1881. On Laridae collected during the expedition. Rep. Sci. Res. Voy. 'Challenger,' Zoöl., 2:133–140.

1882. On some Laridae from the coasts of Peru and Chili collected by Capt. Albert H. Markham, R. N., with remarks on the geographical distribution of the group in the Pacific. Proc. Zoöl. Soc. London:520–530, pl. 34.

1891. On eggs of *Larus maculipennis* and *Sterna trudeaui*. Proc. Zoöl. Soc. London: 373.

1895. On *Rhynchops*. Bull. Brit. Orn. Cl., 4, no. 25:xxv.

1896. Gaviae. Cat. Birds Brit. Mus., 25:1–339, pl. 1.

1901. The antarctic manual for the use of the expedition of 1901. London, Roy. Geogr. Soc., pt. 16, Zoöl., Birds:225–238.

SCHALOW, HERMANN, 1897. Über die Vogelfauna von Juan Fernández. Sitzungsberichte der Gesellschaft naturforschender Freunde, Berlin:68–69.

1898. Die Vögel der Sammlung Plate. Zoologische Jahrbücher, Jena, Suppl. 4, Heft 3: 641–749.

SCHLEGEL, H., 1863–1867. Anseres to Urinatores. Mus. Hist. Nat. Pays-Bas, 6, Monogs.:21–33.

SCHOKALSKY, JULES, 1917. Okeanografia [in Russian]. Petrograd: xiii and iv, 69 and 614, maps, illus.

SCHOMBURGK, RICHARD, 1847, 1848. Reisen in Britisch-Guiana in den Jahren 1840–1844. Leipzig, 1:1–469, 2:1–530, 3:534–1212.

1922. Travels in British Guiana 1840–1844. (Eng. trans. by Walter E. Roth.) Georgetown, 1:1–368, 2:1–409.

SCHOTT, GERHARD, 1926. Geographie des atlantischen Ozeans. Hamburg, 368 p., 27 pls., 115 figs.

1931. Der Perú-Strom und seine nördlichen Nachbargebiete in normaler und anormaler Ausbildung. Annal. Hydr. und Marit. Meteorol., pt. 5:161–169; pt. 6:200–213; pt. 7:240–252; pls. 17–22.

1935. Geographie des indischen und stillen Ozeans. Hamburg, 413 p., 37 pls., 114 text-figs.

SCHWEIGGER, E. H., 1931. Observaciones oceanográficas sobre la corriente de Humboldt. Bol. de la Compañia Administradora del Guano, 7:3–39, maps, tables.

1931. Temperaturas en las islas guaneras del Perú (1926–1930). Bol. de la Compañia Administradora del Guano, 7:121–143, figs., tables.

SCLATER, P. L., 1856. Notes on some birds from the island of Ascension. Proc. Zoöl. Soc. London:144–145.

1860. Catalogue of the birds of the Falkland Islands. Proc. Zoöl. Soc. London:382–392.

1861. Additions and corrections to the list of the birds of the Falkland Islands. Proc. Zoöl. Soc. London:45–47.

1868. (Note on Falkland I. ornithology in a report on additions made to the Zoölogical Society's Menagerie). Proc. Zoöl. Soc. London:527–529.

1878. Reports on the collections of birds made during the voyage of H. M. S. 'Challenger.' No. 10. On the birds of the Atlantic Islands and Kerguelen's Land, and on the miscellaneous collections. Proc. Zoöl. Soc. London:576–579.

1888. Notes on the emperor penguin. Ibis (5) 6:325–334.

SCLATER, P. L., and HUDSON, W. H., 1889. Argentine Ornithology. London, 2, 232 p.

SCLATER, P. L., and SALVIN, OSBERT, 1868. List of birds collected in the Straits of Magellan, by Dr. Cunningham. Ibis (N.S.) **4**:183–189.

1869. Second list of birds collected during the survey of the Straits of Magellan, by Dr. Cunningham. Ibis (N. S.) **5**:283–286.

1870. Third list of birds collected during the survey of the Straits of Magellan, by Dr. Cunningham. Ibis (N. S.) **6**:499–504.

1872. Reports on the collection of birds made during the voyage of H. M. S. 'Challenger,' no. 9. On the birds of Antarctic America. Proc. Zoöl. Soc. London: 431–438.

1881. On the Steganopodes and Impennes collected during the expedition. Rep. Sci. Res. Voy. 'Challenger,' Zoöl., **2**:117–132, pls. 25–30.

SCLATER, W. L., 1924. Systema Avium Æthiopicarum. London, pt. 1, 304 p.

SCOTT, W. E. D., 1891, 1892. Observations on the birds of Jamaica, West Indies. Auk, **8**:249–256, 353–365; **9**:9–15, 120–129, 273–277, 369–375.

SCOTT, W. E. D., and SHARPE, R. B., 1904–1915. Reports of the Princeton University expeditions to Patagonia, 1896–1899. Princeton, **2**, Ornithology. 1904:58–84, 85–114. 1910:114–176, 176–234, 234–344. 1912:345–349, 407–504, pl. 1. 1915:505–525.

SCOULER, JOHN, 1826. Account of a voyage to Madeira, Brazil, Juan Fernandez, and the Gallapagos Islands, performed in 1824 and 1825, with a view of examining their natural history, etc. Edinburgh Journ. Sci., **5**:195–214.

SEALE, R. F., 1834. The geognosy of the island St. Helena. London, 25 p., 10 pls., 8 illus.

SETH-SMITH, DAVID, 1911. On the moulting of the king penguin in the Society's gardens. Proc. Zoöl. Soc. London, **1**, 1912:60–62, pl. 1.

SHACKLETON, E. H., 1920. South: the story of Shackleton's last expedition 1914–1917. New York, 380 p., 88 illus.

SHANAHAN, E. W., 1927. South America. An economic and regional geography with an historical chapter. New York, 318 p., maps, 50 figs.

SHARPE, R. B., 1879. Petrological, botanical, and zoölogical collections made in Kerguelen's Land and Rodriguez during the Transit of Venus expeditions, 1874–75: Zoölogy, Birds. Phil. Trans. Roy. Soc. London, **168**:101–162, pls. 6–8.

1881. The survey of H. M. S. 'Alert II,' Birds. Proc. Zoöl. Soc. London:6–18.

1902. Report on the collections of natural history made in the antarctic regions during the voyage of the 'Southern Cross.' London, Aves:106–173.

1904. Report on the birds obtained by the National Antarctic expedition at the island of South Trinidad. Ibis (8) **4**:214–217.

1904. On *Sula coryi*. Bull. Brit. Orn. Cl., **14**, session 1903–1904:65–69.

SHEPPARD, GEORGE, 1927. Geological observations on Isla de la Plata, Ecuador, South America. Amer. Journ. Sci., **13**:480–486.

1930. Notes on the climate and physiography of southwestern Ecuador. Geogr. Rev., **20**:445–453, 8 figs.

1933. The rainy season of 1932 in southwestern Ecuador. Geogr. Rev., **23**:210–216, 5 figs.

SHUFELDT, R. W., 1885. Variations in the form of the beak, that take place during its growth, in the short-tailed albatross (*Diomedea brachyura*). Auk, **2**:175–178.

