ORNITHOLOGY OF THE SECOND BYRD ANTARCTIC EXPEDITION

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THE second Byrd Antarctic Expedition embarked from Boston on October 11, 1933. After passing through the Panama Canal, we touched Easter Island, then crossed the Pacific to Wellington, New Zealand. A southeast course from there brought our vessel into ice-filled antarctic waters east of the Ross Sea. A large area of unknown ocean was explored by ship and airplane as far east as the 116th meridian, where we turned westward again. One month after the ship had first entered the pack-ice, it reached the southernmost shore of the Ross Sea. The Bay of Whales is that point on the circumference of the antarctic continent where the ocean encroaches farthest toward the pole. Here at 78° 34′ S. and 163° 56′ W., the base camp was established on the floating shelf ice of the Ross Barrier. The ice-party occupied the Bay of Whales base from January 17, 1934, until February 5, 1935, while the ships wintered in New Zealand. The itinerary of the return voyage included Dunedin, New Zealand, Easter Island, Albemarle Island of the Galapagos archipelago, and Panama. The expedition arrived in the United States on May 10, 1935, after an absence of nineteen months.

The present paper reports the birds observed at sea and on the antarctic continent by the writers during the second Byrd expedition, when Lindsey studied the vertebrates of the Bay of Whales region, and Siple worked for two months in Marie Byrd Land. Observations in the Bay of Whales made by Siple during the first Byrd expedition are also included in the discussions of seasonal occurrence. His collection of bird skins made in 1929–30 has been reported on by Dr. R. C. Murphy in 'Oceanic Birds of South America' under the biographies of the species in question. The 1933–35 collection made by Lindsey is summarized below. The writers are grateful to Professor A. A. Allen and Dr. R. C. Murphy for critical reading of the manuscript, and to Dr. Murphy for verifying and correcting their identifications of the oceanic-bird material collected, which has been placed in the American Museum of Natural History.

Fifty-four species of birds were identified in the course of the second expedition. Twenty-three of these were non-oceanic birds which came aboard ship from October 14 to 30 between New York and Panama. Nine species of sparrows and four species of warblers were among the passerine birds. The following list includes the non-passerine birds identified at sea, but not collected.

Galapagos Penguin, *Spheniscus mendiculus* Sundevall
Sooty Albatross, *Phoebetria fusca* (Hilsenberg)
Light-mantled Sooty Albatross, *Phoebetria palpebrata* (Forster)
Giant Fulmar, *Macronectes giganteus* (Gmelin)
Cape Pigeon, *Daption capensis* (Linnaeus)
? Bulwer's Petrel, *Bulweria bulwerii* (Jardine and Selby)
White-faced Storm Petrel, *Pelagodroma marina*, subsp.
Caribbean Man-o'-war Bird, *Fregata magnificens rothschildi* Mathews
Man-o'-war Bird, *Fregata minor*, subsp.
Flamingo, *Phoenicopterus ruber* Linnaeus
Purple Gallinule, *Porphyrula martinica* (Linnaeus)
Red-billed Gull, *Larus novaehollandiae scopulinus* J. R. Forster
Antarctic Tern, *Sterna vittata* Gmelin
White Tern, *Gygis alba*, subsp.

The ornithological collection of the second Byrd Antarctic Expedition consists of one hundred and seventeen skins, chiefly of the larger oceanic birds. Twenty species are included, representing ten families, as follows:

Emperor Penguin, *Aptenodytes forsteri* G. R. Gray
Adélie Penguin, *Pygoscelis adeliae* (Hombron and Jacquinot)
Black-browed Albatross, *Diomedea melanophris* Temminck
Wandering Albatross, *Diomedea exulans exulans* Linnaeus
Silver-gray Fulmar, *Priocella antarctica* (Stephens)
Snow Petrel, *Pagodroma nivea* (Forster)
Antarctic Petrel, *Thalassoica antarctica* (Gmelin)
Pediunker, *Adamastor cinereus* (Gmelin)
Galapagos Shearwater, *Puffinus l'herminieri subularis* Ridgway
Wilson's Storm Petrel, *Oceanites oceanicus oceanicus* (Kuhl)
Red-tailed Tropic-bird, *Phaëthon rubricauda*, subsp.
Blue-footed Booby, *Sula nebouxii* Milne-Edwards
Masked Booby, *Sula dactylatra granti* Rothschild
Spotted Cormorant, *Phalacrocorax punctatus punctatus* (Sparrman)
Galapagos Man-o'-war Bird, *Fregata magnificens magnificens* Mathews
South Polar Skua, *Catharacta skua maccormicki* (Saunders)
Brown Skua, *Catharacta skua lönnbergi* Mathews
Dusky Gull, *Larus fuliginosus* Gould
Kelp Gull or Southern Black-backed Gull, *Larus dominicanus* Lichtenstein
Panama Potoo, *Nyctibius griseus*

