

COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF EXTERNAL AFFAIRS

AUSTRALIAN NATIONAL ANTARCTIC RESEARCH EXPEDITIONS



ANARE REPORTS

SERIES B

VOLUME I

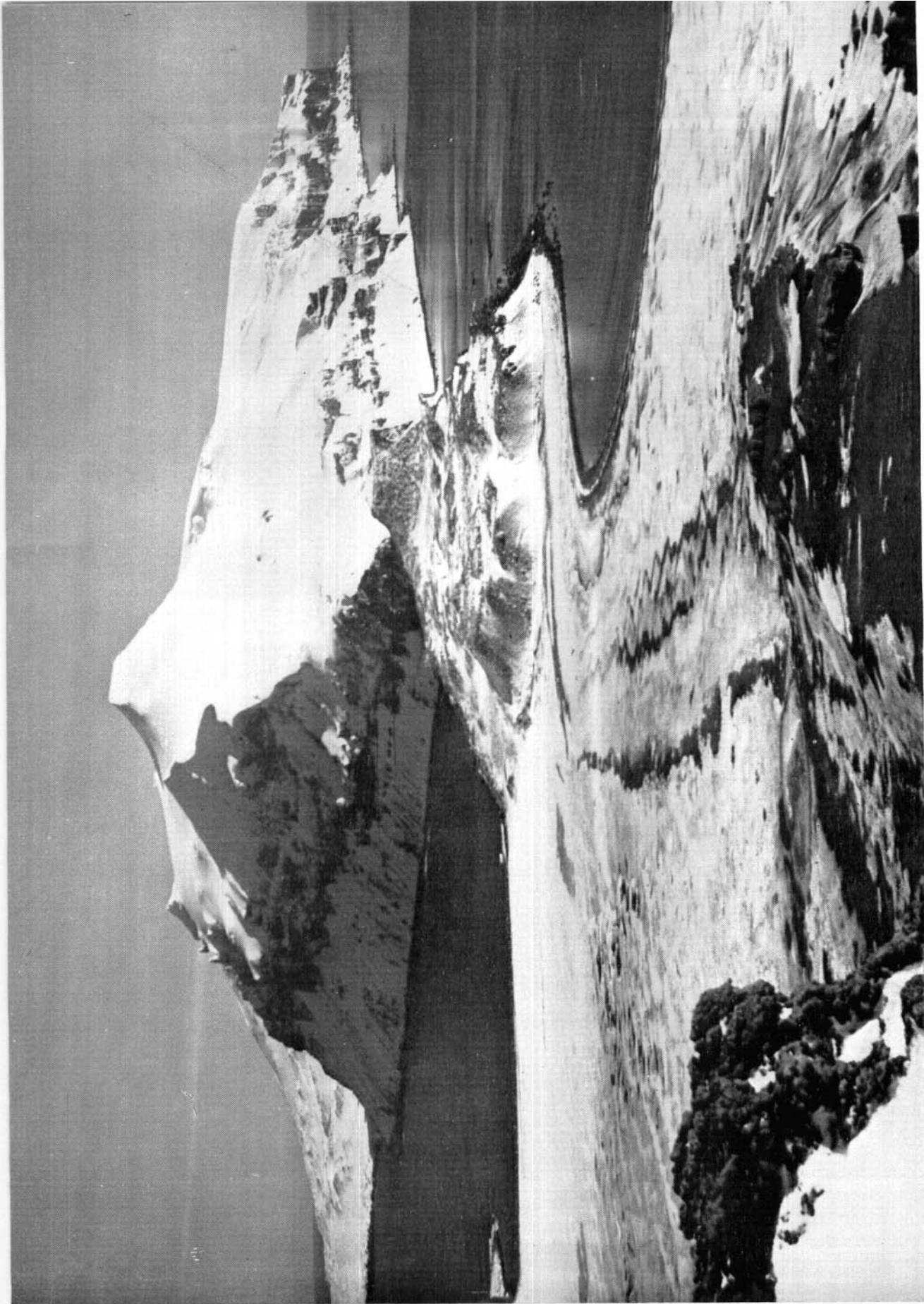
ZOOLOGY

The Birds of Heard Island

by

M. C. DOWNES, E. H. M. EALEY, A. M. GWYNN, and P. S. YOUNG

ISSUED BY THE ANTARCTIC DIVISION,
DEPARTMENT OF EXTERNAL AFFAIRS, MELBOURNE,
NOVEMBER, 1959.



Laurens Peninsula and Mt. Olsen from Mt. Drygalski.

CONTENTS

	PAGE		PAGE
Introduction	7	Dove Prion	85
King Penguin	14	Fulmar Prion	89
Emperor Penguin	19	Cape Hen	96
Gentoo Penguin	19	Wilson's Storm Petrel	96
Adelie Penguin	29	Black-bellied Storm Petrel	98
Chinstrap Penguin	30	Kerguelen Diving Petrel	98
Rockhopper Penguin	35	South Georgian Diving Petrel	100
Macaroni Penguin	38	Southern Skua	103
Black-browed Albatross	58	Dominican Gull	111
Light-mantled Sooty Albatross	64	Antarctic Tern	117
Giant Petrel	69	Arctic Tern	123
Cape Pigeon	79	Heard Island Cormorant	124
Antarctic Petrel	83	Heard Island Sheathbill	128
Snow Petrel	83	Acknowledgments	133
Silver-grey Fulmar	83	References	134
Blue Petrel	84	Distribution Map	in back cover

THE BIRDS OF HEARD ISLAND

INTRODUCTION

Heard Island lies in the Southern Ocean at longitude $73\frac{1}{2}^{\circ}$ E. and latitude 53° S. It is approximately 2,400 nautical miles from Western Australia, 2,300 miles from South Africa, and 900 miles from the Antarctic Continent. The nearest significant land is Iles de Kerguelen, 280 miles to the north-west. The island is about 27 miles long and 13 miles wide, and is of volcanic origin, being dominated by the dome of Big Ben, whose highest point, Mawson Peak, rises to 9,005 feet. The mountain is covered by an ice-sheet which descends steeply to the sea in broad ice-cliffs on all sides. Between these project numerous ice-free headlands and promontories. The principal ice-free areas are—

- (1) The Laurens Peninsula, which has three peaks over 2,000 feet with glaciers and ice-fields of its own. However, the extensive ice-free coastal areas and cliffs of this peninsula provide the richest ornithological area of the island;
- (2) the extensive moraines at Spit Bay;
- (3) the ice-free slopes and cliffs above Long Beach.

In December, 1947 the Australian National Antarctic Research Expeditions established a station on the shores of Atlas Cove which was continuously manned until March, 1955. The present paper⁽¹⁾ contains the accumulated observations of ANARE parties who have occupied the station. Most of the observations were made in the "Four Bays"⁽²⁾ area and the Laurens Peninsula, but Spit Bay was visited in all years except 1953, and Long Beach in 1951 and 1954.

The medical officer of the 1948 party, Dr. A. Gilchrist, kept a biological log and made numerous observations on birds, including the only record of snow petrels yet seen at Heard Island (Gilchrist, 1952). The 1949 party included two biologists, R. G. Chittleborough and E. H. M. Ealey, who banded 150 birds, principally dove prions and giant petrels (Chittleborough and Ealey, 1950), besides keeping comprehensive notes on other bird species (Ealey, 1954, *a, b*). In 1950 Dr. A. M. Gwynn, who had previously spent a year at Macquarie Island, and P. S. Young made further contributions to the ornithology of the island, Gwynn, working chiefly on penguins (Gwynn, 1953 *b*) and Young on petrels. M. C. Downes, of the 1951 party, was the first biologist to devote his attention entirely to birds. He made special studies of the sheathbills, fulmar prions, giant petrels, skuas and terns (Downes, 1952). The

⁽¹⁾ Prior to 1947, the birds of Heard Island were known chiefly from R. A. Falla's report on the birds of the BANZAR Expedition (1929-31). The reports of the "Challenger" Expedition, which visited Heard Island in 1874 (Selater and Salvin, 1880; Moseley, 1892), and of the German South Polar Expedition of 1901-03 (Vanhöffen, 1912), contain little of ornithological interest. None of these parties remained at Heard Island for more than a few days.

⁽²⁾ Corinthian Bay, Atlas Cove, West Bay, South-West Bay and adjacent areas, including the Rogers Head Peninsula.

sections of this report dealing with these species are based largely or entirely on his work. In 1953 Dr. Gwynn again spent a year on Heard Island, continuing his studies on the penguins with the use of flipper bands for individual marking (Downes and Gwynn, 1955). From 1951 to 1954 a programme of bird banding was carried out (Downes, Gwynn and Howard, 1954; Howard, 1954, *a, b*, 1956).

The preliminary drafts of this paper were written by Ealey, Gwynn and Young in 1951, and Ealey and Young prepared the map showing the distribution of nesting colonies. In 1952 Downes wrote the greatly expanded sections on the giant petrel, fulmar prion and skua, and in 1954 Gwynn prepared the introduction and the final draft. Further papers are in preparation by Downes, on the species specially studied by him, while Dr. D. L. Serventy (¹) has undertaken to report on the collections of skins brought back to Australia. Parasites collected from Heard Island birds are described by de Meillon (1952), Zumpt (1952), Mawson (1953), von Kéler (1954) and Edmonds (1955).

LIST OF HEARD ISLAND BIRDS

Order Sphenisciformes—Family Spheniscidae—		
King penguin	<i>Aptenodytes patagonica</i> Miller	Has bred
Emperor penguin	<i>Aptenodytes forsteri</i> Gray	Rare visitor
Gentoo penguin	<i>Pygoscelis papua</i> (Forster)	Resident
Adelie penguin	<i>Pygoscelis adeliae</i> (Hombron and Jacquinot)	Occasional visitor
Chinstrap penguin	<i>Pygoscelis antarctica</i> (Forster)	Few; breeding suspected
Rockhopper penguin ..	<i>Eudyptes chrysocome</i> (Forster)	Summer resident
Macaroni penguin	<i>Eudyptes chrysolophus chrysolophus</i> (Brandt)	Summer resident
Order Procellariiformes—Family Diomedidae—		
Black-browed albatross	<i>Diomedea melanophris</i> Temminck	Summer resident
Light-mantled sooty albatross	<i>Phoebastria palpebrata</i> (Forster)	Summer resident
Family Procellariidae—		
Giant petrel	<i>Macronectes giganteus</i> (Gmelin)	Mainly summer resident
Cape pigeon	<i>Daption capensis</i> (Linné)	Resident
Antarctic petrel	<i>Thalassoica antarctica</i> (Gmelin)	Rare visitor
Silver-grey fulmar	<i>Fulmarus glacialisoides</i> (Smith)	Irregular visitor
Snow petrel	<i>Pagodroma nivea</i> (Forster)	Rare visitor
Blue petrel	<i>Halobaena caerulea</i> (Gmelin)	Irregular visitor
Dove prion	<i>Pachyptila desolata</i> (Gmelin)	Summer resident
Fulmar prion	<i>Pachyptila crassirostris</i> (Mathews)	Resident
Cape hen	<i>Procellaria aequinoctialis</i> Linné	Occasional visitor
Family Hydrobatidae—		
Wilson's storm petrel	<i>Oceanites oceanicus</i> (Kuhl)	Summer resident
Black-bellied storm petrel	<i>Fregetta tropica</i> (Gould)	One record

(¹) Wildlife Section, C.S.I.R.O., University Grounds, Nedlands, Western Australia.

Family Pelecanoididae—				
Kerguelen diving petrel	.....	<i>Pelecanoides urinatrix exsul</i>	Salvin	Resident
South Georgian diving petrel	.....	<i>Pelecanoides georgicus</i>	Murphy and Harper	Summer resident
Order Pelecaniformes—Family Phalacrocoracidae—				
Heard Island shag	....	<i>Phalacrocorax atriceps nivalis</i>	Falla	Resident
Order Lariformes—Family Stercorariidae—				
Southern skua	....	<i>Stercorarius skua lönnerbergi</i>	(Mathews)	Summer resident
Family Laridae—				
Dominican gull	.....	<i>Larus dominicanus</i>	Lichtenstein	Resident
Family Sternidae—				
Antarctic tern	.....	<i>Sterna vittata vittata</i>	Gmelin	Summer resident
Arctic tern	.....	<i>Sterna macrura</i>	Naumann	Regular passage migrant
Order Charadriiformes—Family Chionididae—				
Heard Island sheathbill	.....	<i>Chionis minor nasicornis</i>	(Reichenow)	Resident

Latin names follow the New Zealand check-list (1953) where this is applicable. Trinomials have been avoided except in well recognized cases, where the name has previously been applied to Heard Island birds. We have followed Serventy and Whittell (1952) in using *chrysocome* for the rockhopper penguin; the trinomial is used for the macaroni penguin to indicate our agreement with the authors of the New Zealand check-list in treating the royal penguin (*E. c. schlegeli* Finsch) of Macquarie Island as a subspecies of *chrysolophus*; trinomials have not been applied to the Heard Island prions pending critical examination of the series now available; *macrura* is retained for the arctic tern pending a final decision on the *macrura-paradisea* controversy (Oliver, 1954); the Heard Island sheathbill is treated as a subspecies, as there appear to be no adequate grounds for regarding it as specifically distinct from the Kerguelen form.

Following Rankin (1951) the name "chinstrap" has been adopted as the vernacular name of *Pygoscelis antarctica* as it appears to have good currency in the Weddell Sea area (the home of this species), and it is more apt than either "ringed penguin" or "antarctic penguin". As suggested by R. A. Falla the name "fulmar prion" has been used to denote *Pachyptila crassirostris*.

The American term "juvenal" has been adopted to indicate a bird's first covering of true feathers.

Consideration of this list raises many interesting questions. An outstanding fact about Heard Island is the complete absence of the introduced predators which have ravaged so many of the sub-antarctic and antarctic islands. An extreme example of this is Macquarie Island, where

rats, cats and wekas (*Gallirallus australis*) have almost or completely exterminated nearly all the smaller petrels and other elements of the indigenous fauna. Murphy (1936) has noted the devastation caused by rats at South Georgia (p. 787) and at the Falkland Islands (p. 631) and this deadly pest is established on most of the sub-antarctic islands. We have therefore in Heard Island an example of a southern ocean bird community still virtually undisturbed, as it was before the advent of man.

In his volumes on the "Oceanic Birds of South America" Murphy (1936) lays great stress on the zonation of related species. In particular, in comparing the rockhopper and macaroni penguins, he states that only the macaroni occurs at Heard (p. 417). He correctly anticipates that the South Georgian diving petrel would be found at Heard Island (p. 785), and elsewhere (Murphy and Harper, 1921) emphasizes the "narrow latitudinal confines" of the Kerguelen diving petrel, and the strict zonation of the diving petrels generally. Since then, our knowledge of the avifauna of the islands of the Southern Ocean has been revolutionized by the publication of Rand's paper on the birds of Marion Island (1954) and Paulian's on the birds of Iles de Kerguelen (1953). We now know that both macaroni and rockhopper penguins, and both these species of diving petrels, occur together at Heard, Kerguelen and Marion. It is clear that there is much more overlapping than Murphy had suspected.

There is also evidence that breeding and feeding range do not necessarily coincide. In its oceanic distribution, the blue petrel is well known as one of the most southerly of all petrels, apart from those which nest on the Antarctic Continent itself. Yet it nests abundantly on Kerguelen and Marion, but not on Heard. The same applies to some extent to the Cape hen. This species ranges both north and south of its breeding centres, but is abundant in antarctic seas.

There are some other interesting absentees from the Heard Island list. The black-bellied storm petrel nests on other antarctic islands, and also at Kerguelen, and may yet be found nesting at Heard Island.

The following species nest at South Georgia and also at Kerguelen, but not at Heard Island:—

King penguin, *Aptenodytes patagonica*; Wandering albatross, *Diomedea exulans*; Grey-headed albatross, *Diomedea chrysostoma*; Cape hen, *Procellaria aequinoctialis*; Grey-backed storm petrel, *Garrodia nereis*.

A small breeding group of king penguins was found at Heard Island in 1948 but there is no evidence that there have ever been any sizeable colonies on the island, while very large rookeries occur both on Kerguelen and at South Georgia. The king penguin and the wandering albatross both tend their chicks throughout the sub-antarctic winter, which might place them at a disadvantage at Heard Island, where even in coastal areas the ground may be deeply snow-covered for several months during the winter.

The two petrels both make their burrows in soft soil fairly early in the season, at a time when the ground at Heard Island is usually still hard frozen and often deeply snow covered, circumstances which would also account for the absence of the blue petrel as a breeding species ⁽¹⁾. There is some uncertainty about the nesting of the grey-headed albatross at Kerguelen (Paulian, 1953, p. 155) but there seems little doubt that this will eventually be confirmed. This species is generally regarded as having a breeding range identical with that of the black-browed albatross, so it is interesting to note that it is completely absent from Heard Island, whereas Rand has shown that it is the only mollymawk nesting on Marion Island. It therefore seems to have a slightly more northerly breeding range than that of its black-browed relative. These records suggest that South Georgia has more sub-antarctic elements than Heard Island. There are, however, some anomalies. The rockhopper penguin breeds at Heard and Kerguelen, but not at South Georgia. This might be explained by the proximity of Kerguelen to Heard Island. The snow petrel nests at South Georgia, but not at Heard, though the circumstances in this case are exceptional. At South Georgia it retains its antarctic environment by nesting high on the mountains (Rankin, 1951) and, while such conditions could be reproduced at Heard, the smaller size of the island and its greater distance from the pack-ice would account for the absence of the snow petrel. The other antarctic species which Heard Island shares with South Georgia, but which are absent from Kerguelen, are the chinstrap penguin and the blue-eyed shags of the *atriceps* group.

Iles de Kerguelen, though less than 300 miles from Heard Island, lie on the other side of the Antarctic Convergence, and have a distinctly milder climate. It is therefore not surprising to find several other petrels with a strictly sub-antarctic distribution which nest at Kerguelen, though neither at Heard Island nor at South Georgia. These are:—

Long-winged petrel (*Pterodroma macroptera*); White-headed petrel (*Pterodroma lessoni*); Kerguelen petrel (*Pterodroma brevirostris*); Soft-plumaged petrel (*Pterodroma mollis*) ⁽²⁾; Grey petrel (*Adamastor cinereus*); Thin-billed prion (*Pachyptila belcheri*).

The fulmar prion (*Pachyptila crassirostris*) which breeds at Heard Island and probably at Kerguelen is not represented in the Weddell Sea quadrant.

In general South Georgia and Heard Island have an avifauna characteristic of low antarctic latitudes with a few elements from high antarctic latitudes and from the sub-antarctic zone, which reach their northern and southern limits respectively at these islands. The slightly more varied fauna of South Georgia is probably a reflection of its larger size, affording

⁽¹⁾ Ardley's (1936) record of blue petrels nesting at the South Orkney Islands if true, may have been an exceptional occurrence. It is based on the evidence of an untrained observer, and he was not able to confirm it himself.

⁽²⁾ Nesting at Kerguelen probable, but not proven.

more varied conditions than at Heard Island. The former has much more extensive areas of tussock-covered ground, and its indented coast-line must provide many relatively sheltered localities, possibly with a slightly milder climate than at Heard. It is possible to exaggerate the importance of latitude, which is only one of the factors which determine the presence or absence of a species at any given island. The situation of an island in the appropriate latitude does not necessarily mean that it will provide all the conditions for the establishment of successful breeding colonies. Neither is the oceanic distribution of a species necessarily a clear guide to its breeding range, as already pointed out in the case of the blue petrel. The non-breeding populations of several other species, with a strictly low-latitude breeding range, resort regularly in large numbers to antarctic seas. These include the white-headed petrel (*Pterodroma lessoni*), the mottled petrel (*Pterodroma inexpectata*), and the sooty shearwater (*Puffinus griseus*).

The effect of latitude and climate on nesting dates provides some interesting contrasts. Some species appear to nest at the same time throughout their breeding range, irrespective of latitude. The best example of this is the light-mantled sooty albatross which lays at the same time ⁽¹⁾ at Campbell and Macquarie Islands as it does at Heard Island and South Georgia. On the other hand the black-browed albatross nests nearly a month earlier at Macquarie than at Heard Island. The gentoo penguin appears to nest as early as local conditions permit, each island population having its own laying season, depending on the local climate; in general this becomes progressively later with increasing latitude. Wilson's storm petrel reverses this rule, laying dates being later as latitude decreases. Data for comparison is in many cases inadequate, but the following table compares selected Heard Island species with their representatives at Macquarie and Kerguelen. Dates refer to the onset of laying, as data are insufficient to determine peak periods.

TABLE I. LAYING DATES OF SPECIES AT HEARD, KERGUELEN AND MACQUARIE ISLANDS COMPARED.

<i>Species</i>	<i>Heard Island</i>	<i>Iles de Kerguelen</i>	<i>Macquarie Island</i>
Gentoo penguin	3rd & 4th week October	End August to early September	2nd week Septem- ber
Macaroni penguin	2nd week Novem- ber	?	2nd week October ⁽²⁾
Rockhopper penguin	4th week Novem- ber	4th week Novem- ber	2nd week Novem- ber
Dove prion	End December	? ⁽²⁾	Mid December ⁽²⁾
Giant petrel	3rd week October	4th week August	Early October
Southern skua	3rd week Novem- ber	October	4th week October

⁽¹⁾ First week November.

⁽²⁾ The royal penguin (*E. chrysolophus schlegeli*): date refers to the Nuggets rookery.

⁽³⁾ See Falla (1937). Several well incubated eggs were found at Macquarie Island early in January, 1949.

Heard Island dates refer to the Laurens Peninsula and Four Bays area. On 21 December, 1954, Budd found that the macaronis in the vast rookery at Long Beach had well grown chicks, indicating that these birds lay substantially earlier than those on other parts of the island. (On the previous day Budd had seen no chicks in a rookery of this species at Winston lagoon.) Hatching at the northern end of the island begins about this date. Long Beach faces the prevailing winds, and is therefore little influenced by the clouds which perpetually form around the mountain. For this reason it is possible that snow disappears from the coastal areas here earlier than in the northern and western parts of the island. This is an important demonstration of how there may be substantial differences in breeding dates between local populations of a species nesting in different parts of the same island.

It is interesting to consider the distribution of birds over the in-shore and off-shore waters of the island. Apart from a few terns, and occasional incursions of blue petrels and silver-grey fulmars, the in-shore waters of the bays are fished almost exclusively by three species⁽¹⁾, Cape pigeons, dove prions, and Wilson's storm petrels. During the summer a very interesting zonation of the three petrel species may be observed on certain days along Corinthian beach. The Cape pigeons feed along the edge of the surf, at the line where the waves break. Immediately behind them scores of storm petrels flit over the surface of the water, and behind them the sea may be dotted with hundreds of dove prions.

The Heard Island shags feed entirely on the coastal fishes, and the gentoo penguins probably largely so, though the latter must also make excursions farther out to sea. How the diving petrels distribute their fishing is not known.

It is obvious that several other species, including Cape hens, white-headed petrels, and Kerguelen petrels, must frequently pass out at sea, but these apparently never forage over the inshore waters.

Several of the headlands around Heard Island have never been examined, but these are all precipitous and closely hemmed in by ice, and are not likely to add materially to our knowledge of the birds. Off-shore, the only rocks of importance are the Macdonald Islands, which have never yet been visited. It may reasonably be supposed that they house a selection of the species which would be found in corresponding situations on the main island.

⁽¹⁾ Some giant petrels scavenge over the bays, but a large proportion of this species apparently fish out at sea.



PLATE 1—Adult king penguin.

KING PENGUIN

Aptenodytes patagonica Miller

King penguins tend to nest in very large colonies numbering thousands of pairs. Small nesting groups are less common and may be either the last survivors of a dying colony or birds attempting to found a new one. It was, therefore, of particular interest to find a small nesting group, consisting of less than a score of birds, at Heard Island in 1948. They were nesting in association with the gentoo rookeries on the Vahsel Moraine, and in the winter of 1948 had two chicks which were successfully reared. Owing to an unfortunate failure to appreciate their rarity, the whole of this group was deported to Australian zoos in February, 1949, the only survivors being a few birds which were at sea at the time.

It is fairly certain that this was an attempt to found a new colony. Falla's account (1937) shows that this area was carefully searched in December, 1929, and only one king penguin was found on a nearby beach. A second was found the next day on the beach at Corinthian Bay.

After February, 1949, king penguins were occasionally seen, singly and in small parties, at the beaches which were regularly visited. During



PLATE 2—Juvenal king penguin at Spit Bay, with down still on head and neck.

the winter of 1949 one was seen on 5 May at West Bay; one sick bird seen on 30 June was taken as a specimen at South-West Bay; one appeared on 27 October at Spit Bay. Then, in the middle of December, there were at least seven in the Four Bays area, of which three stayed to moult at the site of the old colony at South-West Bay. The first of these had started its moult by 30 January.

The only winter record for 1950 was one at South-West Bay ⁽¹⁾ on 17 September. Possibly the same bird remained for ten days among the gentoo at Vahsel Moraine at the end of November. A second bird was seen at West Bay on various dates from 29 November onwards, and in mid-February at least five other birds appeared, including a juvenal in fresh plumage in Atlas Cove on 14 February.

During subsequent years the occurrence of king penguins followed a similar pattern, the birds being seldom seen during winter and often during summer. Of these, occasional birds stayed to moult, while others seen in fresh plumage may have moulted elsewhere on the island. Prior to 1951 it was thought there might be a rookery at Long Beach, but only one bird was seen there when the beach was visited in November, 1951, during the first circuit of the island. On that occasion five king penguins were seen in Spit Bay, including a young bird with its head and neck still covered in down (plate 2). This area had been searched the previous July, and no young or adult king penguins was found, but it seems likely that this chick was overlooked. It may have been unattended at the time.

During the summers of 1952-53 and 1953-54 king penguins were reported in increasing numbers. Of particular interest were:—

A bird in juvenal plumage on 31 October, 1953; this bird weighed 24 lbs. and was probably approaching its moult; it would therefore have been nearly two years old.

McNair's discovery of ten birds at different points in the Sydney Cove area at the end of November, 1953. Only one was here in mid-February, 1954. During February, 1954, they were frequently seen in the Four Bays area; it was noted that they were usually in pairs. Of these at least five stayed to moult, others were in very fresh plumage. However, on 7 April Budd noted "no king penguins have been seen for many weeks" and during the following summer comparatively few were reported.

Two birds were given flipper bands in November, 1953, but neither was seen again. One of these was the juvenal already noted, the other an adult weighing $22\frac{3}{4}$ lbs.

To understand the significance of these records it is necessary to turn to an area where the movements of the king penguins are well known. At Macquarie Island there is a colony of some 10,000 birds based on Lusitania Bay, a beach a little over a mile long. In spite of the fact that large numbers are present here all the year round, none are seen elsewhere on the island between March and the end of October. But about the end of October small parties and single birds begin to come ashore at any beaches where there are congregations of royal or gentoo penguins. From then onwards such parties are to be found on any of the main royal penguin beaches,

⁽¹⁾ This is the landing beach for the Vahsel Moraine gentoo rookeries.

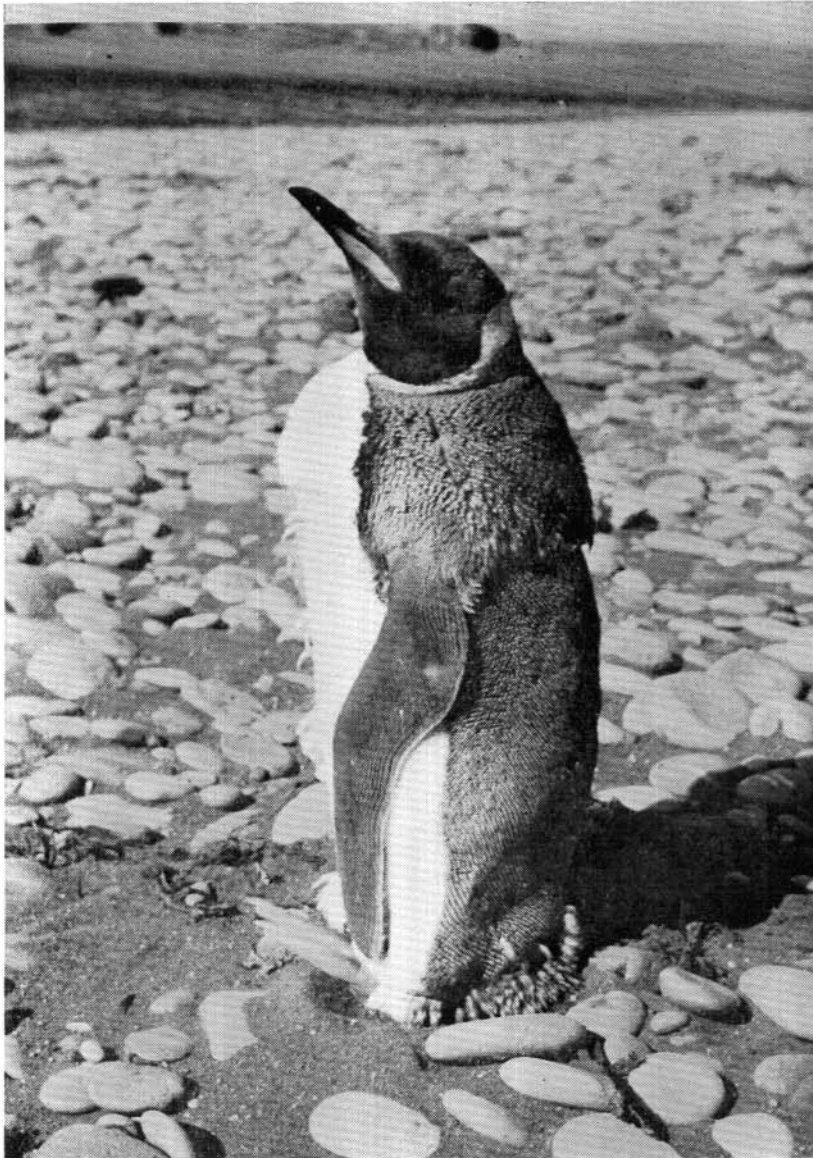


PLATE 3—Moulting adult king penguin.

and in early January these parties begin to moult. These birds are non-breeders, and make up only about one per cent of the total population, the vast majority of which undergo their moult at Lusitania Bay, the breeding birds moulting in November and December. In January and February, these groups are often joined by a few recently moulted juvenals.

It seems clear that the same thing is happening at Heard Island. The individual at South-West Bay in 1950 was probably a survivor, per-

haps the last, of the Vahsel Moraine colony. However, most of the others must be stragglers from some big colony elsewhere. The possibility that they could all be survivors from the South-West Bay colony is refuted by the occurrence among them of the juvenals and the chick mentioned above. As their parent colony has not been found anywhere on Heard Island it is reasonable to assume that it is on Iles de Kerguelen, where very large rookeries are known to occur (Dr. A. Migot, personal com-

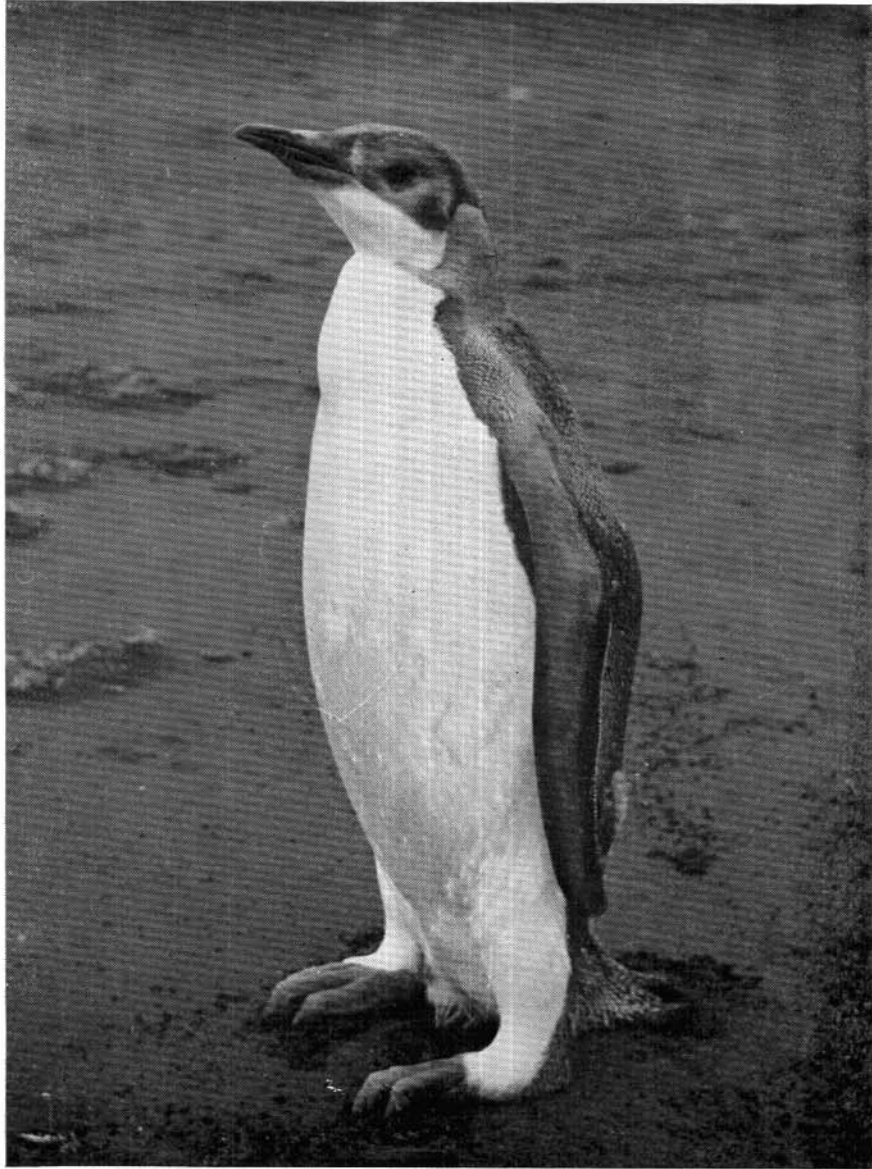


PLATE 4—Juvenal emperor penguin at Heard Island, 11 February, 1954. Note feathers extending to end of tarsus.

munication). Paulian (1953) found scattered groups of moulting birds along the shore of the bays there from the end of November to early February. Falla states that they were reported by sealers to breed on Heard Island, and suggests Spit Bay as the probable locality, but there is no colony there now. The absence of any large colony of kings on Heard Island may be due not to persecution by man, but to climatic conditions. A species which tends its chicks throughout the southern winter would be labouring under a formidable handicap at Heard Island.

EMPEROR PENGUIN

Aptenodytes forsteri Gray

On 11 February, 1954, an emperor penguin in juvenal plumage came ashore in Atlas Cove close to the ANARE Station and after being weighed and measured was released (plate 4). It weighed 34 lbs. and stood about a metre high, without extending its neck. It was presumably a bird of the year, in which case it must have left its rookery only a few weeks previously.

On 28 February, 1955, another juvenal emperor land in Atlas Cove, again close to the Station. It stood about thirty inches high, but its weight was not taken.

On 2 February, 1898, Hall found a young emperor penguin at Kerguelen "when ashore moulting" (Falla, 1937). This must have been a bird in its second year, but the possibility that the Heard Island specimens may also have been second year birds seems unlikely in view of the weight of the first and the lateness of the dates.

GENTOO PENGUIN

Pygoscelis papua (Forster)

Habitat, distribution and numbers. Gentoos require satisfactory landing places close to their rookery sites. Rookeries are never more than a few hundred yards inland and are usually situated on open, vegetated flats and hillsides, the nests as a rule being among grass tussocks or on *Azorella* hummocks. Gentoos are distributed in small or medium-sized colonies round the shores of Heard Island but nowhere do they approach the huge concentrations recorded by Bagshawe (1938) on the Danco Coast. In 1950 fairly accurate figures were obtained for the numbers of nesting pairs at colonies within easy range of the ANARE Station.

In 1953 the colonies in the Four Bays area were again counted and considerable changes were noted. The first and most striking difference was that the actual nesting areas bore little relation to those occupied in 1950, in marked contrast to the macaronis and rockhoppers. In general, the colonies had tended to move inland. This was thought to be related to the fact that 1950 was a year of heavy snowfall, and the snow was late in disappearing from the coastal regions, whereas 1951-1953 were all years



PLATE 5—Pair of gentoo penguins “pointing” into their nest.

in which frequent thaws had prevented any great accumulation of snow in low lying areas, which were free from major drifts well in advance of the nesting season.