1914. Anatomical notes on the young of *Phalacrocorax atriceps georgianus*. Mus. of Brooklyn Inst. of Arts and Sciences, Sci. Bull., **2**, no. 4:95–101.

1915. Comparative osteology of Harris's flightless cormorant. Emu, **15**:86–114, pls. 15–19.

SIMMONS, G. F., 1927. Sinbads of science. Narrative of the voyage of the windjammer 'Blossom' to the Sargasso Sea and Senegambian Africa, and among islands of high adventure in the South Atlantic. Nat. Geogr. Mag., **52**, July, no. 1:1–75, illus.

SIMPICH, FREDERICK, 1931. Skypaths through Latin America. Nat. Geogr. Mag., **59**: 1–79, illus.

SIMPSON, G. G., 1934. Attending marvels: a Patagonian journal. New York, 295 p.

SIPLE, P. A., 1931. Emperor penguins from Antarctica. Cardinal, **3**:40, 41.

Skottsberg, Carl, 1911. The wilds of Patagonia. New York, London, 329 p., maps.
1918. The islands of Juan Fernández. Geogr. Rev., **5**:362–383, map, figs.
1920. The natural history of Juan Fernández and Easter Island. **1**, geography, geology, origin of island life. Pt. 1: notes on a visit to Easter Island. Uppsala:3–20, 14 pls., 3 figs.
1928. The natural history of Juan Fernández and Easter Island. **2**, botany, pt. 4. Uppsala:449–550.

Slevin, J. R., 1931. Log of the schooner 'Academy.' Occ. Pap. Calif. Acad. Sci., **17**, 162 p., 16 pls., map.

Smith, H. M., 1927. The Uruguayan fur-seal islands. Zoologica, **9**, no. 6:271–294, 7 figs.

Smith, J. R., 1904. The economic geography of Chile. Bull. Amer. Geogr. Soc., **36**, no. 1:1–21.

Snethlage, Emilie, 1908. Ornithologisches vom Tapajóz und Tocantíns. Journ. f. Orn., **56**:493–539.
1913. Über die Verbreitung der Vogelarten in Unteramazonien. Journ. f. Orn., **61**: 469–539.
1914. Catalogo das aves amazonicas. Boletim do Museu Goeldi, Pará, **8**:1–530, pls. 1–5, map.
1917. Nature and man in eastern Pará, Brazil. Geogr. Rev., **4**:41–50, figs.

Snethlage, Heinrich, 1927–1928. Meine Reise durch Nordostbrasilien. Journ. f. Orn., **75**: 453–484; **76**:503–581, 668–738.

Snodgrass, R. E., and Heller, Edmund, 1902. The birds of Clipperton and Cocos Islands. Proc. Wash. Acad. Sci., **4**:501–520.
1904. Papers from the Hopkins-Stanford Galápagos expedition, 1898–1899. 16, Birds, Proc. Wash. Acad. Sci., **5**:231–372.

Snouckaert van Schauberg, R., 1930. Les formes de *Gelochelidon nilotica*. Alauda, **2**:155–161.

Snow, W. P., 1857. A two years' cruise off Tierra del Fuego, the Falkland Islands, Patagonia, and in the river Plate. London, 2 vols.

Sonnini, M., 1810. Note sur le pélican. In: Ledru, A.-P., Voyage aux iles de Ténériffe, La Trinité, Saint-Thomas, Sainte-Croix et Porto-Ricco, **1**:245–246.

Sperling, R. M., 1868. Ornithological notes from the Ethiopian region. Ibis (N.S.) **4**:282–295.
1872. Letter on Tristan da Cunha, etc. Ibis (3) **2**:74–79.

Spiess, F., 1928. Die 'Meteor'-Fahrt. Berlin, 34 text-figs., 420 illus., 130 tables, 4 maps.

Spry, W. J. J., 1877. The cruise of her Majesty's ship 'Challenger.' Toronto, 388 p., illus., map.

Squier, E. G., 1877. Peru: Incidents of travel and exploration in the land of Incas. New York, 588 p., illus.

Starks, Edwin C., 1925. Experiences of a fish collector in Brazil. Nat. Hist., **25**:357–370.

Steffen, Hans, 1929. Grenzprobleme und Forschungsreisen in Patagonien. Stuttgart.

Steinen, Karl von den, 1890. Allgemeines über die zoologische Thätigkeit und Beobachtungen über das Leben der Robben und Vögel auf Süd-Georgien. Die Deutschen Expeditionen und ihre Ergebnisse, Internationale Polarforschung, 1882–1883, **2**:194–279, pls. 2, 7–10.

Stenhouse, J. H., 1929. Some birds of historical interest in the Royal Scottish Museum; birds of the voyage of H.M.S. 'Adventure' and 'Beagle,' 1826–30. The Scottish Naturalist, no. 180:181–187.

Stevenson, James, 1933. Experiments on the digestion of food by birds. Wilson Bull., (4) **45**:144–167.

Stevenson, W. B., 1825. A historical and descriptive narrative of twenty years' residence in South America. London, 3 vols.

Stiglich, Germán, 1931. El Fenómeno Marítimo del Aguaje. Bol. de la Compañia Administradora del Guano, **7**, no. 8:345–348, 4 figs.

Stone, Witmer, 1918. Murphy on a new albatross. Auk, **35**:249.
1921. Note on: Fish-catching by the black skimmer. Auk, **38**:595, 596.

Stone, Witmer, and Mathews, G. M., 1913. A list of the species of Australian birds described by John Gould with the location of the type-specimens. Austral Avian Record, **1**:129–180.

Streets, T. H., 1912. The fork-tailed gull. Auk, **29**:233–234.

Stresemann, Erwin, 1922. Zur Kenntniss der Pelecanoides-Formen der Chilenischen Küste. Orn. Monatsb., **30**:130.

1924. *Oceanodroma hornbyi* (Gray) aus einem chilenischen Salpeterfelde. Orn. Monatsb., **32**:61–63.

1924. *Puffinus griseus* (Gmelin) Brutvogel in der nordchilenischen Pampa. Orn. Monatsb., **32**:63, 64.

1927. Die schwarzen Austernfischer. (Mutationsstudien 26). Orn. Monatsb., **35**:71–77.

1927. Ueber *Tachyeres cinereus* und *T. patachonicus*. Orn. Monatsb., **35**:47.

1927–34. Handbuch der Zoologie, Eine Naturgeschichte der Stämme des Tierreiches. Aves. Bearbeitet von Dr. Erwin Stresemann. Berlin-Leipzig, **7**, pt. 2, 880 p., 944 figs.

1929. Eine weitere Fundstelle von *Oceanodroma hornbyi* in der chilenischen Salpeterwüste. Orn. Monatsb., **37**:3.

Strong, R. M., 1911. On the olfactory organs and the sense of smell in birds. Journ. of Morphology, Phila., **22**:619–660, 2 pls.

Struthers, P. H., 1923. Observations on the bird life of Porto Rico. Auk, **40**:469–478.

Stuart-Sutherland, R., 1920. Penguins. Emu, **20**:24–30, 74–81, pl. 6.

1922. Round the lamp. Emu, **22**:54–59.

1923. Some notes on young penguins. Emu, **23**:34–42.

Studer, T., 1879. Die Fauna von Kerguelensland. Archiv f. Naturgeschichte. Berlin, **45**, pt. 1:104–141.