ALBATROSSES.—Throughout most of the year the Ross Sea is completely shut off from the open Pacific by a band of drifting ice as much as three hundred miles in width. This is the antarctic ice-pack, a purgatory for the navigator but a paradise for the observer of bird and mammal life. Unfortunately for the latter, no pack ice was encountered on our return voyage. However, this brought a measure of compensation in its effect on the southward occurrence of albatrosses, so that the known non-breeding ranges of three species were extended.

The most southerly wanderer of the Diomedeidae is the Light-mantled

Sooty Albatross (*Phoebetria palpebrata*). The southernmost prior record of this bird is that of Dr. Edward A. Wilson, who died with Scott's sledging party on the return from the pole. In 1904, Wilson had observed this bird at 74° S. At the beginning of our return voyage a Light-mantled Sooty Albatross was patrolling our wake at 77° 50′ S. Three days later, five Black-browed Albatrosses (*Diomedea melanophris*) joined us at a southward advance of 3.5 degrees beyond its former record. The stately Wandering Albatross (*Diomedea exulans exulans*) appeared at 68° 40′ S.; its previous limit had been set at 67° S. by the naturalists aboard the 'Scotia' (Clarke, 1915, p. 267). These are advances of 230, 210 and 100 geographical miles, respectively, for the three species. If the albatrosses had followed a vessel southward into these high latitudes the position might not truly represent natural occurrence, but the birds were picked up on the northward voyage, with ours the only two ships in the entire Ross Sea.

On the southward trip the first albatrosses were met at 34° 3′ S. These were the Wandering and the Black-browed Albatross. In the 'roaring forties' two male Wandering Albatrosses were collected, the larger weighing 19 pounds and measuring 10 feet 9 inches in extent.

SNOW PETREL AND ANTARCTIC PETREL.—We are here concerned primarily with the nine species of antarctic and sub-antarctic birds which were found in summer at the southern limit of the Ross Sea, along the Ice Barrier cliff. The Bay of Whales region marks the southernmost limit of eight of these species, a fact which lends increased interest to these records.

When an experienced ice-pilot in antarctic waters sights the first Snow Petrel he concludes that ice is not far away. The first part of its generic name, *Pagodroma*, means ice, its specific name, *nivea*, means snowy, and the bird itself is seldom found far from either ice or snow. This is the most abundant bird in the pack ice. It lives largely on the shrimp-like reddish crustacean, *Euphausia superba*, which is also the principal food of the Adélie Penguin, the Crab-eater Seal, and other denizens of the antarctic pack. The Snow Petrel's plumage is white with ivory tones; its beak, eyes, tarsi, and feet are black. This would be an altogether attractive bird were it not for its accuracy and eight-foot range in ejecting the oily, orange-colored contents of its stomach at the intruder.

After four months below the horizon, the sun reappears at the Bay of Whales on August 22. The earliest spring migrants are the Snow and the Antarctic Petrels. In 1929, a single Antarctic Petrel was seen October 2, but no Snow Petrels appeared until October 31. In 1934, a lone Snow Petrel and two Antarctic Petrels arrived October 6. In terms of the calendar this is analogous to the Bluebirds' delaying their arrival in the northeastern United States until the first week of April. The last Snow Petrel seen in the autumn was on March 13, after which no birds of any kind were seen.

Snow Petrels did not become common in the bay until December, or midsummer, when they congregated by thousands on the sea-ice and barrier cliff near open water. A few habitually coursed back and forth along the higher ridges of pressure ice, where it was possible to collect them by hiding among the ice blocks. A tractor party returning to the base saw a Snow Petrel flying over the barren shelf ice forty miles from the sea. Though this is the southernmost recorded individual, several of Scott's sledging parties saw these birds seventy miles inland (Wilson, 1907, p. 90). The breeding habits have been observed by half a dozen different expeditions.