The known colonies are set out below:—

Wharf Point. A small colony of about 60 pairs existed in 1948 and 1949, but after 1950 no attempt was made to nest—probably because of the introduction of huskies to the Station in 1950.

West Bay. In 1950 there were at least 300 pairs nesting on the slopes of Mt. Aubert de la Rue. At that time the remains of old nests indicated that the colony used to extend higher up the hill. In 1952 Dr. Faulkner counted 242 nests and in 1953 Gwynn estimated there were about 250. Gwynn observed that “compared with 1950 the entire colony has moved higher up the hill, beginning at about the upper border of the area occupied in 1952”. In 1951 and 1952 some eggs were taken for eating, but none were taken in 1953.

Vahsel Moraine. Four groups nesting on the northern slopes of this moraine in 1950 totalled about 400 breeding pairs. In 1954, 412 nests were counted but the distribution of nesting groups in this area had radically altered. The main body still nested along the foot of the moraine, though

the area covered differed greatly in detail; a slope on the hillside above this, in 1950 occupied by 115 pairs, was now completely abandoned; and 92 pairs were now nesting in two groups on the hillside in a previously unoccupied area half a mile inland. This colony was normally subject to little interference.

Erratic Point. This group shares the same landing beach as the Vahsel Moraine rookery. In 1950 it had about 185 breeding pairs on hillocks close to the sea, but by 1954 these had dwindled to 81 pairs, who occupied an area 200-300 yards back in the moraine, well away from the old rookery site. This group was the subject of a report (Gwynn, 1953, *b*), but in other years was rarely visited.

Rough estimates have been made at various times of the colonies in other parts of the island:—

Cape Gazert. About 250 breeding pairs in 1950.

Jacka Valley. About 300 breeding pairs in 1953.

Red Island. From 500 to 1000 breeding pairs. There is some evidence of an increase since 1950, two new colonies having been established in the interval, about a mile from the main rookery. One of these is exceptional in being on the reverse slope of a boulder beach where there is no higher vegetation, nests being made from stones, bones, &c.



PLATE 6—Seal lying between incubating gentoo and chinstrap penguins.
This shows typical terrain for a gentoo rookery.

Saddle Point. There are large rookeries on both sides of this headland, each containing over 500 pairs in the breeding season. In late July, 1951, daylight counts showed 32 birds in one rookery, 19 in the other.

Little Beach. The small beach between the Baudissen Glacier and the Little Challenger Glacier is (at least in late winter) the resort of large numbers of gentoo penguins though they apparently do not nest there. 1950-51 is the only season for which this was definitely established. Little Beach backs almost directly on to steep glacier slopes and the small strip of flat ground behind the beach is snow-covered till very late. On 6th September, 1953, some 700 to 1,000 birds were encamped here at noon and three large parties later came ashore. Many were in juvenal plumage and it is possible that the site is chiefly a resort of non-breeding birds, probably from the Saddle Point rookeries.

Fairchild Beach and Skua Beach. There are well over 1,000 breeding pairs on the grassy flats behind both these beaches, though in the winter of 1951 there were no more than 300 birds at each beach.

Spit Bay area. Several thousand pairs are distributed in colonies of about 500, a little back from the sea among the grassy hummocks. Spit Bay probably supports the largest concentration of gentoos on the island.

Winston Lagoon. A small colony of gentoos was found in the small valley near this lagoon in 1951.

Long Beach area. Rookeries totalling several thousand birds were discovered by the party which explored this area for the first time in 1951.

The gentoos are present at Heard Island all the year round. Their numbers are reduced in winter, however, either because they are partly migratory or simply because during winter they spend more time at sea. On 26 June, 1953, some hundreds of birds were seen porpoising a mile or more out to sea from the Jacka Valley, one large group coming ashore in a body. At most seasons of the year the groups on the beaches include a large proportion of juvenals, and the small parties which come ashore on beaches unconnected with any rookery are nearly all juvenals.

Winter counts of gentoo penguins on beaches can be misleading unless the time of day is taken into consideration. They go to sea in the early morning and most of the returning birds land shortly before sunset, though these are not necessarily the same birds as those which went out in the morning. Thus, a beach which is almost deserted before noon may have a couple of hundred ashore by sunset.

Even in August, when the ground is deeply snow-covered, some of the birds will move up to their rookery sites in the evenings. The number doing this has greatly increased by the beginning of October, and from then on more and more are spending whole days in their rookeries.

Nest building. In 1949 nest building had commenced by 7 October, but in 1950 it was not in progress till the third week in October, probably due to the depth of the snow cover. Wherever the body-heat of a bird had melted a hole in the snow down to the ground, a depression was scratched in the *Azorella* and lined with grass. Beginnings of nests were also to be seen on any large tussocks of grass which were not snow covered. Other groups of birds took no part in nest making at first and merely camped on top of the first tussocks to appear above the snowdrifts which still covered their nesting areas. The nests, which are often substantial, are usually made from leaves, stems and roots of grass, but when this is not convenient *Azorella* or any other available material may be collected. Stones are seldom gathered, possibly because at Heard Island the gentoo rookeries are mainly on peaty soil.

The open nature of the rookeries, with the nests spaced widely apart, is in contrast to the compact rookeries of the macaronis and rockhoppers, and fights are correspondingly less frequent, though they are not uncommon when territories are being established. The habit of pilfering one another's nesting material, so characteristic of this species, also at times leads to trouble, though the offender usually gets away in time.

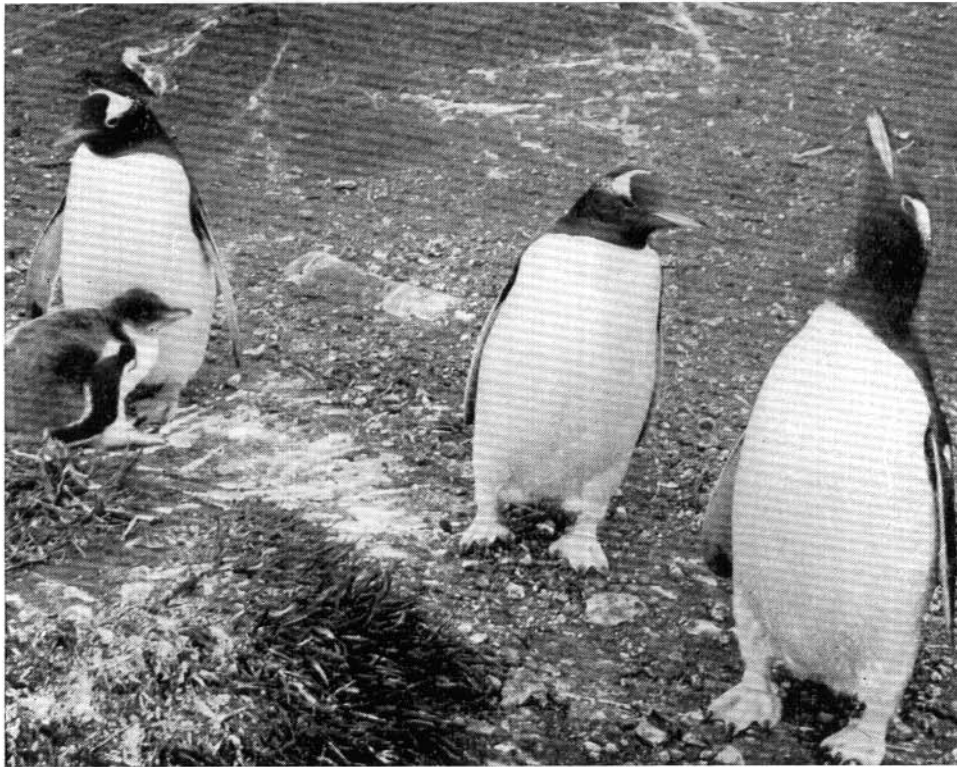


PLATE 7—Adult gentoo penguin with chick. The bird on the extreme right is in the ecstatic attitude.

Mating. Copulation was first observed in 1949 on 13 October. The pair of birds bowed to each other, at first face to face but later, as one slowly worked its way behind its mate, the bowing becoming sideways. On many occasions the bird in front would take a few steps forward and the display would cease for a time. If it continued the bird behind would rub beaks with its mate, which by now would be leaning forward or sitting down with its beak pointed vertically upwards or slightly backwards, and proceed to step on to its pelvic region. The bird on top, while lifting its feet up and down and still rubbing beaks with its mate, would proceed to tap the other's neck rapidly with its flippers. This would continue for several minutes until the one lying underneath raised its tail while the one on top slowly moved its tail to the right (in the case observed) and under its mate's. Actual apposition of cloacae took only a moment after which the one on top stepped down. On one or two occasions a single gentoo was observed carrying out this entire procedure with a tussock of grass.

Egg laying. The following table gives the dates of first eggs in the years under review:—

TABLE 2.
FIRST EGGS OF GENTOO PENGUINS.

<i>Year</i>	<i>Date</i>	<i>Locality</i>	<i>Eggs</i>
1949	22 Oct.	West Bay	2 single eggs
1950	26 Oct.	Vahsel Moraine West Bay	4 single eggs
1951	21 Oct.	Vahsel Moraine Erratic Point Cape Gazert	9 eggs including 2 clutches of 2
1952	15 Oct.	Vahsel Moraine	3 eggs
1953	21 Oct.	West Bay	About a score of completed clutches

In 1949 and 1950, laying in some rookeries commenced several days later. In 1949 no eggs were found at the large rookeries from Saddle Point to Spit Bay on 24 and 25 October, and none at Spit Bay till 29 October. These observations illustrate the importance of snow cover in determining the exact date of laying. 1950 was a year of heavy snow, which was late in disappearing.

Once the first eggs were laid, other birds in the same group quickly followed suit. The normal clutch is two eggs of approximately the same size, laid with an interval of about three days. Three-egg clutches are rare, and single-egg clutches are also abnormal. In the early groups laying was almost complete within about twelve days from when the first eggs were laid. However, in any one rookery, there was often a marked difference in time of laying between one group and another, depending

on when the ground in their immediate vicinity became snow-free. After the middle of November, fresh clutches were difficult to find except in a few late areas (Gwynn, 1953, *b*).

Incubation and chicks. Incubation begins shortly before the second egg is laid and the incubation period is 35-36 days (Gwynn, 1953, *b*). In 1950 the first chick was found on 30 November with one wing out of its shell. In 1949 the first chicks were found on 26 November, corresponding to the earlier start of laying at West Bay and South-West Bay in that year. Each pair tends its chicks for at least four weeks after the first chicks hatch, one parent always remaining on guard (plate 7). At the end of this period a few of the older chicks begin to wander short distances from their nests, but still return to their own parents to be fed. At this stage it was noted that in many families one chick was conspicuously larger than the other, and in several nests the surviving chick was sitting on the remains of its weaker sibling. This is apparently because in many cases the second chick never catches up on the start obtained by the first to hatch and, as competition becomes more severe, it commands less and less attention at feeding time. Nevertheless a proportion of pairs are successful in rearing two healthy chicks to this stage. During laying and incubation occasional juvenals may be seen wandering about the rookeries, investigating anything which arouses their curiosity.

Formation of nurseries. A fortnight later the situation has altered radically. The following is a description of West Bay rookery just after sunset at this period (12 January, 1951):— "Chicks wandering about at random; some in small huddles up to six or so, many resting solo in a nest (any nest?), some guarded by one or two adults, but many untended; others just asleep on their faces on the bare ground. Only one penguin seen brooding a late chick." Three days later, in a section of another rookery about noon, 45 chicks were counted with only eight adults in attendance. Two of these were guarding single, rather late chicks but all the other chicks were gathered in one big nursery.

Where the rookeries were situated at a distance from the sea the groups of chicks tended to move down towards the shore, probably through the hungry chicks anticipating the arrival of the adults. At West Bay in 1950 the original rookery was deserted once the chicks became independent of their nesting sites and the whole group moved down to the grassy hummocks just behind the beach saving the parents the long walk up to the rookery. Adults coming ashore distended with food were hounded by a ravening horde of chicks until they disgorged, but it was not clear if feeding was in fact indiscriminate. One adult coming ashore at this time was found to contain $1\frac{1}{2}$ lbs of fish. On 8 March, 1953, a fully moulted chick was seen being fed on the beach after much begging, but this may be exceptional.

Moultling. Moultling is evident in the ninth week after hatching and begins around the head at the same time as the rectrices start protruding through the down. A week later the earliest chicks have the moult practically complete over the entire head and mantle. Last to shed is the white down on the belly. The new plumage is a blue-grey and darker than the parents, whose plumage is now somewhat faded. Late chicks may be seen with tufts of down still adhering at the beginning of March.

Among the older birds, first to moult are the yearlings. These start coming ashore before the end of January and on 2 February one was seen in the puffy stage which is a sign of the onset of moult⁽¹⁾, and a fortnight later many yearlings were in pre-moult or early moult.

The main body of the adults returns to the rookeries to moult during March; as with their other activities this moultling period is somewhat drawn out. On 5 April, 1953, the Vahsel Moraine rookery contained about 450 adults. The great majority had just completed their moult, but there were a few birds in early moult, and occasional one still in pre-moult.

Feeding habits and parasites. Ealey (1954, b) has shown that the gentoo penguins at Heard Island are mainly fish-eaters. The data on which his findings are based come mainly from breeding birds, as the stomachs of birds which come ashore to rest are nearly always found to be empty except for a little green or yellow slime and the collection of small stones which is the rule of this species. Single small gastropods have occasionally been found in these collections, apparently picked up in mistake for pebbles. These pebbles may number up to 50 or 70 and, in the case of four winter juvenals examined, the collections weighed 15.6, 21.0, 21.8 and 26.1 grams respectively. Probably associated with their fish diet, the stomach not infrequently contains a few nematodes, though heavy infestations have not been encountered, suggesting that these parasites do not survive long. (This is in contrast to the massive infestations often found in seal stomachs.) If the contents are carefully washed, cestodes may be found in both the stomach and intestine. Trematodes are occasionally found in the liver, nine cysts having been found in one case, and they would probably be found more often if careful search were made. The helminth cysts which workers in some other areas have found commonly in the intestines (Sladen, personal communication) have not been noted and are certainly not common at Heard Island.

Plumage changes, colours and variations in the chick. The down of a newly-hatched chick is a light silver-grey ventrally, with the head a very dark grey and the back and flippers a little lighter than the head.

⁽¹⁾ All the feathers stand out from the body, giving the bird a characteristic puffy appearance; this lasts for a few days before the feathers begin to fall out: it is convenient to have some means of designating this stage, and the term *pre-moult* is suggested as appropriate.

After the moult of the neossoptyle down, the head and dorsal plumage become a uniform light grey-brown with white underparts. At no time is the down as dark of that of the macaroni chicks.

The eye of the newly-hatched chick is only half open. It is a very dark blue, which, after a week, becomes a dark blue-brown and finally dark brown.

Up to the time of their moult at the end of the first year, juvenals can almost always be identified with certainty by taking into account all of the relevant features (see plate 8). Occasional anomalous individuals may be second-year birds which still retain some juvenal characteristics. The most useful single feature is the area around the eye. In the adult the white fillet across the top of the head always reaches to the eye, and the eyelid is white; in juvenal the white is in most cases separated from the eye by a somewhat variable band of "pepper-and-salt" feathers, and the lid is dark, with a few white flecks. However, an examination of freshly-moulted chicks at West Bay showed that a sprinkling had white extending to the eye, and that a few of these had all-white lids. In the young juvenals the bill is noticeably weaker than in the adults, but this character probably become less distinctive as the year proceeds.

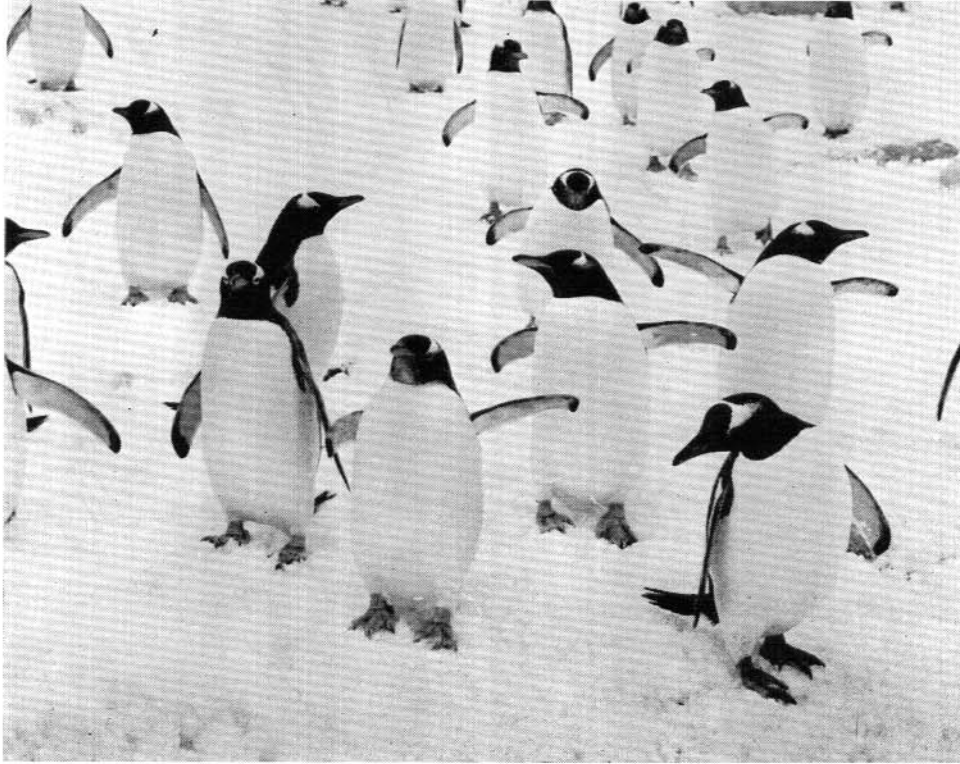


PLATE 8—Gentoo penguins in winter. These are mostly birds in juvenal plumage.

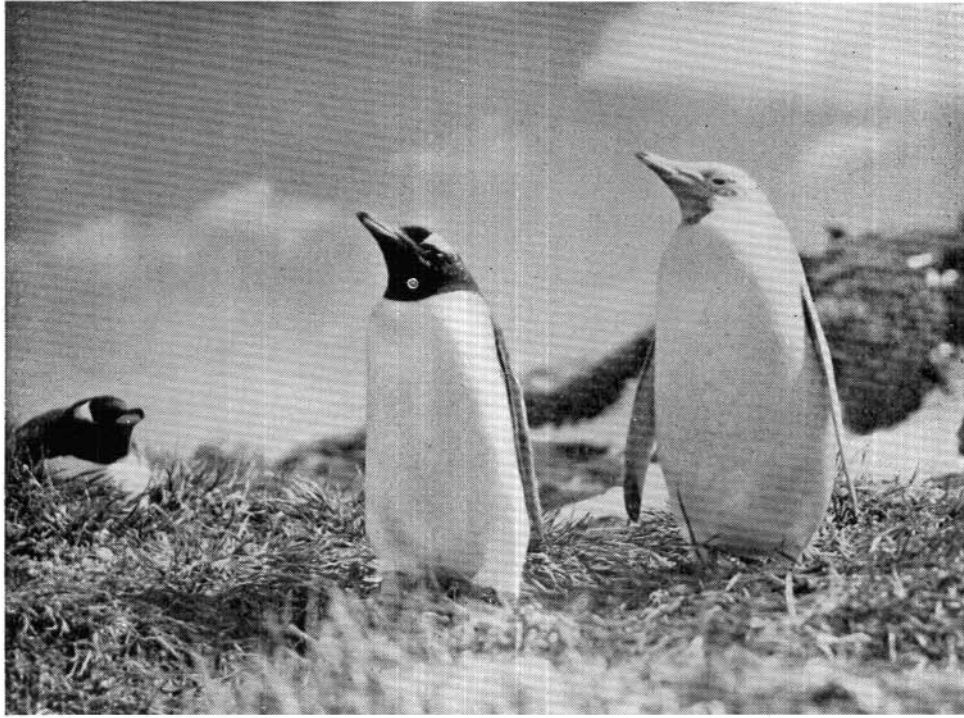


PLATE 9—Albino beside normally coloured gentoo penguin.

In the juvenals the throat is slightly and uniformly dusted with grey and there are few white flecks on the neck, while in the adults the throat is jet black right to the juncture with the white breast and the sides of head and neck are flecked with single pure white feathers. The white band across the top of the head was not found to be of much assistance, though in some chicks it is poorly developed.

Colour variations in the adult. On 26 May, 1949, a complete albino was collected (plate 9). This specimen is now mounted in the Western Australian Museum. Its plumage was entirely white and there was no sign of pigment in its pale pink feet. The beak was a light horny colour and the iris of the eye was tinged slightly with pale yellow instead of the usual dark brown.

On several occasions light fawn or light grey birds, often with much white about the head, were observed. One such bird was observed to be nesting at West Bay in 1949 and in 1950. In 1949 it had two chicks—one with the usual grey down, the other with a light brownish down which suggested it would grow up like its parent.

In 1948 Gilchrist remarked that some birds had very deep orange bills and feet, in contrast to the more usual pale yellow bills and flesh-coloured feet. He also considered that adults with the deep colouring

had chicks with the same colouring. The birds with deep colouring undoubtedly stand out, but on trying to classify a group of birds according to colour of bill and feet, Gwynn came to the conclusion that the deep orange colour is one extreme of a rather complex variety of shades. He was, however, able to confirm that the same variety occurs among the chicks, though the colours tend to be brighter in the adults, and on at least one occasion he saw a bird with deep orange bill and feet guarding a half-grown chick with the same colouring. There is, then, evidence that the colour of bill and feet is primarily a genetic character and not an index of age, sex, or season. This colour variation within a colony is important as it invalidates the suggestion (Murphy, 1936, p. 370) that colour of bill and feet might be of value as a subspecific character, though it is probable that the proportion of birds with bright orange bills and feet varies from one population to another.

ADELIE PENGUIN

Pygoscelis adeliae (Hombron and Jacquinot)

An interesting result of the presence of permanent observers at Heard Island has been the discovery that Adelie penguins very occasion-

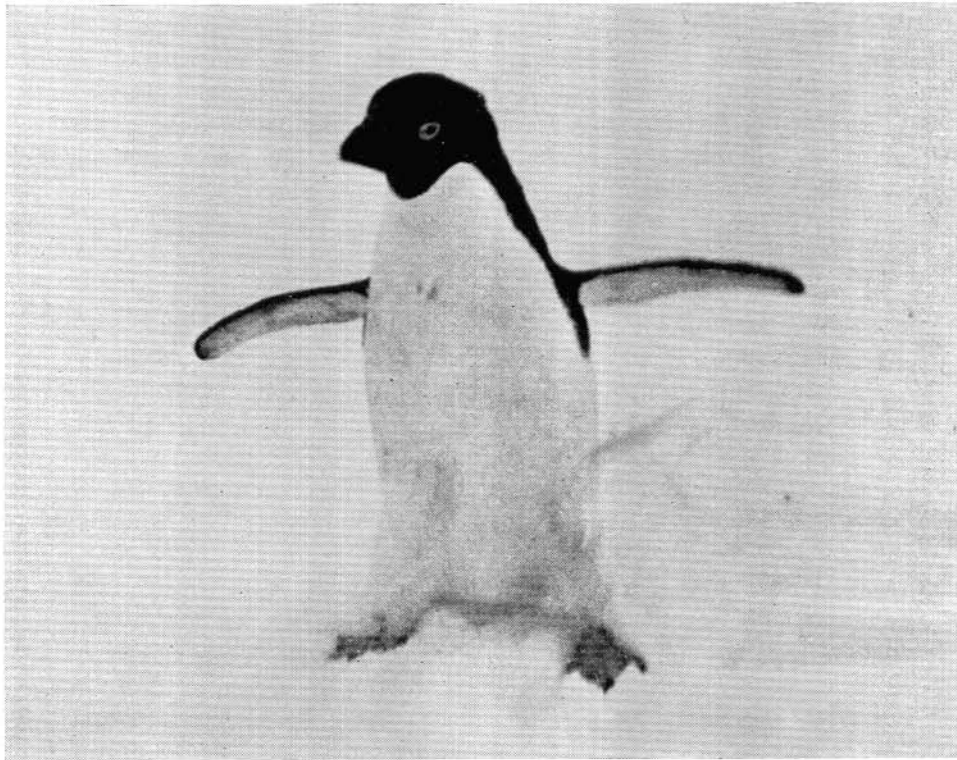


PLATE 10—Adelie penguin at Heard Island, 1951, displaying to the photographer.

ally come to land there. In September, 1948, R. Dovers, ANARE Surveyor, saw a party of three come ashore at Wharf Point. On 25 October, 1949, a single Adelie penguin was observed standing amongst nesting gentoos at Fairchild Beach, making an occasional hiss at the passing penguins. On 27 October, 1951, one was seen to surface 50 yards off-shore in Atlas Cove at dusk; it came rapidly ashore, emitting its characteristic call each time it broke surface.

In 1953 one was found on 21 November on Corinthian Beach. Once again, its disregard of other penguins, its characteristic call, and its rapid gait were most noticeable. It covered the half mile from there to the station in little more than half-an-hour, without any encouragement. This bird was a healthy female in non-breeding condition, weighing $7\frac{1}{2}$ lbs. Like all others noted at Heard Island, it was in adult plumage. Another was seen on Atlas Cove beach on 5 January, 1954, but this took to sea again very soon afterwards.

These records suggest that Heard Island may be at the fringe of the Adelie penguin's normal pelagic range, about which little is known. Previous records of their occurrence at low latitude antarctic islands such as South Georgia and Bouvetoya has been doubted (Murphy, 1936, p. 387), but in the light of these new observations it is clear that occasional stragglers reach such latitudes. This is further supported by the appearance of an Adelie at Macquarie Island in 1950 (Gwynn, 1953, a). The only Australian records are one from Portland, Victoria (Learmonth, 1955), and the finding of an Adelie penguin on the beach near Fremantle in April, 1937, but there is reason to believe that the latter was released by a passing whaling ship (Whittell, 1937).

CHINSTRAP PENGUIN

(Ringed or Antarctic Penguin)

Pygoscelis antarctica (Forster)

Occasional specimens of this penguin were seen at Heard Island in the summer of every year during the occupation of the ANARE Station (December, 1947 to March, 1955) and several attempts at nesting were observed. However, in most cases where the details are known, this involved pairing with a gentoo penguin though no satisfactory evidence of successful breeding was obtained.

Nesting was first observed in 1949. On 12 November a member of the expedition, seeing a strange-looking penguin in the West Bay gentoo rookery, brought it back to the ANARE Station where it was placed in a pen. It was seen to be busy picking up pieces of shell, but on the following morning the penguin had escaped, leaving a new laid egg behind. This weighed 107.5 gms. and measured 70 mm x 52.5 mm. This bird subsequently made its way back to the place in the rookery where it was originally found and laid another egg in a shallow nest of small

stones and grass; it was still dirty and dishevelled after its brief captivity, and showed great alarm at the approach of humans. Its mate was not seen and the egg was taken by a skua when the bird fled from its nest.

A second chinstrap penguin in the same rookery later established a peculiar association with a gentoo. The single egg in the grass nest looked very much like a gentoo egg and was usually incubated by the gentoo while the chinstrap stood guard. Whenever the gentoo left the nest the chinstrap would follow it, hissing and bowing until it turned back to the nest. Any intruding gentoos were chased away by the chinstrap which would then return to its mate, bowing and hissing to it with outstretched neck. On one occasion it was seen to mount the gentoo and intercourse. The egg subsequently carry out the usual procedure for hatched, but skuas stole the chick before it could be properly examined.

Since then, a chinstrap penguin was observed every year in this rookery. On 20 November, 1950, one was found sitting on two well-incubated eggs in a nest in the West Bay rookery (plate 11). The bird was very nervous, and had a habit of hurrying off the nest when approached, then cautiously returning from another direction carrying



PLATE 11—Chinstrap penguin with nest and eggs probably laid by a gentoo penguin.



PLATE 12—Chinstrap penguin bowing to an incubating gentoo.

a stone in its bill. On the first occasion the bird's behaviour was so erratic (even after the observer had retired to a distance and the surrounding gentoos had resumed their brooding) that it seemed doubtful if it could be the rightful owner of the nest. During the next few days this nest was the object of much photographic attention, and the bird's presence was checked almost daily up to 8 December. On some visits the sitting bird behaved much more timidly than on others, but there was never any evidence as to whether two birds might be involved. On 30 November only one egg was in the nest. On 8 December, while one chinstrap was sitting on the nest at West Bay, another was seen wandering about the gentoo rookery on the Vahsel Moraine⁽¹⁾, about a mile distant. On 10 December one was still present at Vahsel Moraine, but the nest at West Bay was empty and there was no trace of either parent. After 10 December neither penguin was seen again at either place.

On 7 March, 1951, a chinstrap penguin was seen moulting among the gentoos and another amongst the macaroni penguins at Red Island. Two chinstrap penguins were again reported at Red Island on 26 April, again one among the gentoos and one with the macaronis, there being only eight of the latter present in this previously large rookery. No more were seen that year until 11 November. On that date R. Dingle was

⁽¹⁾ This rookery has been under regular observation for the previous six weeks and this was the first occasion on which a chinstrap had been seen there.

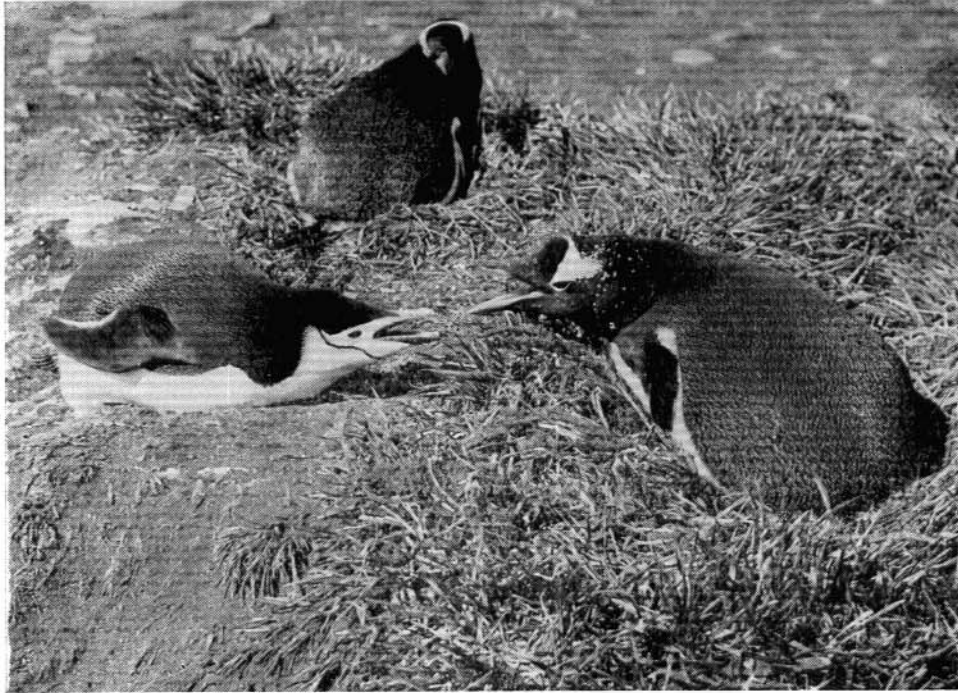


PLATE 13—The gentoo opens its bill in threat, and the chinstrap responds.

sitting in the gentoo penguin rookery at West Bay, waiting for a photograph, when he observed a chinstrap wandering through the rookery. It approached one, bowed, then squatted on the ground close to the nest, pointing its bill at the occupier. The gentoo replied by opening its bill in threat, the chinstrap did likewise, then after a few minutes got up and made its way out of the rookery towards the beach. An excellent sequence of nine photographs illustrates the entire encounter, which lasted only two or three minutes (see plates 12 and 13). This bird did not nest in 1951, but another bird was found by a field party, sitting on eggs, early in December among the gentoos at Fairchild Beach. Single chinstrap penguins were later seen among the macaronis at their landing ground under Mt. Olsen and at Rogers Head.

In November, 1952, a chinstrap was again seen on a nest in the West Bay rookery but no further information is available.

In March, 1953, two chinstraps were ringed (flipper bands) one of which was moulting on the beach near the West Bay rookery. This bird was not seen again, but on 5 November one was found wandering in the West Bay rookery. By this date the gentoo penguins had nearly finished laying and the great majority of the birds were incubating. On 11 November, Brooks found presumably the same bird standing by a nest with a sitting gentoo; the latter fled when disturbed and the chinstrap attempted to shepherd it back to the nest; failing in this, it re-

turned to the nest which contained two eggs, inspected it, walked round the edge and repulsed a threatening skua, but would not sit though it seemed completely fearless of Brooks' presence. The gentoo refused to return so long as Brooks was in sight. On 16 November the chinstrap was sitting alone on one egg, the second having previously been transferred to a neighbouring gentoo. It continued to sit at least till 2 December, but the gentoo was not seen again and on 8 December the nest was found to be abandoned. In the nest to which the second egg had been transferred, two chicks hatched, while the third egg contained a dead chick in an advanced stage of development.

On 22 November McNair found a chinstrap sitting on two small chicks at Sydney Cove; next morning it was relieved by a gentoo, but returned the same evening. A month later this association had apparently dissolved and the only chinstrap seen was wandering by itself in another part of this extensive rookery.

On 13 December McNair found a pair of chinstraps at an empty nest among the macaronis on Olsen Screens; one of these was a bird ringed (flipper bands) the previous March in the same area. This pair was seen again near the same spot on 1 January. McNair also located two chinstraps on the beach below the Vahsel Moraine on 29 November and again in the same place a month later.

Several points emerge from these records. The absence of records from the end of April to November indicate that, as elsewhere in their range, the chinstraps spend the winter months at sea and do not return till November. Both at South Orkney Islands and in Graham Land it has been noted that the chinstraps begin to return to their rookeries in the first days of November (Clarke, 1906; Bagshawe, 1938). Having no rookeries of their own at Heard Island, the chinstraps make their way into those of another species, usually the gentoo which by this time have paired, laid, and are mostly incubating. As the chinstrap penguins frequently fail to find a mate of their own kind, it appears that they then pair with a sitting gentoo, presumably driving away the rightful mate when it reappears. If the sitting gentoo eventually deserts, the chinstrap is forced to take over incubation duties for as long as its endurance lasts; if the gentoo accepts the situation, chicks may be successfully hatched. This explanation appears to fit the observed facts better than the supposition that these were normally mated pairs. Dingle's observation quoted above seems very significant in this connection.

The only pair of chinstraps yet seen together at a nest has been that found by McNair among macaronis. The number of chinstraps recorded towards the end of 1953 may reflect the industry of an active observer rather than any actual increase in number, but it does seem that the species is making a determined attempt to colonise Heard Island⁽¹⁾ and it is probable that successful breeding may occasionally occur.

⁽¹⁾ It is of interest in this connection that Routh (1949) on five occasions saw chinstraps at sea in the southern Indian Ocean, and that three of these sightings were in longitudes east of Heard Island. Single stragglers have also reached Terre Adelie (Jouanin and Prevost, 1953) and Macquarie Island (Keith & Hines).

ROCKHOPPER PENGUIN

Eudyptes chrysocome (Forster)

Habitat, distribution and numbers. At Heard Island the rockhoppers compete with the macaronis for rookery sites, and are forced to be content with the less accessible parts of the steep rocky slopes favoured by both. For the most part, the known distribution of the two species on Heard Island is identical, and many macaroni rookeries have a fringe of rockhoppers nesting along their upper borders. The rockhoppers are much the more enterprising explorers, and nest in some surprising situations. A good example is the caves⁽¹⁾ in the lava flows between the ANARE Station and Rogers Head, which can only be reached by quite considerable journeys over bare lava flows from the only landing beach in the area. Another is a horizontal crack, eight to ten inches high, in the vertical rock face on the west side of Rogers Head. From this the nesting rockhoppers look out over a twenty foot drop, looking like a row of guillemots (the approach is concealed in the depths of a sloping crack which leads up from below). One of the larger rockhopper rookeries, numbering several hundred pairs, is on the spit



PLATE 14—Rockhopper penguins incubating. These rocky ledges are typical of their nest sites at Heard Island.