Sturgis, B. B., 1928. Field book of birds of the Panama Canal Zone. New York, London, 466 p., 24 pls., 107 text-figs.

St.-Johnston, T. R., 1920. The Falkland Islands. Stanley, F. I., 100 p.

Sumner, F. B., 1934. Does "protective coloration" protect?—results of some experiments with fishes and birds. Proc. Nat. Acad. Sci., **20**:559–563.

Sundevall, C. J., 1871. On birds from the Galápagos Islands. Proc. Zoöl. Soc. London:124–130.

Sverdrup, H. U., 1930. Some oceanographic results of the 'Carnegie's' work in the Pacific—the Peruvian current. Trans. Amer. Geophys. Union, 10th and 11th annual eetings:257–264, 11 figs.

1930. Some aspects of oceanography. Sci. Monthly, **31**:19–34.

Swainson, William, 1836. On the natural history and classification of birds. London, **1**:1–361.

Swarth, H. S., 1931. The avifauna of the Galápagos Islands. Occ. Pap. Calif. Acad. Sci., no. 18, 299 p., map.

1934. The bird fauna of the Galápagos Islands in relation to species formation. Biol. Rev., **9**, no. 2:213–234.

Swinburne, Spearman, 1886. Notes on birds observed on various voyages between England and the Cape of Good Hope. Proc. Roy. Phys. Soc. of Edinburgh, **9**: 193–201.

Szielasko, A., 1907. Vogelleben auf Süd-Georgien. Journ. f. Orn., **55**:597–616.

1924. Das Brutgeschäft von *Pygoscelis papua* (Forst.) auf Süd-Georgien im Südlichen Eismeer. Beitr. zur Fortpfl.-Biol. der Vögel, **1**:7–9, 26–29.

1926. *Stercorarius antarcticus* (Less.) zur Brutzeit auf Süd-Georgien im Südlichen Eismeer. Beitr. zur Fortpfl.-Biol. der Vögel, **2**:38–40.

Taczanowski, Ladislaus, 1886. Ornithologie du Pérou. Rennes, **3**:1–522, map.

Taylor, G. C., 1859. Account of a visit to a nesting place of the frigate-bird. Ibis, **1**:150–152.

1864. Five months in the West Indies. Ibis, **6**:157–173.

Taylor, W. J., 1857. Investigation on the rock guano from the islands in the Caribbean Sea. Proc. Acad. Nat. Sci. Phila., **9**:91–100.

Tertre, J. B. du, 1667. See du Tertre.

Tessan, U. de, 1844. Voyage autour du monde sur la frégate 'La Vénus' commandée par Abel du Petit-Thouars. Physique, **5**, 472 p.

Thayer, J. E., and Bangs, Outram, 1905. The mammals and birds of the Pearl Islands, Bay of Panama. Bull. Mus. Comp. Zoöl., Harvard Coll., **46**:137–160.

1905. The vertebrata of Gorgona Island, Colombia. Aves. Bull. Mus. Comp. Zoöl., Harvard Coll., **46**:91–98.

1908. The present state of the ornis of Guadaloupe Island. Condor, **10**:102–106.

Thompson, Joseph, 1903. The Tortugas tern colony. Bird-Lore, **5**:77–84, 9 illus.

THOMSON, C. W., 1878. The Atlantic. New York, **2**, 329 p.

TICEHURST, C. B., 1930. On *Puffinus puffinus mauretanicus*. Bull. Brit. Orn. Cl., **50**, no. 343, p. 83.

TODD, W. E. C., 1916. The birds of the Isle of Pines. Annals of Carnegie Mus., **10**:146–296, pls. 22–27.

TODD, W. E. C., and CARRIKER, M. A., 1922. The birds of the Santa Marta region of Colombia. A study in altitudinal distribution. Annals of Carnegie Mus., **14**:3–611, pls. 1–9.

TORREY, H. B., 1902. An unusual occurrence of dinoflagellates on the California coast. American Naturalist, **36**:187–192.

TOWNSEND, C. H., 1895. Birds from Cocos and Malpelo Islands, with notes on petrels obtained at sea. Bull. Mus. Comp. Zoöl., Harvard Coll., **27**:121–126.

1910. A naturalist in the Straits of Magellan. Pop. Sci. Monthly, **77**:5–18.

1927. The Galápagos penguin in captivity. Auk, **44**:509–512.

1929. The flightless cormorant in captivity. Auk, **46**:211–213.

1930. The Astor expedition to the Galápagos Islands. Bull. N. Y. Zoöl. Soc., **33**:135–155.

TOWNSEND, C. H., and WETMORE, ALEXANDER, 1919. Reports on the scientific results of the expedition to the tropical Pacific in charge of Alexander Agassiz, etc. 21. The birds. Bull. Mus. Comp. Zoöl., Harvard Coll., **43**:151–225.

TOWNSEND, C. W., 1909. The use of the wings and feet by diving birds. Auk, **26**:234–248.

1912. Bird genealogy. Auk, **29**:285–295.

TRAVERS, H. H., and W. T. L., 1873. On the birds of the Chatham Islands. Trans. and Proc. N. Zealand Inst., 1872, **5**:212–222.

TRISTRAM, H. B., 1881. Letter on birds obtained at San Ambrosio Island. Ibis (4) **5**:177.

TSCHUDI, J. J. VON, 1844–1846. Untersuchungen über die Fauna Peruana. St. Gallen. Ornithologie:1–316, 36 pls.

1846. Peru, Reiseskizzen aus den Jahren 1838–1842. St. Gallen, **1**:1–346; **2**:1–402.

1851. Die Huanolager an der peruanischen Küste. Denkschriften der Kaiserlichen Akad. der Wissens., Wien, **2**:1–20, pls. 1–7.

1856. Beiträge zur Geographischen Verbreitung der Meeresvögel. Journ. f. Orn., **4**:134–162, 177–191.

TULLOCH, A., 1916. Macquarie Island penguins. Emu, **16**:92–96, pls. 26, 27.

TURLE, W. H., 1891. A visit to the Blasket Islands and the Skellig Rocks. Ibis (6) **3**:1–12.

TUTTLE, A. W., 1911. Pomarine jaeger capturing a phalarope. Auk, **28**:482.

ULRICH, FRANZ, 1904. Zur Kenntnis der Luftsäcke bei *Diomedea exulans* und *Diomedea fuliginosa*. Wissenschaftl. Ergebnisse der Deutsche Tiefsee-Exped. Dampfer 'Valdivia' 1898–99. Jena:319–342, pls. 19–22.

UNITED STATES HYDROGRAPHIC OFFICE PUBLICATIONS.

1920. West Indies Pilot. No. 129, **2**, 3d edit.

1920. South America Pilot. No. 173, **2**, 2nd edit.

1920. *Idem*. No. 174, **3**, 2nd edit.

1927. West Indies Pilot. No. 128, **1**, 5th edit.

1927. Centr. Amer. and Mexico Pilot. No. 130, 3d edit.

1927. South America Pilot. No. 172, **1**, 3d edit.

VALETTE, L. H., 1906. Viaje á las Islas Orcadas Australes. Anal. Minist. Agric. República Argentina (Sección Zootecn. Bacteriol. Vet. y Zool.), **3**, no. 2, pt. 1:3–68, maps, pls., illus.