No birds breed in the Bay of Whales region. The only known breeding ground within four hundred miles is a rookery of Snow Petrels discovered by a four-man sledging party which Siple led into the mountain ranges of Marie Byrd Land. On the return trip through King Edward VII Land an ascent of Mount Helen Washington was made on December 19, 1934. A great flock of birds enveloped the summit of the peak, about one thousand by estimate. Both Snow and Antarctic Petrels were represented, in approximately equal numbers, and the presence of a rookery was suspected. On the lower slopes many bleached petrel bones were found in the profuse matting of lichens covering the rocks. As the summit was approached the bones became more numerous, and fragments of egg-shells were found. The birds began swooping at the heads of the two climbers. Finally, at the summit of the peak the rookery was located, where Snow Petrels were sitting on their eggs deep in crevices among the rocks. They defended their nests with the customary marksmanship. The eggs collected were found to be in the early stages of incubation. No nests of the Antarctic Petrel were found, but from the numbers of the birds it seems likely that they nest on this peak with the Snow Petrels. A fact of unusual interest is the distance of this nesting site from the nearest water. These birds nest fifty-one statute miles from their nearest possible source of food. This disadvantage seems to be counterbalanced by the nature of the peak, where many sheltered nesting sites are available among the loosely aggregated rocks. Winds of hurricane force sweep over the peak and prevent large accumulations of snow, while the dark rock contributes by absorbing the sun's heat and melting the snow. Finding this rookery extends the breeding range of the Snow Petrel 6° 36′ or 452 statute miles to the south.

In the ice pack in January flocks of hundreds of Antarctic Petrels were seen wheeling in unison above the great tabular bergs. About seventeen inches in length, or three inches longer than the Snow Petrel, this bird is no less handsome. Its chocolate-brown head, back, and wings furnish a pleasing contrast with the whiteness of the wing coverts and other parts. Our northernmost observation of it was at the same position as that of the Snow Petrel, 63° 30′ S. Both species are circumpolar in distribution from the northern limits of the pack to the coasts of Antarctica.

In the Bay of Whales the Antarctic Petrel was much more common in 1929 than in 1934. Large flocks were seen frequently in the summer of 1929–30, but disappeared after the middle of January, and from then on even single individuals were very rarely seen. In 1934, no flocks of more than four were to be found in the bay, and the bird was uncommon throughout our stay there.

SILVER-GRAY PETREL (*Priocella antarctica*).—This is the least common of the birds known to visit the Bay of Whales. In 1930, it occurred rather frequently among the large flocks of Antarctic Petrels early in January, but has not been recorded in the bay since that time. Our only specimen collected was secured on the antarctic circle and the 150th meridian, at the northern edge of the pack.

CAPE PIGEON (*Daption capensis*).—This petrel has never been reported in the Bay of Whales. Its southernmost record is at Discovery Inlet, 78° 30′ S., where it was observed December 26, 1928, in the course of the first Byrd Antarctic Expedition. Apparently it had not been following the ship, for it paid little attention to it, and soon disappeared from sight.

WILSON'S STORM PETREL (*Oceanites oceanicus oceanicus*).—Breeding only on antarctic and sub-antarctic islands and on shores of the antarctic continent, this species migrates as far north as Labrador during the southern winter. As for all birds which reach the Bay of Whales, except the South Polar Skua, this station marks its southernmost limit. Wilson's Storm Petrel is frequent here in January and February, and may be seen ten miles back from the sea, careening over the flat bay-ice in a very swallow-like manner. We never saw them alight on the ice. Scott's expedition observed these birds flying over the shelf ice some sixty miles from open water (Wilson, 1907, p. 79).

GIANT FULMAR (*Macronectes giganteus*).—In summer during the second Byrd Expedition, after the sea ice at the mouth of the bay began to break up and float northward to join the pack, the Giant Fulmar or Giant Petrel was frequently seen soaring over the open water. This was not the case in 1928–30, however, for although several had appeared at Discovery Inlet, not one had been reported at the Bay of Whales until the autumn of 1933. The two stations are about eighty miles apart.