⁽¹⁾ These were formed by buckling of the lava sheets as they cooled. Here and there the roofs have fallen in, giving access to extensive subterranean galleries.



PLATE 15—Pair of rockhopper penguins, the female brooding a large chick. Note the larger and heavier bill of the male standing behind.

on the south side of West Bay. Much of this rookery is situated among large boulders, but it includes one of the few open pieces of ground where rockhoppers are free from intrusion by macaronis. Other moderately large groups nest in the boulder screes on the north side of Mt. Aubert de la Rue; on the talus slopes below the Black Cliffs⁽¹⁾, and in the fringes of the surrealistic wilderness of A-A lava near Red Island. Smaller groups are found at all suitable spots as far as Cape Gazert, but their numbers are nowhere very great, and their total population can be only a small fraction of that of the macaronis.

Return to nesting. The rockhoppers are among the last birds to return to Heard Island for their nesting season. In 1950 early arrivals were first seen on 5 November, when there was a small sprinkling of them standing sleepily about their rookery below Mt. Aubert de la Rue. Next day 14 were found in Cave Bay, and two days later the number had trebled. In 1951, 24 had arrived at Corinth Head by 2 November. In 1954 the first two were found at the cave rookeries on 3 November. Three days later there were about 100 at Mt. Aubert de la Rue, and more were arriving hourly.

⁽¹⁾ For a considerable distance these are occupied by alternating groups of macaronis and rockhoppers, the latter inhabiting the caves and recesses of the more tumbled portions.

On 25 April, 1950, Young and Gibbney banded 50 rockhoppers in the Aubert de la Rue rookery, using aluminium poultry bands placed above the tarsal joint. Eighteen of these were recovered at the same spot on their return in November, but, as the bands were rather crude, and several of the birds were lame, all rings found were removed. Two more were recovered in subsequent seasons, one of these having worn its ring without any ill effect through two breeding seasons and three winters at sea. In this case the clip on the band had broken off, the band being kept in position by its own tension.

The nesting behaviour of rockhopper penguins is closely similar to that of macaronis, but a fortnight later in time. Some of them take more trouble over their nests than macaronis, and grass or other vegetation is frequently incorporated.

An example of direct competition with the macaroni penguins occurred in one of a small group of rockhopper nests under daily observation at the fringe of a small macaroni rookery. Among the rockhoppers was a single pair of macaronis. It appeared that the macaronis were one of those pairs which select sites, but do not lay, and they had made little or no attempt to make a nest. Then, a week after incubation had begun, one of the macaronis was found to have evicted the rockhoppers. The macaroni was standing in the nest and the egg was lying cold outside. The intruder was ejected and the egg restored to the nest, in the hope that the owners would resume possession, but two weeks later both macaronis were standing at the empty nest and there was no sign of the rightful owners. In December, 1953, the distribution of rockhoppers along the fringe of this rookery was closely similar to that in 1950, with some pairs occupying identical sites. Among them a pair of macaronis were on a nest close to, if not on the actual site of this incident.

Egg laying and incubation. In 1950 the first egg was found on 23 November. Two other rookeries examined on the same day contained no eggs, but two days later twelve were collected in the Aubert de la Rue rookery and egg-laying was well started. A clutch of two is usual, the first egg being much smaller than the second⁽¹⁾, but clutches of three are occasionally laid. There is an interval of up to five days between the two eggs. Only a minority had completed their clutch before the end of November, but the majority of clutches was completed during the next few days, and egg-laying was virtually finished by the end of the first week in December. Ealey and Chittleborough found a rockhopper incubating two eggs on 25 January, but such late nesting is unusual and the eggs may have been addled. The small first egg is frequently lost, but a proportion of birds will continue to incubate both eggs up to hatching time, though only one chick is reared. The incubation period has not been determined at Heard Island, but at Macquarie Island it was found to

(1) Average weights are 76.9 gm. for the first, and 111.5 gms. for the second.

be 33-34 days (Gwynn, 1953, *b*). Several nests were found at Heard Island to contain small chicks on 3 January, 1950, none of them being more than two or three days old. On account of the rocky nature of their rookeries, rockhopper chicks do not form nurseries of any size, but as they grow older little groups of two or three are often seen huddled together.

Chicks and juvenals. Like the macaroni, a newly-hatched chick has a darker dorsal surface than the gentoo. After a fortnight the down of the head is black with the dorsal portion of the body a dark grey-brown and the ventral down white. The maxilla is pink with the culminicorn dark grey. The mandible is grey except for a pink patch each side. The feet are brownish-grey with dark grey claws and the iris is brown. There is a central area of bare pigmented skin extending from the vent to the xiphisternum. The skin on each side of the pigmented region is pink.

As the other crested penguins, the juvenals are easily distinguished by the absence of head plumes, the crest of the adult being represented only by an inconspicuous line of short yellow feathers. In 1953 the first juvenal was seen at Corinth Head on 26 December and several more on the Olsen screes the following day. During the next few weeks they were to be commonly seen in the rookeries, and on 31 January, 1950, of many juvenals at Mt. Aubert de la Rue, several were in early moult.

On 8 March, 1953, the chicks in the rookeries below Mt. Olsen were moulting, mostly with the remaining down more or less confined to head and shoulders; the year-old birds had apparently all left by this date, and some unemployed adults were already moulting. A fortnight later two late chicks were seen still in down, but most of the chicks had left and most of the adult population was away feeding preparatory to their moult. At the beginning of April the breeding adults begin to return for their moult and by the end of April nearly all of them have completed it and are leaving for the winter. On 1 May, 1954, out of some hundreds of pairs in the cave rookeries near Rogers Head, all had left except for a score or so on the rocks above their common landing beach. These left the following morning except for a solitary bird still in early moult. (This bird was banded, and was found nesting in one of the caves the following season, proof that these occasional laggards are not necessarily sick birds.)

MACARONI PENGUIN

Eudyptes chrysolophus (Brandt)

Habitat, distribution and numbers. Like other members of their genus, macaronis come to land only for breeding and moulting, which occupy about six months of the year. The bulk of the population is concentrated into huge rookeries often numbering many thousands of pairs. The approach to these rookeries almost invariably involves a landing on



PLATE 16—Macaroni penguin rookery on north coast of Laurens Peninsula.
The edges of the rookery are sharply defined though there is no change
in the nature of the surface.

rocky beaches subject to heavy breakers. Some rookeries are situated on flat lava or on gently sloping ground (plate 16) but most of them are found on steep rock-strewn slopes. In the former the birds are very evenly and closely packed throughout the rookery, but in the latter their density is reduced and their distribution more scattered.

Single birds and isolated pairs of macaroni penguins are often found in rockhopper rookeries. Some of these appear to be guarding sites but do not lay, and in the light of Richdale's observations (1951) on the yellow-eyed penguin (*Megadyptes antipodes*), it seems likely that most of these may be two or three-year-old birds which in subsequent years transfer their allegiance to rookeries of their own kind. In one instance a macaroni was found sharing a nest with a rockhopper, on a sloping ledge where neither could stand upright. It seemed that they might be a mated pair, but the egg (rockhopper) was lost before it could hatch. Conversely, there is usually a number of rockhoppers scattered about the macaroni rookeries, their nests set apart from the macaronis in the shelter of boulders and overhanging rocks.

The macaroni is by far the most numerous species of penguin on Heard Island. The vast rookeries on the southern slopes of Mount Olsen number hundreds of thousands of pairs. Other large rookeries are situated all along the west coast of the Laurens Peninsula, up to the very large rookery at Red Island. A striking feature at the western end of the



PLATE 17.



PLATE 18—The penguin road leading to the macaroni penguin rookeries below Hayter Peak. Plate 17 shows the higher part of the road.

Mount Olsen scree is the penguin road traversing the steep hillside, leading to rookeries higher up (plates 17 and 18). This track is several hundred yards long, and has been worn by the feet of countless generations of penguins. It looks like a man-made road in miniature, and seen at a busy time of day, thronged with hundreds of pedestrians, presents a most remarkable sight. Other very large rookeries are found at the north end of the Black Cliffs, at Rogers Head, and at Corinth Head. The largest rookery of all occurs on the southern side of Heard Island at Long Beach (plate 19). Other small rookeries occur at various intermediate points. One of the two small rookeries at Erratic Point at the end of South-West Bay is illustrated in Falla (1937, p. 16), incorrectly called West Bay, and appears today exactly as it did thirty years ago. This rookery was the subject of special studies in 1950-51 and in 1951-52, and some of these observations have already been published (Gwynn 1953, *b*; Downes and Gwynn, 1955; Downes, 1955). In 1953-54, flipper banding was tried for the first time and further observations on breeding behaviour were made on a small group of marked birds in the great Corinth Head rookery (plate 20). The main results of this study are incorporated in the present account.



PLATE 19—Cliff-top macaroni penguin rookery at Long Beach.

All the activities of the macaronis are highly synchronised, and the dates of their return, laying, moult, and departure vary little from year to year.

Arrival of males to breed. The first macaronis to return from their winter wanderings arrive towards the end of October. The dates of their arrival during the years 1949-53 are set out in Table 3. On 25 October, 1950, a single individual, the first arrival, was standing in the small rookery by the glacier stream at Erratic Point. Two more appeared the same afternoon. This rookery was at that time under daily observation, so an exact picture of the progress of the return is available (see table 3). In 1953 the return was about four days earlier than usual. It has been shown by Downes that the male birds come ashore first and await the females. When a bird first arrives, it at once goes to a nest site, probably the one occupied by it the year before. Once there, it immediately proceeds to establish its claim by:—

TABLE 3.
RETURN OF MACARONI PENGUINS, HEARD ISLAND, 1949-1953.

ROOKERY ⁽¹⁾	1949		1950		1951		1953	
	Date	Number	Date	Number	Date	Number	Date	Number
Erratic Point			25/10	3			21/10	5
			26/10	7				
			27/10	11	27/10	8		
			28/10	17			24/10	18
	29/10	30	29/10	25				
			31/10 (10 a.m.)	88	31/10	78	28/10	90 (2 prs.)
			31/10 (2.30 p.m.)	99	1/11	128 (3 prs.)		
			2/11	165 (8 prs.)				
			6/11	340				
		8/11	400					
Rogers Head	23/10	Several	25/10	ca 200	23/10	103	24/10	208 ⁽²⁾

⁽¹⁾ Counts at some other rookeries are given for future comparison: Olsen Screes, 19/10/53—100 to 200; Corinth Head, 23/10/55—80; Balanced Rock, 23/10/51—20; 24/10/53—150; Cape Gazert, 21/10/51—6.

⁽²⁾ Areas in sight from cliff-top only.

- (a) Braying ecstatically.
- (b) Repelling any bird encroaching on its territory.
- (c) Collecting pebbles or dirt to mark the spot.

All this may be done within a few minutes of setting foot in the rookery for the first time. Once established, the bird sits back on its heels to await the arrival of its mate (plate 21). During the first few days the rookery presents a very somnolent air, disturbed only by the occasional appearance of fresh arrivals, or a bird breaking into ecstatic display.

Arrivals of females. On 2 November, 1950, 165 birds were present at Erratic Point and the first eight pairs were noted, indicating that the females had begun to arrive. The following description of the arrival of a presumed female, straight from the sea, is quoted from field notes:—The new arrival “penetrated the rookery for a short distance, where it was received with great ceremony by a single bird. Then followed much ecstatic head-swaying with head bowed, at times pointing at nest, at other times pointing at newcomer’s feet. Display also included sitting in nest twice. Meanwhile newcomer stood nonchalantly by, flippers extended, occasionally preening itself.” Next day many more pairs had formed. On



PLATE 20—Ledge in the Corinth Head macaroni penguin rookery, showing banded birds incubating, 1953.

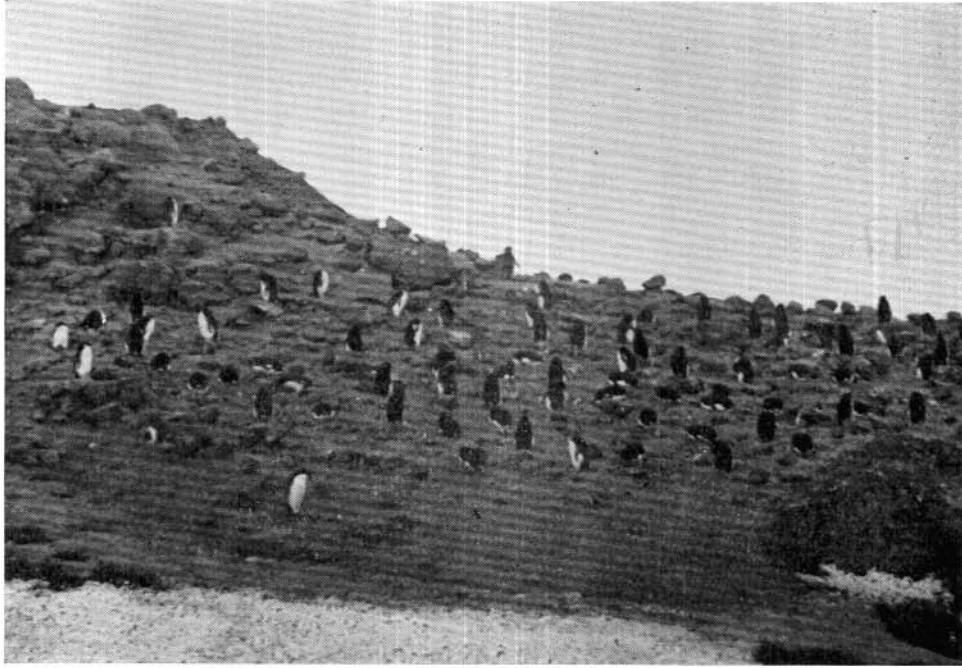


PLATE 21—Macaroni penguin rookery at Erratic Point: males awaiting the arrival of the females, 31 October, 1950.

4 November copulation was observed for the first time, and by 6 November there were more pairs than single birds present, the number of birds in the rookery totalling 340. On 8 November this had risen to about 400, nearly all now in pairs, and the return was now largely complete. (This rookery ultimately totalled somewhat between 220 and 250 pairs.) Visits to Rogers Head indicated that matters there were following a closely similar course.

Observations suggest that a territory-owning male is prepared to accept any female which comes to its territory. Males in the centre of a group are the first to acquire mates, while those around the edge, or in isolated situations are generally late in doing so, and in some instances remain single throughout. There appears to be a definite excess of territory-owning males among the breeding population. In the early stages there is a considerable switching of mates. For example a female, 7548, was first banded as the mate of 7521; at the following visit she was paired with 7537, defending her position in a furious fight with an intruding female, 7541; two days later she was with an unringed male, with which she finally settled down, and 7537 was without a mate. 7521 and 7537 both subsequently acquired permanent mates, while 7541 found a mate in a nearby group. Some of the switching observed was certainly due to the disturbances caused by banding operations, but it does suggest that many

of the arriving females have at first no precise objective ⁽¹⁾. However, once accepted, the female appears to take the initiative in repelling intruders of her own sex, though in the case mentioned both members of the pair set upon the intruder.

Once a pair is established, both remain at the nest till the eggs are laid. At first the two birds squat side by side, one often extending a flipper round its mate; or they stand breast to breast, at times preening one another. As egg-laying approaches, the female spends much more time sitting in the nest.

The macaroni's nest is an extremely skimpy affair, consisting only of a slight hollow in the ground paved with a few rock chips. A few make quite a well formed saucer with these materials, but others may lay on bare rock ledges, where any rock chips collected have a very transitory stay. Macaronis never try to amass vegetation for their nests, as the rockhoppers habitually do when this is available, though a few grass stalks may be added to the collection. In addition to the pebbles brought by the male, the female will drag into the nest any larger rock fragments which may be within reach. The pebbles on an abandoned site are soon gathered by the neighbours, and they will sometimes pilfer from a bird incubating alone which is unable to make an effective protest.

Egg-laying. The first eggs are laid about 10 November. The macaroni normally lays a clutch of two eggs, with an interval of three to five days. Of these two eggs, the first is always much smaller than the second ⁽²⁾ and is always rejected long before the chicks are due to hatch. In this striking differentiation between first and second eggs, both in size and in destiny, the macaroni is similar to the rockhopper (and probably to other members of the genus *Eudyptes*) but as far as we are aware is otherwise unique in the bird world. This has been fully discussed elsewhere (Gwynn, 1953, *b*).

While waiting for the second egg the bird crouches over the first, rather than broods it, and the egg can very often be seen projecting in front of the bird. These first eggs become very dirty. With the macaroni, the first egg is very often lost even before the second is laid, presumably getting kicked out of the nest in one of the fights which are such a frequent occurrence in these rookeries; but if it survives it is usually lost when the second egg is laid. A few birds continue to brood two eggs till incubation is well started, but no cases were observed in which both eggs were successfully guarded for long. It is rare for both eggs to survive more

⁽¹⁾ In the season when the bands were put on, there were eight pairs in which both birds were banded. Next year, four of these pairs were still mated, and in the same area of the rookery. One pair was "divorced", both birds having new mates, and two others from different pairs also had unbanded mates. The remaining four birds were not seen that year.

⁽²⁾ Average weights for 14 unselected clutches were 94.0 gms. for the first egg, and 154.5 gms. for the second.

than a few days after the completion of the clutch. Very occasionally a bird will be found incubating a small (first) egg, presumably having lost the second. It has been shown by Downes that such an egg is fertile and capable of producing a chick. It is also thought that this may be the explanation for the rare occurrence of "runt" penguins in macaroni rookeries (Downes, 1955).

At this time the watching skuas and sheathbills reap an abundant harvest, gathering the first eggs as they roll out of the nests—unless they roll into nests lower down the slope. This not infrequently happens, and is probably responsible for the statement that the macaroni lays three eggs (Sclater & Salvin, 1880). Intermediate-sized eggs are sometimes found and in two such cases, when the bird was killed after the large egg was laid, dissection showed that three eggs had been laid. In neither case was the first egg found, and both birds had been subject to much disturbance in the early stages of nesting.

Egg-laying among the macaronis is extremely well synchronised. By 16 November, 1950, the great majority of birds at Rogers Head were sitting on small first eggs, while a minority had already laid their second eggs. A week later about 95% were sitting on large second eggs, having lost the first. The remaining 5% were either still managing to incubate both, or were sitting on warm first eggs, but egg-laying was practically over. A haversack full of the freshest-looking eggs to be found was collected for the kitchen on this date (23 November), but in the majority even of these incubation was well started.

Incubation and care of chicks. The incubation period is 35 to 37 days (Gwynn, 1953, b). Falla (1937, p. 97) made a curious error when he visited Heard Island on 26 November, 1929, and reported: "Laying had just commenced and about half the pairs already had eggs". His account of the rookery as he saw it would have been equally applicable on the same date in 1950, except that the number of birds without eggs seems rather high, but his interpretation of what he saw was wrong. The birds had in fact already finished laying, and those which were "standing close together . . . in the expectant attitude that precedes laying" had in fact lost both eggs. The date, and Falla's own description of what he saw, leave no reasonable doubt about this.

If laying had still been in progress, he would certainly have found some birds still guarding both eggs of their clutch and would have noted other small eggs laying about. On 28 November, 1950, there were still pairs at the majority of nests though many birds were sitting singly, but nearly all the unoccupied partners left during the next few days to refresh themselves before taking their turn at incubating. This sudden clearance of the rookeries in the space of about three days is a very striking phenomenon.

In 1953, records of 18 nests where one or both members of the pair were banded, and where eggs were retained through the full incubation period, revealed that it is the males which leave first, about eight days after the completion of the clutch. There is some evidence that males may leave for short periods before this, possibly only to bathe at the beach, but even this appears to be exceptional. After their departure the males remain at sea for about 12 days, during which period the rookery is occupied solely by incubating females and a few pairs which have lost both their eggs. Then at the end of the third week of incubation the rookery is once again a scene of great activity, with a stream of well-fed males making their way up to the rookery and a counter-stream of lean females, which have now been ashore for at least five weeks without a break, going down to the sea. The males probably take over incubation soon after their return. The females then remain standing by their mates for a while before leaving. In one case, where the male was a little late in getting back, the female left before his return and the egg was of course lost, but she returned to join him at hatching time. The females in their turn remain at sea for another 12 days, returning plump and well-fed when the chicks are due to hatch. The return of a female at this time is described under "Types of Display". They usually return just before hatching, but in some cases the chick is already out of the egg when they arrive, in which case the chick is at once fed. Both birds remain at the nest for 2 or 3 days, the female feeding the chick at frequent intervals. The female then goes to sea again, leaving the male in charge. The males remain on guard over the chick up to 10 January (i.e. twenty days after hatching had commenced) when the last observations were made, while the females came and went with food. An interesting point is that going fishing is a hazardous occupation, owing to the leopard seals which are often patrolling off-shore, though the toll taken is probably only a very small proportion of the total strength of the rookery.

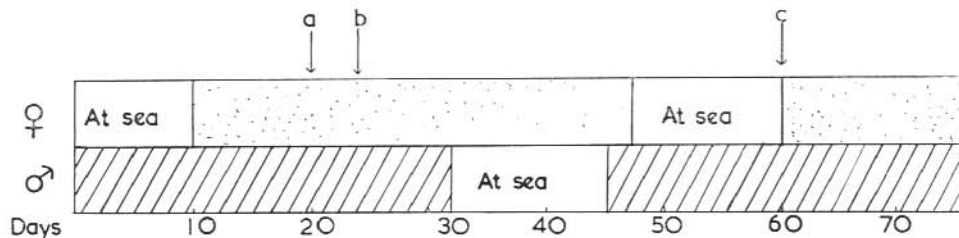


FIG 1—Diagrammatic nest history up to hatching of eggs (cp. Sladen, 1953).
Male fasting periods at nest hatched; female fasting periods at nest dotted. a. First egg laid. b. Second egg laid. c. Hatching.

Territory-holding birds without eggs. These may be either males which failed to obtain mates at the usual time, or pairs which lost both eggs soon after laying. Behaviour varies to individual circumstances, but in general these sites are abandoned at the time the exodus of the males and

are re-occupied some time between the return of the males and hatching time.⁽¹⁾ This happened at eleven out of twelve such sites under observation (at four of these the females had been killed for dissection). In one case, in which both eggs had been taken immediately after laying, the female sat in the incubating posture throughout the first shift till the return of the male, which then stood at the empty site till the female returned at hatching time. In two similar cases, both birds left at the time of the male exodus and both returned soon after the return of the males. Pairs without chicks tend to remain together at their sites, in many cases up to three weeks after hatching time.

Of three males which had never obtained mates, all left at about the same time as the rest of the males. Two of these returned shortly after the rest of the males, the other at hatching time, and two remained at their sites till early January.

A peculiar case was that of male 7549. This bird had occupied two different but equally uninviting sites, at the second of which (a ledge on which there was no possible room for a nest) he obtained a mate when laying in the rest of the rookery was about complete. The two remained together till shortly after the departure of the successful males, when they were seen molesting an incubating female a short distance from their site. Both had disappeared by the next visit and the male returned alone about hatching time to its ledge, where it remained till early January. Such loosely attached females were occasionally noted, usually as the temporary associates of males known to be unmated.

In addition to these territory-holding birds, there was always a small crowd of unemployed birds in adult plumage at the lower fringe of the rookery.

Development of chicks. Newly-hatched chicks are covered dorsally with dark grey down which is very sparse on the back and almost black on the head. The ventral parts are white, becoming grey towards the cloaca. The beak is black, slightly lighter towards the tip and armed with a white egg-tooth. The feet are pink-grey above and darker below, with white claws which have grey tips. The eyes are dark brown when open.

Two chicks from second eggs were weighed at intervals in the early stages:—

TABLE 4.
WEIGHTS OF MACARONI PENGUIN CHICKS.

Egg weight	7514 (136 gms.)	7519 (?)
At hatching	110 gms. (probably fed once)	106 gms.
Third day	186 gms.	171 gms.
Fifth day	225 gms. (female absent)	275 gms.
Twentieth day	1300 gms.	1500 gms.

⁽¹⁾ In other parts of the rookery a few pairs were noted at empty sites well after the male exodus and single birds at empty sites before the return of the main body of males.

Two other normal newly-hatched chicks weighed 90 gms. and 107 gms. In each case, except 7514, half the shell was still in or just outside the nest.

In contrast to these, three chicks from first eggs (substituted at laying for second eggs), weighed 54, 72 and 68 gms. at hatching. Of these only the last survived and this weighed 650 gms. on the 17th day after hatching. The second may have been fed before weighing. A fourth chick from a known first egg, weighed 600 gms. when 19 or 20 days old.

As already shown, the feeding of the chick, at least during the first three weeks, is undertaken exclusively by the female. During the absence of the females, the males frequently preen the chicks about the head, apparently to still the chicks' demands for food. Before the appearance of the mesoptyle down, the almost naked backs of the chicks may be seen to be crawling with lice.

When observations were discontinued in January, 1954, the males were looking very lean. Most still stood fast, but pairs with empty sites now panicked easily, and this at times involved birds with chicks. Larger chicks, when abandoned, tended to scuttle away from their nests, and in some

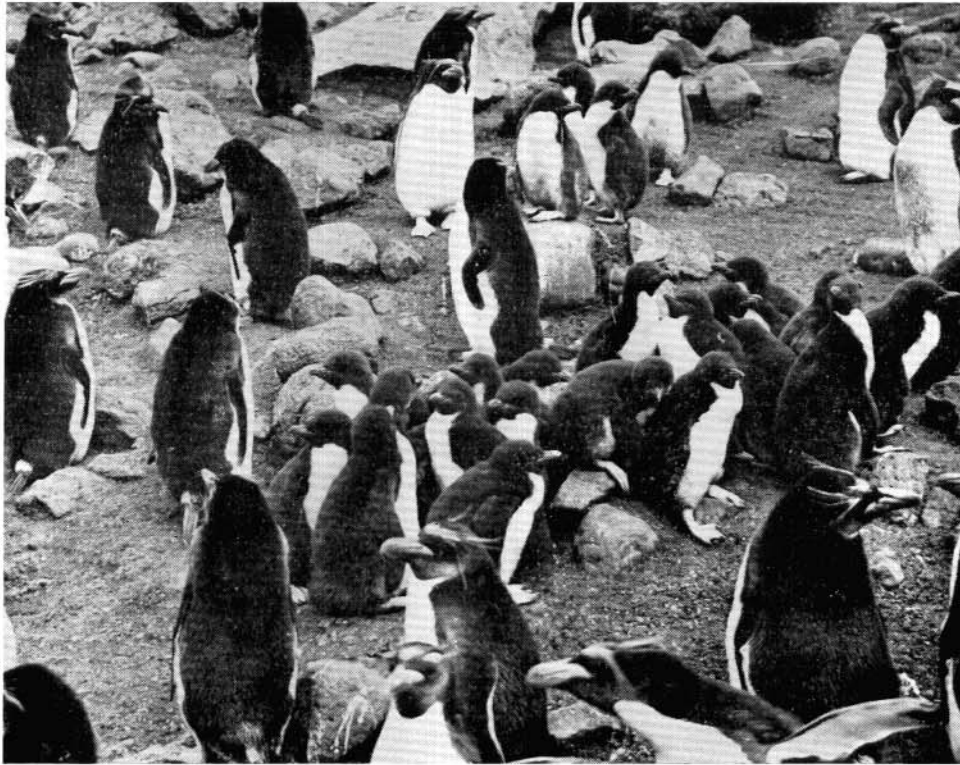


PLATE 22—Macaroni penguin nursery. The adults present are still at their nest sites, their partners being away fishing.

cases the chick fled at the observer's approach even when the parent stood fast. In 1951 at Erratic Point it was noted that on 15 January most chicks were still being individually guarded, though a few of the older ones were in small groups of two to four. By the end of that month most of the chicks were gathered in tight little groups of from four to ten, but in the macaroni the nursery system is never as highly developed as in the gentoo. The crowded nature of the macaroni rookeries, with large numbers of adults present, probably affords adequate protection from depredation by skuas at this stage and the tendency of the chicks to huddle into small groups may be as much to escape the pecks of the adults on their territories as from any other cause. Plate 22 is very informative. The chicks are gathered into nursery groups, but the adult penguins (probably males) are still standing at the nest sites. Unfortunately this picture was taken before the peculiarities of their organisation was understood, and the exact date is not known. An observation by McNair suggests that a chick must follow its parent back to its own nest to be fed. The chicks begin moulting before the middle of February and probably leave about the end of that month.

Reproductive success. Compared with the gentoo, the macaroni is a surprisingly inefficient parent. In the small rookery at Erratic Point, out of over 200 nesting pairs only about 68 reared chicks to an age of six or seven weeks. Observations at the other rookeries suggested that this was a fairly average figure. Most losses undoubtedly occur during the incubation period from marauding sheathbills, many pairs losing their second as well as their first eggs. Pairs on the outskirts of rookeries are particularly vulnerable. A proportion of eggs is addled, and of sixteen marked pairs which incubated second eggs to full term, three failed to hatch eggs although they continued to sit for two or three weeks beyond the normal period.

Juvenals. First-year birds are easily distinguished by the absence of head plumes, the crest of the adult being represented by an inconspicuous band in which short yellow feathers are interspersed among the black. The bill is relatively weak without any marked ridges across the base of the culmen and is chocolate brown in colour instead of the red brown of the adult. The bare skin at the angle of the mouth is weakly coloured. The iris is brown instead of garnet red. The white spot above the tail is absent and the feathers under the chin have a greyish bloom.

These birds return to the rookeries together with the females about hatching time, when they make their first landfall nearly ten months after first leaving the rookeries. From about 20 December they are seen commonly, chiefly among the unemployed birds near the beach, though a few are found at the very top of the rookeries.

On 20 December, 1953, six were weighed and their bills measured in the Corinthian Head rookery. Live weights ranged from $6\frac{1}{2}$ to $7\frac{3}{4}$ lbs.,

culmen lengths from 49 to 54 mm., and the depth of the bill from 19½ to 22 mm. Details of two of these which were killed, together with a third killed on 27 December, are as follows:—

TABLE 5.
WEIGHT AND BILL MEASUREMENTS OF JUVENAL MACARONIS.

Date	Sex	Weight in lbs.	Culmen Length in mm.	Depth of Bill in mm.
20-12-53	♂	7	53	19½
20-12-53	♀	6½	51	19½
27-12-53	♂	7¾	50	22

In the two killed on 20 December, the subcutaneous fat was rather meagre, and it is clear that much feeding must take place between the return of the penguins to the rookery and their moult in February. On 14 February, 1951, at Erratic Point, it was noted that a large proportion of juvenals were in early moult and on 19 February, 1952, that the juvenals had almost finished moulting. On 8 March, 1954 a few moulting juvenals were still present in the Olsen Screes rookeries.

Moult and departure of adults. After the departure of the chicks, the adults go to sea to feed for the moult, and during early March the rookeries are deserted except for a sprinkling of non-breeding adults, some of which begin their moult in February⁽¹⁾, and a few late juvenals. The main body of adults returns during the second half of March to settle down for moulting. In 1954, between 22 and 25 March, the Olsen Screes rookeries, which a fortnight earlier had been relatively deserted, were crowded with adults preparing for their moult (plate 24), and more were arriving continuously on the beaches. These rookeries were next visited on 19 April, by which date nearly all the birds had completed their moult and some had already left. At this stage large parties could be seen moving both ways on the roads leading to the rookeries and flocks were bathing in the surf at the beaches. These bathing parties remained close inshore, probably on account of the leopard seals patrolling outside the breakers, and they presently came ashore again, only occasional birds being seen making for the open sea. It is uncertain whether any feeding was done at this time, though the return of a few birds at sunset suggested that some at least were feeding again before their final departure. After this the exodus was rapid, and on

⁽¹⁾ In February, 1951, an attempt was made to transfer adult macaronis from Heard to Macquarie Island to see if they would find their way back to Heard Island. The birds selected were believed to be in pre-moult, as it was considered they would travel best. Owing to the breakdown of H.M.A.S. "Labuan" it was not possible to carry through the experiment as planned. Some of the survivors were eventually released at Fremantle, and others went into moult in Perth Zoo some two months later. If nothing else, the experiment proved that most of the birds in the rookery were still feeding, and had not yet accumulated sufficient reserves to undergo their moult.

23 April the great rookeries at Rogers Head and Corinthian Bay were deserted except for a few stragglers. For some reason departure from the Erratic Point rookery was a little later than in the big rookeries. Table 6 illustrates the population variations during this period.

TABLE 6.

MACARONI POPULATION OF ERRATIC POINT ROOKERY AFTER DEPARTURE OF CHICKS AND JUVENALS, 1953.

Date	Population	Notes
11 March	28	Probably non-breeders
20 March	121	Breeding adults returning
28 March	414	Most in early moult or pre-moult
5 April	412	Most in early moult
13 April	380	Most well on in moult
21 April	207	
22 April	185	
23 April	130	Big rookeries now almost deserted
24 April	102	
26 April	16	
27 April	1	Still in early moult



PLATE 23—Macaroni penguin chick being fed.



PLATE 24—Macaroni penguin rookery at the beginning of moult. Many of the birds are in the "pre-moult" stage.

On 25 April, 1949, there were about 100 birds at Erratic Point; on 28 April, 1950, it was completely deserted. A few other counts indicate the position in other rookeries on comparable dates: Corinthian Head, 25/4/51—20; 23/4/53—7 or 8; Red Island, 26/4/51—8; Rogers Head, 2/5/51—2. In the big rookeries one or two birds, whose moult has been delayed, are usually still present in early May.

Types of display. The display of the macaroni penguins was not intensively studied, but it is convenient to discuss the writer's notes on the subject under the headings proposed by Roberts (1940, *b*).

- (1) After the acquisition of a mate the male spends much time collecting pebbles which he places at the feet of the female. In the pre-egg stage, this is often followed by mutual bowing, or peering into the nest, both birds making a chattering noise as they do so. The male is liable to indulge in pebble carrying at any time during the breeding season if his mate is on the nest, though it is most frequently observed up to the time that the second egg is laid.
- (2) In the macaroni, "bowing" is more aptly described as pointing at or peering into the nest, as the nest or its contents

always appears to be the main object of this gesture. Pointing to the nest by both penguins is a frequent preliminary to ecstatic braying.

- (3) Two instances of "nest relief" may be quoted. In the first a bird (sex unknown) returned from a short absence. The sitting bird shuffled round to face its partner and half rose, exposing the egg; then both birds "pointed" at the nest, following this with a full epigamic display, though the posture was somewhat constrained on the part of the sitting bird. The display was repeated in a less intense form several times, but change-over did not take place.

The second instance was of a female returning, after a twelve-day absence, for the hatching of the chick. Her arrival was the signal for a tremendous burst of epigamic display by both birds. After a few minutes the male stepped off the nest and the female shuffled on. The male then began to collect pebbles.

- (4) In mutual epigamic display, both birds stand facing each other or side by side, flippers held well back, necks outstretched with the bills pointing skyward, braying loudly while swinging heads in wide arcs from side to side. This is essentially similar to that illustrated for the rockhopper by Roberts (1940, *b*, p. 251). As indicated in the previous paragraph, this display is by no means confined to the pre-egg stage. A frequent routine is for one bird to burst into ecstatic braying while its mate stands in a submissive attitude, then for both to point to the nest together. This is then followed by the full mutual epigamic display. Another form of behaviour is mutual preening, when the two birds stand opposite one another, each nibbling the other round the face.
- (5) Ecstatic display is apparently identical with epigamic display. This is most frequently seen after the females have begun to return, when it is often indulged in by territory-holding males which have not obtained mates. Another "ecstatic" gesture is for the bird to stand hunched up over its nest, head bowed and beak open, shaking its head vigorously and making a chattering noise. This is chiefly seen in males waiting for mates, or when the appearance of the first egg is imminent. In the latter case the male goes through this gesture while its partner stands by in an expectant attitude.

Ecstatic braying is also evinced by the passage of a skua overhead and when one of these birds makes a swoop for an egg, the whole area breaks out into a loud clamour.