VALLAUX, CAMILLE, 1931. El problema de la Corriente de Humboldt. Bol. de la Compañia Administradora del Guano, **7**:147–158.

1933. Géographie générale des mers. Paris, 796 p.

VALLENTIN, RUPERT, 1904. Notes on the Falkland Islands. Memoirs and Proc. of the Manchester Lit. and Philosophical Soc., **48**, art. 13:1–47, pls. 1–3.

1905. On rocks scratched by the feet of penguins. Bull. Brit. Orn. Cl., **15**:48–50.

1924. Zoology, pt. 4 in: Boyson's "The Falkland Islands." Oxford, birds: 285–335, illus.

VANDERBILT, W. K., 1927. To Galápagos on the 'Ara.' (Appendix C., on fishes and birds, by W. E. Belanske.) New York, 161 p., illus.

VANHÖFFEN, E., 1901. Bericht über die bei der deutschen Tiefseeexpedition beobachteten Vögel. Journ. f. Orn., **49**:304–322.

1904. Die Tierwelt des Südpolargebiets. Zeitschr. der Gesellsch. für Erdkunde zu Berlin:362–370.

1905. Bericht über die bei der deutschen Südpolar-Expedition beobachteten Vögel. Journ. f. Orn., **53**:500–515, map.

VAN ROSSEM, ADRIAAN, 1915. Notes on murrelets and petrels. Condor, **17**:74–78.

VERRILL, G. E., 1895. On some birds and eggs collected by Mr. Geo. Comer at Gough Island, Kerguelen Island, and the Island of South Georgia. Trans. Conn. Acad. of Arts and Sciences, **9**:430–478.

1923. Rough notes on the avifauna of Paita, Peru. Auk, **40**:303–312.

VICUÑA MACENNA, B., 1883. Juan Fernández, historia verdadera de la isla de Robinson Crusoe. Santiago de Chile.

VIGORS, N. A., 1833. On the habits and economy of the frigate-bird *Tachypetes aquilus*. Proc. Zoöl. Soc. London, **1** (1830, 1831): 62–63.

VILLAREAL, FEDERICO, 1927. Corriente peruana o de Humboldt. Rev. de Marina, Lima, **12**:159–195.

VINCIGUERRA, D., 1884. Sulla fauna dell' America Australe. Boll. Soc. Geogr. Ital., **21**:785–811.

VIVIAN, R. A., 1904. Some bird life in British Papua. Emu, **4**:52–57, 1 fig.

WACE, R. H., 1921. Lista de aves de las islas Falkland. Hornero, **2**:194–204.

WAIT, W. E., 1931. Oceanic bird wanderers to Ceylon. Spolia Zeylanica, **16**, pt. 2:181–198.

WAITE, E. R., 1909. Vertebrata of the subantarctic islands of New Zealand. Art. 25, in: Chilton's "Subant. Is. of N. Z.," **2**:542–600, figs. 6–23.

WALLACE, A. R., 1853. A narrative of travels on the Amazon and Rio Negro. London, 541 p., map, illus.

WALTER, WILLIAM, 1903. More about muttonbirds. Emu, **2**:219.

WARD, R. DEC., 1903. The climate of South America. Bull. Amer. Geogr. Soc., **35**: 353–360.

WATERTON, CHARLES, 1839. Wanderings in South America. London, 307 p.

WATSON, A. C., 1930. The guano islands of southwestern Africa. Geogr. Rev., **20**: 631–641, 2 figs.

WATSON, J. B., 1908. The behavior of noddy and sooty terns. Papers from Tortugas Laboratory of Carnegie Inst. Wash., **2**: 187–225, 11 pls., 2 text-figs.

1910. Further data on the homing sense of noddy and sooty terns. Science, **32**, no. 823:470–473.

WATSON, MORRISON, 1883. Report on the anatomy of the Spheniscidae collected during the voyage of H. M. S. 'Challenger.' Rep. Sci. Res. Voy. 'Challenger' during the years 1873–76. Zoöl., **7**:1–243, pls. 1–19.

WAYNE, A. T., 1894. Effect of the great cyclone of August 26–27 upon certain species of birds. Auk, **11**:85.

WEDDELL, JAMES, 1825. A voyage towards the South Pole. London, 276 p., illus., maps.

WELLS, J. G., 1902. Birds of the island of Carriacou. Auk, **19**:237–246.

WERTH, E., 1925. Beobachtungen zum Vogelleben von Kerguelen. Deutsche Südpolar Expedition 1901–1903, **17**, Zoöl. **9**:547–604, 1 pl., 14 text-figs.

WETMORE, ALEXANDER, 1916. Birds of Porto Rico. U. S. Dept. Agric. Bull. 326:1–140, pls. 1–8.

1917. The birds of Culebra Island, Porto Rico. Auk, **34**:51–62.

1918. The birds of Desecheo Island, Porto Rico. Auk, **35**:333–340.

1919. Note on the eye of the black skimmer. Proc. Biol. Soc. Wash., **32**:195–202.

1923. List of sea birds collected by Mr. Charles Fagan. Condor, **25**:170, 171.

1925. Bird life among lava rock and coral sand. Nat. Geogr. Mag., **48**:77–108, phots.

1926. Report on a collection of birds made by J. R. Pemberton in Patagonia. Univ. Calif. Pub. Zoöl., **24**:395–474, pls. 12–14, 11 text-figs.

1926. Observations on the birds of Argentina, Paraguay, Uruguay, and Chile. Smithson. Inst. U. S. Nat. Mus. Bull. **133**, 434 p.

1927. Our migrant shorebirds in southern South America. Technical Bull. no. 26, Dept. Agric.

1927. Scientific survey of Porto Rico and the Virgin Islands. 9, pt. 3. The birds of Porto Rico and Virgin Islands, Colymbiformes-Columbiformes. N. Y. Acad. Sci.: 248–406, pls. 55–61.

1932. Birds collected in Cuba and Haiti by the Parish-Smithsonian expedition of 1930. Proc. U. S. Nat. Mus. 81, art. 2:1–40, pls. 1–7.

1932. Notes from Dr. R. Ciferri on the birds of Hispaniola. Auk, 49:107–108.

1933. Pliocene bird remains from Idaho. Smithson. Misc. Coll., 87, no. 20:1–12.

1934. A systematic classification for the birds of the world, revised and amended. Smithson. Misc. Coll., 89, no. 13:1–11.

WETMORE, ALEXANDER, and LINCOLN, C., 1933. Additional notes on the birds of Haiti and the Dominican Republic. No. 2966.—From: Proc. U. S. Nat. Mus., 82, art. 25: 1–68, pls. 1–6.

WETMORE, ALEXANDER, and MILLER, W. DEW., 1926. The revised classification for the fourth edition of the A. O. U. Check-List. Auk, 42:337–346.

WETMORE, A., and SWALES, B. H., 1931. The birds of Haiti and the Dominican Republic. Bull. 155, U. S. Nat. Mus., 483 p., 26 pls.

WETZEL, W., 1925. Vogelmumien und "Guano" in chilenischen Salpeter-Ablagerungen. Centralblatt für Mineralogie, Geologie, und Paleontologie, Abth. A:284–288.