This species has two color phases, a brown and a white, with intermediate conditions. Wilson (1907, p. 96) pointed out that in proceeding southward the proportion of white specimens greatly increases. From 33° S. to 66° 7′ S., he saw only one white bird in five hundred, while south of 66° 7′ eighteen white and sixty dark birds were counted. Of about ten Giant Fulmars seen in the Bay of Whales in 1934–35, all were brown birds. None of these was seen at rest on the ice or flying over it, but always flying a few feet above the waves. In cruising along the barrier cliff between the Bay of Whales and

Discovery Inlet, we saw a flock of about fifty which had settled on an ice floe. Only two of these represented the white plumage phase. Although these two stations are at the very southernmost limit of the range, within the scope of our observations the white birds constituted only 3.3 per cent of the sixty individuals, as compared with Wilson's 23 per cent.

SOUTH POLAR SKUA (*Catharacta skua maccormicki*).—The drama of antarctic bird life is not without its villain. Theft and pillage, murder, cannibalism and infanticide, these crimes are all in the repertory of the South Polar Skua. The Adélie Penguin rookeries suffer heavily from its depredations. The Emperor Penguins are immune to this plague only because they nest in the middle of winter, sharing with no other bird species the rigor of the polar night. At the afore-mentioned Snow Petrel rookery there were skuas about. Doubtless the petrels' habit of laying their eggs in narrow crannies serves to protect the eggs and young from skuas, as well as from the force of frequent severe blizzards. It was not possible for the sledging party to remain in the region until the eggs hatched, but the bones scattered around the rookery probably bear witness to the work of skuas, at least in part.

At the summit of an unnamed peak near Mt. Saunders, the Marie Byrd Land party made a find which is unusual indeed in these latitudes. A small unfrozen fresh-water lake in the black sedimentary rock supported considerable plant and animal life. The muck bottom was pinkish in color due to innumerable red rotifers. There was a profuse growth of filamentous green algae in the pool, and the water had a stagnant odor. The moss, *Grimmia antarctica*, grew along the bank. The tarn served as the rendezvous of skuas, and a deposit of guano around it attested to long use of this haunt. A half-dozen skuas loitered about all day, bathing in the lake and resting on the rocks. Snow Petrel feathers and bones disgorged in definite pellets were scattered around the lake. Since this is 180 geographical miles from the Snow Petrel rookery in King Edward VII Land, it seems likely that the skuas had brought the remains of the young petrels here from as yet undiscovered rookeries on those hundreds of nearer peaks along the coast, which have never been visited by man. The date of this observation was December 3. No egg-shells or other evidences of nesting were found, but the abundance of the skuas in the general neighborhood suggests the proximity of a rookery. This mountain is thirty geographical miles from the coast. A similar 'robbers' roost' of the skuas was found at the summit of Mt. Saunders, 76° 47′ S., and thirty-five miles from the nearest water.

The South Polar Skua wanders farther south over the continent than any other bird. Amundsen saw two of them on the Ross Shelf Ice at 84° 26′ S., and Dr. Gould, in 1929, photographed one at the Queen Maud Range, 85° S. On the second Byrd Expedition, the southern geological party reported one

skua at 81° 41′ S. However, the record of greatest interest is an observation made by this party at 86° 05′ S., thirty miles up the Thorne Glacier, at an altitude over two thousand feet. The date was December 20, 1934, and the position 464 geographical miles from the nearest water and 235 miles from the pole. Here the men saw four skuas flying toward them from up-glacier, i. e., from the polar plateau, presumably. When the birds settled on the snow near the dog lines, the tethered dogs went into a frenzy at the sight of them. The birds rested for a time and finally took off, flying north, continuing the flight down the glacier. These facts suggest that the skuas may have been on a flight across the antarctic continent.

There is one still more southerly bird record, though the circumstances seem rather less suggestive. Captain Scott on his last journey wrote in his diary, January 2, 1912: "One skua gull visited us on the march this afternoon—it was evidently curious, kept alighting on the snow ahead, and fluttering a few yards as we approached. It seemed to have had little food—an extraordinary visitor considering our distance from the sea." This was on the plateau, at an altitude of 9,980 feet. The position was 87° 20′ S., or 160 geographical miles from the south pole, and 560 geographical or 640 statute miles from the sea.