Ecstatic braying has therefore a variety of applications with the macaronis, being used for ecstatic display (assertion of territory?), mutual epigamic display, mutual recognition, and as a response to a hostile presence. The writers have not, however, noted it as a hostile reaction to other penguins, which usually takes the form of a savage lunge, without other preliminaries. In fights between neighbouring birds the two may crouch low on the ground, beak pointing to beak, first making tentative pecks at each other; then they may seize each other by the beak, shaking vigorously. In one such fight, while the two males opposed each other in this attitude, the two females (one of which was brooding a chick) tentatively sparred diagonally across their partners' heads. In this case the offending pair had been displaced by an observer. More serious encounters involve the use of flippers as well as beaks, and in one such fight the victor seized its opponent by the neck, belabouring it with its flippers as it drove the vanquished head-first down the slope and out of the rookery. Such engagements probably concern trespassers in search of territory.

A peculiar occurrence, noted a few times, was the assault on incubating females, in the absence of their mates, by birds without nests or without mates. In one such instance a male which had held two different but uninviting territories without obtaining a mate till the other pairs had finished laying was later seen with an unringed bird some distance from either site. Both birds were viciously attacking an incubating female by jabbing at and tweaking the feathers on its back, while their victim crouched helplessly over its egg. Other instances concerned males without mates. All these assaults occurred shortly after the departure of the successful males.

Another characteristic posture is the submissive attitude adopted by a bird making its way through a crowded part of the rookery. The bird progresses in a hunched up attitude, head down, feathers flattened, flippers held parallel, pointing forwards and downwards, pausing at some safe refuge to raise its head with rapid jerks from side to side, as if taking bearings. Having reached a point close to home, the bird makes a quick rush through the protesting neighbours, still in the submissive attitude, then immediately on entering its own territory raises its head and throws itself into ecstatic display, facing its mate, which

does likewise. After a short pause, both birds lower their beaks to the ground, then repeat the ecstatic display, after which they settle down quietly. The neighbouring pairs through whose territory the homing bird passes, crane their necks towards it braying loudly, as does the bird's mate. This description is taken from notes on birds returning at the time of the moult, so it is purely a recognition display.

Plumage variations. In view of the modern tendency to regard the royal penguin (*E. c. schlegeli*) of Macquarie Island as a white-faced race of the macaroni⁽¹⁾ (Gwynn 1953, *b*), it is interesting to record the rare occurrence of white-faced birds among the otherwise uniformly black-faced macaronis at Heard Island. Unfortunately no specimens have been collected, and it is impossible to say whether these are actual royal penguins which have wandered from Macquarie Island, or white-faced mutants in the macaroni population. One such bird was twice seen in the Corinth Head rookery in November, 1953, looking very conspicuous, even from a distance, among its black-faced neighbours. A similar bird was seen a few weeks later on the beach at Red Island. A third bird was seen at the Olsen Screees in March 1953, among adults returning for their moult. This bird at first sight seemed a typical white-faced royal, but on closer inspection was found to be a uniform very pale grey on the throat and sides of the face up to the crest, as well as along a half inch strip on either side of the upper chest. Its eyes seemed lighter than normal. It was noted at the time that birds with grey cheeks were not uncommon, though this is not the usual impression among breeding birds. As already mentioned, juvenals have a greyish bloom on the throat, and at Red Island three or four were seen whose throats appeared much lighter than usual, but these were black above the eyes, except for a line of white feathers just below the crest. Another juvenal had a white forehead. Isabelline birds and partial albinos have also been recorded.

Adult weights. In view of its long fasts, and the necessity of feeding before its moult, a penguin's weight must vary greatly according to season and so far this has not been adequately investigated. However, the weights of 5 pairs, weighed at banding on November 4, may be of interest. The 5 males ranged from $10\frac{1}{4}$ to 11 lbs., averaging $10\frac{1}{2}$ lbs.; the 5 females ranged from 11 to $12\frac{1}{4}$ lbs., averaging $11\frac{1}{2}$ lbs. The fact that the females weighed more than the males is of course accounted for by the fact that the males had by this time been ashore fasting for about 10 days, whereas the females had only just returned from the sea. Later weighings showed a continued drop in weight, three other males banded on 10 November weighing $8\frac{1}{2}$, $9\frac{1}{4}$, and 10 lbs. respectively. Two females, killed after completing the unusual clutch of three eggs, each weighed $8\frac{3}{4}$ lbs. One of these had weighed $11\frac{1}{2}$ lbs., the other $11\frac{1}{4}$ lbs., when banded.

⁽¹⁾ The royal penguins of Macquarie include a proportion of more or less black-faced individuals.

Bill measurements. Downes (1955) has pointed out that the bill of the male tends to be longer than that of the female, and the studies done in 1953 have abundantly confirmed this. In nearly every case it is possible to tell the sex of members of a pair by inspection alone, and with practice most single birds can be diagnosed without difficulty. In only one of the banded pairs did confusion arise, till it became evident from their behaviour that the original assumption as to their respective sexes was wrong. In this case the bill length of the male was 56 mm. and depth 25 mm., the measurements of the female being 57.5 and 23.5 mm. This was the first pair to be banded, and it is probably that had they been done at a later stage the heavier bill of the male would have led to a correct diagnosis, in spite of its relative shortness.

TABLE 7.

BILL MEASUREMENTS OF 25 MALE AND 13 FEMALE MACARONIS.

	Males		Females	
	Length in mm.	Depth in mm.	Length in mm.	Depth in mm.
Average	59.7	27.5	53.6	23.6
Maximum	63.5	30.0	57.5	25.0
Minimum	55.0	25.0	50.0	22.0

The length is measured from the base of the horny culmen to the tip; the depth of the closed bill is taken at the point where the mandibles begin to diverge. All males were measured in life. In the females, six dead measurements of bill depth (average 24.25 mm.) gave a slightly higher value than eight live measurements (23.15 mm.), one bird being measured in both states (24 and 23 mm.), suggesting that live measurements of bill depth tend to be low. However, it is clear that bill depth is at least as important a criterion as bill length, and if both are considered together, few errors are likely to be made. The bill of the male tends to be larger in all dimensions. Some maximum and minimum bill sizes for each sex are given below:—

TABLE 8.

MAXIMUM AND MINIMUM BILL MEASUREMENTS IN MACARONIS.

Males	Females
63.5 x 28.5 (twice)	57.5 x 23.5
60.5 x 30.0	55.5 x 24.5 (post mortem)
55.0 x 25.5	53.0 x 25.0 (post mortem)
56.0 x 25.0	50.0 x 22.0



PLATE 25—Section of black-browed albatross colony at Jacka Valley.

BLACK-BROWED ALBATROSS

(Black-Browed Mollymawk)

Diomedea melanophris Temminck

Until 1954 the only known colonies on Heard Island were in and around the Jacka Valley. Here the main colony comprises over 80 pairs nesting at 500-600 feet above sea-level, on a terraced area at the top of the first tier of cliffs overlooking the moraine of the Jacka Glacier (plate 25). A subsidiary colony occurs on the sea cliffs a few hundred yards south of Jacka Valley. Twenty-two sitting birds were counted here in November, 1953. Others are believed to nest on the high cliffs to the north of Jacka Valley, but details are lacking. In 1948, a colony was suspected on the cliffs south of the Abbottsmith Glacier but this was not proved till a large colony was discovered here by the party which made the circuit of the island in 1954. On 22 December 110 albatrosses were counted here, nearly all incubating. (This colony is not shown on the map.)

In 1953-54 one was seen several times rounding the cliffs at Corinth Head, but the eastern side of this feature cannot be seen from land. In general, this species is rarely seen near land except in the immediate vicinity of its nesting grounds.

Nesting and display. The re-occupation of their nesting grounds in spring evidently takes place gradually. On 17 September, 1951, on a visit to the Jacka Valley rookery, Downes found that 6 nests of the previous year were freshly disturbed, and one bird was seen flying past the rookery. By 25 September, the majority of nests showed signs of disturbance, in some cases with piles of grass, roots, &c., freshly gathered around them. Two had large white patches of excreta nearby, but no birds were seen. On 6 October, 25 birds were at the rookery, some of them building nests while others slept on old nests or on the ground. The nest-building behaviour of one bird was studied and most of the building activity of others appeared to follow the same pattern. This bird, having placed a small heap of grass stems and roots nearby, sat on its nest facing away from the heap. To an accompaniment of head-nodding and croaking, it began to pick up the material from behind and put it firmly into the nest structure. At the same time, a neighbouring pair were preening each other, one bird on the nest and one standing beside it. On 16 October, 1949, 60 birds were present and many nest mounds were being built or cleared of snow, of which much had accumulated during the severe winter of that year. Mating was proceeding in several parts of the rookery accompanied by much head-nodding, soft quacking and rubbing together of beaks and heads. During copulation one bird stands on the other with its long wings hanging down, perhaps for balance (plate 26). One bird was observed, after coitus with one partner, to waddle straight off to another bird and commence display.

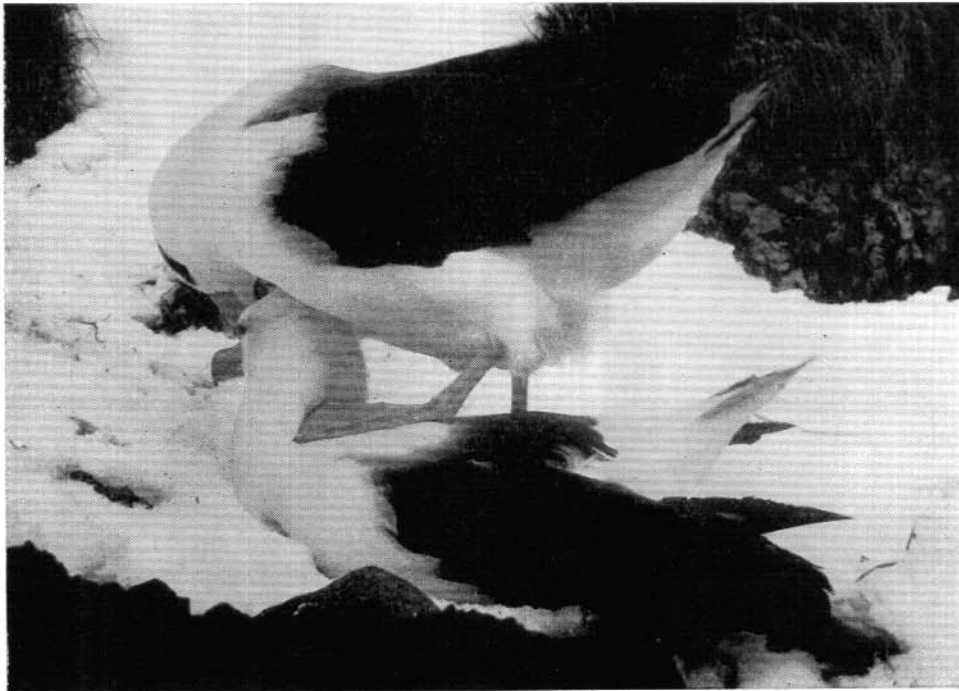


PLATE 26—Preliminaries to copulation in the black-browed albatross.

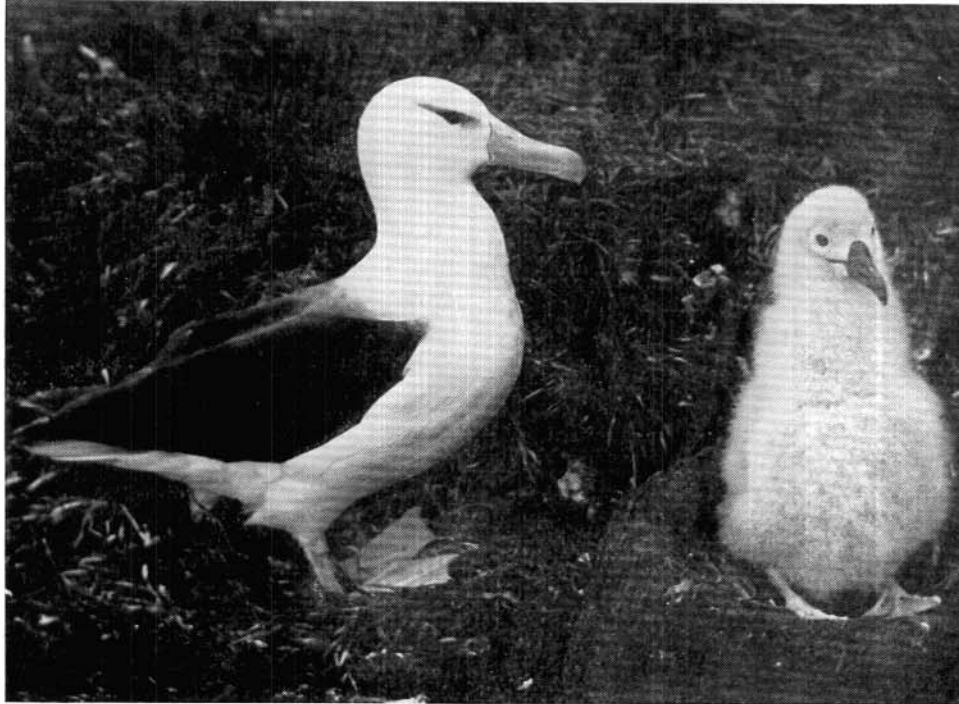


PLATE 27—Black-browed albatross and chick.

Egg-laying. In 1950 a visit on 21 October failed to reveal any eggs. However, on 20 October, 1951, one egg was found lying on the grass outside a nest away from other nesting birds. On this occasion about half the birds were in pairs, the majority being engaged in nest building, sleeping, or mutual preening accompanied by croaking and head-nodding. On 23 October, 1955, at least two eggs had been laid. On 12 November, 1949, approximately 70 nests were found, each containing a single egg, some with embryos up to $\frac{3}{4}$ inch in length. The eggs are a very light pinkish colour with reddish-brown markings around the broad end. These markings are variable and in some cases absent, but this may be due to wear.

It seems likely that a bird may lay again if the first egg is lost. A bird sitting on an egg on 1 January was found to have another half-buried in the floor of the nest. This egg was still fresh and unincubated so had probably been lost by the parent among the nesting material.

Hatching. On 1 January, 1952, 71 adults were present, of which 64 were caring for chicks or still incubating eggs. Of the 69 occupied nests, 5 were inaccessible, 14 contained unchipped eggs and 38 chipped eggs, while 12 contained chicks that were mostly not more than one or two days old. None of the birds with eggs or chicks had a mate with it, but some of the 18 birds sitting by empty nests were in pairs. Most of these flew off when approached and could not be banded, but birds with eggs or chicks sat very closely. In January, 1950, pairs at empty nests were found to

have well-developed brood patches. On 25 January, 1950, the chicks were still attended by one parent. The chicks were scratching and picking in their down and often the parent went over the chick with its beak. This process appeared to be enjoyed by the chick which would close its eyes and turn its head to expose the area the parent was combing. A chick of this age has very light down and brown eyes with a narrow black lid. Its beak is dark grey-brown with a dark brown ridge of skin edging the gape and extending 2 cms. past it, making the gape appear much larger. Feet and claws are a pale cream (plate 27). The chick from which this description was taken snapped its beak at its visitors and vomited up yellow oil and squid tentacle.

During this visit, several adults were seen coming in to feed their chicks. Upon the arrival of the parent, the young bird pecks vigorously at its beak until the parent lowers its head to regurgitate food. As it raises its head it opens its beak, whereupon the chick puts its beak inside at right angles to the parent's and catches in its mandibles the lumps of solid food and liquid that the parent brings up. Each time the parent lowers its head to bring up more food the chick resumes pecking (plate 28).



PLATE 28—Black-browed albatross chick being fed.

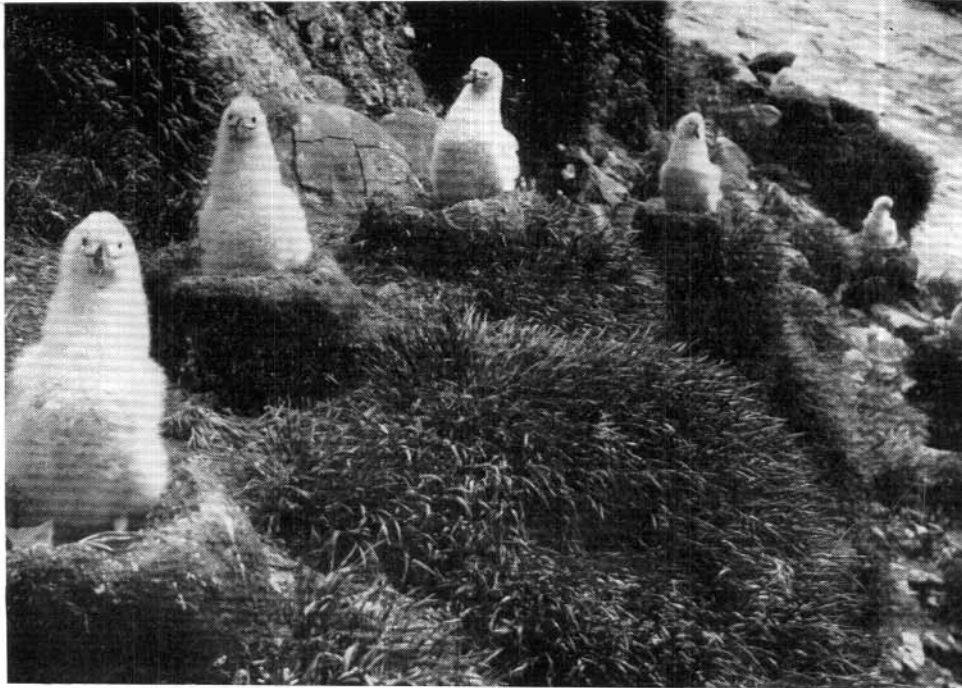


PLATE 29—Black-browed albatross chicks at Jacka Valley. Note how they draw themselves up to their full height when danger threatens.

There is a heavy mortality among the chicks, which seems to be mainly due to the clumsiness of their parents. Out of about 70 chicks hatched annually in the accessible part of the colony, only about 40 reach their final moult. The following table summarises the available information.

TABLE 9.

SURVIVAL OF BLACK-BROWED ALBATROSS CHICKS, JACKA VALLEY.

1948-49:	19 chicks ringed, 9 inaccessible on 25 March.
1949-50:	70 nests with egg on 12 November, chicks not counted.
1950-51:	57 adults, 48 with chicks on 21 January; 38 chicks banded on 22 February.
1951-52:	69 eggs and chicks at end of incubation. 46 chicks banded on 6 February.
1952-53:	40 chicks banded on 10 April, 4 inaccessible.
1953-54:	On 6 December, 87 sites occupied in the main colony, of which about 75 contained eggs; about 15 additional birds sitting on inaccessible ledges nearby, mostly visible only from below. 33 chicks banded on 5 February.
1954-55:	102 birds counted on 16 November, all but a few being on nests. This was a very unsuccessful season, as only 17 chicks were found on 23 February.

In each year there were a number of inaccessible nests and the ledges occupied varied slightly from year to year, so the number of chicks banded was always a little less than the total number present.

On 5 February, 1954, McNair noted chicks dead on and about the nests, and one on a nest moribund, apparently from starvation. The chicks moult in March (plate 30), and on 10 April, 1953, one was fully moulted, most had a tuft or so of down on the belly, and a couple of late chicks had a good mane of down along the back of the neck with a good mat of down on the belly. Some of the chicks were exercising their wings by flapping.

Food. Of two adults collected by Ealey and Chittleborough, the stomach of one contained 3 squid beaks and some green slime, the other green slime only. Cephalopod beaks were also found in the stomach of a moulting chick, and on another occasion a squid tentacle on the rim of a nest. When banding chicks in February, 1952, Downes noted that they vomited fish remains, cephalopod beaks, and squid tentacles.

Banding returns. The only banded bird yet recovered away from Heard Island was one banded as a chick in February, 1951, and recovered at Broughton Island, N.S.W., on 9 October, 1953 (Howard, 1954, *b*).

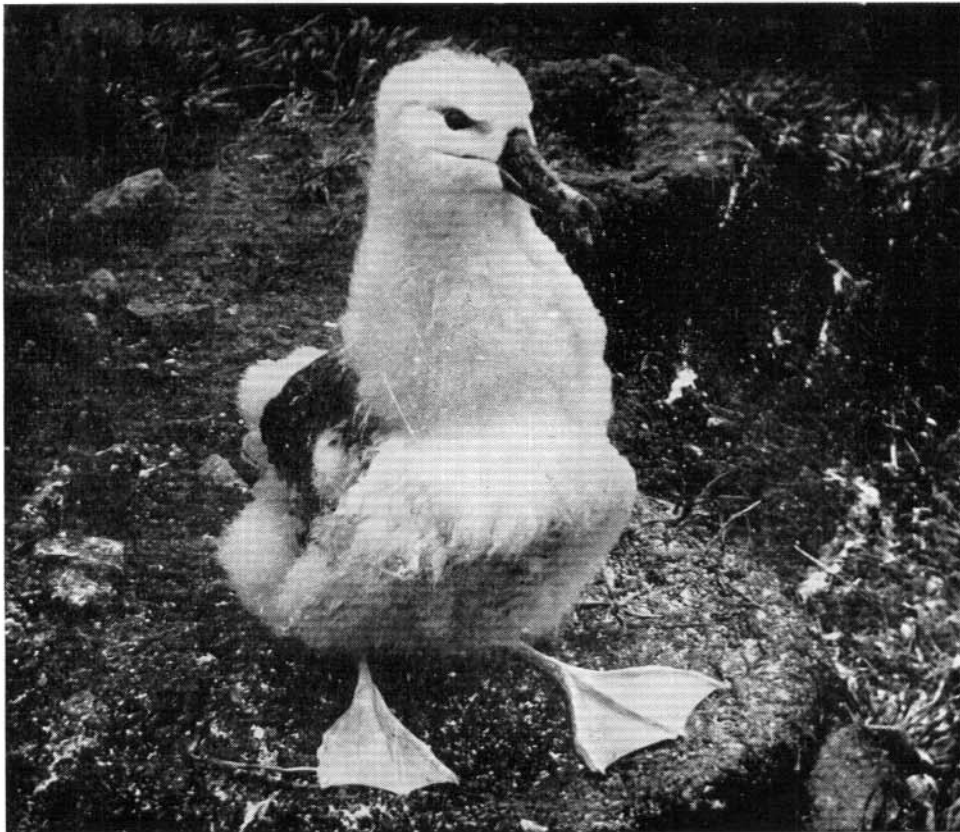


PLATE 30—Black-browed albatross chick fledgling.

LIGHT-MANTLED SOOTY ALBATROSS

Phoebetria palpebrata (Forster)

The light-mantled "sooty" breeds on the island wherever suitable cliffs are found, not only along the coast but occasionally inland, e.g. at Northwest Cornice. The important requirements for a nesting site appear to be a cliff, a ledge suitable for landing and taking off, and (usually) a rock wall rising behind the nest. Many pairs of birds nest singly, but very frequently two, or even three, pairs share the same ledge.

On the west of the Laurens Peninsula a number of nests are found in a somewhat unusual type of situation on the sloping sides of *Azorella*-covered hillocks. One such group contained five occupied nests in close proximity. On the cliffs, while some pairs nest high on towering crags, some were found on Cape Gazert in recesses a few feet above the high tide mark. The great majority nest between these extremes, very often on cliffs occupied by Cape pigeons.

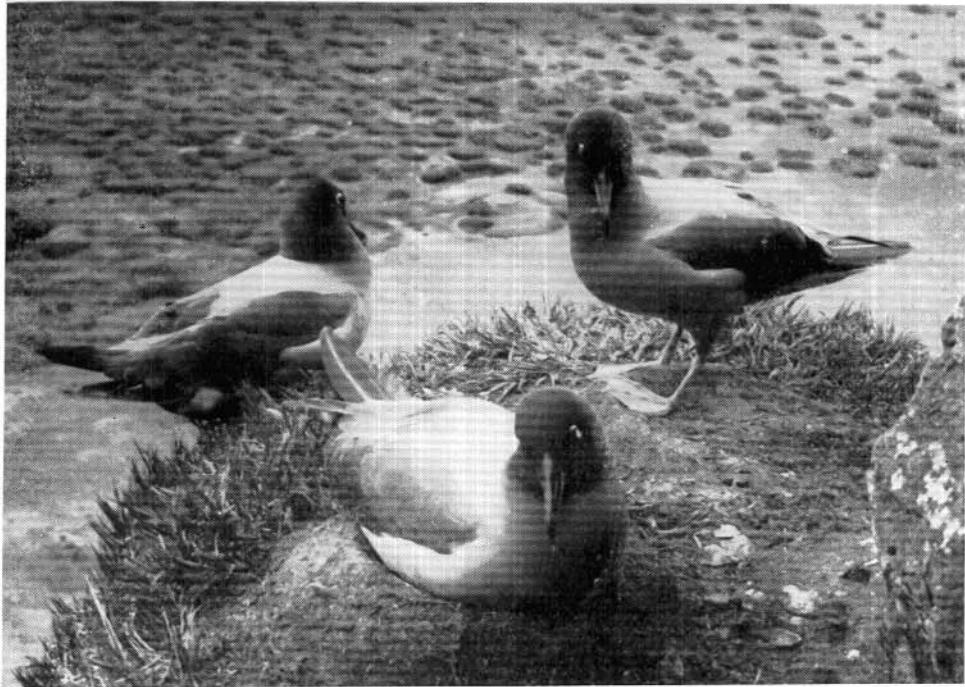


PLATE 31—Group of light-mantled sooty albatross, 7 November, 1953. The bird in the foreground is incubating. The bird on the right may be its mate, but may equally be guarding the old nest-site, (not used in 1953) on which it stands. It was displaying vigorously to the third bird, which presently took off again.



PLATE 32—Light-mantled sooty albatross incubating.

The breeding population on the whole of the Laurens Peninsula is probably not more than 100 pairs. This is believed to be the most closely populated part of the island, and the total population nesting each year at Heard Island is thus probably between 200 and 500 pairs. The lower figure seems likely to be nearer the mark.

Breeding habits. In some areas the same ledges are occupied year after year, but this is not always the case. On the cliffs of Mt. Andrée, three pairs nested in 1950-51, four in 1951-52, four in 1952-53 and seven in 1953-54. In the last season all three nests from which chicks had been fledged the previous year were occupied again, and one of these birds was one which had abandoned the fourth site when banded the year before.

On the *Azorella*-covered hillside of the Laurens Peninsula, where five nests were found in 1950-51, there were six in 1952-53, though only two of these were in the area previously occupied. Only two pairs nested here in 1953-54, though others were nesting not far away. In the absence of banding records, it is impossible to say to what extent the same birds nest in consecutive years (see Sorensen, 1950).

The nest is built of packed soil mixed with roots and other vegetation. The diameter of the cup is about 12 inches, the mound is about 18 inches wide at the base and the whole structure is usually 6 to 8 inches high.

The arrival and courtship of these birds has been described by Sorensen (1950), whose account agrees well with our observations. In 1950 and in 1951 "sooties" were first noted on 4 October. On 1 October, 1953, four birds were seen. Many ledges are temporarily occupied by non-breeding birds, often till well after most of the breeding birds have laid, and this can lead casual observers to make many erroneous reports of "nests". "Sooties" call at *any* passing bird. The call is most often heard (a) from single birds standing at unprepared sites or on casual perches, or (b) from one of a pair resting together. In either case the cry is elicited by the sight of any passing bird, and appears to be a declaration of ownership rather than invitation. Incubating birds, or birds sitting alone on prepared sites, usually remain silent.

On one occasion two birds were sitting on a ledge, one incubating, the other a short distance away. The latter was calling to three birds flying up and down. One of these landed opposite the calling bird, and for several minutes they snapped bills at one another, each snap accompanied by an upward jerk of the head. The incumbent bird paused frequently to preen itself on the flank and shoulder, fanning its tail peacock fashion. No such display was made by the visiting bird. The incubating bird also made



PLATE 33—Light-mantled sooty albatross with chick a few days old.



PLATE 34—Light-mantled sooty albatross chick three to four weeks old.
Note the well-developed "mask".

desultory snaps at the intruder, whose mantle appeared distinctly browner than the blue-grey of the other two. The intruder presently took off again, and it is not clear whether the original two were a mated pair, the behaviour of the bird approached strongly recalling courtship display (see plate 31). In another case Downes saw one of a nesting pair vigorously repelling an intruder, grabbing it by the feathers as it hustled it off the ledge.

Copulation may sometimes take place away from the nest site. The following description is taken from notes made on 15 October, 1949, when two birds were observed on a narrow mossy ledge 50 feet above the sea where there was no sign of a nest, nor, indeed, was there room for one. "After much chattering, squawking and rubbing heads and beaks together, one stood on top of the other, still rubbing beaks. Apposition of cloacae took only a moment, during which the wings of the uppermost bird drooped low over the mossy ledge. This occurred twice in twenty minutes, after which both birds flew away."

The earliest egg date was 24 October, 1953, both birds being present at the nest; but this was a little earlier than usual, laying commonly taking place about the end of October or early November. A nest was found with the chick almost hatched on 31 December, 1949. In 1950-51 the first chick

was reported on 3 January, and other nest observations indicate that hatching about the first week of January is the rule, though some may be rather later. Sorensen (1950) has shown the incubation period is 63-67 days. Nest-building activity has been reported quite late in November, but where these sites have been subsequently checked they have been found abandoned.

In 1952 Faulkner kept the Mt. Andrée nests under almost daily observation for a period of one month during incubation, one bird of each pair having a colour band. It was evident that long spells are the rule, one bird remaining on the nest for 19 days from the date of ringing, another for nine days, while the third returned after an absence of at least nine days.

On 30 January, 1950, several chicks unattended by their parents were watched on the cliffs at West Bay. One was seen eating pebbles and blades of grass. Adults were patrolling the cliffs in twos and threes and one was seen to land at a nest, not to feed the chick but merely to rub beaks with it and caress the chick's body with its beak before flying off again.

Chicks at this stage, when defaecating, lean forward and squirt clear over the rim of the nest. Older chicks always face the cliffs for this purpose and the appearance of a sudden white jet at times gives away the site of a nest, even from a considerable distance.

One chick taken on 30 January already had the stubs of its tail feathers appearing. By the middle of April the final moult is almost complete, except for a mat of down on the belly, but this may not be shed till early May.

On 29 April, 1953, parent birds came in to feed two of the three Mt. Andrée chicks within a few minutes of one another, but this was the last date on which any adults were seen that season. Two of these chicks left their nest on 13 May, the third on 17-18 May. A fourth fully moulted chick was taken on 11 May. The stomach of this last was empty and its cloaca clean, though it was heavily larded with subcutaneous and abdominal fat. This, together with the minimal signs of recent defaecation around the nests, suggests that the parents of these chicks had abandoned them some days before they left their nests. Wing flapping was first noticed a month before fledging, and for a fortnight before, much time is spent by the birds standing facing the cliffs and flapping their wings. Indeed, the amount of time spent standing by these chicks at this period is remarkable for a bird which normally has little use for its legs except for landing and taking off on the water. At this stage they are often found off their nest mound, if the size of their ledge permits, but always close against the face of the cliff. One chick in particular spent its last few days before leaving in the space between its nest and the cliff wall.

Food. At two of these nests casts of squid beaks were found. One of these beaks was 35 mm. long. Another chick collected when about a month old vomited some squid beaks and remains of long legged crustacea. Of two adults collected by Ealey and Chittleborough, the stomach of one contained 44 squid beaks as well as fish bones, the other fish remains only.

GIANT PETREL

(Nelly)

Macronectes giganteus (Gmelin)

Habitat, numbers and distribution. At all times of the year up to one dozen giant petrels may be seen flying along the coast of the island or out to sea. Often a carcass will attract greater numbers but it is only during the summer that two or three hundred may be seen. Analysis of feeding flocks on the beaches throughout the year shows a change of composition but such small samples of the total island population may be very liable to error.

TABLE 10.

RELATIVE NUMBERS OF BROWN-HEADED AND GREY-HEADED GIANT PETRELS—APRIL-DECEMBER 1951.

Date	Composition of Flock	Total Number
25 April	Majority grey-headed, few brown-headed	100
30 June	Majority brown-headed, 1 in 3 grey-headed	25
23 July	21 out of 23 brown-headed	23
5 August	Nearly all brown-headed	13
23 September	9 out of 11 brown-headed	11
6 October	27 out of 40 brown-headed	40
27 October	7 out of 200 brown-headed	200
23 November	25 out of 35 brown-headed	35
14 December	20 out of 25 brown-headed	25
19 December	16 out of 40 brown-headed	40

Brown-headed indicates immature phase of Murphy (1936).
Grey-headed indicates fully adult birds. White phase birds were not considered.

The only conclusion to be drawn from this is that a number of brown-headed immature birds are passing through the island all the year and that there is an influx of grey-headed birds in spring which depart again before the winter.

In winter the few birds present are flying over the ocean or feeding along the beaches. In spring the arrival of elephant seals and their subsequent pupping attract flocks of giant petrels and vast numbers collect at Spit Bay, where the great majority of seals are concentrated. On 1 December, 1951, Brown estimated that there were 4500-5000 giant petrels here, and on 18 December, 1954, Budd noted "many thousands" still cleaning up after the dispersal of the breeding herds. However, the fact that the chicks are largely fed on small birds and cephalopods indicates that at that season much of their foraging is done over the open sea.

At Heard Island giant petrels nest on grass or *Azorella*-covered slopes and ridges, mostly concentrated in loose colonies of 300-400 pairs, though scattered groups and single pairs nest over a wide area of the Laurens Peninsula. The main colonies on the Laurens Peninsula are all near the tops of low sea cliffs, but the important requirements seem to be a covering of soil, on a commanding position in view of the open sea, with a clear take

off, a good runway being necessary for these rather awkward birds. The usual presence of grass about their nests may be as much a result of the presence of the birds as an ecological requirement. Exposure to the prevailing south-westerly wind might also be claimed as important. It would explain their absence from the headlands along the north-east coast of the island and from the moraine hillocks overlooking Spit Bay.

The largest nesting area is found above Long Beach where 3000 adult birds were counted by Dingle on 3 November 1951. It was estimated that at least 2000 chicks were produced in this area.

TABLE 11.
GIANT PETREL POPULATION, 1951-52.

Date	Number of Chicks	Locality
November 1951	2000 estimated	Long Beach
April 1951	375 counted	Cape Gazert
January 1952	400 counted	West Cape
January 1952	416 counted	West Coast Laurens Peninsula
January 1952	347 counted	Red Island and Sydney Cove

Although giant petrels may nest at Cape Arcona all other colonies are accounted for and thus at least 3500 juvenals leave Heard each year while the total number of nesting birds is at least 8000.

At the end of December, 1954, Sweetensen counted 900 nests in the West Cape and West Coast areas combined, and 494 at Red Island and Sydney Cove. Chick mortality and addled eggs could account for the difference between these figures and those obtained in 1951.

Breeding habits. The nesting grounds are deserted during the winter and the earliest spring visit by ANARE personnel was made to Cape Gazert on 23 September, 1950. Many nelliies were flying over the area and 250 were sitting about the Cape. Several definite nests were seen, consisting of depressions amongst the grass, while it was reported that one pair showed courting behaviour. The shallow nests scratched in the grass or *Azorella* roots may be built up by the sitting parent but many are left as mere depressions in the soft brown roots. In nesting groups they are generally 10-20 feet apart.

Very little is known about the courtship of the giant petrel because of its timid nature. The adults take flight when observers are close, except when sitting on heavily incubated eggs or very young chicks. On 21 October, 1951, at Cape Gazert, when laying was at its height, a pair of birds without an egg was observed from a distance. A large white-headed bird



PLATE 35—Grey-headed male giant petrel on nest with brown-headed female standing alongside.

was on top of a smaller brown bird, rapidly vibrating its beak and head sideways to tap the under bird's bill. All the time it kept uttering a chattering call and catching the brown bird by the neck. This performance lasted at least 15 minutes.

On 25 November, 1951, at West Cape a white-headed male was incubating an egg when a small brown female started up from beside him and ran nervously around on either side ready at any instant to take flight (see plate 35). The male stretched out his head towards her, arched his neck slightly, chattered with his bill, and gave his neighing call. He waved his head from side to side and moved his beak toward her each time she moved. But she quietened after a while and sank down beside him. Similar behaviour was noted by brooding birds towards intruding birds fleeing through a compact part of a colony at the approach of an observer. While an intruder was more than three or four feet away the sitting birds waved their heads, but if he moved closer the sitters stretched out their heads and snapped their bills viciously. These reactions were much more marked on the part of the males.

Laying begins in the third week of October, with only slight variation due to season, and the bulk of the eggs are laid within a very short period, as indicated by the observations on hatching quoted later.