1930. Der Wüstenguano der hochariden Zone Nordchiles. Chemie d. Erde, 5: 260–275.

WHITE, E. W., 1881. Cameos from the silverland or the experiences of a young naturalist in the Argentine Republic. London, 1:1–436, 2:1–527.

WHITE, S. A., 1918. Further notes upon cormorants, their food, temperatures, etc. Emu, 17:214, 215.

WHITLOCK, F. L., 1927. Ocean derelicts. Emu, 26:154–157.

1931. Further notes on ocean derelicts. Emu, 30:263–267.

WIED, MAXIMILIAN PRINZ ZU, 1833. Beiträge zur Naturgeschichte von Brasilien. Weimar 4, Abth. 2:443–946.

WILCOX, MARRION, 1910. The territory of Magellan. Journ. Amer. Geogr. Soc., 42: 826–831.

1910. Argentine Patagonia. Journ. Amer. Geogr. Soc., 42:903–909.

WILD, FRANK, 1923. The voyage of the 'Quest.' Geogr. Journ., 61:73–97.

WILKES, CHARLES, 1845. Narrative of the United States exploring expedition during the years 1838–1842. Philadelphia, 5 vols.

WILKINS, G. H., 1922. Account of the voyage of the 'Quest.' Bull. Brit. Orn. Cl., 43:2–5.

1923. Report on the birds collected during the voyage of the 'Quest' (Shackleton-Rowett expedition) to the southern Atlantic. Ibis (11) 5:474–511, pl. 16.

WILKINS, SIR HUBERT, 1929. The Wilkins-Hearst antarctic expedition, 1928–1929. Geogr. Rev., 19:353–376.

WILL, HERMANN, 1884. Das Exkursionsgebiet der Deutschen Polarstation auf Süd-Georgien. Deutsche Geogr. Blätter, 7: 116–144.

WILLFORD, A. H., 1925. The effect of hot sun on young birds. Brit. Birds (10) 18:293–295.

WILLIAMS, LAIDLAW, 1931. Further notes on California brown pelicans at Point Lobos, California. Condor, 33:66–69.

WILLIS, BAILEY, 1929. Earthquake conditions in Chile. Sect. 2: San Felix and San Ambrosio. Carnegie Inst. Wash., publ. no. 382:120–124, pls. 64–68.

WILLIS, BAILEY, and WASHINGTON, H. S., 1924. San Felix and San Ambrosio: their geology and petrology. Bull. Geol. Soc. Amer., 35:365–384.

WILSON, EDWARD, 1904. The birds of the Island of South Trinidad. Ibis (8) 4:208–214.

1907. Aves. Brit. Nat. Antarct. Exped. 1901–1904, 2, Zoöl., pt. 2:1–121, 13 pls., 46 text-figs.

WILTON, D. W., PIRIE, J. H. H., BROWN, R. N. R., 1908. Report on the scientific results of the voyage of S. Y. 'Scotia.' 4, Zoöl., pt. 1, Zoölogical log, 101 p., 33 pls., 2 maps, 100 phots.

WIMAN, CARL, 1905. Über die alttertiären Vertebraten der Seymourinsel. Wissensch. Ergeb. Schwed. Südpol.-Exped. 1901–1903, 3, pt. 1:1–37, 8 pls.

Winge, O., 1888. Fugle fra Knoglehuler i Brasilien. Mus. Lundii, Copenhagen, 1, pt. 2:1–54, 1 pl.

Winton, W. E. de, 1898. On the moulting of the king penguin. Proc. Zoöl. Soc. London:900–902.

1899. Further notes on the moult of the king penguin. Proc. Zoöl. Soc. London:980–981.

Witherby, H. F., 1920–1924. A practical handbook of British birds. London, 2, 959 p.

Wollaston, A. F. R., 1925. The Sierra Nevada of Santa Marta, Colombia. Geogr. Journ., 66:97–111.

Worth, C. B., 1935. Behavior of the yellow-billed tropic-bird. Auk, 52, p. 442.

Wright, H. W., 1909. An ornithological trip to Los Coronados Islands, Mexico. Condor, 11:96–100.

Wynne-Edwards, V. C., 1935. On the habits and distribution of birds on the North Atlantic. Proc. Boston Soc. Nat. Hist., 40, no. 4:233–346, pls. 3–5.

Young, C. G., 1928, 1929. A contribution to the ornithology of the coastland of British Guiana. Ibis (12) 4:748–781, pls. 35–42, text-fig. 18; (12) 5:1–38, text-fig. 1; 221–261, text-fig. 2.

Zorell, Franz, 1928. Der "El Niño"-Strom im Jahre 1925. Annal. Hydr. und Marit. Meteorol.:166–175, tables 15, 16.

ADDENDA TO BIBLIOGRAPHY

Joubin, Louis, 1912. Carte des bancs et récifs de coraux (Madrépores). Ann. Inst. Oceanographique, 4, pt. 2: 1–7, 5 pls.

Kerhallet, C. P. de, 1867. General examination of the Pacific Ocean. 212 p., maps.

Smith, H. H., 1879. Brazil, the Amazons and the coast. 644 p., illus.

Spix, J. B. von, and Martius, C. F. P. von, 1824. Travels in Brazil. 2 vols., illus.

INDEX

(The uniformly arranged, descriptive sections which precede each biography have not been included in the indexing, and details of morphology and distribution should be sought primarily in them. The index will then serve as a key to supplementary textual references.

Part I of the book (pages 1–322), which is the narrative and geographic portion, has been indexed in considerable detail with respect to names of places, individuals, and institutions. In Part II stress has been placed rather upon concepts relating to the natural history and behavior of birds. Authors' names and other personal references appearing in this part have therefore been largely omitted from the index.)

B

C

D

F

G

H

J

K

L

S

Fairy Terns and Black Noddies, South Trinidad Island.

Pediunkers, or Gray Petrels, at the nest burrow,
Nightingale Island, Tristan da Cunha.

Peruvian Pelicans, Ancón, Peru.


F.L. JAQUES-

Blue-footed Boobies in courtship performance, Lobos de Tierra Island, Peru. Turkey Vulture in flight.

Piqueros, or Peruvian Boobies, Pescadores Island, Peru.

Guanays, or Peruvian Cormorants,
Santa Rosa Island, Peru.

Fuegian Oyster-catchers, Falkland Sound.

Gray Gulls, Ancón, Peru.

Belcher's Gull (with banded tail) and Kelp Gull, Santa Rosa Island, Peru. The other birds are Peruvian Boobies.

Red-footed Cormorants and Inca Terns,
coast of Peru.