Soon after the Byrd Expedition arrived at the Bay of Whales, numbers of Weddell Seals were being killed for dog food. At the time when our search for a seal embryo was first rewarded, the specimen was left lying on the sledge while preservative was being prepared. A sudden swift rush of wings, then skua and embryo were making for the horizon. On another occasion the thieving nature of the skua was accidentally sublimated into usefulness. We were attempting to collect fish by dynamiting from a small boat in open water. A current from beneath the ice, however, apparently carried most of the victims far out to sea before they floated to the surface. After shooting eighty sticks of dynamite at various depths, we had secured only two small specimens of *Pleurogramma antarctica*. A skua was then seen flying in from sea with a fish in its beak. While it alighted on the ice to devour its find, we rowed ashore and rushed toward it with wild shouts, so that it flew off, abandoning the scarcely damaged fish. Two other skuas were seen carrying fish ashore that day, whereas throughout both expeditions only one other case of a skua with a fish was observed. The only items in the stomachs of skuas we collected were pebbles, the blubber, flesh and hair of seals, flesh and bones from skua carcasses that we had skinned, and cuttlefish beaks.

The first springtime arrival of skuas in the Bay of Whales was on November 9, when three appeared. They were common during December, January, and February. The last autumn record for them was March 13, when the temperature had been dropping to −30° F. for a week. Eighteen

specimens taken in the middle of December were equally divided between the sexes, and the gonads of both evidenced reproductive activity.

ADÉLIE PENGUIN (*Pygoscelis adeliae*).—After twelve days of cruising eastward through pack ice and bergs, we saw the first Adélie and Emperor Penguins at 68° S. and 124° W. The Adélies were the more abundant of the two. Both adult and immature birds of each species were seen. The immature Adélies greatly outnumbered the adults, and two seen January 2 carried the remnants of their down plumage. This is remarkable, for Wilson (1907, p. 58) found that the nestling down is moulted *at the rookery* between January 9 and 16. The two white-throated young in question were on a large ice-pan 180 miles north of the nearest possible unknown coast line. They were not seen to enter the water. Perhaps they were carried away accidentally from the vicinity of the rookery with the break-up of sea ice along the shore, and were finishing the moult on floating ice as the Emperor Penguin chicks do in the spring during their ride north to the pack. Even so, January 2 would seem to be unusually early for the last of the down to be shed. This occurrence may indicate the presence of a rookery near the 115th meridian, and probably to the east of it since the ocean current is westward-flowing along these coasts.

The white-throated immature plumage is carried for thirteen months, and is replaced by the black-throated adult plumage in the latter part of February of the bird's second year. Only birds in the adult plumage migrate south to the rookeries in the spring. The black-throated birds which we find in the pack in early January are obviously not breeding. These may be third-year birds remaining in the pack for another year after acquiring the adult plumage. If so, as Wilson (1907, p. 58) has suggested, it follows that the penguins are three years old before they breed.

In the Bay of Whales the earliest spring record is a specimen taken November 14, 1934, nine days after the first Emperor had arrived. Both species are merely visitors in the bay, for their nearest known rookeries are at Cape Crozier, 400 miles to the west. Not another Adélie was seen until January 5. After this date they appeared occasionally in the bay in groups of from two to four, but only one such group was seen at a time. In fact, throughout the summer's work in the Bay of Whales, only fourteen Adélies were seen here in all. Yet at Discovery Inlet, eighty miles to the west, they were numerous after the middle of January. Some of the latter were presumably from a rookery, for the gonads were enlarged. The relative abundance at the two stations also suggests that the birds had come from the rookeries west of us, and that most of them go ashore at Discovery Inlet, only a few continuing to the Bay of Whales. It also may indicate the absence of any rookery along the equivalent four hundred miles of coast to the east, the more strongly because the westward-flowing coastal current

would favor movement of birds toward the bay from the east, while opposing it from the west.

With a single exception, all the Discovery Inlet specimens were in the adult plumage. The one immature bird was in the bleached and weathered white-throated plumage, ready to moult soon into the black-throated adult plumage. Such birds are not to be found in rookeries, but are met with in the pack ice. The fact that this year-old bird, which had spent the previous winter in the pack, was on the continental coast in January, suggests the possibility that some of the black-throated birds collected with it were also birds which would normally be in the pack at the time, and had come from there rather than from any rookery. These would then correspond to the black-throated non-breeding Adélies which we saw in the pack along the antarctic circle in January. Instead of remaining in the pack to moult with their fellows, they had wandered perhaps eight hundred miles to the south to moult in the security of a sheltered bay along the Ross Ice Barrier.

Of the twenty-seven specimens taken in January on the coast, ten were females and seventeen were males. The mean total length of twelve males was 29.0 inches, and of seven females, 26.9 inches. The weight of twelve males ranged from 7.5 to 10 pounds, averaging 8.5 pounds. Three females averaged 8.2 pounds. Wilson (1907, p. 43) states that a collection of small pebbles is invariably found in the stomach. This does not apply to birds in the moult, which are fasting since they dare not enter the water. Most stomachs examined contained from one to ten pebbles each, but six stomachs were completely empty.