TABLE 12.
LAYING DATES OF GIANT PETRELS, 1949-53.

Year	Eggs first recorded	Number of eggs	Locality
1949	18 October	20	Cape Gazert
1950	17 October	14	Cape Gazert
1951	21 October	About 100	Cape Gazert
1952	23 October	250-300	West Cape
1953	19 October	6 dozen	West Cape

After the first 14 eggs laid at Cape Gazert in 1950 were removed; the rookery was visited two days later and about 20 more eggs had been laid.

Each of these colonies comprises about 400 breeding pairs. During September and October, 1949 and 1950, much snow lay about the nesting areas, though it began to disperse shortly after incubation commenced;

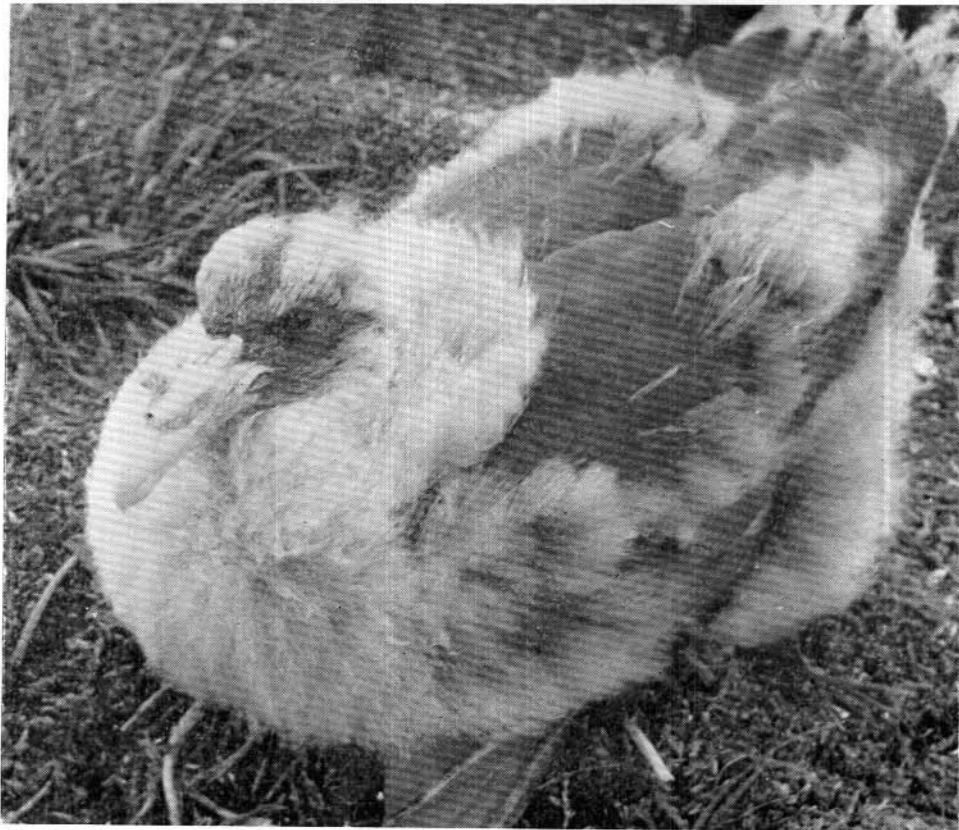


PLATE 36—Giant petrel chick beginning to lose its down.

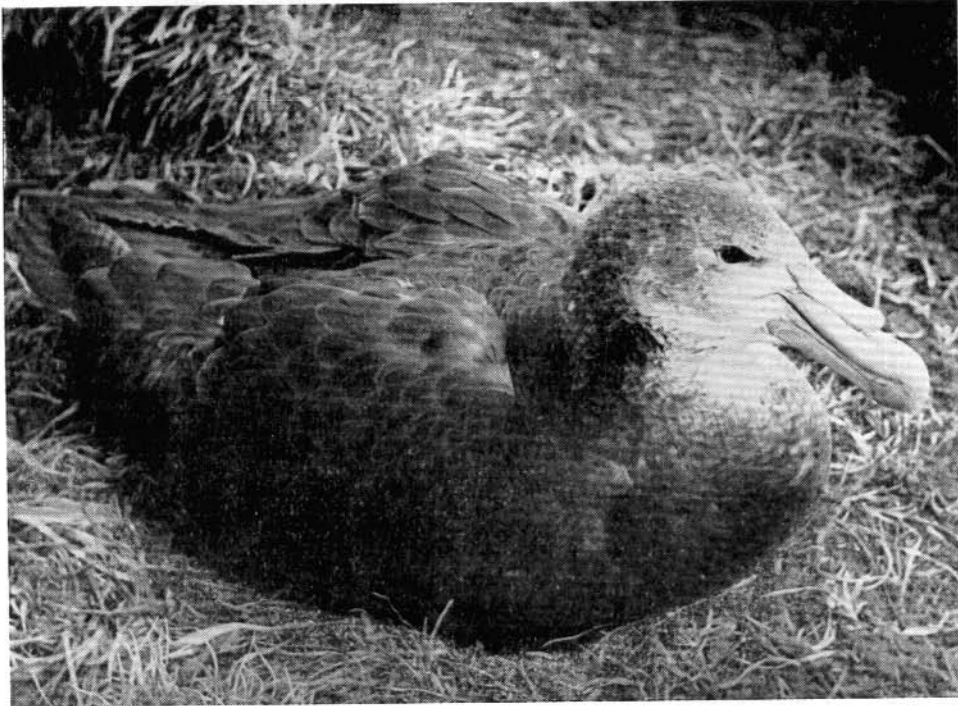


PLATE 37—Brown-headed giant petrel with brown eye.

but by the end of September, 1951, there were large areas free from snow, and there are indications that laying was earlier in that year, though only by a few days. Both 1952 and 1953 were also years of little snow-cover in coastal areas.

All through incubation the brooding bird gathers grass roots by its beak from where it sits and by the time of hatching its nesting mound is a good deal larger. Much variation in size of nest was noted between birds at the same stage. On 30 December, 1951, at West Cape approximately half the eggs were in various stages of hatching, while between 20-30 nests out of 400 had the chick clear of the shell. Thus the incubation period is approximately 70 days. Approximately 1 in 20 birds deserted their nests after being handled for banding, but it was only in a few rare cases that the parent left before being handled. Each young chick which was uncovered by the parent gave a great yawn.

On 9 January, 1952, about half the chicks were sufficiently large for the parents to desert them when approached and by 14 January, 1952, only a quarter of the chicks were guarded by adults. From a very early stage the chicks vomit oil which is at times intermixed with food. This vomiting is caused by alarm at the sight of intruders. Adult vomit is mainly food, but all proportions of food and oil are encountered.

By the middle of March, black juvenal feathering was beginning to show through grey mesoptyles and by 4 April, 1951, very few had any tufts of grey down left (see plate 36). On this date the nestlings rose off the ground a few inches as they flapped their wings in the strong wind but none could fly. On 25 April, 1949, a large proportion of juvenals still remained on nests at Cape Gazert. On 26 April, 1951, the rookeries at Red Island were completely deserted except for one juvenal which had been noted seven weeks previously, having fallen off the cliffs onto the sand 12 feet below. Here it had evidently been fed by its parents though its departure from the nest was retarded.

On 20 April, 1953, about 200 chicks remained in the West Cape colony, indicating that nearly half had already flown. Notes were made of the plumage stages of the first 100 chicks banded with the following result:

Fully moulted	28
Trace of down only	27
Few wisps of down	15
Small patches of down	8
Down on neck and belly or belly only	20
Extensive down	2

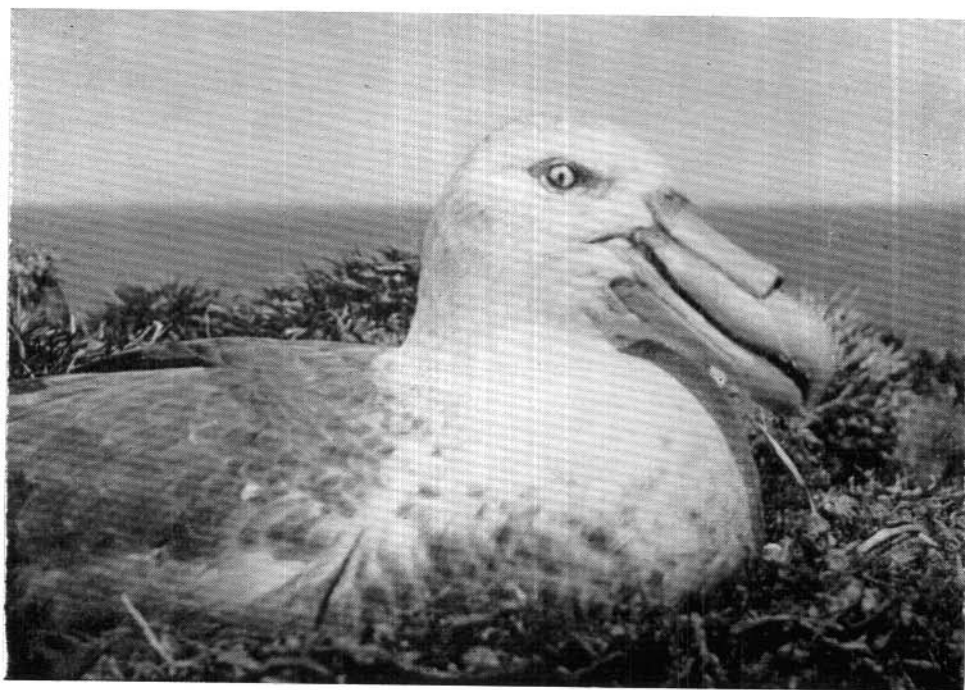


PLATE 38—Grey-headed giant petrel with white eye.

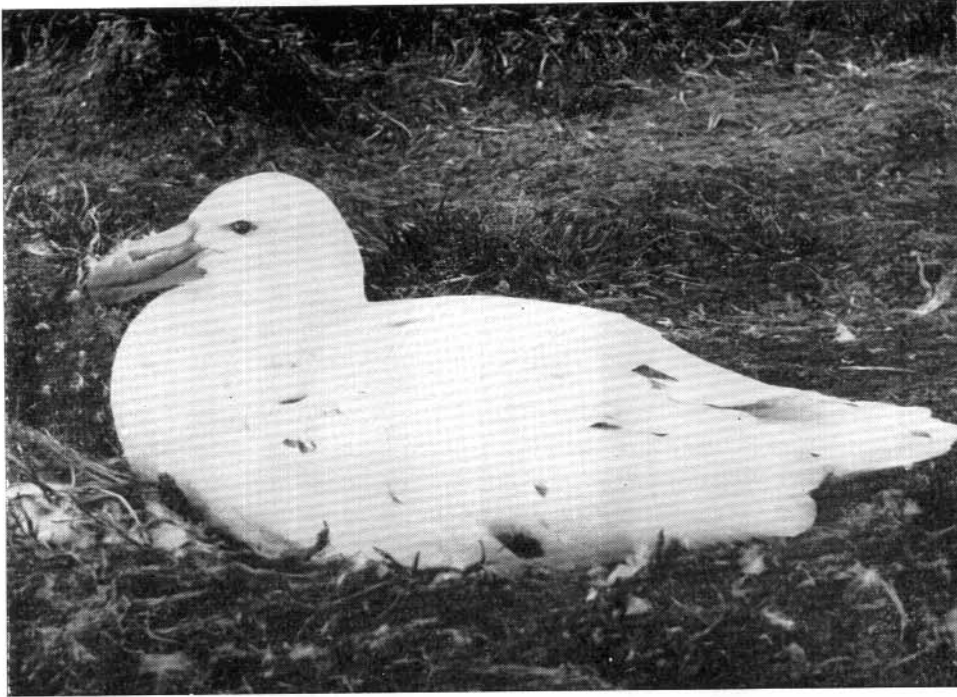


PLATE 39—White phase giant petrel.

The last large patches of down to be shed are on the neck and belly. The neck down usually goes before that on the belly, leaving a mat of down on the belly when other areas are, more or less, completely feathered, but in a few cases a collar of down persists when the belly has been almost completely denuded.

At the end of December, 1954, Sweetensen examined all nesting birds on the Laurens Peninsula in search of bands. The birds in the West Cape and West Coast areas were checked twice, on consecutive days, so that both members of a pair might be examined. Fifty-one birds previously banded as adults were found and, as there was no note of any band being seen on two consecutive days, it appeared that at this stage the parents changed guard daily. In all about 2,000 birds were examined. Though 300 chicks were banded at the West Cape in March, 1951, and over 500 in the whole area in the following season, not one of these was recovered, suggesting that the giant petrel does not breed till it is at least five years old.

Immediately after leaving the nest juvenal giant petrels are not infrequently seen resting on the beaches where they are easily caught, but they soon leave the vicinity of the island to set off on their circumpolar flights (see Downes, Gwynn and Howard, 1954; Howard, 1956).

Plumage changes. The plumage changes in the giant petrel are the subject of a separate study in preparation, but it may be stated briefly that, apart from white phase birds, fledglings leaving the nest have a uniform shiny black plumage and brown eyes. Three cases have been noted of moulting chicks with small patches of white-tipped feathers on the forehead or round the eyes, but this is very exceptional.

Breeding birds vary from ones in brown plumage with a little white around the face (plate 37) to ones with the entire head and neck greyish white (plate 38), and eye colour varies from plain chocolate brown to almost plain white, but the extent to which these variations may be due to age is by no means clear.

There appears to be a distinct post-juvenal plumage of a uniform, slightly mottled blackish-brown colour, with little or no pale colour around the face. Such birds are seen on the beaches, or as non-breeding visitors to the breeding colonies, but in the latter circumstances they always take flight at the first sign of an intruder and do not permit close observation.



PLATE 40—Giant petrel in threat display at seal carcass. Note tail spread, wings half raised, feathers erected on back of neck.

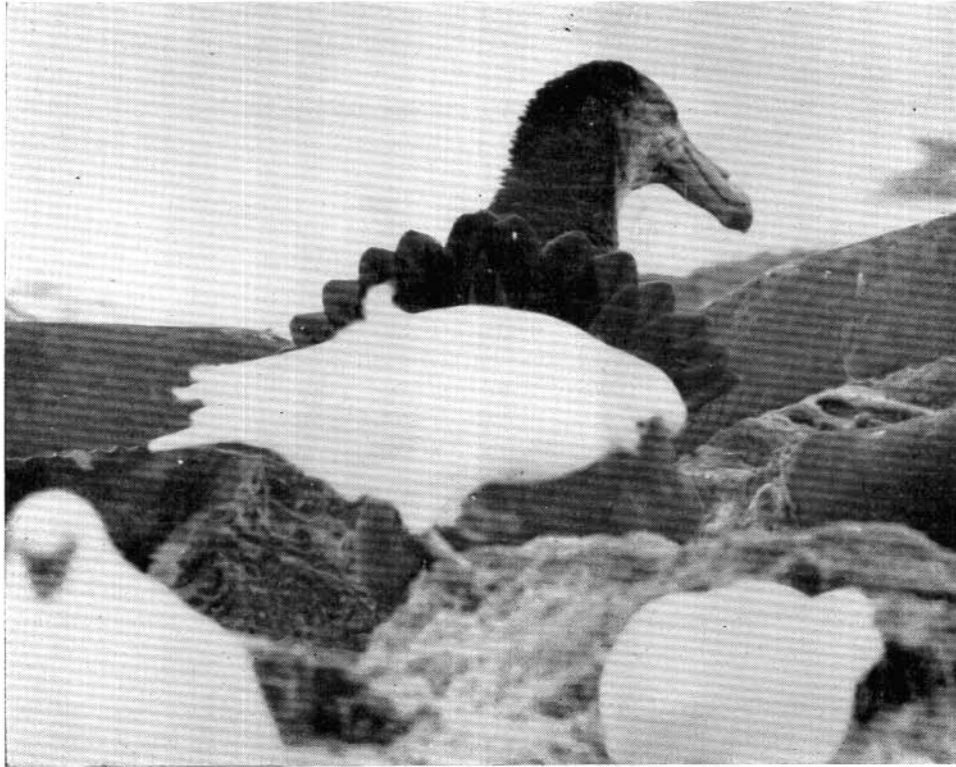


PLATE 41—Close-up of giant petrel in threat display, showing tail fanned and erect feathers on back of neck. Sheathbill in foreground.

The occurrence of white phase birds is now widely known, and these vary from almost pure white to white birds heavily spotted with scattered black feathers (plate 39). At Heard Island these make up only about one-half per cent of the total population. They can be recognised from the first appearance of the mesoptyle down, which is pure white in contrast to the grey down of the dark phase chicks.

Feeding habits. The behaviour of nellies feeding on seal carcasses and other carrion along the beaches has often been described but it has seldom been noted that much of this behaviour is calculated to threaten and drive away other birds from the food. The giant petrel swims or walks away from the carcass, its wings held out and its tail raised (plates 40 and 41). It then turns and, waving its head from side to side, rushes back to drive away the skuas and lesser nellies. It may stop three feet from its opponent rivals, neighing and waving its head from side to side, with neck flattened and neck-feathers raised. It then charges and bites viciously if the other bird does not take to flight. The younger birds in most cases give way to the heavier older ones but often two equally matched opponents of the same colour (generally white-headed birds) stand chest to chest, each reaching

up with its beak in an attempt to bite the other's head. All the time the feathers on the neck are raised and the neck flattened, the tail is fanned peacock-fashion and the wings are half stretched. The same behaviour was noted in birds feeding on a floating carcass in the water. Racovitza (quoted by Murphy, 1936, p. 590) erroneously describes this behaviour as courtship.

When a leopard seal catches a penguin in the water the commotion usually attracts 10-20 giant petrels in a few minutes. At first, a passing bird sees the splash and alights on the water. This attracts the attention of others, which at times have been seen to come from more than a mile away. They swim right up to the feeding seal, poking their heads beneath the water to secure the smaller pieces and almost taking hold of the penguin in the jaws of the leopard. They swim about very casually looking down at the leopard through the water. A leopard seal has been seen to rise suddenly toward a giant petrel floating above it, but the bird easily swam out of reach, half rising from the water with powerful strokes of its feet. The ease with which it avoided the seal and the fearlessness with which it dived at the spot where the seal was eating, suggest that the danger to the bird is not great. Matthews (1929, *a*) gives an account of a leopard seal catching a giant petrel, but this is evidently a very exceptional event.

Downes noted that the commonest item in food vomited by giant petrels while being banded was small bird intestines (probably from prions and diving petrels). Next in abundance was cephalopod meat and beaks, while beside nests where young were being fed he often found prion heads and feet; penguin chicks, heads, legs and tongues of adult penguins; eye lenses up to three-quarters of an inch in diameter; seal skin; and once ten-inch slices of fish. The quantities of these materials confirm that most of the nelly's feeding is done at sea, since none of the smaller petrels have been seen to be caught by a giant petrel on land.

Murphy quotes instances of giant petrels catching small birds (prions and terns) at sea. Once when a diving petrel was shot over the sea, a giant petrel alighted in the water and swam after the fugitive, which tried to escape by repeated dives, but was finally captured.

Natural enemies. The only enemies known to be of any importance are the ever-watchful skuas, many of which nest in the neighbourhood of the giant petrel colonies. Giant petrels abandon their nests if disturbed by humans at the beginning of incubation, and this may lead to a considerable theft of eggs by skuas. However, if not disturbed it seems probable that such egg loss is not high, and that a large majority of breeding pairs—perhaps about 80 per cent—succeed in rearing a chick. The young chicks may be left alone at an early stage, and seem to be capable of looking after themselves when about ten days old, or even earlier. Losses after this stage are probably negligible.

CAPE PIGEON

(Pintado petrel)

Daption capensis (Linné)

Habitat, distribution and numbers. In the summer Cape pigeons' nests can be seen on all precipitous coastal cliffs, and in a few cases on cliffs as far inland as North-west Cornice and on the seaward side of Scarlet Hill. The positions of the nests do not depend on the height but on the nature of the region. Where there are large scree slopes nests can be found from the bottom to the top of the main vertical cliff, which is sometimes from 700 to 800 feet high. In regions where cliffs rise straight from the sea, birds can be found nesting close to the bottom. No Cape pigeons nest in the Spit Bay region as there are no suitable cliffs there, but huge flocks can sometimes be seen feeding in the vicinity. Large numbers nest on the cliffs in the south-west portion of the coastline below the South Barrier but the rugged cliffs of the Laurens Peninsula support the largest breeding population on the island.



PLATE 42—Pair of Cape pigeons outside their nest crevice.

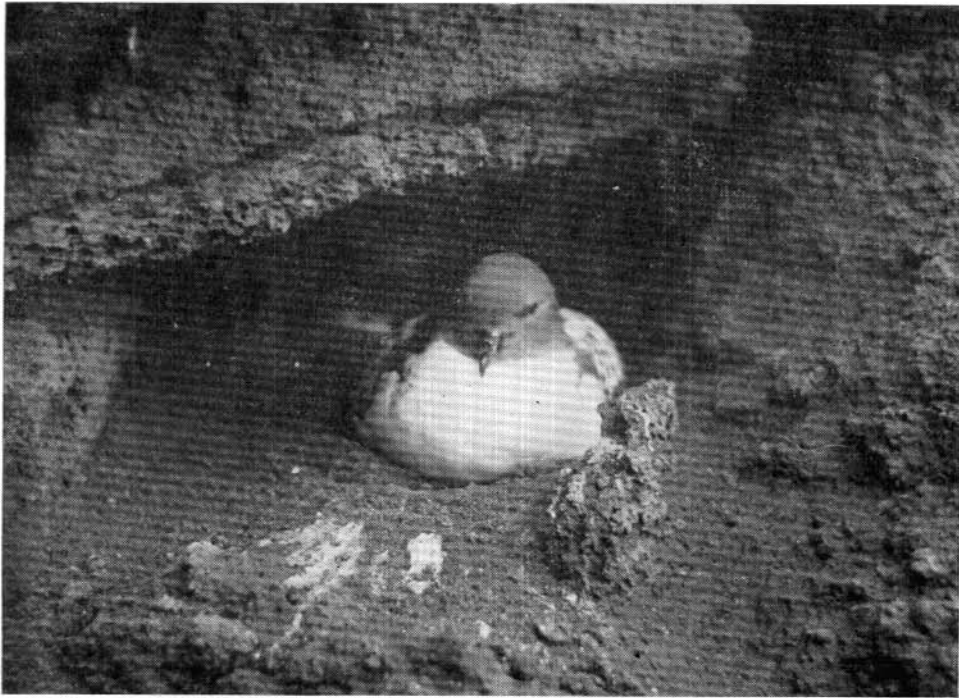


PLATE 43—Cape pigeon at nest.

Cape pigeons are present at Heard Island throughout the greater part of the year in considerable numbers and it is only during the months from May to July that their numbers diminish appreciably. Until late April they can be seen at their nests on any of the coastal cliffs, but during late April and May these nests are gradually deserted, at least during the day. During the next three months birds are seen less frequently, though if food is abundant large numbers may gather off-shore at any time of year. For example, on 17 July, 1953, there was an invasion of some hundreds of Cape pigeons into Atlas Cove coinciding with the appearance of quantities of plankton on the beach. Similar instances could be quoted for any month of the year, indicating their presence in numbers in the waters around Heard Island throughout the winter. They have also been heard calling from the cliffs at night in June, showing that some at least may return to their nesting areas to roost at night during the winter, but more information is required before it is possible to generalise about their winter habits.

Nesting. Towards the end of August there are signs of increasing diurnal activity at the nesting cliffs and during the following weeks this becomes more and more evident. At this time flocks may be seen resting on snowdrifts along the beaches. In the afternoon of 30 August, 1953, two pairs were seen already in occupation of their ledges, and parties of twenty or more were flying across the plain between Atlas Cove and

South-West Bay, apparently to roosting places on the cliffs there. On 17 September, 1951, Cape pigeons were seen coming in to the Laurens Peninsula cliffs about an hour before dark. Many thousands were roosting on the cliffs, whereas during the day only a few could be seen. In 1949 the severe winter caused many of the ledges to be still choked with snow at this time, and the birds were actively cleaning it away. Where drifts had banked up at the base of the cliffs occasional birds could be seen scratching in the snow even where it was too deep to dig through to the cliff-face.

The nest, which is at times wet or even muddy, is merely a small depression ringed by a few small stones and often protected by an overhanging ledge (plate 43). By the middle of November most of the nesting sites are occupied.

Egg-laying. Only one egg is laid. It is at first pure white in colour but very soon becomes dirty. In 1949 the first eggs were found on 26 November, one at West Bay and the other at Mount Aubert de la Rue; on 25 November, 1950, three eggs were found in nests on a ledge at Balanced Rock; and on 29 November, 1953, freshly laid eggs were plentiful at Corinth Head. On 31 December, 1949, two eggs were found under a brooding bird. One egg was slightly incubated but the embryo appeared

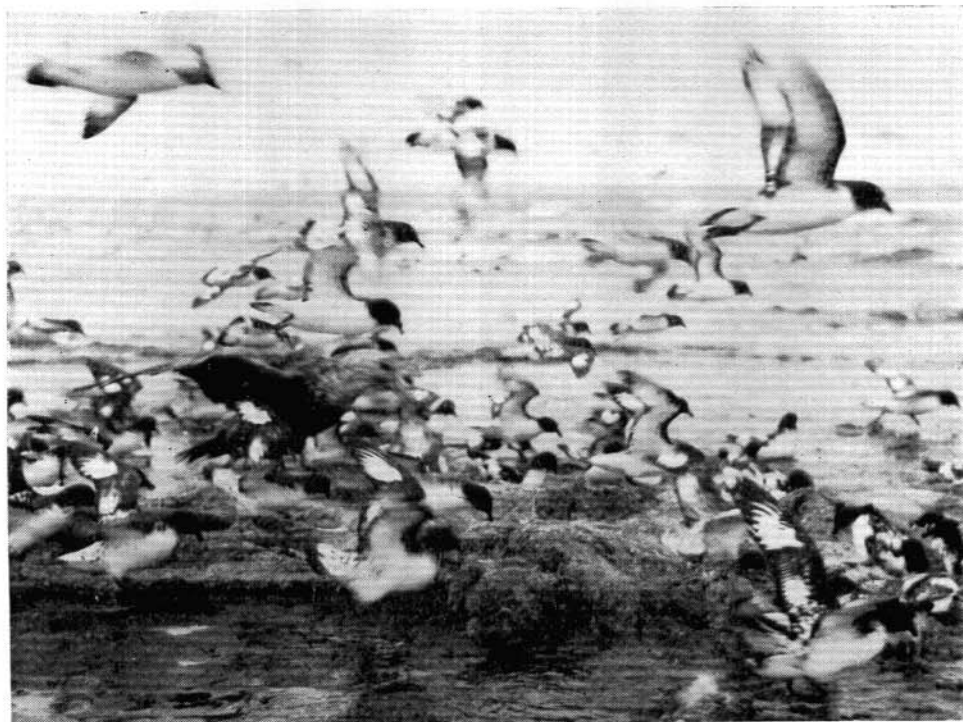


PLATE 44—Cape pigeons flocking to stranded seal. Giant petrel in middle of picture.

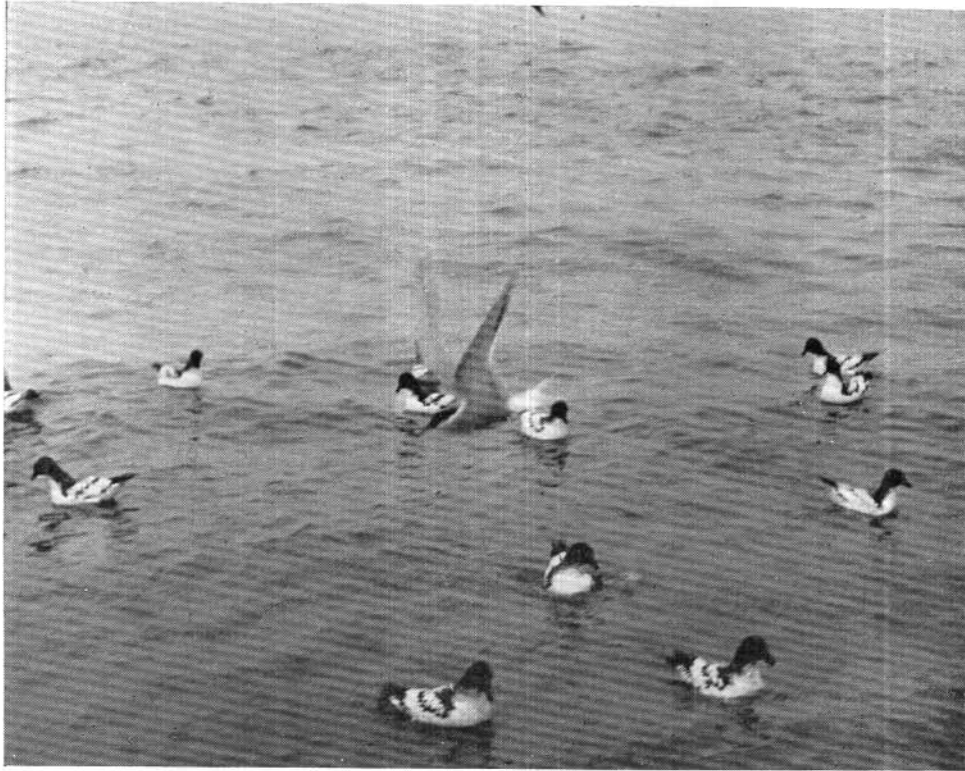


PLATE 44A—Cape pigeons on the water; antarctic tern in flight.

to be dead and slightly decomposed, although the egg was recorded as being "not particularly smelly". The other egg was fresh and there was no sign of incubation. Laying continues into early December and ultimately birds could be seen scattered over every cliff and ledge in the coastal area.

Chicks. In 1950 the first chick was found on 9 January on a small ledge at West Bay. Other Cape pigeons in the vicinity were still incubating and as the next chick was not seen until 15 January this was probably unusually early. Hatching was general from 15 January so that the incubation period must be about 45 days.

The newly hatched chicks have very dark down and are almost helpless. A chick collected on 21 January, 1950, was covered with grey-brown down with an area of almost bare skin round the eyes and extending under the chin. The feet were already patterned as in the adult but the dark parts were a greyish-brown. The eye was brown and the beak black.

The chicks grow very quickly and after a week are capable of ejecting oil as far as their parents. In 1955 Budd noted that the Cape pigeons were guarding "fair-sized chicks" on 21 January; on 26 January the

chicks were being left unattended; on 17 February one was moulting, the chequered wing feathers showing through the down; and on 1 March three chicks seen had completed their moult, but were still on their nests. By the middle of March most of the young were fully fledged and almost indistinguishable from the parent birds.

Feeding habits. During the summer months flocks are very frequently seen feeding off-shore, one of their most favoured places being in Corinthian Bay, where they feed close inshore, at the very edge of the surf (see p. 13), apparently on plankton stirred up by the breaking waves. Another much-favoured resort is off the mouth of the stream which enters Atlas Cove below the Station. In Atlas Roads they have been observed feeding on the siphonophore *Pyrostephas vanhoeffeni*, often diving to a depth of two or three feet. Ealey and Chittleborough also noted large numbers feeding on *Thysoanessa vicina* when spent swarms of this Euphausiid were washed into Atlas Cove. At other times their scavenging habits are prominent. When a seal was killed at the water's edge scores gathered to the half-submerged carcass (plate 44), some scrambling on to the remains in their eagerness, while others (plate 44A) sipped the oil drifting on the water, a short distance off-shore. Similarly they would gather to any floating carcass, to a leopard-seal kill, or to the vomit of a giant petrel forced to take flight when fully gorged.

ANTARCTIC PETREL

Thalassoica antarctica (Gmelin)

This species is a rare straggler to Heard Island. On 7 August 1950 Gwynn identified one among a flock of Cape pigeons from the bridge of H.M.A.S. *Australia* when she was lying at anchor outside Atlas Roads. On 25 November, 1950, another was seen by Gwynn and Young flying from the slopes of Mount Aubert de la Rüe towards the open sea. Downes observed one flying along the Spit at the south end of the island on 25 July, 1951.

SNOW PETREL

Pagodroma nivea (Forster)

Gilchrist (1952) recorded this species at Heard Island in 1948. On 2 August of that year three were watched fishing immediately outside the first line of breakers at West Bay and others were seen on 4 and 6 August. None were seen during the rest of the occupation of the island.

SILVER-GREY FULMAR

(Antarctic Fulmar, Silver-grey Petrel)

Fulmarus glacialisoides (Smith)

During late 1950 there appeared to be an influx of these birds into the seas around Heard Island. On 14 November, Young saw a flock of 24 feeding in company with large numbers of Cape pigeons 50 yards

off-shore in Spit Bay. On 22 November, 12 were seen in Sydney Cove, on 25 November there were three in Corinthian Bay, and on 3 December three at the entrance to West Bay feeding with a flock of prions.

None were seen in 1951, though a careful watch was kept, but they appeared again in late 1953. The first was seen on 14 November, flying below Corinth Head. A week later nine were seen feeding on the water in company with large numbers of Cape pigeons in Corinthian Bay, and it was noted that they swam very high in the water compared with the smaller birds. The last record was of four seen off Wharf Point on 31 December. When one of these flew over the point it was chased by skuas till over the sea again.

These are the only records of this species at Heard Island and, since it is reasonably certain that it does not breed there, they must be non-breeding birds from Antarctic colonies.

BLUE PETREL

Halobaena caerulea (Gmelin)

This species occasionally appears in some numbers in the Heard Island bays. During September, 1950, they were seen frequently, singly and in small parties, and on 10 and 17 September in large numbers over Atlas Cove. During this period they often flew over the beach, at times passing very close to observers.

After 4 October, when one was seen, no more appeared till 3 December, a calm day with poor visibility. On this occasion they were flying in scores over Corinthian Bay in company with prions and storm petrels.

After this blue petrels were not recorded again till 9 May, 1953. On this date at least a score (and probably several times that number) were flying over Corinthian Bay just before a violent north-east gale struck the island. The wind was already rising and several times birds were swept in over the beach. The only other species present were several Cape pigeons far out, one prion, and one unidentified petrel (possibly *Pterodroma brevirostris*).

On 2 June, a swarm of blue petrels was seen over Atlas Cove, the wind now blowing moderately hard from the north-west. None was visible in Corinthian Bay half-an-hour later. One or more were again present over the cove four days later

No more were seen till 24-25 September when a few were seen at South-West Bay and Atlas Cove. Two of the latter followed one another along the shore, in snow driving from the north. The only other record for Heard Island is Falla's (1937) note of having seen them over the land at the end of November, 1930.

These sightings appear to fall into two categories. The September records coincide with their return to their breeding grounds. At other times it would seem that they approach land only when driven before a storm, or in misty weather. Though they are an abundant breeding species at Kerguelen (Paulian, 1953), and their oceanic distribution is mainly southerly, it is unlikely that they breed at Heard Island. The explanation for this is simple. They are an early-nesting species, and in many years at Heard Island their potential nesting areas are still deeply covered in snow and the ground hard frozen at the beginning of their season.

Observations at sea. No blue petrels have been identified on the summer relief voyages to Heard Island (1947-55) except in the immediate vicinity of Iles de Kerguelen. However, on the winter voyage of H.M.A.S. *Australia* to Heard Island in August 1950, blue petrels were seen for four days before Heard Island was reached on 7 August and, during the twenty-four hours before the island was sighted, though not numerous, they were the commonest species seen, having almost entirely replaced the prions.

On the 1954 voyage of M.V. *Kista Dan* from Kerguelen south to the pack-ice the first blue petrel was sighted late on the second day out. A few others were seen during the next two days till the pack-ice was encountered late on 31 January.

Iles de Kerguelen. In view of Falla's (1937) observations that this species was abundant in and at the entrance to Royal Sound on 12 November, but absent from Kerguelen waters in mid-February it is worth noting that at 8 p.m. on the evening of 22 January, 1954 as *Kista Dan* entered Royal Sound she was surrounded by vast numbers of homing prions, but their ranks were searched in vain for any blue petrels. As they must still be feeding their young at this date, it would seem that at this season they do not approach land till well after dark.