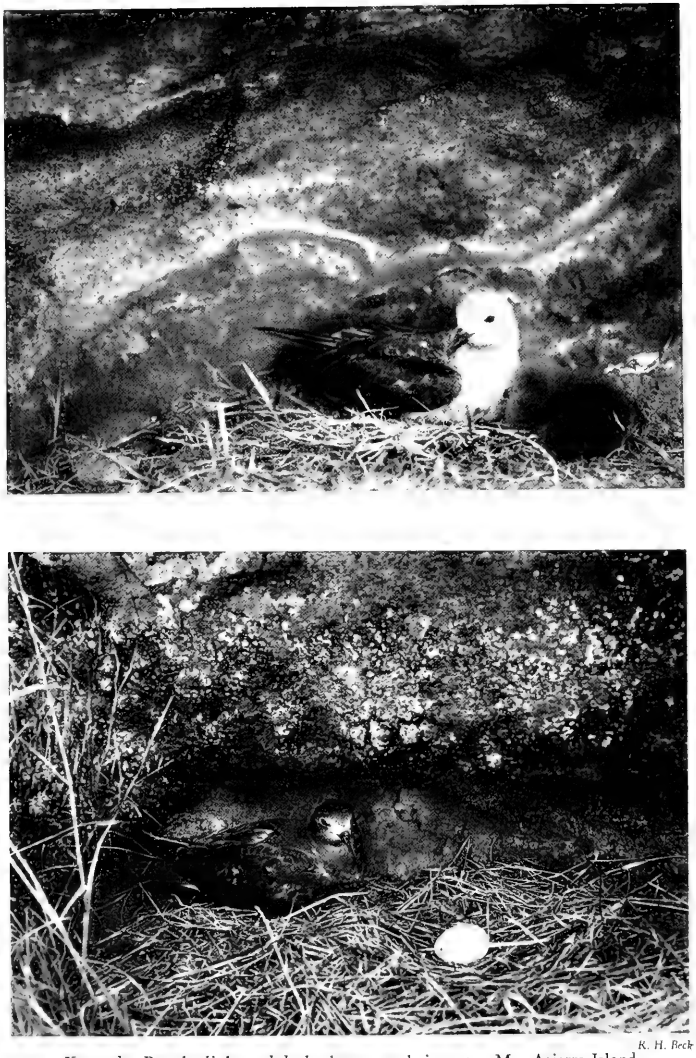
PLATES

D. S. Bullock

Nest burrows of the Pink-footed Shearwater, in the forest of Mocha Island, about 250 meters above sea level. November, 1932.

R. C. Murphy

A Shoemaker at the entrance of its burrow. South Georgia, November, 1912.



K. H. Beck

Kermadec Petrels, light and dark phases, at their nests. Mas Atierra Island, December, 1913, and January, 1914.

R. C. Murphy

Fledgling Peruvian Diving Petrel, after removal from its burrow.
Vieja Island, November, 1919.

R. H. Beck

Falkland Diving Petrel, after excavation of its nest within the base of a hummock.
Kidney Island, November, 1915.

Fahnestock Expedition

Incubating Caribbean Man-o'-war Birds of both sexes. Pearl Islands, January, 1935.

J. P. Chapin

Red-billed Tropic-bird on its egg. Daphne Island, Galápagos, April, 1930.

PLATE 43

J. P. Chapin

Fahnestock Expedition

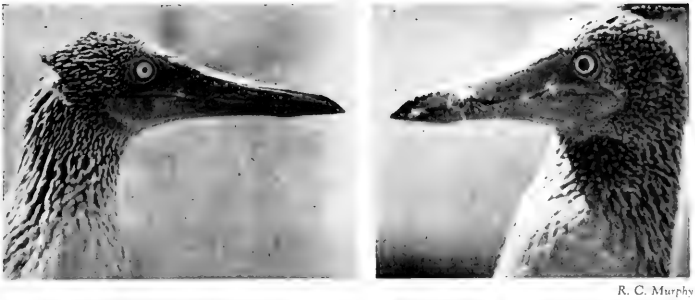
Brown Pelicans at the Pearl Islands. Upper, April, 1930; lower, January, 1935.

J. P. Chapin

Peruvian Pelicans. Chincha Islands, February, 1935.

J. P. Chapin

Incubating female Ridgway's Man-o'-war Bird. Tower Island, Galápagos, April, 1935.



R. C. Murphy

Male (left) and female Blue-footed Boobies. A mated pair, photographed simultaneously at Lobos de Tierra Island, to show the characteristic sexual dimorphism in the eye.

Van Campen Heilner

The author interviewing a Blue-footed Booby at El Muerto Island.

PLATE 46

R. C. Murphy

Piqueros. Upper: A ledge of the Amphitheatre, north Chincha Island. Lower: Parent and young, south Guañape Island. November, 1919, and January, 1920, respectively.

Van Campen Heilner

Coming in to the nest. La Plata Island, February, 1925.

J. P. Chapin

The characteristic ring of guano. San Felix Island, February, 1935.

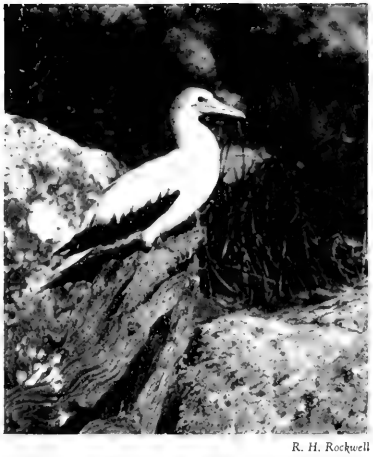
PACIFIC MASKED BOOBY

F. M. Chapman

Male Colombian Booby, showing the gray head which distinguishes it from the Atlantic race. Pearl Islands, March, 1931.

F. M. Chapman

Brown Booby beside its nest. Cay Verde, Bahama Islands, March, 1917.



R. H. Rockwell

R. C. Murphy

Adult in white phase, and immature. South Trinidad Island.

J. P. Chapin

Nesting adult, gray phase. Tower Island, Galápagos, March, 1935.

RED-FOOTED BOOBY

R. C. Murphy

South Georgian Blue-eyed Shags in courtship on an uncompleted nest. Bay of Isles, December, 1912.

R. C. Murphy

Naked chicks, one and two days old, respectively, of the South Georgian Blue-eyed Shag, December 24, 1912; and below, the same chicks as seven-week fledglings, on February 16, 1913. Bay of Isles, South Georgia.