In 1929, the white-throated juveniles were not uncommon in the flocks of adults. The largest group of Adélies we saw at any one time was a compact flock of 85 adults on the sea ice at Discovery Inlet.

EMPEROR PENGUIN (*Aptenodytes forsteri*).—These largest of living penguins were more frequent visitors to the Bay of Whales than the Adélies in 1934–35, but the reverse was true in 1929–30. Their remarkable habit of breeding during the extreme cold and darkness of the antarctic night leaves them free in summer to wander along the coast and through the ice pack. Many Emperors are to be seen in the pack during December and January, both juvenile and black-throated birds. Others of both groups seek coastal bay ice, such as the Bay of Whales affords, on which to moult.

Although conspicuous by virtue of their size, coloration, and loud, reedy, whining call note, Emperors are by no means abundant in the bay. Throughout the summer of 1934–35, though we were on the bay almost daily for three months, the total number of Emperors seen was only thirty-two. The first in the spring appeared November 5, after which none was seen for a month. On the first expedition they were even less commonly found.

An Emperor was found starting to moult as early as December 5. The

birds avoid the water and take no food during the moult, which lasts nearly one month. Eighteen specimens taken in November and December, before the moult, ranged from 60 to 84 pounds, while eleven taken after the moult, in February, ranged from 39 to 55 pounds. The mean weight before the moult was 70.1 pounds, and after the moult, 49.8 pounds. Some taken in the latter part of December had already completed the moult and were feeding. Their stomachs contained fish and *Euphausia* remains, and usually pebbles, though not invariably. The pebbles had undoubtedly been secured elsewhere, for no land is exposed within one hundred miles and the sea is 1800 feet deep beneath the bay ice. Sixty-eight grams was the maximum weight of pebbles found in one stomach; the largest pebble weighed six grams. Sclater (1888, p. 325) reported pebble masses from two to ten pounds in weight. They rest remarkably far down, since the lowest part of the greatly elongated stomach reaches nearly to the base of the body cavity. The weight of pebbles at this point lowers the penguin's center of gravity and possibly helps it to some extent to maintain its upright posture on the ice. This may also serve as ballast when diving, as Murphy (1936, p. 364) has suggested.

Only two of the Bay of Whales Emperors were in juvenile plumage. These individuals were about seventeen months old and soon to assume the adult coat. Four such birds caught at Discovery Inlet moulted into the adult plumage while in captivity. All of the juvenile Emperors seen along the coast were over one year old.

The pupil of the eye is capable of great change in size in relation to light intensity. In the bright sunlight of the antarctic summer the pupil is less than a millimeter in diameter. The iris is dark rufous in color. The shapes which the pupil assumes at different apertures are similar to those of the King Penguin (*Aptenodytes patagonica*) as described by Murphy (1936, p. 343). At a moderately small aperture the Emperor's pupil is distinctly square, and in closing further the corners become more sharply defined. Finally, when less than three or four millimeters in diameter, the pupil shows very sharply attenuated corners, since the iris bows inward from the four sides. The characteristic call note is given by both sexes.

A dog-team driver on the trail east of the base saw an Emperor's tracks fifteen miles south of the coast in the first week of January. The penguin was heading south, on the high shelf ice. Such wanderings are typical of the moulting period. It is not probable that this bird was lost, for we found that captive penguins released on the barrier surface were able to head accurately in the direction of the nearest water, possibly by a reaction to the dark band of 'water-sky.'

These penguins displayed apparently intelligent behavior when a group of them skirted the edge of the high barrier cliff in an effort to find a way