However, on 12 February, 1951, as H.M.A.S. *Labuan* left Kerguelen, a few blue petrels were sighted among the swarms of prions waiting off-shore. Two nights previously fledgling blue petrels had predominated among the scores of birds caught at the ship's lights as she lay at Port Jeanne d'Arc.

DOVE PRION

Pachyptila desolata (Gmelin)

Habitat, distribution and numbers. These prions are one of the most abundant nesting species on the island, making their burrows under *Azorella* hummocks and in steep grass-covered slopes wherever there is sufficient depth of soil. Some also nest in the steep slopes of loose bare soil found in a few places against the cliff foot, and other nests have been found in crevices among the mounds of broken lava on the Laurens Peninsula. In this last situation the sitting birds can occasionally be seen from outside without disturbing the site.



PLATE 45—Dove prion, with band on left tarsus.

The absence of suitable habitats at higher levels for the most part limits them to the low coastal areas, but they have been found nesting at 600 feet on Mount Olsen.

Return and nesting. Prions are entirely absent from Heard Island during the winter months. The evidence of their return at the beginning of the breeding season is of five kinds—birds feeding off-shore along the open beaches, birds flying over their breeding grounds by day, prion remains around the skua nests, birds attracted to the station lights on misty nights, and birds calling in their burrows.

There is some evidence of their presence in small numbers off-shore during the latter part of October (prions, believed to be this species, feeding close in-shore below the cliffs of Corinthian Bay on 15-16 October, 1951, and a single prion flying over the beach in Atlas Cove on 21 October 1950) but the earliest note of their presence in the bays in large numbers is on 29 November, 1953. On this date Corinthian Bay was dotted with many hundreds of prions feeding and resting on the water, where eight days previously only one was seen.

The first re-occupation of burrows is in early November. On the night of 4-5 November, 1951, an inspection of burrows revealed one prion; the other nests were empty, many being partly snow-filled, and the ground was still frozen. By the middle of November birds could be heard calling

in their burrows, but not in any number till late in the month. On 24 November, 1953, one was seen flying over the breeding grounds by day for the second time that season, but from the end of November onwards prions were often seen flying over their nesting areas, on some days in considerable numbers. At the same time many began to come to the station lights at night.

There is, then, a variety of evidence that while a few birds begin to seek out their burrows at the beginning of November, or even earlier, the bulk of the population does not return till late in that month.

The nest burrows are very variable. Some are simple burrows, usually curved, with the nest chamber five or six feet from the entrance. Others are complex branching systems, with a common entrance, often shared by two or more pairs each with a nest chamber at the end of one of the branches. One nest chamber measured was nine inches long by eight inches wide and five inches deep. A typical branching burrow system is illustrated.

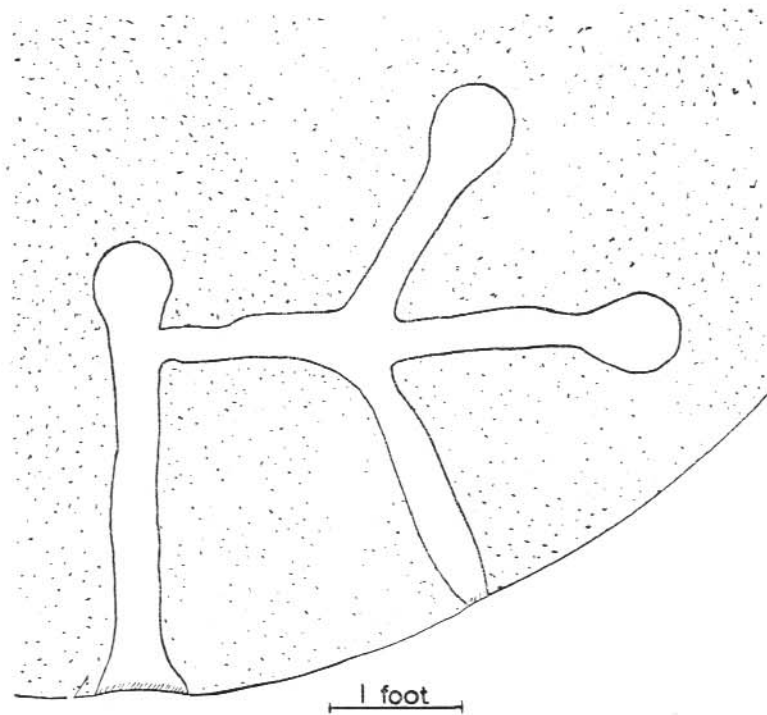


FIG 2—Plan of burrow network of dove prions containing three occupied nest chambers. The chambers were about five inches high, and about two feet below the surface. The fourth branch was presumably abandoned when the bird working in it broke through to the outside; the narrow mouth suggests that this fourth burrow had been excavated from inside and was not in use as an entrance.

The most thickly populated areas are in steep grass slopes with loose soil, and here a network of burrows may develop with multiple entrances. The entrance to a burrow is often inconspicuous, but in some cases the entrance tunnel is wide, usually narrowing to about four inches a short distance in. These wide entrances may be due to interference by skuas, which will sometimes attempt to dig the prions out of their burrows. The egg is laid in a shallow depression with little or no lining.

Egg-laying. Egg-laying begins at the very end of December. Of 12 eggs collected on 31 December, 1949, ten were completely fresh and in two development had just begun. Records from other years indicate a very similar laying date. In view of the rather varied laying dates given by Falla (1937) and Murphy (1936) it should be stated that this very definite laying period is supported by the records of numerous tenanted but egg-less burrows examined in December, and the finding of only freshly laid or very slightly incubated eggs about 1 January in each of the three years for which relevant records are available. Freshly laid eggs are not infrequently found unattended, showing that, as in many other burrowing petrels, the birds often leave their burrows for short periods before starting incubation (cf. Paulian, 1953, on the blue petrel).

In a female taken in a burrow with its mate on 22 December 1949, the largest follicle was 14.2 mm. in diameter and the second largest 2.2 mm. Two females taken on newly-laid eggs on 31 December each had a burst follicle 9-9.5 mm. in diameter, the largest remaining follicle being 2-3 mm. In three males taken on 22 December the larger testis averaged 15.2 x 8.9 mm., the smaller 12.7 x 9.0 mm. In six males taken in burrows with eggs on 31 December the testes already showed regression, averaging 6.3 x 3.4 mm. (one measurement only in each case).

No exact data as to length of incubation is available. An egg obtained on 30 January, 1950, was in a very advanced state of incubation, and on 22 February part-grown chicks in down were found unattended in their burrows.

Fledgling dove prions began to appear at the station lights in the last few days of March, some with tufts of down still attached. In 1953 their first appearance was 25 March. However, this may be rather early, as downy chicks were found on their nests about the same time, and many prions were seen returning to their burrows, presumably to feed their chicks, on the Laurens Peninsula on the night of 4 April, 1951.

By this time the number of prions to be seen over the bay has dwindled to a very marked extent and few are seen after the middle of April. There is an isolated record of a young prion seen at night on the sand flats at Sydney Cove on 26 April, 1951, and a remarkable flight of dove prions occurred on the night of 7 May, 1950, when 73 were taken with the searchlight and ringed, but this is the latest record of their presence before the winter.

Finally should be mentioned the remarkable "zone of prions" which is encountered a few miles off-shore by visiting ships during the breeding season. These are birds feeding and resting during the day, apparently waiting for nightfall to return to their burrows.

On 15 March, 1954, when leaving Heard Island, it was noted that at their maximum concentration prions were around the ship in hundreds—perhaps thousands—within a few hundred yards radius, (though strong wind and heavy seas made an accurate count impossible). This was in the late afternoon. Similar concentrations were seen at Kerguelen both in January and March. In contrast to this, while H.M.A.S. *Australia* was approaching Heard Island on 7 August 1950, only one single prion was seen between the first sighting of the island and the landing 24 hours later.

Feeding. From December to March prions often feed close inshore, a little further out than the Cape pigeons. On some days they feed mainly or entirely on the surface, but on others they may be seen diving freely, wings half spread, disappearing briefly from view. On these occasions they have been seen bringing to the surface long white or pale pink worm-like creatures. It seems likely that they feed to a large extent on small plankton, but few records of stomach contents are available (Ealey, 1954*b*), as most of the birds examined from burrows had only green slime in their stomachs.

Natural enemies. As already mentioned, at the time of the re-occupation of their burrows the prions fly freely over their nesting areas by day, and it is a remarkable fact that the skuas which abound in the same areas seldom pay any attention, apparently recognising that they are no match for the prions' dashing, erratic flight, though on two or three occasions they have been seen to catch a free-flying prion on the wing by day. However, the skuas do kill prions in large numbers at this time, and it would seem that they depend on catching them as they enter or leave their burrows, probably chiefly at dawn or dusk. It is possible that many of the prions which fall victim to the skuas are birds breeding for the first time, attempting to find or excavate new burrows, and so caught with inadequate shelter. Skuas will also attempt to dig prions out of their burrows, but their success must depend on finding a burrow which is very short or otherwise inadequate. Over the sea it would seem that the prions are hardly ever molested by the skuas. Even on quite calm days prion flocks may feed close inshore without interference.

FULMAR PRION

(Cliff prion⁽¹⁾)

Pachyptila crassirostris (Mathews)

Habitat, distribution and numbers. The use of the island by these birds is confined to breeding holes within the cracks and crevices of laval cliffs and scree slopes, which they enter at night. During the period when

⁽¹⁾Current at Heard Island, a name completely appropriate to their essential way of life.

these birds were the only prions on the island, they were never seen to fly more than two or three feet inland over the edge of the cliffs, unless swept inland by a sudden gust, in which case they quickly returned to the sea. Their flights and butterfly-like hoverings all took place along cliff faces and scree slopes and never over the open beaches. This feature became the basis for field identification. Prion flight is so swift and the conditions of observation are usually so poor that use of morphological features to distinguish between various types of prion is rarely possible (the smaller head, lighter colouring and broader tail band are the characteristics which distinguish *Pachyptila crassirostris* skins from *Pachyptila desolata* skins). However, dove prions were absent during the winter and familiarity with the habitat of fulmar prions, while they alone were present, facilitated analysis of later observations on both species.

The laval cliffs used by fulmar prions were all at least fifty feet of vertical, cracked rock face, mostly without vegetation and soil, and directly above the sea (plate 46). Fulmar prions fly in from the sea and circle several times past their particular landing spot, hovering and dangling their feet, before alighting on the ledge and disappearing into the depths of the crack. The layers of lava are twisted and cracked and all the holes which have been examined are at least six feet deep with many turns, which makes it impossible to find any sign ⁽¹⁾ of the birds once they have entered.

The fallen masses of rock and earth below these cliffs also contain in their 45° slopes numerous spaces and cracks and these areas accommodate many prions. However, there are fewer prions there than in the cliffs, probably because of the high content of loose soil. Beneath the large scoria column of Rogers Head and Balanced Rock great slabs of rock have fallen, and through the caves and crevices the prions find their way to the internal maze of cracks underlying these conspicuous landmarks. Here they nest and roost at night but again all their activities are carried on in the depths. Birds may be seen entering or leaving, but all else is out of reach of the observer. Thus the factors determining the presence of fulmar prions appear to be lava cliffs or screes with crevices, in very close proximity to the sea.

Fulmar prions have been found in greatest numbers along the cliffs of the Rogers Head Peninsula, the Atlas Cove cliffs and Corinthian Bay cliffs. Others were seen at Saddle Point, Cape Gazert and on Cape Laurens westward from Red Island to West Cape, but not continuously. The other high cliffs along the remainder of Laurens coast and the Cave Bay area were unused and apparently unsuitable due to lack of extensive cracks and crevices. No inland cliffs contained fulmar prions nor did moraine areas such as Fairchild Beach and Spit Bay. Some seasons went by before the presence of large numbers of fulmar prions on the island was recognized.

⁽¹⁾ Only in 1953 a few fulmar prions were found nesting in one of the tunnels in the lava, with an entrance on the cliff face used by the rockhopper penguins. Here two well incubated eggs were taken on 13 December.

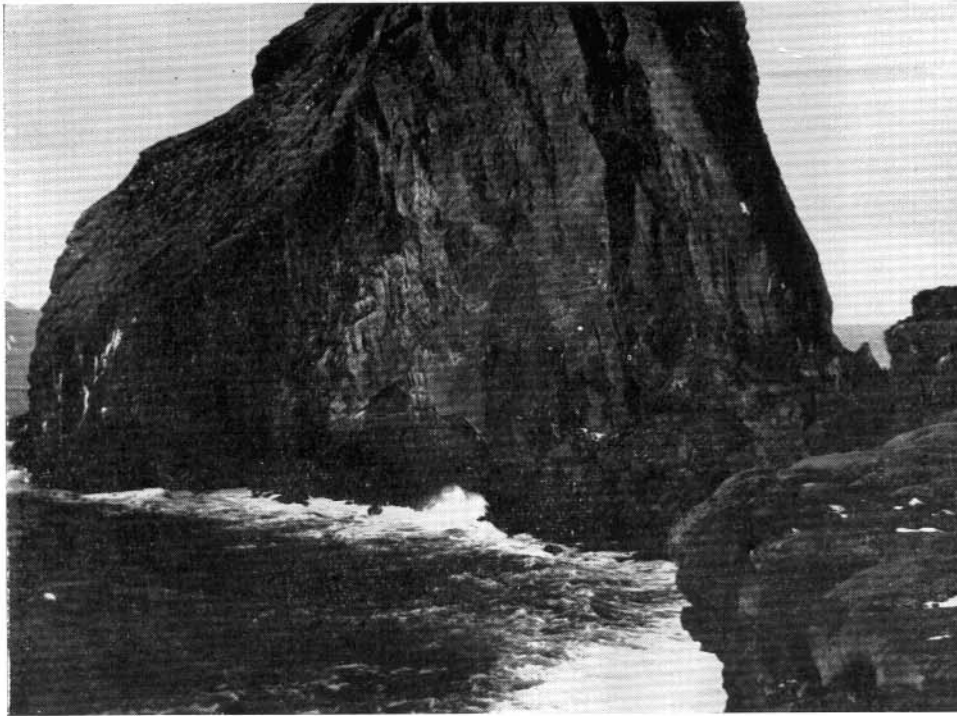


PLATE 46—Rogers Head. The crack in the centre near the base of the rock face leads into the recesses where thousands of fulmar prions nest.

Previously their presence had been indicated by Falla (1937) who had found their remains at a skua nest. Two birds were ringed among hundreds of dove prions attracted to the station lights in 1949 and 1950, and in November, 1950, a specimen of a cliff-flying bird was obtained by Young, establishing for the first time that the cliff birds were *Pachyptila crassirostris*. However, repeated search in that year failed to find any nests.

During 1951 the fulmar prions were fully investigated by Downes. On 10 June, 1951, during a routine round of the cliffs in the Atlas Cove area, he found prions to be still using the cliff holes. Occasional single birds entered the holes from 4 p.m. till 4.30 p.m. when it was almost completely dark. After this time hundreds were seen by torch-light to circle in from the sea and enter the holes. Each bird flew back and forth over the rocks several times and often disappeared towards the sea. Several were noticed over the scree and specimens were secured as they alighted on the rocks beside the entrances to their crevices. By shining the torch on one particular rock several birds would be attracted to rest within the light, and when the torch was directed at an approaching bird it often veered towards the light and could be caught in the air.

On examining the area during the daytime the used holes could be detected by the scraped earth around them, caused by the prions' shuffling walk, and by red excreta before each entrance. Later this colour was found to be characteristic of these prions amongst other rock-frequenting birds and it often aided in the detection of the most-used caves. At this time of year no prions approached the cliffs before sunset and then only few until complete darkness prevailed. On nights with bright moonlight very few prions could be seen arriving at dusk, and for several hours after dark only occasional birds entered, compared with the clouds of birds which arrive together on dark nights.

On 18 June, 1951, the light during the day was very dull, due to heavy mist down to 300 feet and thinner mist right to sea level. At 2 p.m. prions in large numbers were found to be flying along the cliff faces, 20-30 every fifty yards with more out to sea. Some were flying up and down the coast, circling over the sea. Others flew up to a ledge, fluttered for a few seconds a foot from it, then dropped away to wheel several times before repeating the same procedure. Those flying over the screes would fly very close to the rocks, pausing at particular places to flutter and dangle their legs for a few seconds before veering off to sea. Only one or two were observed to land during the day but many more did so as evening approached. As the observer approached the places which were receiving attention, the prions would come less close to the rocks each time they wheeled in until eventually they would disappear out to sea. This was observed so frequently that a gradual dispersal of the cliff fliers was evident as the observer walked along the cliff top. Their timidity and their panic flight when disturbed on a rock during daylight seemed unusual in an antarctic bird.

On the west face of Rogers Head a horizontal crack a foot wide gives access to crevices in the depths, and alongside this a large slab of rock has fallen down to form a little cave (plate 46). Prions landed on this slab and moved down a gutter near its centre toward a hole in the floor through which they passed into the deeper cracks. One or two pairs could be heard cooing from within and at 4 p.m. six birds landed on the slab. Scuttling and scrambling with outstretched wings, these let themselves move down the steep slope as in a chute, with bodies close to ground on thin weak legs. They came in waves after that, so it was possible for the observer sitting at the hole in the floor to band them as they passed, stemming the flow with a foot over the hole if numbers became too great to handle. Many landed on the top of the slab and more half way down, but others flew straight in at the opening and landed in heaps on the floor. The passage of one or two irritable and rather pugnacious birds from top to bottom of the chute could be followed by the sound of numerous squabbles as they passed their neighbours. Some seemed in a hurry for, with flapping wings, they slid to the ground. Others with wings folded crept slowly down, close in under the shelter of rocks. When the observer

reached out to take birds in daylight, their reaction was usually quick flight; but in the dark, on feeling the hand touch them, they would give it a gentle nibble, then harder bites and "growl" a little as when quarrelling with neighbours. Finally, realizing they were caught, they would struggle violently and bite. These bites could be quite painful. The volume of cooing and gurgling gradually increased from the depths as the numbers grew. The majority were in pairs but many single birds soon began roosting about the ledges and outside under rocks in the entrances to crevices.

On 20 June, 1951, fifteen hundred birds left the cave between 6 and 7.30 a.m. before daybreak. That evening the peak of the arrival was from 5-6 p.m. with few birds arriving before darkness at 4.50 p.m.

Many other counts at dawn and dusk showed that when prions were coming in from out at sea odd birds arrived before sunset, a few after darkness had set in, but the great majority came together in a wave centred about three-quarters to one hour after daylight failed. When leaving again in the morning the same time distribution prevailed, the peak of the wave occurring one and a quarter to three-quarters of an hour before daylight.

Many modifying factors were indicated. The time at which light was first or last visible varied each day because of cloud and mist condition. On nights with moonlight or light snowfall, very few prions arrived, indicating that feeding was continuing well through the night, whereas on foggy, dark nights they started in along the cliffs before dark and apparently the whole population returned to roost. On one occasion the sudden arrival of a cold front before dawn turned many back into the cave and stopped others from leaving the depths. The weather on 18 July, 1951 had been calm and warm with rain till 6.00 a.m., then an extremely violent wind with snow blew up. From 5.15 till 6.15 a.m., 132 birds came out, from 6.15-7.15 a.m. 34 birds. Through the remainder of the winter the numbers using the cave as a roosting place for the night gradually fell. There were many nights during which only 100 or so birds were present but on others, usually the dark, foggy nights, the numbers rose again. One important factor in the decrease may be the spread of the juvenal prions over the Southern Ocean.

Breeding habits. During September cliff-flying is more evident but it is still confined mainly to dusk, dawn, and dull foggy days for the majority of prions. The build-up in numbers along the cliffs, however, suggests that they are returning for the nights more frequently than in past weeks. Several times birds were observed arriving in the early hours of the morning and disappearing into the holes, where, from their cooing and gurgling, it could be inferred they spent the day. By the middle of this month the aggregations of prions reach three times their winter size. In October odd prions may be seen entering the cliffs on any day, and eventually even bright days do not keep the birds away from their

holes. During the last few days of October and the first few of November the gurgling and cooing under the rocks increases in volume, especially during the night, and more pairs are to be found billing and necking in the entrances of crevices. Only one pair of the thousands on Heard was found to occupy an accessible ledge, and this was only to be reached after ten minutes sliding in a prone position down a 45° crack 18 inches wide. This pair was found on 5 November to be engaged in courtship behaviour, one bird sitting in the midst of a circle of small stones with another on top vigorously working its beak to and fro with a vicious sideways motion against the under bird's beak. The latter continually gave out a soft, wheezy squeaking which varied in tempo with the upper bird's movements but, though watched for twenty minutes until the lower bird was dozing off to sleep, copulation was not recorded.

It was not possible to record accurately dates concerning the breeding of the cliff prions for a number of reasons, but judging from the dates on which the egg was noted on the ledge and the size of the chick on a certain date, and assuming a closely parallel development of *Pachyptila crassirostris* and *Pachyptila turtur* as determined by Richdale (1944), the following tentative dates may be indicated:—

TABLE 13
BREEDING DATES OF THE FULMAR PRION

Observed	Preliminaries to Copulation	Egg Present	Chick	Other chicks left nest
	5.11.51	23.11.51 18.12.51 20.12.51	27.1.52 (longest primary 26 mm.)	From 17.2.52 for one week
Estimated	Egg laid	Egg hatched	Chick	Departure
	7.11.51	1.1.52	26 days old	19.2.52

The survival value of nesting deep down in cracks in the rocks is clearly shown by the fate of the nest already described. About the time when fulmar prions' eggs are laid, the rockhopper males occupy territories throughout all negotiable crevices, working their way into any cracks sufficiently wide to allow entry. Both rockhoppers, but more particularly the male, are very persistent in investigating or pecking any living object within reach, so that the prions discontinue their practice of roosting in the open cave after the arrival of the penguins. This nest was in a gutter only 18 inches from a rockhopper nest, but survived successfully till 27 January. However, on 28 January, the fluffy half-grown prion chick had been removed to the penguin nest and the young penguin had squatted on top of it. The grass so often seen in other rockhopper nests was quite unobtainable inside the caves and the penguin had gathered the only available material.

On 28 January the prions were arriving after dusk in their full numbers. Their plumage was clean and their crops were full of plankton. About one quarter as many as arrived were coming out of the cracks with feathers dishevelled and dirty, making for the outside to fly away. These, of course, had empty crops.

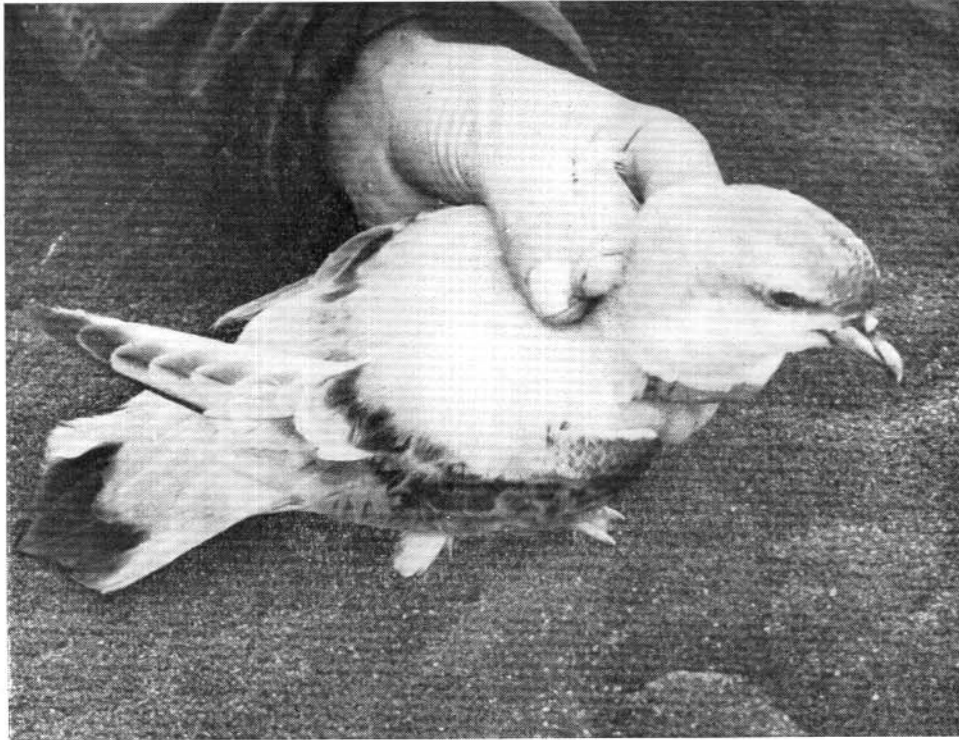


PLATE 47—Fulmar prion, adult.

On 17 February the first juvenal fulmar prion was noted among the dove prions attracted to the Station lights at night. Wisps of the nestling down still adhered to its flanks and the weaker nature of its bill was noted. At the cave on 18 February only six adults entered from dusk to 12 p.m., while twenty-seven juvenals gradually crawled out of the cracks and moved up the slab preparatory to taking flight over the water. These young birds had to fly immediately they left the rock, situated 30-50 feet above the very rough sea, for there was no landing beach below and the strong winds whirling about Rogers Head would never allow them to reach the rocks again unless they were fairly proficient in flight.

Juvenal birds alone are attracted to light but even so constitute only one or two per cent of prions flying about the Station lights at night. The rest are dove prions.

On 21 February, 1953, a calm misty night, large numbers of petrels came to the lights of the M.V. *Tottan* as she lay at anchor in Atlas Cove. The dominant species were dove prions, but there was quite a sprinkling of fulmar prions, some at least being fledglings. Late records of a single fulmar prion coming to the station lights are 14 April and 5 May, 1953.

On 15 April, 1953, a wet and windy day, many fulmar prions were seen executing their characteristic manoeuvres all along the cliffs to Rogers Head, where there was a big concentration, and they were noted again at the end of that month and the beginning of May, so it would appear that at no time of the year are they completely absent.

CAPE HEN

(White-chinned petrel)

Procellaria aequinoctialis Linné

In early December, 1951, several birds of this species were reported by a boating party to be flying with other petrels in Atlas Roads. This was the only record for Heard Island till one was seen on 26 November, 1953, flying along the shore of Atlas Cove just over the water's edge. This bird, or another, was seen again at the same spot six weeks later, being pursued by a skua, apparently from the direction of Mount Drygalski.

As this species breeds commonly at Iles de Kerguelen and is frequently seen further south, the birds must often pass close to Heard Island, so the surprising thing about these records is that they are so few. Apparently they do not normally approach land except at their breeding places.

WILSON'S STORM PETREL

Oceanites oceanicus (Kuhl)

The flocks of this species which may at times be seen feeding close inshore indicate that they breed abundantly on Heard Island, though not in comparable numbers with the dove prions. Among the large flocks of prions seen off-shore from January to March there is always a sprinkling of storm petrels, though they form only a small proportion of the total birds present. The nests are relatively difficult to find, and seem to occur chiefly in two types of situations. One is beneath large, flattish rocks, at the ends of short burrows, usually about 18 inches long, of which the rocks form the roofs. The other is in crevices among boulder scree and in the broken, vesicular lavas of the Laurens Peninsula. This last habitat is very extensive, and it is possible that it houses a large proportion of the Heard Island population, to judge from the frequency with which birds may be heard calling there at the beginning of their breeding season, both at night and during the day. However, storm petrels have been found in a wide variety of localities, some almost at sea level, as on Wharf Point, others near the top of 500-foot lava cones, and others up to half a mile or more inland. No doubt they could be found on almost all the headlands and ice-free coastal areas of Heard Island.

They are the last of the migratory petrels to return to Heard Island after the winter, the earliest record being of one seen flitting along the beach at dusk on 1 December, 1950. Two days later a large number

was over the sea in Corinthian Bay. In most other years, storm petrels were not seen till the middle of this month. This is probably due to inadequate observation, but it also suggests that they do not venture much inshore by day till some time after their arrival in the surrounding seas. The 3 December, 1950, was a calm, foggy day on which there was a big incursion of petrels into the bays, including species not normally seen close to land (see p. 98). After the middle of December individuals may be seen occasionally flying erratically over their nesting areas by day, and occupied burrows have been found towards the end of the month.

Out of the limited number of nests investigated, the earliest egg date is for two fresh eggs taken from sitting birds on 7 January, 1950. On 22 January of the same year eight eggs were collected. One of these was fresh, in three incubation had commenced, and in four development was moderately advanced. On 15 January, 1951, two absolutely fresh eggs were taken from unattended burrows and two more "quite fresh" eggs were taken from sitting birds on 26 January.

The nest is merely a shallow depression, some times with a slight lining of feathers, moulted seal hair, or pieces of vegetation.

For four months from the middle of December storm petrels are flying regularly over the bays. The most favoured place is Corinthian Bay, where on certain days the entire beach would be fringed with storm petrels feeding just beyond the line of breaking waves. Most of them disappear after the middle of April, but single stragglers have been seen as late as 22 May. In 1950 Young recorded uncommonly late flocks of storm petrels between 16 and 20 May, on the latter date encountering considerable numbers while out trawling in Atlas Roads, though noting that they were not as numerous as a month previously.

If these dates are compared with the table given by Roberts (1940a) it is clear that the entire cycle of the Heard Island storm petrels is considerably later than that found in more truly Antarctic regions, where the first arrivals have been recorded quite early in November, with egg dates about the middle of December. Whether it differs significantly from the cycle in Kerguelen is doubtful, though recorded egg dates are earlier at Heard Island. On 1 March, 1950, Ealey and Chittleborough investigated nests on Murray Island, Kerguelen, and although many chicks had hatched, they obtained eight eggs.

As the call notes heard from these petrels in their burrows have not been very adequately described, it is worth quoting a note made after listening to them calling at night on the Laurens Peninsula. The call is described as having "a rhythm similar to that of the prions, but a grating note, remotely recalling the distant call of a British corncrake at night".

The few stomachs examined add nothing to the information already published by Murphy (1936) and Roberts (1940a) except that in two cases nematodes were found.

Wilson's storm petrels appear to be relatively immune from interference by the skuas. The latter have only once⁽¹⁾ been seen to pay any attention to storm petrels flitting over land by day, and due to their preference for nesting under or among rocks, their nests must be almost entirely immune from the skuas' attentions. Nor have the remains of storm petrels been found round the skuas' nests.

BLACK-BELLIED STORM PETREL

Fregetta tropica (Gould)

On 3 December, 1950, a calm morning with thick mist, Corinthian Bay was found to be swarming with petrels close inshore, including blue petrels, prions, Cape pigeons, three antarctic fulmars, Wilson's storm petrels and at least two of the present species. The distinctive triangular white patch on the underwing surface of the black-bellied petrels was clearly seen.

This is the only record of this species for Heard Island, but in view of its occurrence as a breeding species in South Georgia and similar localities, and of the fact that it rarely ventures inshore by day, it is not unlikely that it may yet be found as a breeding species on Heard Island.

KERGUELEN DIVING PETREL

Pelecanoides urinatrix exsul Salvin

Habitat, distribution and numbers. This petrel nests in burrows in loose earth, chiefly in steep grassy slopes near the sea. Almost all the known nesting places have a northerly exposure. A few burrows have been found under grass tussocks on the flat top of the point of Cape Gazert and a few of the burrows near Erratic Point were under *Azorella* hummocks. Because of the limited number of suitable nesting localities, it is probable that this species is much less numerous on Heard Island than the South Georgian diving petrel. All the known colonies are around the north end of the island, but it is probable that other breeding areas occur in the Spit Bay and Long Beach regions.

Winter habits. As this species is hardly ever seen by day except from boats working off-shore, little is known about its winter habits, but there is some evidence that these birds are present in Heard Island waters all the year round, and that some at least come ashore to roost in any month of the year. Sight records are not specifically identifiable, but in the absence of any winter records of the South Georgian diving petrel, all the following are tentatively regarded as referring to the present species.

⁽¹⁾ A bird flitting along the beach in May was being shadowed by a skua.

At dusk on 3 May, 1953, while Dr. Gwynn was standing by the great boulder which gives its name to Erratic Point, he saw a diving petrel fly straight up from the sea and lodge in a shallow crevice on the face of the boulder. On a subsequent visit, excreta marks below this crevice indicated that it was still being used. Single birds of this species were taken at the station lights on 6 June and 3 July. In 1949, diving petrels were seen on 7 July by Chittleborough and Ealey, while out trawling in Atlas Roads.

On 15 August, 1951, Downes found that many burrows in the Mt. Andrée colony had recently been cleaned out, and took two of the birds in their burrows by day. At several of the burrows the birds had dug through snow to reach the entrance, and three of the burrows opened contained fresh feathers in the nest chamber. One diving petrel flew over the colony and out to sea again at 3.45 p.m., our only note of a diving petrel voluntarily venturing over land by day.

In the previous year Young, having found evidence that the burrows in this colony were in use, spent two evenings watching them on 20 and 22 September. There was still much snow on the slopes, but large numbers of diving petrels came in after dusk to roost on ledges and crannies in the cliff. Some of these were in pairs and one pair was flushed from a small hollow between the snow and the cliff face. Others were no doubt in the accessible burrows. As at Erratic Point, at least one was seen clinging to the cliff face like a martin.

On the latter occasion they were calling freely, making "a gentle crooning noise, sometimes resembling the low 'mi-a-ow' of a cat, more often between this and the coo of a dove" (Gwynn). On a similar occasion a year later, Downes described them as "cooing like mewing cats".

Breeding habits. At most of these places the dove prions burrow in the same slopes. The diving petrels use mainly the upper part of the slope, near the cliff foot, the prion burrows tending to be lower down, but in places nest chambers of both species are found in one intercommunicating network of burrows. The nests are usually lined with bits of grass and sometimes feathers from the birds themselves.

The earliest egg date noted by us is of one egg found on 3 December, 1949, other burrows opened at the same time being empty. Of three nests opened on 6 December 1950, all contained an egg. One of these was completely fresh and unguarded, the other two were slightly incubated. Ten eggs collected on 12 January 1950 showed every stage of incubation from "just begun" to "late", but no chicks had hatched. One egg was completely fresh. Laying dates are evidently rather variable, but the bird with a well-incubated egg taken by Falla on 1 December, 1929, appears to have been unusually early. On 23 January, 1952, Downes collected four chicks from burrows at Erratic Point.

Natural enemies. Diving petrels released from their burrows in daylight fall an easy prey to the skuas on account of their simple, direct flight, and no doubt for this reason they hardly ever venture over land in daylight.

When they begin to return to their cliffs at dusk in September some skuas are generally patrolling the cliff face, but in the failing light these appear to have little success.

Hamilton (1939) has recorded one case of diving petrel remains being found in the stomach of a leopard seal and in September 1953 part of the shoulder girdle of a diving petrel was found in a leopard seal stomach at Heard Island. Such a fate can be little more than an occasional accident.

Stomach contents and parasites. Of 15 stomachs examined by Ealey (1954, b), only two contained identifiable remains (crustacea). No internal parasites were found. Ticks of two species were found in several of the burrows (Zumpt, 1952). Both species of diving petrel are usually heavily infested with bird lice.

SOUTH GEORGIAN DIVING PETREL

Pelecanoides georgicus Murphy and Harper

Habitat, distribution and numbers. This species nests very abundantly on Heard Island, digging its burrows wherever bare sand or loose bare soil is available. The flats between South-West Bay and Atlas Cove are riddled with burrows except where the ground is subject to flooding⁽¹⁾. The steep slopes of loose earth close to the penguin rookeries at Rogers Head and the loose soil on the cones and ash moraines of the Laurens Peninsula are also extensively used. On the undulating country between the station and Corinth Head their burrows may be found wherever there is a sufficient extent of bare soil among the *Azorella* hummocks. In such mixed habitats they are found as close neighbours of the dove prions, but in general their nesting requirements are totally distinct from those of the prions or of the Kerguelen diving petrels. A few burrows of dove prions have been found in the bare steep slopes below the lava cliffs at Rogers Head, and Downes found the prions nesting on the bare surface of Macey Cone in places where there was a slight bank into which they could dig. The diving petrels had their burrows in the flat surfaces round about, and he noted that the entrances to the prion burrows were noticeably larger than those of the diving petrels.

Breeding habits. The burrows are usually dug on flat or gently sloping ground and are two to three feet long, sloping gradually from the entrance and typically with a sharp turn several inches before the nest chamber is reached. Occasionally the entrance is under a stone or in the side of a rut (plate 48) or some similar situation, but usually it is in completely open level ground. The egg is laid on the floor of the nest chamber with no other lining than a ring of small pebbles. The sand is usually so loose that the nest chamber readily caves in under a passing tread.