R. C. Murphy

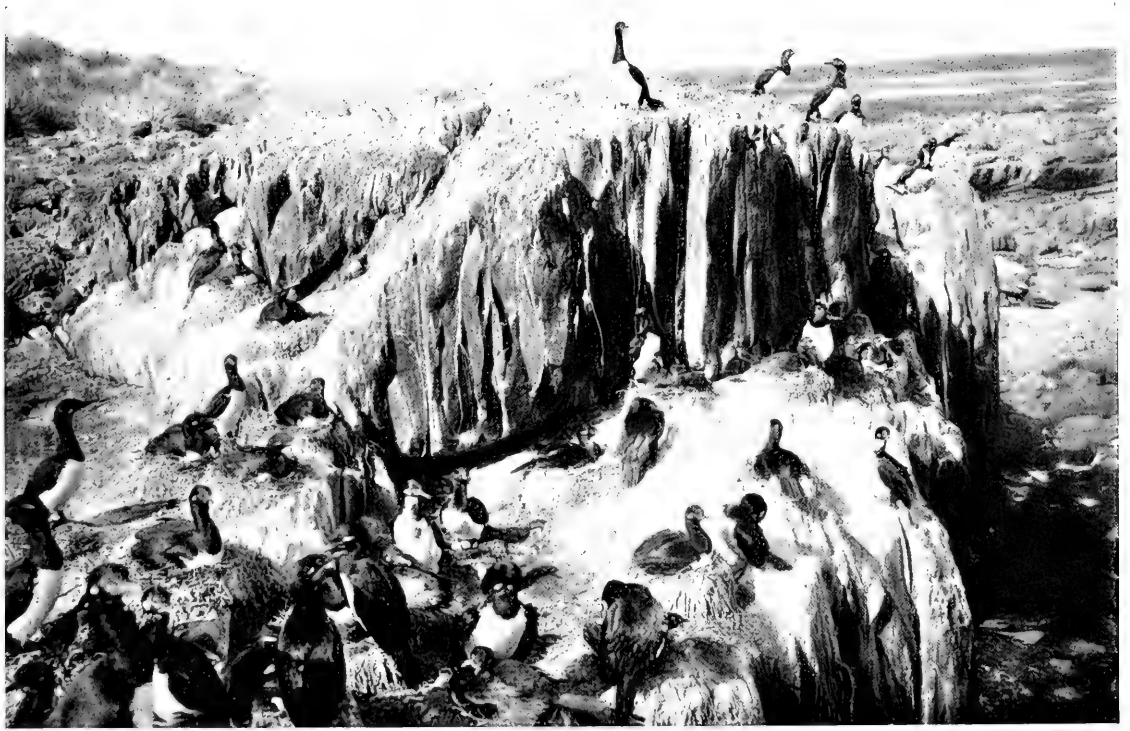
Young Guanay, which voluntarily came aboard a launch off northern Peru. The photograph shows well the length and robustness of the wing in this strong-flying cormorant.

R. C. Murphy

Brooding female South Georgian Blue-eyed Shag. Bay of Isles, December, 1912.

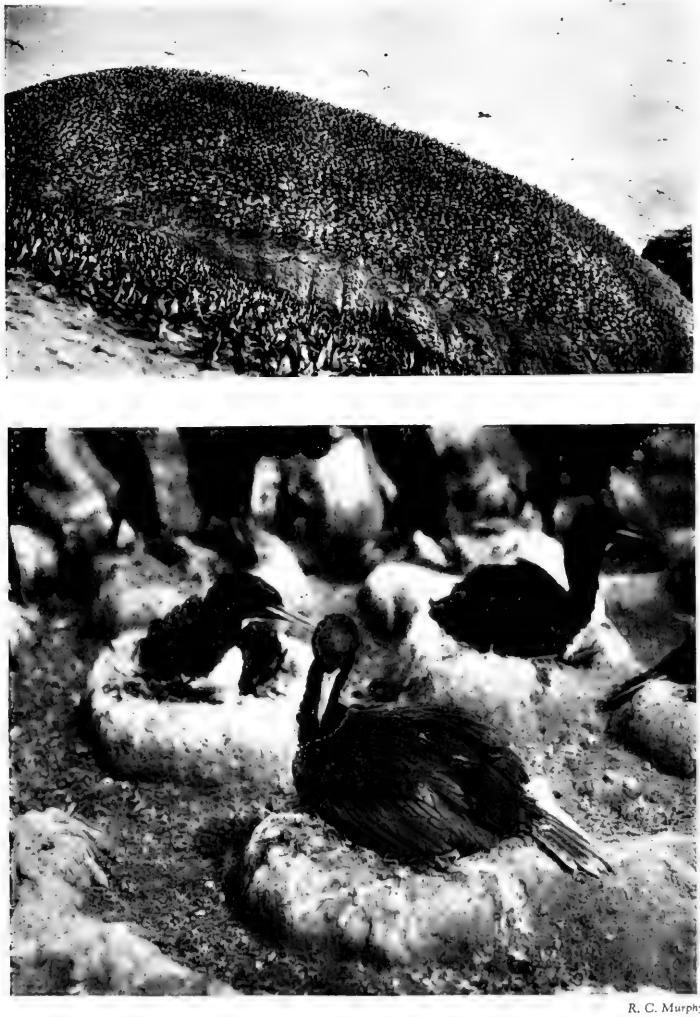
R. H. Beck

A King Shag colony. Bleaker Island, Falklands, December, 1915.



R. H. Beck

A Rock Shag colony. East Island, Falklands, December, 1915.

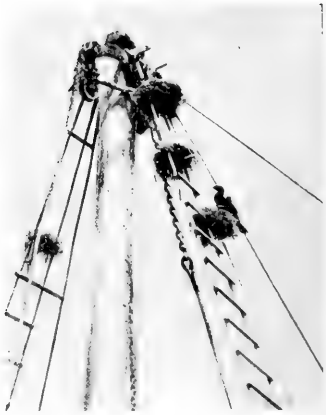


R. C. Murphy

Glimpses of a Guanay colony, Pescadores Island, December, 1919. New eggs have been laid in nests recently deserted by fledglings of an earlier generation.

R. C. Murphy

Roosting on the wreck of the 'Leonidas.' Chincha Islands, November, 1919.



J. P. Chapin

Nesting in the rigging of a hulk. Coquimbo, Chile, February, 1935.

BIGÜÁ CORMORANTS

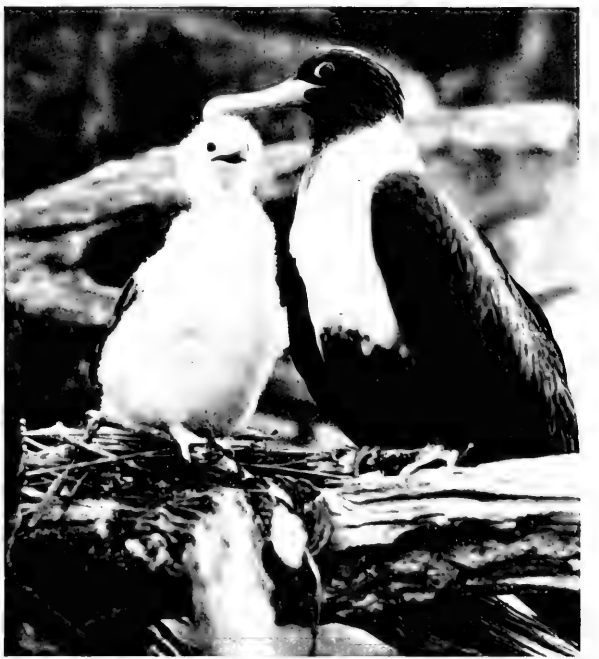
W. K. Gregory

J. P. Chapin

Flightless Cormorants. Tagus Cove, Albemarle Island, Galápagos.

R. H. Beck

King Shag with a billfull of nest material. Bleaker Island, Falklands, December, 1915.



R. H. Rockwell

Female and young of the South Trinidad Man-o'-war Bird (*Fregata minor nicolli*).