down into the water. One or two of the flock would drop down on their bellies and toboggan up to the edge. After peering over and finding a precipitous sixty-foot drop, this advance guard would turn directly about and slide back to the flock which had remained at a distance of twenty feet from the edge. Here the birds would again stand up on their feet and the whole group would waddle along parallel to the edge forty feet or so, when the whole performance would be repeated. This continued for miles, and was observed with different groups of Emperor Penguins. Those who have seen the barrier edge calve off into the sea under the slight weight of man or dogs might be prone to attribute to the penguins a realization of this danger. This anthropomorphic interpretation fits well with the popular idea of the birds' cleverness. The ornithologist, however, might reach either of two conclusions. Since antarctic seas are filled with great tabular icebergs, merely loose pieces of shelf ice derived from the Ross Barrier or similar formations, it would seem probable that penguins find sloping edges and make their way to the top, later following along the steep edge in search of the same or another route back down. An instinctive fear of high and steep places would have survival value and be implanted in the race through a long period of selection. Or, again, it might be concluded that some or all of these birds had been conditioned by personal experience with unstable overhanging snow cornices on a smaller scale, or had been blown by high winds off the edges of ice cakes, particularly when walking or standing erect. These possible explanations, however, seem unnecessarily elaborate. Consider the approach of a flock of Emperors toward a man or a dog team. They come up to within fifty or sixty feet, some walking, others tobogganing. Then they stand erect in a curious yet cautious group while one of them slides along on its belly to investigate, approaching to within ten feet or less of the strange object. After some trumpeting, bowing and scraping, it returns to the group. Another bird may then carry out the same procedure, or its curiosity satisfied, the flock may resume its leisurely walk. If man or dog advances menacingly, however, all the birds at once drop to their bellies and skitter off at such a pace that a man running full tilt is hard put to overtake them. It seems, then, that the Emperor Penguin when out of water reacts in the same way toward any object of curiosity and potential danger, such as man, tractor, or the more usual problem of the steep edge of the ice. Their habit of approaching such situations on their bellies shows an apprehensive state of 'mind'. They are prepared for a quick retreat if the edge of the ice begins to crumble or in case of attack by natural enemies such as the Sea-leopard (*Hydrurga leptonyx*). Danger from the latter is confined largely to the water, however (Levick, 1914, p. 84).

After an unsuccessful attempt on the first Byrd Expedition to bring back

living antarctic penguins for American zoos, another attempt was made on the second trip. The captives were kept at the base camp, where an area of about 5000 square feet of snow was enclosed by a wire netting. The first birds caught were kept here for two months before being transferred to the ship. Frozen fish had been purchased in New Zealand for feeding them. This was thawed in water and cut into strips of convenient size with the larger bones removed. The birds were fed once a day, and care was taken not to overfeed them, since some were moulting. Because the penguins were unable to recognize dead material as food, and were unwilling to accept the hospitality of their captors, forcible feeding was necessary. This required two men, one to catch the bird, overpower it and hold it down, another to pry open its beak and administer the food, piece by piece. At the end of two months one of the flock, an Emperor, had become reconciled to eating, and would open its beak for food.

On leaving the Antarctic we had twenty-one captive Adélies and nineteen Emperors housed amidships in an air-conditioned, refrigerated, cork-insulated room forty feet long, six feet wide, and seven high. Half its length was given over to a concrete tank of cooled sea water three feet deep. Air was pumped down from the masthead and cooled by passing through a large honeycomb coil of ammonia veins. On the cooler days the birds were taken out to a canopy-covered enclosure on deck for a chance to dry their feathers, since the necessity of continually washing down the room kept it too humid and the penguins were sometimes unable properly to dry themselves. After three weeks at sea, when the birds had been kept for two or three months in captivity, most of the Emperors no longer required forcible feeding. On the contrary, they had become very tame and friendly, since a new association had finally been formed and man now symbolized food. The task of feeding them was scarcely lightened on this account, for their greedy shoving and squabbling over each piece of fish created new difficulties. The fact that a very few of the adult birds ultimately learned to pick up food from water in a pan did not facilitate the feeding, because of their clumsiness and slowness in trying to feed themselves. The young Emperors were far behind the adults in their conditioning to hand feeding, and were more vicious in defending themselves against being fed. The Adélies showed still less adaptability and more pugnacity. Their stout hooked beaks proved much more formidable weapons than the long, curved bills of the Emperors. If the powerful Emperors had fought as strenuously in proportion to size, keeping them alive would have been quite impossible.

Unfortunately for the captives, the return voyage to America took more than three months due to the slow pace of the ships and an extended stay in New Zealand, where many of the Adélies died. By the time the expedition

had crossed the tropics, nine of the Emperors had died from a heavy mycosis infection of the lungs, tracheae, and air sacs. Ten Emperors and one Adélie Penguin reached the United States alive and were delivered to the Chicago Zoological Society. The last of these died about two months later of the same disease. The Society transferred these birds to the Field Museum of Natural History, where they are now on display as a habitat group.

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