⁽¹⁾ Falla (1937) was mistaken in assuming that the burrows he saw near Atlas Cove were for shelter only. Many nesting burrows are little above flood level.



PLATE 48—Burrows of South Georgian diving petrel. Note how the tractor tracks are frequently used as a starting point.

The entrances of the burrows are mostly silted up or fallen in by the end of the winter, the situation of the previous year's burrows being marked only by a slight depression, if at all, so that they must be freshly dug out each year. In 1951 the first signs of re-excitation were noted on the flats above South-West Bay on 27 October, and in 1953 on 1 November, with numerous tracks visible on the sand. On 78 November, 1953, many diving petrels were seen at night flying over their nesting areas between Atlas Cove and West Bay. Others were resting on the ground or working at their burrows, though few of these were deep enough to conceal their owners. By the beginning of December many of the burrows are occupied by day, often by a pair of birds. In years of heavy snowfall, such as 1949 and 1950, the main nesting areas are not accessible till well into November but this does not seem to affect the laying dates.

The earliest recorded egg-date is 7 December, 1950, when Young dug out a dozen fresh burrows at Rogers Head, of which two each contained a bird with a fresh egg, one a pair of birds only, the others being empty. Twelve more burrows examined during the next eight days at other localities either contained birds without eggs or were unoccupied. However, eight out of another twelve burrows examined at Rogers Head on 18 December contained fresh or slightly incubated eggs. Records for other



PLATE 49—South Georgian diving petrel and egg.

years indicate similar egg dates, laying being rather protracted, and it is not till late in the month that a majority of the burrows may be expected to contain eggs. Of 14 eggs collected during the last six days of December, 1949, eleven were fresh and three were slightly incubated. A fresh egg was taken on 12 January 1950.

Natural enemies. As with the Kerguelen diving petrel, the South Georgian diving petrel does not venture over land till after dark, but at dusk skuas may be seen standing about the diving petrel nesting flats and

no doubt many petrels are caught as they come into their burrows. Skuas have also been seen digging out burrows in the sandy flat, trenching back along the burrow from the entrance. Trenches of this kind are frequently seen, chiefly late in the season when other sources of food are scarce, so that it is probably mainly young birds which are taken this way.

The occasional capture of diving petrels by leopard seals has been noted under the previous species.

SOUTHERN SKUA

(Brown skua)

Stercorarius skua lonnbergi (Mathews)

Arrival. All but a few stragglers are absent during the winter months. The first few birds to return arrive early in September, but for the first fortnight one seldom sees more than two or three at a time. Then there is a marked increase in numbers during the third week in September, and by the end of the month they are fairly numerous. The return of the main vanguard was very clearly marked in 1950. On 17 September in that year a tour of the bays showed a party of four in South-West Bay, one in West Bay, none in Atlas Cove; the following day there were many about; and on 19 September they were "everywhere". In 1951 six were counted in South-West Bay on 17 September, 24 on 18 September. Data for 1949 and 1953 are less critical, but indicate an identical picture; first there are a few heralds then, about 18th September, the main vanguard begins to arrive.

There is some evidence that the first birds to arrive are the breeding pairs. Certainly there is a further big increase in the population during October, in which month the breeding herds of elephant seals provide an abundant food supply and the skua flocks reach their maximum. In 1951 Downes estimated that the beach flocks in the "Four Bays" averaged about 50 during the first half of October, 120 in mid-October, and 200 by the end of the month.

During December and January, available records show that on some days nearly as many skuas are to be seen on the beaches as in November but by the end of January food is becoming difficult to find. The pickings from the elephant seal breeding season are long since exhausted, the penguin egg harvest is over, and most of the penguin chicks are big enough to look after themselves. It is chiefly at this season that the skuas resort to the laborious effort of digging out petrel burrows, and mobs of them may be seen fighting over leopard seal faeces in just the same manner as they fought over elephant seal placentae two or three months previously. In February and March the beach flocks are diminishing, indicating that some skuas have left the island. During March and April some birds of the year may be seen among the beach flocks, but these

probably leave the island very soon after leaving the nesting territories and by mid-April the decrease in numbers is very noticeable. During May and the first half of June groups of three or four are to be seen every day, and congregations of one or two dozens are occasionally observed. After the third week of June all but a few stragglers have gone. Table 14 lists the numbers counted by Downes in the Four Bays area during the winter months of 1951:—

TABLE 14.
SKUAS SIGHTED IN FOUR BAYS, HEARD ISLAND,
JUNE-SEPTEMBER, 1951.

June		July		August		September	
Date	No.	Date	No.	Date	No.	Date	No.
21st	4	2nd	7	5th	3	1st	3
25th	8	4th	1	29th	1	5th	2
26th	4	5th	6	30th	1	6th	1
27th	4	6th	4	.....	.....	7th	4
28th	13	7th	6	.....	.....		(two
29th	10	9th	3	.....	.....		pairs)
30th	6	10th	4	.....	.....	11th	3
.....	.....	11th	2	.....	.....	12th	6
.....	.....	12th	2	.....	.....	13th	2
.....	.....	16th	6	.....	.....	15th	5
.....	.....	17th	1	.....	.....	16th	2
.....	.....	20th	2	.....	.....	17th	6
						18th	30
						24th	30

It is possible that the regular killing of seals to feed the dogs may be responsible for the persistence of these few stragglers through the winter. In 1949, when there were no dogs, Chittleborough and Ealey recorded several skuas on 15 June, but after that only four single birds—one on 23 June, two in July and one in August. In 1950 none were recorded between mid-winter and 17 September.

The juvenals have a uniform sooty plumage, and in 1953-54 it was noted that birds in this plumage were not seen till December, and then only a few. This suggests that many young birds may not return to Heard Island till two years old, as appears to be the case with the antarctic terns. A curious incident was noted in this month, when a bird in sooty plumage was seen approaching two adult birds standing on the beach, calling at them as if soliciting food. The adults repelled it, but only half-heartedly.

Breeding habits. Occasional pairs were seen circling over the *Azorella* at Mt. Drygalski on 20 September, 1951, and two days later a pair was seen to chase a third bird from the area. The number of pairs occupying territory over the inland *Azorella* increased gradually until by 4 October, 1951, most future nesting areas had one or two occupying pairs circling overhead. However, occupation of the area does not appear to be complete until the end of the first fortnight of October. This may be due to the late arrival of some pairs or to the fact that at this stage

some spend part of the day feeding at the seal beaches. Two records of single birds over a nesting territory indicate that one member of a pair may arrive before the other, or else that at this early stage the pair bond is not so strong that the members feed together at all times, as is usual a week or two later.

Territory. The most common type of territory is found in an area of *Azorella* or moss-covered lava which contains a number of dove prion burrows. The size of the area varies with the type of terrain, perhaps correlated with the density of petrel burrows, but several rough estimates place the area at not larger than one acre. Other territories are adjacent to penguin rookeries, the birds patrolling overhead to watch for eggs and young penguins. Near the centre of the territory a patch of poa grass contains the nest while adjacent mounds or hillocks are used as resting places for the unoccupied member of a pair. Here quantities of pellets of food remains, eggshells, bones and feathers are found.

Defence of territory. The skuas' defence of their territory becomes more vigorous as hatching approaches. Some spend a great deal of time throughout the season chasing any wandering skuas which appear, and are correspondingly vigorous in their attacks on humans. The parents always leave a human intruder to attack another skua entering the territory. When chasing other skuas the nesting birds usually attempts to bring it to the ground by striking with claws and beak, at times catching the fleeing bird by the tail with its bill and pulling it down backwards. Once on the ground it bites savagely. This behaviour may explain the frayed and broken state of the retrices noted in many specimens. With a human the attack is modified in that the bird rises in the air to gain momentum and dives against the wind directly at the intruder. It levels out overhead and lowers its feet and may deliver a solid blow on head or face. The birds strike at the highest object so that a hand held aloft or stick raised above one's back is sufficient protection. Usually the attack is pressed only when close to the nest, and it is intensified as nesting proceeds. Some birds are timid and veer off repeatedly without hitting, others fly down to head level intent on striking. It is then possible to grab these by the feet, though care is needed.

The origin of this habit of attack on humans in a bird which normally has no natural enemies on land is at first sight obscure, but it may have been developed to frighten away the seals which occasionally wander into the nesting areas when they haul out for their moult in December.

Nesting. On 14 November, 1951, at Mt. Drygalski twelve pairs were scattered about the *Azorella* slopes, nesting in the ledges of grass. Of these, six had commenced a nest, scratching the *Azorella* stalks around a hollow, while one pair had two such nest beginnings. In examining another 10 nests on the Vahsel Moraine only one pair gave a single warning cry but all hovered over-head or stood nearby. This behaviour lasted approximately another week.



PLATE 50—Adult skua on its nest in *Poa*. This bird is calling for its mate (see p. 107).

Description of nest. The nest is most usually placed near the centre of the territory in a small patch of grass where the incubating bird on the eggs will be comparatively hidden. It is hollowed out in the roots of the grass and lined with *Azorella* or grass roots (plates 50, 51). In one instance a pair built a low mound of moss on the lava where grass was not growing and in another a skua pair nested near the edge of vegetation in a hollow of sand. The latter nest was flooded out within a few days. Several "squats" may be made in various patches but the lining of roots is added to the nest only a few days before the eggs are laid.

Egg-laying and incubation. On the Rogers Head peninsula during November, 1951, a count showed that between 70 and 75 pairs had established territory. Of these 45-50 laid a clutch of two eggs. Two pairs were noted to have only one egg, but these may have lost one egg after laying. The remainder, though they commenced nests and frequented the area most of the season, did not lay and soon discontinued defence reactions. In 1951 the first egg was found on 18 November, and on 22 November, of 18 pairs which were going to lay, four had laid two eggs by the morning, another completed the clutch in the afternoon and three pairs had one egg. In 1950 the first eggs were found on 19 November,

one at Rogers Head and one at Vahsel Moraine, the latter clutch being completed the following day. This pair had the first egg removed immediately the second was laid but no re-laying was observed. Pairs which never lay may be seen about their territories at odd times, either one or other birds, but often they are absent, returning at dusk perhaps to hunt for prions. A pair which lost their eggs during incubation and which had been particularly vigorous in defence of the nest gradually weakened in their reactions toward man, until by the end of January they merely followed silently overhead.

The sexual dimorphism of a mated pair is usually obvious in the field and is especially so when the birds are handled. According to Falla (1937) and Murphy (1936) the female is larger, being heavier and stronger than the male. The plumage of the female is often a paler brown than that of the male, and with many pairs she is less timid when attacking intruders. The female was found on the nest more times than the male, and she usually betrayed her whereabouts by high pitched cries before she could be seen. This seems to be a call for assistance to the mate, which usually quickly appears, coming in low and fast to the attack. When its mate appears, the bird on the nest usually rises to join in. While the female is pressing its attack, the male often slips quietly

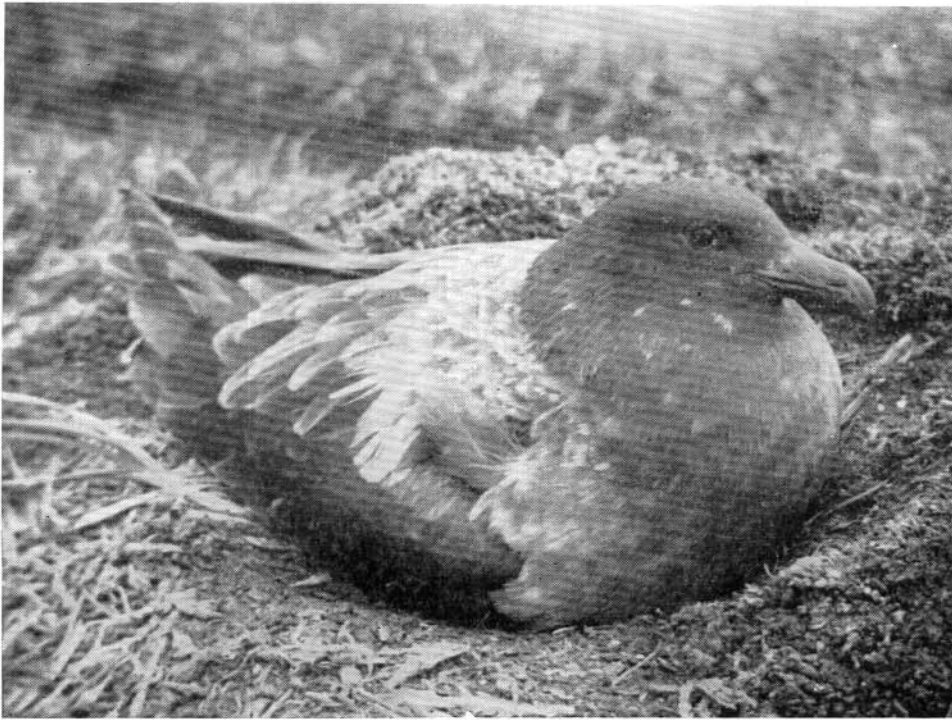


PLATE 51—Adult skua on its nest in *Azorella*.

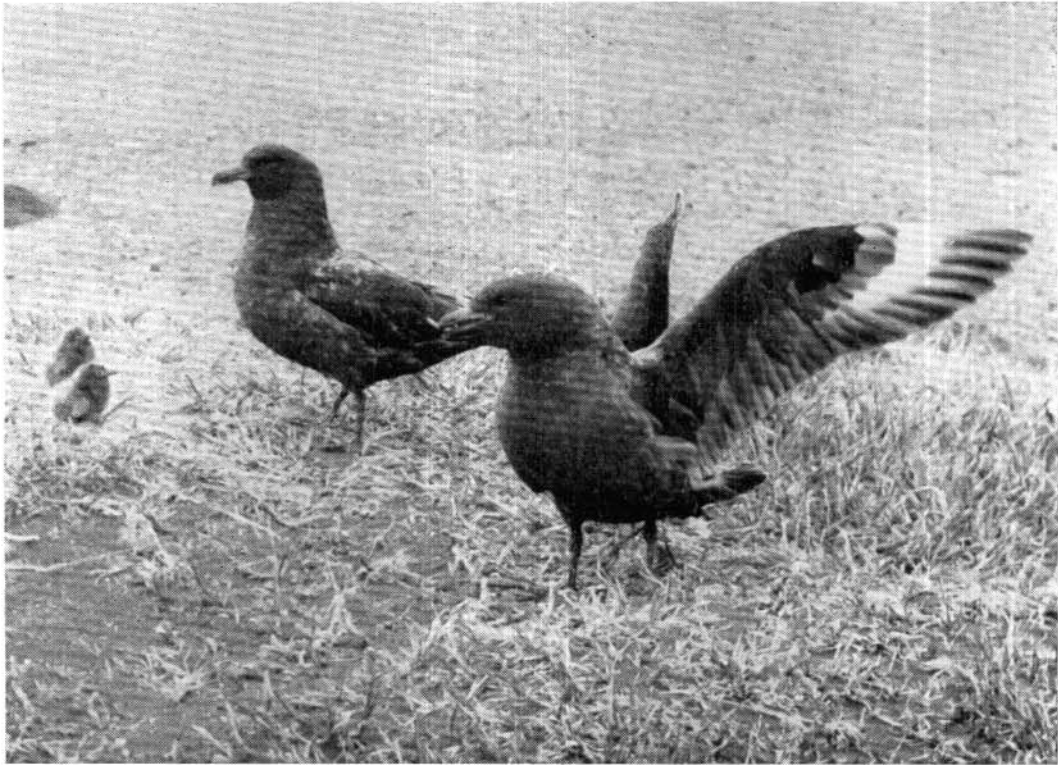


PLATE 52—Pair of skuas with two young chicks. The right-hand bird has its wings raised in threat.

onto the nest to take over the care of the eggs, with only an occasional short sharp cry. Any commotion about the nesting area often attracts a few roving skuas, which stand about waiting for opportunities of stealing eggs, until set upon by one of the parents.

Both in 1950 and 1951 the first chicks were found on 18 December, but the majority hatched from about 22 December onwards. However, nests with eggs or newly hatched chicks may be found up to the middle of January. Individual nest records indicate an incubation period of 28 or 29 days.

Within a very few days of hatching the chicks are often found away from the nest where incubation was carried out (plate 52). There are several "squats" or unlined nests in the grass and the chick may be brooded in these by either parent. As they grow older they actively run from the observer to crouch down behind some hummock before his approach so that among the uneven *Azorella* hummocks it is very difficult to find both members of a clutch. They may be up to 25 yards apart. During ringing operations it is best to catch the chick, then grasp the parents as they come near. However, the skua learns such tricks quickly

and it is necessary to make certain the first time as they rarely approach closely again. At times both parents had been secured in this way. In one instance the roving flock of skuas which had been standing about watching the commotion now started to chase the chick and several pecked it on the back of the neck and would have carried it off had the female not been released to drive them from the territory.

Some chicks have completed their moult into juvenal plumage by the middle of February, but it is some time before they can fly strongly, and they remain in their territories under the care of their parents for a considerable time after their moult is complete. It is still possible to catch some by running them down even late in March, though most are by then flying too strongly. At this stage when danger threatens the chicks first run for safety in a crouching attitude and only on being pressed will take to flight.

Reproductive success. In 1951, of 30 nests near Rogers Head in which two eggs were laid and the history determined at a later date, 10 reared two chicks to the flying stage, 15 reared one while five had no chicks, giving the percentage of two-chick broods as 40 per cent. Causes of loss of one member of a pair were not obvious except that in two cases one of the clutch was an infertile egg, and a chick from each of two pairs died in the nest when 4-5 days old. In one of these the survivor was the smaller of the siblings.

From banding records for 64 nests (including some of the above 30) 24 had two chicks and 40 had one chick, giving 37 per cent of two chick broods. In view of the difficulty of finding both chicks under the conditions of the census it is justifiable to record the percentage of two chick broods in this year as not less than 40 per cent of those which managed to raise a family.

Feeding habits. There is a well defined sequence in the foods available for the skuas during their months on Heard Island. Their return in September coincides very closely with the onset of the breeding season of the elephant seals, the first pups being born about the middle of that month. The first skuas to arrive may experience some difficulty in foraging, but soon the rapidly growing trickle of new births begins to provide an ample food supply, and during the first weeks this is certainly very important to the new arrivals. The birth of seal pups reaches its peak in the middle of October, and during the next few weeks placental remains and dead pups form the staple diet of the large population of non-breeding birds which make up the beach flocks. The birth of each pup is the signal for a rush of waiting skuas which battle fearlessly for the spoils even in the middle of the seal harem, though at the peak of the pupping season even the skuas' voracious appetites are sated.

The breeding pairs begin to take up their territories soon after arrival, though they probably continue to resort to the beaches for feeding until other food supplies become available in November. During October the only small petrels which are at all numerous are the fulmar prions and the Kerguelen diving petrels, but the former appear to be too elusive for most of the skuas and the latter are restricted to a few localities of limited extent. A few remains of fulmar prions have been found in skua territories, only two cases being known. On 21 October, 1951, fulmar prion remains were found at two nests on Cape Gazert, and on 1 December, 1929, Falla (1937, p. 203) found one pair specialising in this prey when all others were feeding exclusively on dove prions or on penguin eggs.

At the end of October the South Georgian diving petrels return to re-excavate their burrows, during November the dove prions also begin to return to their burrows, and about 12 November the harvest of the first eggs of the macaroni penguins begins, so that before egg-laying starts there are various sources of food on the territories themselves. All skua territories appear to control or are immediately adjacent to some such source, and this may be an important factor in the selection of territory. As already mentioned, many skua territories are on the nesting grounds of the dove prions, others include or are adjacent to those of the South Georgian diving petrels, others are on the fringe of the macaroni penguin rookeries, and on the Laurens Peninsula the giant petrel colonies may be important in this respect. Many pairs seem to specialise in one particular item. Those which feed on prions may be recognised by the remains, chiefly heads and wings, scattered round about the nest. Others seem to feed mainly on penguin eggs at this time, broken shells and pellets of egg-fragments making up most of the litter, but at many nests there are few or no obvious food remains.

Territory-owning pairs will jealously defend their rights over feeding grounds under their control. A good example of this was noted by Downes one December day when he was working along a sandy slope, digging out diving petrel burrows, followed by a mob of fifty skuas from the beach. As Downes and his followers moved into the territory of a breeding pair, these suddenly dived out of the sky on the waiting skuas. The latter saw them coming but could not rise quickly enough to escape by flight, instead they flattened themselves to the ground squealing shrilly. Within a minute the whole area had been cleared of trespassing skuas, many of which had to be chased off individually. The nesting pair then flew overhead calling loudly to each other as they usually do when standing on ground with wings raised. They then proceed to dig for diving petrels in the partly excavated burrows.

However, much of the larger penguin rookeries and the nesting flats of the diving petrels are not included in any territory and are a common hunting ground.

As the season progresses, this period of super-abundant food passes. In the macaroni rookeries the harvest of discarded first eggs is soon over, and the skua must now watch for eggs, or (later) chicks, exposed when the parents change guard. The small petrels now spend most of their time in well-dug burrows, and while some are no doubt still taken as they enter or leave, the skuas also resort to laboriously digging out the less well protected burrows. In the giant petrel colonies eggs or chicks are never easily come by, except when the colony is disturbed by human intruders, but discarded scraps by the side of the nest may be a useful source of food later.

In October, Downes studied the pellets thrown up by members of the beach flocks, and found them to consist of sand, small stones, and seal hair, neatly moulded into balls three-quarters of an inch in diameter and covered with a coat of secretion containing fine bubbles. The faeces of these skuas was also found to contain grains of sand, showing that of the sand ingested with the food, some passes down the intestine though most is probably ejected in the pellets.

Co-operation between the two members of a pair is a striking feature in their feeding habits. When an egg is captured, the two birds fly away together to some convenient spot. Here the egg is placed on the ground, broken open with blows of the bill if still intact (as is very often the case; a skua has even been seen to pick up a giant petrel egg in its open bill and carry it away unbroken) and the two birds then sup from it, turn about. When a prion is caught, the partner grabs it by a wing and the two dismember it between them. Unless food is very abundant, the trunk is swallowed whole.

As piracy is such a conspicuous feature of the methods of obtaining food used by the northern race of the great skua, we were interested to find that this is little resorted to at Heard Island, beyond the occasional pursuit of a dominican gull when the latter is actually seen to pick up food. It was, therefore, with particular interest that during a gale on 19 February, 1953, 360 miles east of Heard Island, a skua was watched pursuing a Cape hen (or possibly a long-winged petrel), apparently with the intention of forcing it to disgorge. Again, in latitude 44°40'S. longitude 132°E., on 28 March, 1954, two skuas were seen pursuing an immature wandering albatross, though in this case they desisted without achieving their object. Falla (1937) also records instances of skuas pursuing both these species, so it would seem that on the high seas piracy is an important means of livelihood for the southern skuas also.

DOMINICAN GULL

(Southern black-backed gull, kelp gull)

Larus dominicanus Lichtenstein

These gulls are present at Heard Island all the year round, and there is no evidence of any migration away from the island. As they are dependent for their living on what they can find along the shores, the population



PLATE 53—Nest and eggs of dominican gull.

is necessarily limited, but it is not uncommon to see flocks of 50-60 of these birds at any season though smaller groups are more usual. On 19 May, 1949, a flock of over eighty were counted in the shallow water lagoon behind Atlas Cove, and at other times well over a hundred have been seen around the shores of this bay.

Breeding habits. Alone among the birds which nest in the open at Heard Island, the dominican gulls depend primarily on concealment for the protection of their eggs. The nesting site is never far from the sea and is always in a prominent position which commands a wide view of the surrounding country, and while any intruder is still a long way distant the bird slips unobtrusively off its nests and retires to a point from which it can watch events. However, if the intruder comes too close to the nest the bird flies overhead with loud protests and usually makes determined efforts to drive the enemy away. For this reason the summits of rocky stacks along the shore are often chosen, or the summits of bare moraine hillocks. Other nests may be found out in the middle of wide flats behind the beaches. Skuas passing near the nesting site are always

pursued, and a gull has even been seen to grab one by the tail feathers. The gulls nest singly, though in favoured areas three or four pairs may be found nesting at no great distance from one another.

The adults begin to go in pairs in September. On 16 September, 1953, one pair was calling from the top of a mount in a known nesting area, while a second pair was flying overhead, apparently engaged in some form of courtship flight. The earliest note of nest building was 23 October, 1949, when a pair was found beginning to gather seaweed and scraps of vegetation for a nest on top of a hummock. The nest is not a very elaborate affair, but seaweed, miscellaneous vegetation, penguin feathers, and often shells are gathered to line the shallow saucer. The usual clutch is two or three eggs, sometimes similar in pattern but often strikingly different (plate 53). There may be an interval of several days between the laying of consecutive eggs. In 1949, eggs were taken as they were laid from a nest on Wharf Point on 16, 20 and 28 November. On the first of these dates a three-egg clutch in which incubation had already commenced was found at Corinthian Bay, but a nest with two fresh eggs has been found as late as 6 December (1953).



PLATE 54—Newly hatched dominican gull chicks in nest.

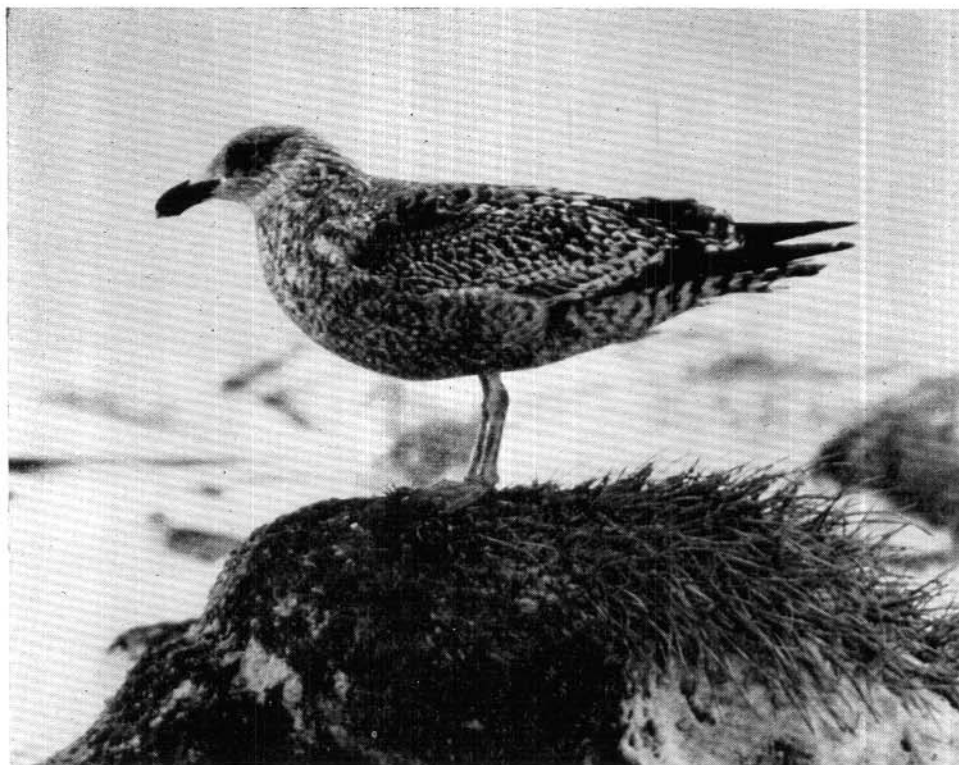


PLATE 55—Dominican gull in juvenal plumage (first winter).

The earliest record of hatching is of a nest found with one egg chipping on 4 December, 1950. The chicks may leave their nest when a very few days old.

The newly hatched chicks (plate 54) have a pale brown down with darker markings on the head. Legs and feet are dark grey, while the bill is black except for a flesh coloured tip. By the beginning of February the chicks have begun to moult into the juvenal plumage. At this stage the bill is black with a lighter tip and legs and feet are black. The full juvenal plumage is assumed by about the end of February. One at West Bay was noted as being able to fly short distances on 19 February, 1950.

Plumage sequence. This requires further investigation, but during the second half of 1953 counts of the composition of flocks gave some interesting results (Table 15). The mottled brown first-year plumage with black bill and legs is worn till the birds are fully one year old (plate 55). This is succeeded by an intermediate plumage (plate 56) in which the head, neck and chest are mottled brown and white; the primaries and back are black⁽¹⁾, but the inner half of the wings is mottled brown; the

⁽¹⁾ Falla (1937) describes the back as brown in this plumage, Dwight (1925) as black mixed with a variable proportion of brown feathers.

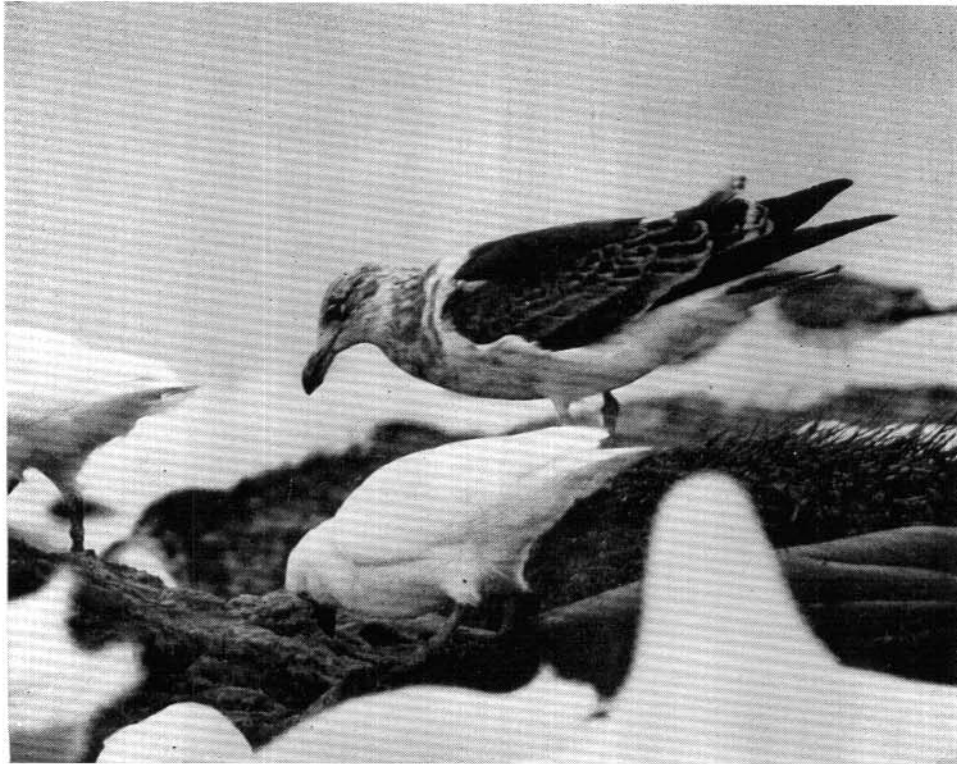


PLATE 56—Dominican gull in intermediate plumage (second winter), with sheathbills.

rump is white with a little fine brown barring; the tail is white with an irregular black terminal bar. The bill has some yellow, and the legs are pinkish grey. In winter some of the birds in otherwise adult plumage have a variable amount of brown flecks on the head and neck, and these were presumed to be birds in their last winter before donning full adult plumage (plate 57).

TABLE 15.
COMPOSITION OF DOMINICAN GULL FLOCKS, AUGUST 1953—
JANUARY 1954.

<i>Date</i>	<i>Adults</i>	<i>Inter- mediate</i>	<i>Juvenals</i>	<i>Locality</i>
11th August (a)	15 (*)	25	3	South-West Bay
(b)	36 (*)	22		South-West Bay
15th August	17 (*)	25	8	Atlas Cove
1st September	25	23	10	Atlas Cove
11th December	20	25	12	Atlas Cove
6th January	3	12	7	Atlas Cove

The large proportion of birds in intermediate plumage is curious and suggests the possibility that two years may be spent in this stage. Adults among the December and January flocks must be non-breeding birds.

* Including birds with brown-flecked heads.

Feeding habits. While both the gulls and skuas spend much of their time foraging along the beach, accepting anything edible which they may find, the diets of the two species are basically different. The most important item in the gull's diet is the limpet (*Nacella kerguelensis*) which is the only common shellfish along the Heard Island shore. These limpets are swallowed whole and the shells subsequently disgorged after the contents have been digested. Wherever the gulls rest, large quantities of these shells may be found, often neatly nested. At other times the birds may be seen feeding on the plankton along the water's edge. Once a young gull was seen to capture a ribbon-like fish, about eight inches long, from a receding wave and swallow it whole. When a giant petrel vomits to lighten itself for a hurried take-off, any waiting dominicans quickly dive for the spoils, whether over land or water. They are also often present when a leopard seal makes a kill off-shore, on the look out for tit-bits. However, during the summer months they come into direct competition with the skuas in scavenging along the shore and at this time are forced to take second place. At least by day they have no part in the spoils at the elephant seal harems. It is perhaps in this connection that they have developed a partly nocturnal habit, for they are the only shore birds which are active by night. During the winter months they gather to a

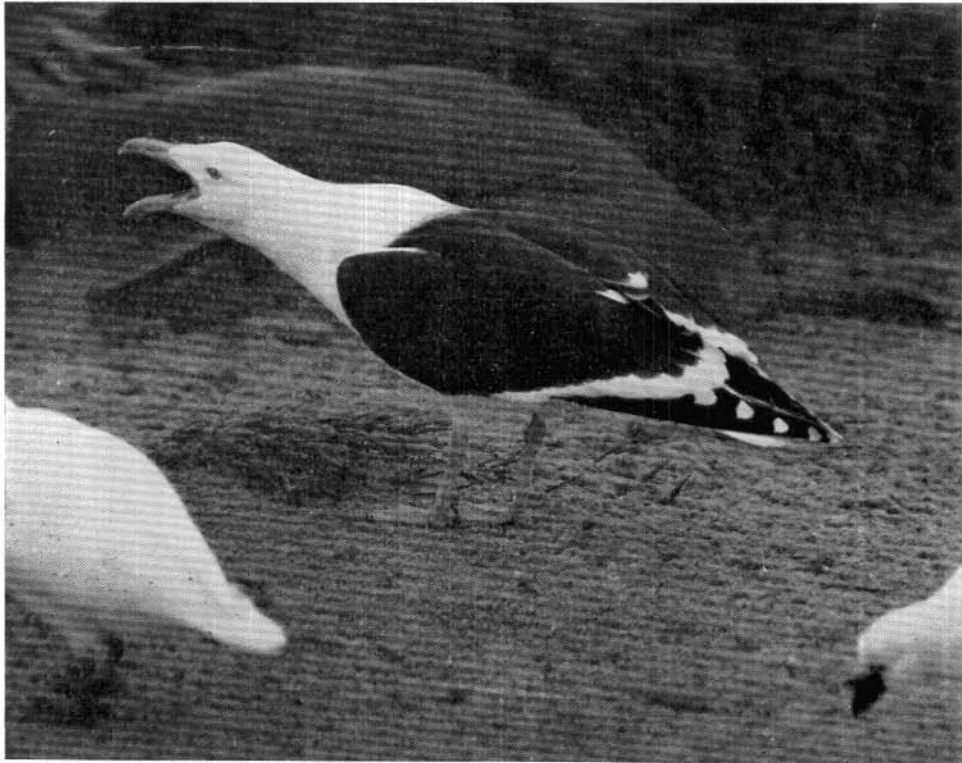


PLATE 57—Dominican gull in adult plumage.

seal kill, but during the summer the mob of skuas prevents their approach by day. However, towards sunset the gulls begin to gather and when the skuas depart to their roosts at dusk the gulls come in for their share. At any time of the year, walking along the beaches late at night, one may expect to hear parties of gulls calling as they pass overhead. In late June and July, when all the skuas have left except for a few stragglers, an interesting reversal in dominance takes place. Now the gulls gather in force to a seal kill, and the two or three skuas which may be about stand in the background. On one such occasion, a skua attempted to challenge one of the gulls, but the latter replied with spirit, and the skua withdrew again.

The contents of eleven stomachs examined were very assorted, the principal findings being:—

Limpet shells	4
Fish bones	3
Algae	3
Seal hair and penguin feathers	3

One juvenal, probably only recently fledged, had evidently been feeding among land vegetation, and its stomach contained wingless flies, beetles and small gastropods, as well as some algae. The algae were probably swallowed incidentally during feeding. Of seven cases examined for internal parasites, four only were infected. Two were heavily infected, one had only a single cestode in the large intestine and one had a similar cestode and a trematode in the gall bladder.