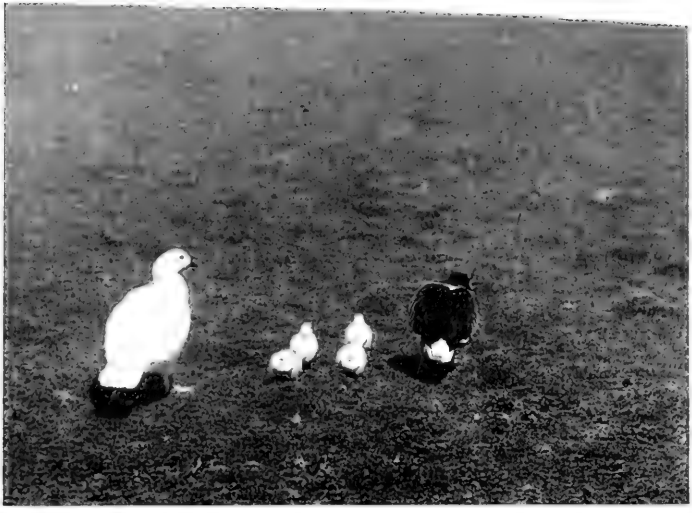
J. P. Chapin

Soaring above the yacht 'Nourmahal.'

J. P. Chapin

A courting male, with inflated pouch.

RIDGWAY'S MAN-O'-WAR BIRD. TOWER ISLAND, GALÁPAGOS, APRIL, 1930



R. H. Beck

A family of Falkland Kelp Geese. Bleaker Island, December, 1915.

R. H. Beck

Nest of Magellanic Kelp Goose. Thomas Island, December, 1914.

R. C. Murphy

A pair of South Georgian Teals, with the drake in the foreground.
Bay of Isles, December, 1912.

R. H. Beck

Magellanic Flightless Steamer Ducks. Hermite Island, December, 1914

PLATE 61

R. H. Beck

Punta Loyola, Atlantic coast of Patagonia, in midwinter. August, 1915.

R. H. Beck

Among King Shags and Rockhopper Penguins. Bleaker Island, Falklands, December, 1915.

SHEATH-BILLS

Sheath-bills. Bleaker Island, Falklands, December, 1915.

R. H. Beck

R. C. Murphy

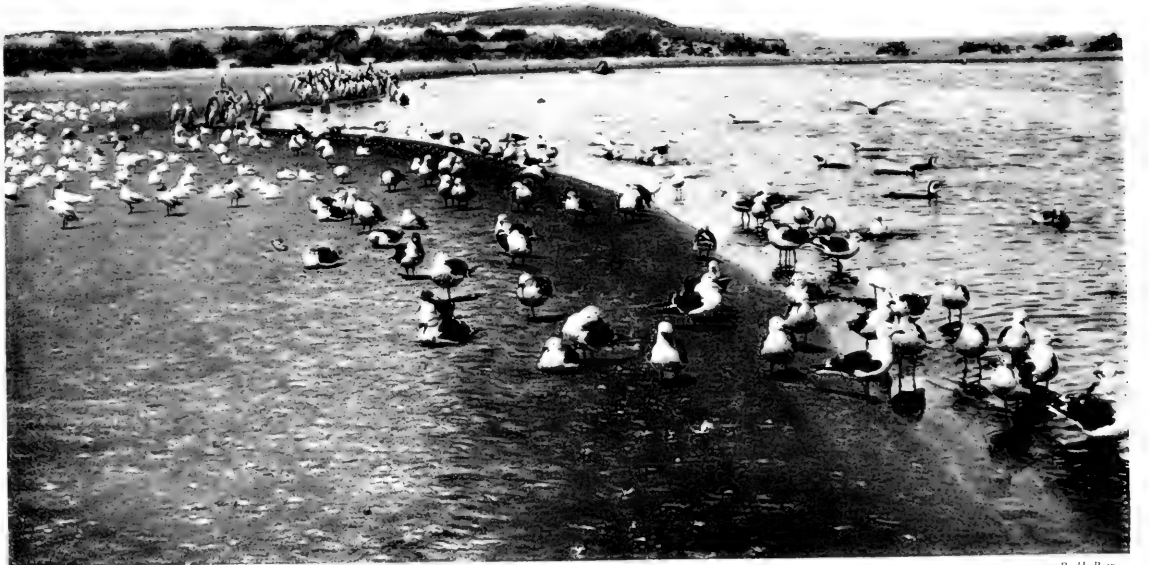
Newly hatched Brown Skua. South Georgia, December, 1912.

R. H. Beck

Nest and eggs of the Chilean Skua. Caroline Island, December, 1914.

R. C. Murphy

Brown Skuas foraging in a glacial stream. Bay of Isles, South Georgia, January, 1913.



R. H. Beck

Dolphin Gulls, Brown-hooded Gulls, and Magellanic Penguins. Sea Lion Island, Falklands, December, 1915.

F. M. Chapman

Kelp Gull on the superstructure of a steamer. Coast of Peru.

J. P. Chapin

Dusky Gulls, Conway Bay, Indefatigable Island, Galápagos.

J. P. Chapin

Dusky Gulls, near the anchorage of the 'Nourmahal.' Darwin Bay, Tower Island, Galápagos, April, 1930.

R. H. Beck

Kelp Gulls following a shoal of fish in the Strait of Magellan. November 22, 1914.

Fahnestock Expedition

Laughing Gull. Panama, January, 1935.

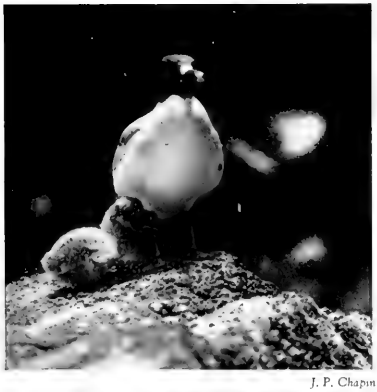
J. P. Chapin

Mountain Gull. Pisco Bay, February, 1935.

J. P. Chapin

The twelve smaller birds in the foreground are apparently Gray-hooded Gulls (*Larus cirrocephalus*), a species of uncertain status on the coast of Peru. The other two are either Belcher's or Kelp Gulls. Pisco Bay, February, 1935.

Toshio Asaeda



J. P. Chapin

Toshio Asaeda

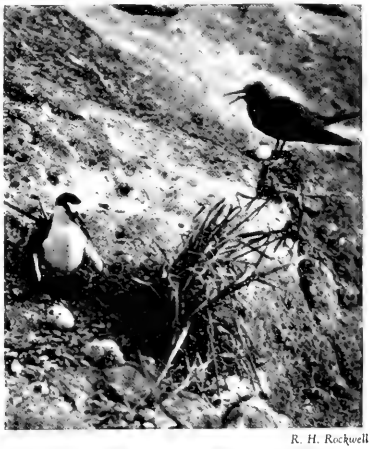
Swallow-tailed Gulls. Darwin Bay, Tower Island, Galápagos, March, 1935.

R. C. Murphy

South Georgian Tern, and its single egg. Bay of Isles, January, 1913.

R. H. Beck

Inca Tern in its nest crevice. San Gallán Island, July, 1914.



R. H. Rockwell

Sooty Tern and Brown Noddy. South Trinidad Island, January, 1925.

J. P. Chapin

R. C. Murphy

Inca Terns at the Chincha Islands. Upper: February, 1935; lower, October, 1919.

Toshio Asaeda

Pacific Fairy Tern, to illustrate the translucence of the wings.
Ducie Island, southern Polynesia.

R. H. Rockwell

Atlantic Fairy Tern and chick. South Trinidad Island, January, 1925.

Murphy, Robert Cu
Oceanic birds c

Date Loaned	Borrower