ANTARCTIC TERN

(Wreathed tern)

Sterna vittata vittata Gmelin

Distribution and habitat. In the summer months *S. vittata* is always to be seen in the bays, fishing along the beaches about the island. The regular occurrence of these birds in pairs or singly and their fishing habits as they feed along the surf render them very familiar. However, they are among the least numerous of the breeding species on Heard Island. It is probable that no more than about six or eight chicks are reared to the flying stage each year in the northern quarter of the island. The maximum number of terns to be seen in the Four Bays area of the island is usually about 50. This maximum occurs during the end of December and again in the autumn just prior to the main exodus.

Nesting colonies were situated at:—

- (a) Cape Gazert—terminal moraine.
- (b) Jacka Valley—terminal moraine.
- (c) Terminal moraine at the glacier on the south side of the Mt. Dixon-Mt. Anzac col.
- (d) Sydney Cove—boulder beach.

These terminal moraine colonies all lie over buried ice and are close to the sea, except in case of the Mt. Anzac colony which is separated from the water by three-quarters of a mile of moss-covered broken lava. The boulder beach at Sydney Cove is a rock spit five to ten feet above sea level. Two previously used sites have been recorded—Saddle Point moraine in 1948 (R. Dovers in personal communication) and Baudissen moraine (Moseley, 1892). Terns have recently been noted over the Baudissen and other moraines during the summer but no nests were built. The moraines above Long Beach and Spit Bay probably support more colonies. Mt. Anzac colony in 1950 and 1951 was confined to the top of the moraine overlying ice, but in 1953 some pairs were also nesting on an out-wash flat below the glacier.

These terns are at all time capricious in their movements, so it is difficult to generalise from the experience of any one season. They are almost entirely absent from Heard Island during the winter, and as Paulian (1953) states that they also leave Kerguelen, it is a matter for conjecture where they go. From the nature of their habits it seems unlikely that they lead a purely pelagic existence, especially as at Macquarie Island they are resident throughout the year. Occasional individuals or small parties may be seen during the winter, and most notable records being parties of five on 18 August, 1950, five on 15 August, 1950 and six in mid-September, 1951, but whether these are pelagic wanderers or birds which never leave the island it is impossible to say. Their winter absence is further emphasized by considering the records for the four years for which most information is available.

1949: None noted between 30 June and 30 November (latter probably arctic terns).

1950: None from 18 August to 31 October.

1951: Records for all months, but two single birds only in October.

1953: None from 8 August to 24 November (four at Sydney Cove).

The earliest note of birds in breeding plumage is of a pair seen resting on a frozen lagoon on 31 October, 1950. A few others have been noted during November and the first half of December, but the main body of breeding birds does not return till late in that month. In 1953 they were very late in returning, and at the end of December no more than four could be counted at Sydney Cove and there was no sign of them at the Mount Anzac colony. Several birds which appeared in Atlas Cove at the same time may have been the vanguard of the breeding birds, being the first terns seen in the four bays since a straggler was noted on 8 August. However, in February, 1954, antarctic terns arrived in unprecedented numbers, an estimated total of 200 being seen by John Béchervaise on one day in late February in Corinthian Bay, while in the same month unusual numbers were present over the nesting grounds at Sydney Cove. The observers failed to find any nests.

Much tern activity is carried out in groups. During the summer non-breeding pairs and small groups of from three to seven fly along the coast. On several occasions groups of terns were observed in direct flight from Atlas Cove or Corinthian Bay towards West Bay past Mount Olsen just at dusk. This happened frequently in summer, but also once in September, so it is probable that there are particular roosting localities.

Breeding habits. When the breeding birds first return to Heard Island they spend most of the day fishing over the surf or resting on the beach at their favourite feeding places. Observed flights indicate that they return to their nesting grounds to roost at night. When resting on the beaches they are often in pairs at this time, and courtship behaviour may be observed.

Laying dates are very scattered, and there is some indication that the Sydney Cove colony tends to lay earlier than birds on the glacier moraines. The clutch is invariably one. The earliest egg date was 17 January, 1951, when two nests, each with a single egg, were found among coarse shingle behind the storm beach at Sydney Cove (plate 58 shows such a nest). About ten birds were flying over the colony. Prior to this ten birds were present at the Mount Anzac colony and three prepared nests were found, but no eggs, nor were any present on 18th January. The difference in time was much more evident in 1953.

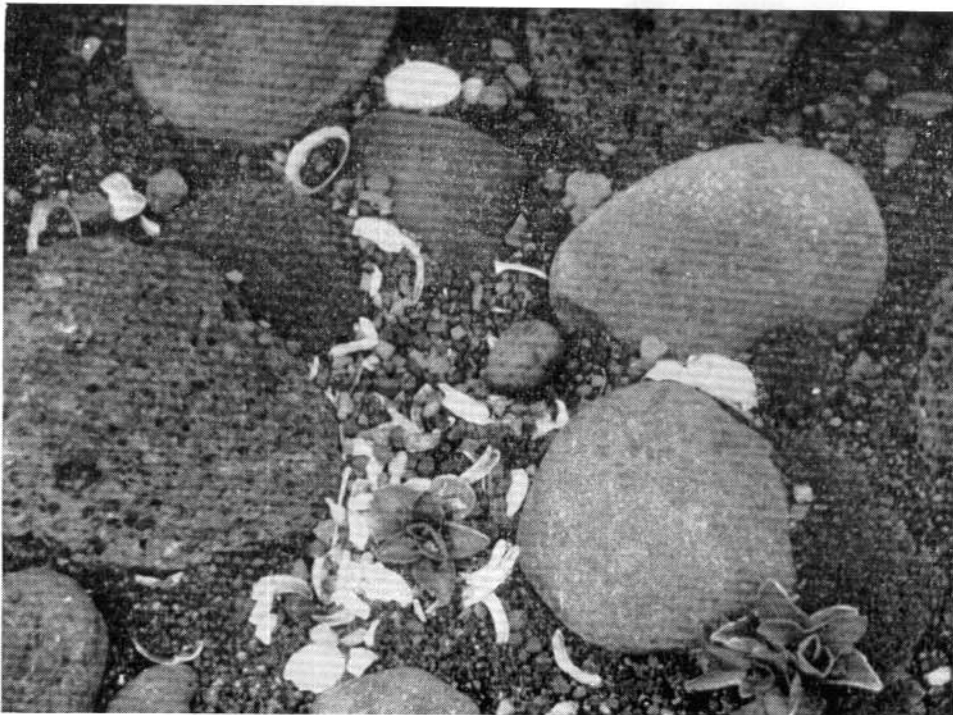


PLATE 58—Nest and egg of antarctic tern.

On 6 February, 1952, two nests were found on the Jacka Valley moraine with one egg each and two pairs of adults overhead, while on 15 February there were three nests, each with an egg, and seven terns. The egg laid since the previous visit was cold, suggesting that incubation had not yet begun. The seven terns consisted of three pairs and one single bird, which was being chased by the others. On 5 February, 1954, Béchervaise noted a dozen terns flying over this moraine, apparently all in pairs, each with a very restricted territory which was vigorously defended, but no nests or eggs could be found.

During incubation a sitting tern will leave its egg when an observer approaches within about 40 feet, and with loud cries and clicks of its bill will fly directly over the intruder and may even strike his head with its beak. The single birds attract the attention of their mates along the sea-shore and these return and add to the clamour. The owners of nests farthest from the observer will often settle on their eggs again if the intruder remains still, but most alight on a nearby stone and continue their protests. Any skuas which approach are quickly sighted and several terns immediately give chase. The skua makes no defence and moves quickly out of the area.

The scatter in nesting time can be seen most clearly in the 1953 fledging data. On 24 March two juvenals were flying short distances in the nesting area at Sydney Cove. On the previous day, two eggs (one cracked) and two chicks, perhaps a week out of the egg, had been found in the lower section of the Mount Anzac colony. On 29 March the first juvenal, escorted by its parents, was seen on Corinthian Beach.

On 20 April two juvenals, at about the same stage as those seen at Sydney Cove on 24 March, were found in the Mount Anzac colony; the cracked egg was still being incubated, though rotten, and the second egg was chipping. The two fledglings were presumed to be the two chicks seen here a month earlier.

On 25 June three of five terns at South-West Bay were juvenals, two of them in very brown plumage.

On 9 July an adult carrying a small fish was seen following a juvenal with a rather brown mantle at South-West Bay. Both landed on the sand, and the young one was fed. This was the latest date on which a bird in juvenal plumage has been recorded.

After leaving the nesting grounds the young birds go to the feeding beaches where for some time they are closely escorted by both parents. Their plumage is at first a warm brown, but after they become completely independent this soon fades to a greyer shade. The number of juvenals seen at any one time never exceeded three, suggesting either a very low success rate or the presence of a large proportion of non-breeding adults.

Moult and departure. There is much variation in the time at which the terns acquire winter plumage. In 1951 Downes noted that in May and June the number of white heads seemed to increase gradually, until at the time of the general exodus in the middle of June about one third of the flocks appeared to be in full winter plumage. In 1953 the first white-capped antarctic terns were two seen on 24 May. However, a few remain in breeding plumage, or with only a slight sprinkle of grey on the forehead, till the end of June. The tern seen feeding a young one on 9 July had a bright red bill and its cap was completely black or almost so.

During April and most of May only small parties of terns are seen along the beaches, and these often include two or three juvenals, but during the first week of June, 1951, Downes noted a marked increase in the number frequenting Corinthian Beach, with a maximum of 35 on 2 June. After this there were rarely more than two or three seen on any one day for the rest of the winter. In 1953, flocks of 18 on 31 May and 20 on 11 June were recorded, and at sunset on 25 June a flock of 11 was sighted gathering to roost behind the beach in Atlas Cove. This flock included only one juvenal, though three had been seen a little earlier over South-West Bay. These observations suggest that a portion of the non-breeding birds or unsuccessful breeders either leave the island in April, or begin to spend much of their time fishing out at sea, but that just before their departure the remaining birds gather into flocks at their favoured beaches, perhaps including birds from other parts of the island's coast. An alternative hypothesis is that they represent a passage of birds from further afield, but there is no other evidence to support this.

Field notes on plumage stages. When the young first leave the nesting areas the warm brown tints in their plumage are conspicuous. The mantle and scapulars are heavily burred; the crown appears blackish brown, but when clearly seen the light longitudinal stripes in the crown can be made out; the primaries appear grey. There is a rust coloured band across the chest, most conspicuous at the sides. Lower back, tail and lower belly appear white, the barring on the outer tail feathers being quite inconspicuous.

As already noted, after the young have been on the wing for a few weeks the brown tints fade, and the effect is then more grey and black with white underparts and tail.

This plumage is presumably followed by a *portlandica* stage in the first summer, but this is rarely seen. On 5 January, 1954, Gwynn saw a party of terns fishing at a stream mouth, the party consisting of six antarctic terns in breeding plumage, four arctic terns in winter plumage, and one white-capped antarctic tern, presumably a bird in its first summer. This bird seemed intermediate in size between the other two groups, but closer to the adult antarctic terns. Its bill was black; the white cap appeared relatively smaller than in the arctic terns and its mantle and underparts were pale grey; there was some brownish wash on the

outer wings; the webs of the primaries appeared centrally translucent, giving a dappled effect not seen in the arctic terns; the outer retrices were long, whereas the arctic terns all had short tails.

On 4 April, 1951, Downes saw a white-capped tern at Cape Gazert ternery which he considered to be an arctic tern, though the possibility of it having been a *portlandica* stage antarctic tern is not excluded.

The transition from summer to winter adult plumage has already been described. Downes reports that all birds seen during August and September, 1951, were in full winter plumage, and he noted that two terns seen on 3 and 4 November of that year still had partly white caps.

Feeding habits. A good deal of feeding undoubtedly takes place over open water in the bays, and possibly farther afield, but observed feeding is mainly along the sandy beaches of Atlas Cove, South-West Bay, and Corinthian Bay, the last being especially favoured. Here the heavy surf stirs up quantities of marine organisms for which the terns dive. Once a tern was watched picking plankton off the wet sand in the wake of a receding wave. At times single birds will establish fishing rights

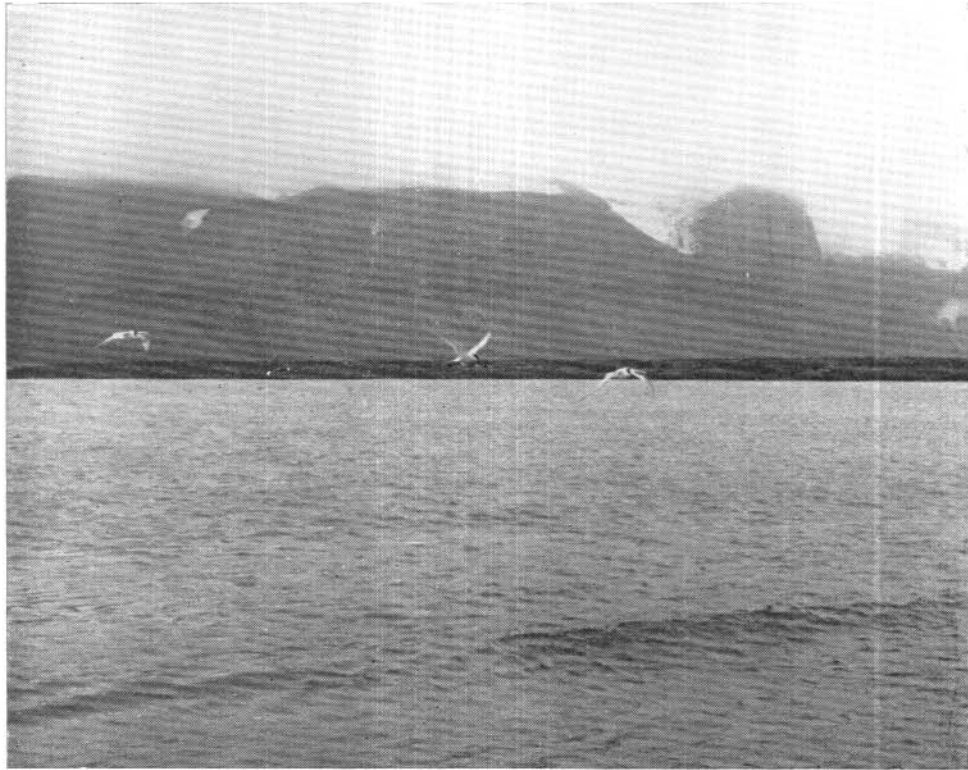


PLATE 59—Two antarctic terns (left) and one arctic tern (right) in flight: the white forehead of the latter shows clearly.

over a section of the beach, driving other terns away from their selected area, but more often they range freely up and down the length of the beach. Their food must consist mainly of plankton and small fish, the latter often being carried to the chicks, or carried about during the courtship flights. However, anything that can be picked up in the surf may be included. The stomach of one juvenal contained a remarkable collection including two small fish, several amphipods, one limpet foot, and the bones, feathers and stomach of some small bird.

Notes are available of the contents of 16 adult stomachs including the seven already reported on by Ealey (1954, *b*). The results are somewhat surprising, since three stomachs, all collected on different dates, included limpets without their shells, and four stomachs contained large polychaete worms, identified by Ealey as belonging to a species inhabiting inter-tidal niches. Two of these stomachs contained both polychaetes and limpets. These animals are therefore evidently a normal item in their diet, but there are no observations to suggest how they are obtained. They could be collected from the vomit of dominican gulls which would also account for the offal in the stomach of the juvenal already noted, but one could not expect this to be a frequent source of supply. The frequent inclusion of a kelp-inhabiting amphipod (Ealey, 1954, *b*) suggests that these terns spend more time foraging in the kelp zone than our observations suggest. Other unusual findings were several small gastropods (once) and unidentifiable splinters of shell (once).

As would be expected, the commonest finding was small crustacea (nine times, one stomach containing 77 amphipods and one euphausiid). Fish was found once only, in the juvenal already mentioned. Much evidently depends on where the terns have been feeding before being shot.

ARCTIC TERN

Sterna macrura Naumann

An account of the occurrence of this tern at Heard Island has already been published by Downes (1952). It is now well-established that this species passes regularly by Heard Island from October to December on its way south. The first of these passage migrants may be seen towards the end of October, but the main passage seems to occur about the end of November and early December. Records of small parties in early January, and occasionally later, suggest that a few birds may go no further than Heard Island, but there is no real evidence of a return passage in autumn. This is not really surprising, as one can surmise that the birds may be glad to pause as they near the end of their great southward journey, but that the early stages of the return migration in April (Bierman and Voous, 1950) are undertaken rapidly, and that the birds pass by out at sea.

TABLE 16
 DATES OF PASSAGE OF ARCTIC TERNS, HEARD ISLAND, 1950-54.

	October	November	December	January
1950-51	22 (1)	18 (3) 25 (several)	11 (10-15) 27 (2)	1 (2)
1951-52	23 (1)	9 (2) 22 (1)	14 (5) 21 (3) 26 (1)	5 (4)
1953-54 .....	.....	29 (5)	18 (9)	5-6 (4)

One tern shot on 1 January, 1951, was moulting its tail feathers and the new outer rectrices were growing. On 3 March, 1953, four white-capped terns, probably this species, were fishing in Corinthian Bay among the antarctic terns, and two were seen on subsequent dates up to 29 March when one was shot. The survivor continued to frequent this beach till it also was shot on 12 April. Unfortunately both these specimens fell into the surf and were lost. On 4 April, 1951, Downes saw one in the Cape Gazert colony of antarctic terns, which he considered to be this species. It was noted on various occasions that the antarctic terns would drive off the arctic terns when they came too close to the spot where the former were fishing.

HEARD ISLAND CORMORANT

(Heard Island shag)

Phalacrocorax atriceps nivalis Falla

Habitat, distribution and numbers. The main problem about this species is that, though moderate sized flocks are occasionally seen, only two small rookeries are known. A jagged islet a few miles off-shore bears the name "Shag Island", a name apparently given to it by the early sealers, but there is no other evidence that shags breed there. The old sealers may have used the name "Shag Rocks" or "Shag Island" for any outlying groups of rocks, irrespective of their fauna.

However, it is possible that a few small colonies could supply the whole of the observed population, for these shags are an excellent example of a species which, because it is so regularly seen, appears to be common, though in fact the total population is extremely small. During the winter of 1950 these birds were always to be seen in Atlas Cove, but these were members of a party of five or six which gathered each evening on the far side of the Cove and spent much of their time there or on Wharf Point. They are poor flyers, and when disturbed always show great unwillingness to take flight. They spend a large proportion of their time resting safely on some conspicuous rocky point, the only enemy to the adult being the sea leopard.

The two known breeding colonies are at Saddle Point, near the top of a low sea cliff, where about twenty pairs nest annually, and on the top of a rocky stack seventy yards off-shore at the southern end of Sydney Cove. Here six or eight pairs nest each year, though there is plenty of room for more. Other points along cliff edges, usually somewhat below the level of the neighboring cliffs, are regularly used as resting places by small groups, mostly immature birds.

There are few notes of large flocks, the earliest concerning a curious incident observed on 1 December, 1950. This was described in the day's field notes as follows:—

“On arrival at Erratic Point found 58 immature shags draped along the cliff edge above the Macaronis and invading area of abandoned sites at upper corner; seven were in sub-adult plumage with black mantles and weakly developed caruncles, the rest were in brown juvenal plumage. Six of sub-adults were in pairs, one pair asleep and one pair courting tentatively with mutual preening and collecting of nesting material (second bird of this pair had no caruncles). Some juvenals also standing in pairs, one pair doing a little mutual preening.”

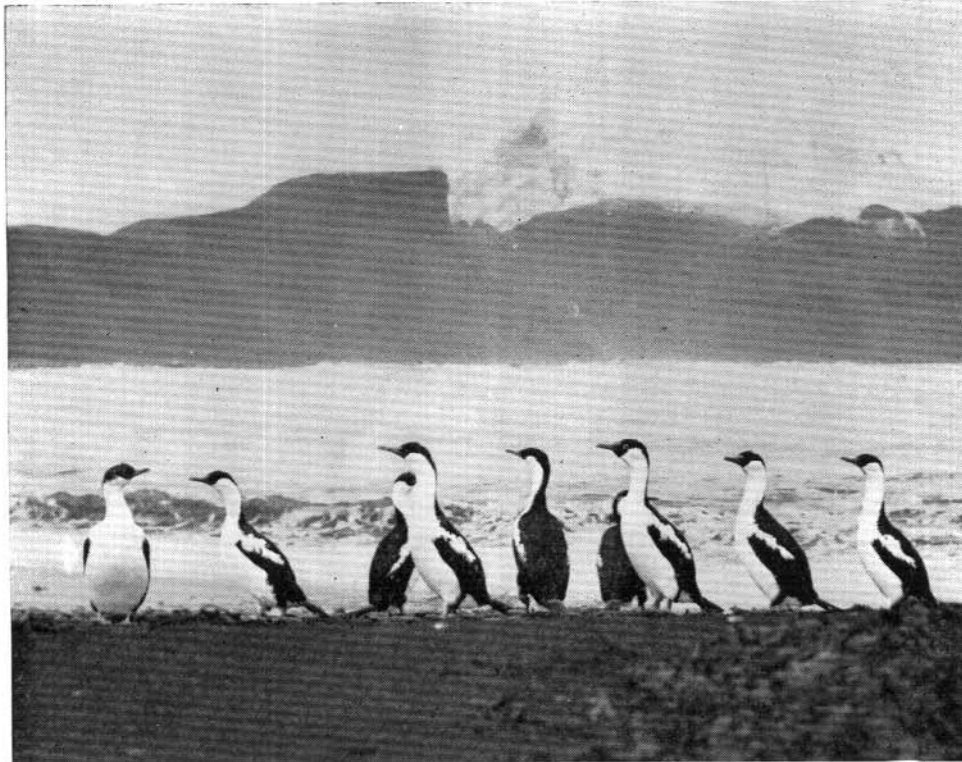


PLATE 60—Party of Heard Island cormorants. The bird with its back to the camera is a juvenal, lacking the caruncles and white dorsal patch of the adult.

All flew off while the macaronis were being checked. Shags had not before been seen at this point, nor did they ever return.

On 27 April, 1953, a flock of 25 shags circled Atlas Cove, then landed on the beach. Meanwhile, another flock of 20 had appeared and flown off towards West Bay while smaller parties of eight and four were also flying about. For the next few months they were much commoner in Atlas Cove than usual. On 30 December about 40 birds in juvenal and immature plumage were resting on the steep, tussock-covered cliffs facing the small colony in Sydney Cove, and it was evident that these slopes were in regular use. Another thirty were seen on the same day on top of the lava cliffs at Red Island, a mile distant.

Breeding habits. These shags are present at their nesting colonies some months before the breeding season. Of thirty birds present at the Saddle Point colony on 1 August, 1951, 29 were adults in breeding plumage. In 1950 this colony was fully occupied and nest building was proceeding by early October. The nest consists of a pile of grass stalks and leaves with a depression in the middle. As the breeding season advances, the area immediately surrounding the nest becomes very slushy with guano and mud, so that by the end of the season enough of this mixture has been trampled into the nest to give the impression that it has been built more of mud than of grass.

Egg-laying and incubation. Laying commences about the middle of October. Eggs were reported on 15 October, 1948, and as they were noted to be "delicious when boiled" it is assumed that incubation had not commenced. Eggs taken on 24 October, 1949, contained embryos one- to three-quarters of an inch in length and it was considered that they had been laid more than a week previously.

Two to four eggs are laid in each nest, the usual number being four. The eggs are a pale greenish-blue with patches of a chalky encrustation.

These cormorants sit closely, hissing and waving their heads at any intruder (plate 61). Often both birds sit on the nest together and become so entwined that it is hard to tell which wings belong to which bird.

On 4 November, 1949, eggs were found to be chipping. Budd visited this colony on 5 December, 1954, and noted that "most birds had two chicks whose size ranged from being only a few inches shorter than adult, to tiny skinny birds just out of the shell: a couple of birds were still incubating".

Moulting. When the Saddle Point rookery was visited on 4 January 1950 the chicks were at various stages of moult. Some were still covered in dark brown down while others had assumed the juvenal plumage except for a little down about the head and throat. Birds at this stage were of course unable to fly and huddled about their parents on the nest. However,

there were birds in the rookery that had the juvenal plumage and which could fly, but these were probably young from the previous season. The juvenal birds can easily be identified by their brown plumage, lack of white dorsal patch and lack of yellow caruncles. In 1951, when Sydney Cove was visited on 17 January, most of the chicks had completed their moult but were still present in the rookery.

Feeding habits and parasites. The main food of the Heard Island cormorant is the Notothenid fish which abounds in the shallows. A juvenal shag which entangled itself while stealing fish from a "graball" net had a stomach full of fish, one of which was identified as *Notothenia cyanobranchia*. Its stomach also contained several isopods, amphipods, and some green algae resembling *Ulva* sp., though this last was probably accidental. Other occasional findings were a squid beak (once) and a small gastropod (twice). The amphipods, isopods, and perhaps also the two small gastropods could have been derived from the stomachs of digested fish. The digestive juices of these birds are evidently very strong, for a fish that a young cormorant was seen to swallow several minutes before its capture had only half entered the bird's stomach, but that half had already changed colour and was losing its skin.



PLATE 61—Heard Island cormorant on nest, in "basking" or threat display.

On one occasion a parent bird was seen to pass its half-moulted chick a piece of grass which stopped its clamouring for a short time. When this chick was later dissected it was found to have its stomach almost full of a mass of grass stems and roots, dirt and pebbles as well as a few fish bones.

Out of ten stomachs examined (including two chicks), nematodes were found only once. One other bird had a heavy infestation of nematodes in the bronchi and acanthocephala in its intestine.

HEARD ISLAND SHEATHBILL

(Paddy)

Chionis minor nasicornis (Reichenow)

This species is resident all the year round at Heard Island. Sheathbills pick up a precarious living along the shore during the winter, while in the summer months they enjoy an abundant food supply among the breeding herds of elephant seals and in the penguin rookeries. Many of them frequented the station (plate 62), scavenging in the refuse tip and looking for scraps in the dog bins. In the winter of 1953 the station flock at its maximum totalled nearly 250 birds, but in the summer it

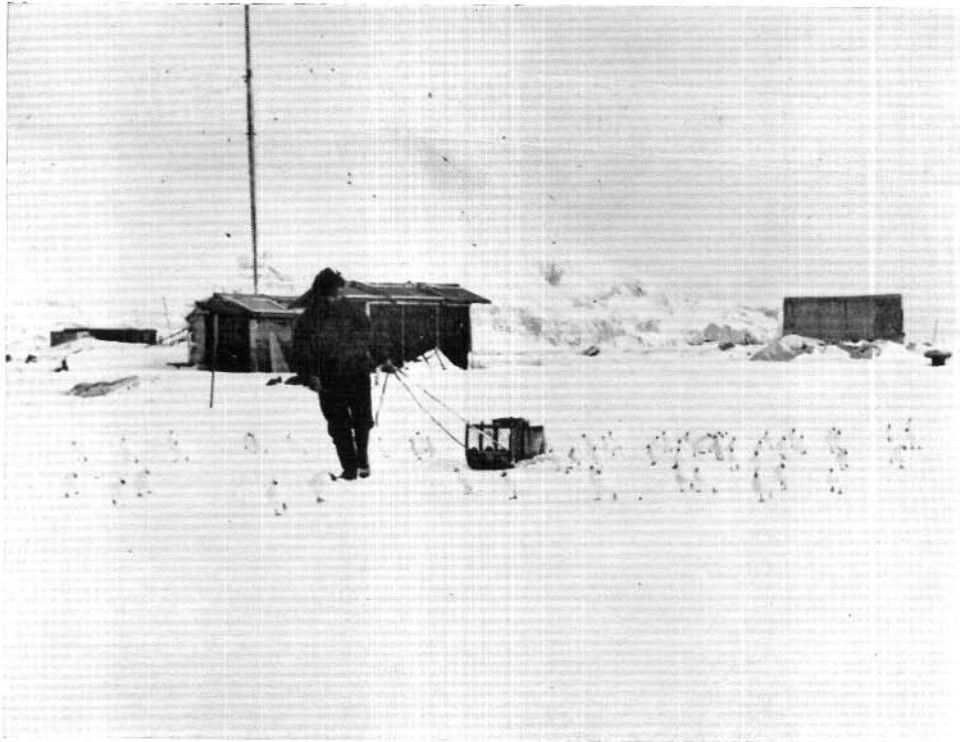


PLATE 62—Sheathbills following sledge to the refuse dump.



PLATE 63—Sheathbill at entrance to nest. The penguin egg was placed there as a decoy. Note leg bands.

dwindled to less than half this number, the remainder having dispersed to their breeding territories and more orthodox feeding grounds. During the day those not actively engaged in foraging gather in flocks round about or retire to Wharf Point, and when conditions are suitable much time is spent in bathing in the streams or in sea pools, but at night they disperse to their roosting places. Many roost in the lava cliffs facing Atlas Roads, but others come from farther afield, and towards sunset may be seen flying, singly or in small parties, towards Corinthian Bay or making the half-mile crossing from Wharf Point to Mt. Aubert de la Rüe, which is the only extensive sea crossing on which they have been known to venture. In reasonably calm weather this flight may be made at a height of 60 to 100 feet above the water, but on other occasions they fly low over the surface. In 1951 Downes banded many with individual colour combinations, making it possible to follow the movements of individuals, and this mainly served to emphasize their sedentary nature. Some birds commuted between Corinthian Bay and the station, others came from West Bay or even South-West Bay, but the birds from West Bay and South-West Bay and those from Corinthian Bay mingled only at the station. The extensive glacier fronts probably impede movement round the island, though flights across the face of the Baudissen Glacier were occasionally witnessed, the birds flying close to the face of the glacier, just below the top of the cliffs.

Sheathbills are not conspicuously gregarious birds. When resting they commonly gather into groups of up to a score or more (the larger congregations seen around the station are exceptional), but these are aggregations of convenience rather than true flocks. Foraging and movements are undertaken singly or in small parties. An important factor in keeping them together is fear of the skuas, which sometimes make passes at isolated sheathbills. The reaction of the sheathbills to this is to fly to the nearest flock or to make for the shelter of the nearest rocks, and no doubt partly for this reason during most of the year they tend to congregate at the ends of the beaches, venturing along the open beach only to feed.

Breeding habits. There is a remarkably close association between the sheathbills and penguins, especially the macaronis. Towards the end of October the breeding pairs take up territories in the penguin rookeries, and the nests are sited in the rookeries or on their immediate fringe. The nest is often quite a substantial, rather untidy structure of grass, but where no grass is available in the birds' territory penguin feathers, egg membranes and other debris are used. Some of these nests become very smelly in time. The nest is placed deep in a cave under a rock (plate 63), and its presence is sometimes betrayed by the broken penguin eggs lying



PLATE 64—Adult sheathbill.

about the entrance. When an enemy approaches, the sitting bird usually leaves the nest to join its mate, and the two retire to watch events from the top of some conspicuous boulder, often that under which the nest is hidden.

The clutch is usually two or three eggs which are laid between the middle and end of December. Downes found the incubation period to be about 29 days. Addled eggs are common and it appears that only two chicks are normally hatched. Two chicks are sometimes reared, but in a large proportion of cases only one chick is fledged. The chicks remain in the shelter of their caves until they are fully feathered. In March and early April family parties consisting of two adults and a juvenal may be seen in the penguin rookeries, but soon after this the young birds wander off on their own, and in 1953 the first of these were seen among the station flocks on 3 April. They are then easily recognised by the flatness of the casque on the bill and by their distinctive call.

Feeding habits. The sheathbill is a scavenger, and picks up what it can find according to the season. During the first half of October most of the sheathbills spend their time in the elephant seal harems, where they run about among the cows, on the look-out for blood or placental remains, and when occasion offers they sip the milk running from the seal's nipples when the pups stop feeding. Towards the end of October most of them move to the macaroni and rockhopper penguin rookeries where they share with the skuas the harvest of discarded first eggs, and later steal eggs from sitting birds, as described by Falla (1937, p. 267). The greater part of most macaroni rookeries is divided into carefully defended territories. The great rookery at Corinth Head in 1951 and in 1953 was completely divided among six pairs, but in some rookeries areas which provide no nesting sites provide a common hunting ground, which may be used by non-breeding birds, otherwise condemned to forage on the outskirts.

After the breeding seasons are over the sheathbills forage along the shore for what they can find. On some days they may be seen hunting along the tide margin for plankton washed up along the beach, their footsteps following the lines marking the limit of the waves on the sand. On rocky coasts they are often seen at low tide picking among the seaweed-covered intertidal rocks. During the winter, especially, they feed on the faeces of seals and penguins. When there are large numbers of leopard seals ashore it is usual to see a number of sheathbills standing around expectantly. They also annoy the leopard seals by picking at the small cuts and abrasions which are common on the tails of these animals. Budd suspected that some of these small wounds, which closely resemble peck marks, may be inflicted by the sheathbills themselves. When resting, the gentoo penguins congregate in large numbers on the snow at their favoured beaches, and here there are always a number of sheathbills in attendance. In early September, 1953, between 25 and 30 sheathbills were counted on the "Little Beach" between the Baudissen and Challenger glaciers, where up to a thousand gentoos were gathered.

Internal parasites. Cestodes are a common finding in the intestine, and in one instance a trematode was found in the gall-bladder.



PLATE 65—Lava and *Azorella* hummocks on the west coast of Laurens Peninsula.

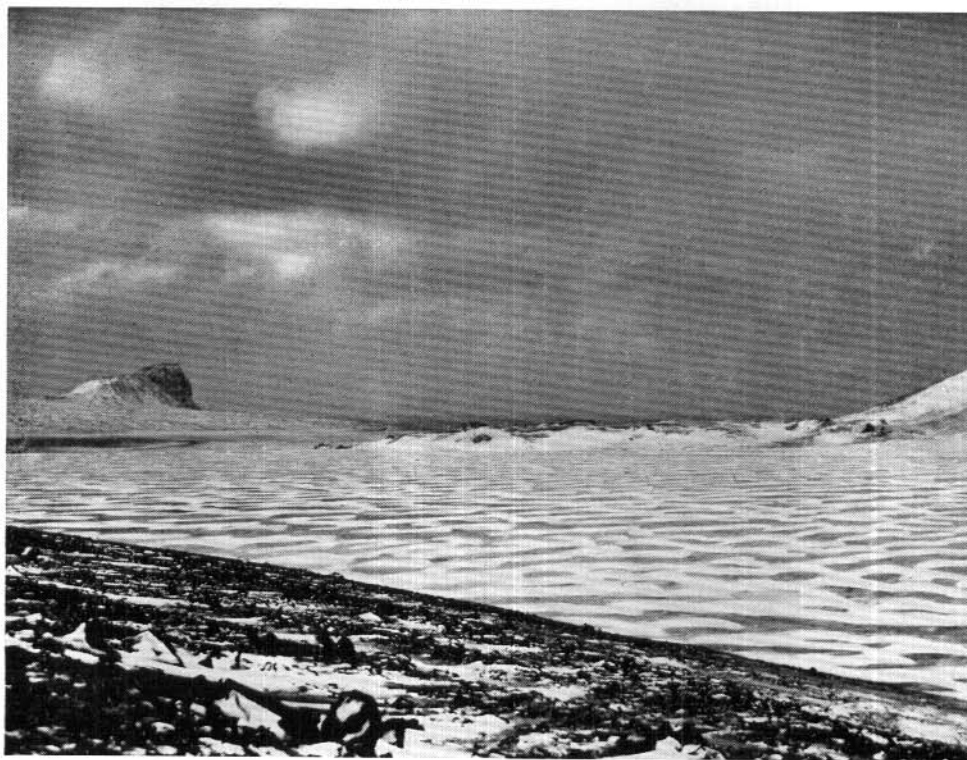


PLATE 66—The flats between Atlas Cove and Corinthian Bay, with Rogers Head in the background.

ACKNOWLEDGMENTS

The authors would like to thank the members of ANARE parties who have contributed useful observations and assistance in the field, notably Dr. G. Faulkner, P. Brown, R. McNair, Dr. G. Budd and D. Sweetensen who maintained the bird banding programme from 1952 to 1954. Acknowledgments are also due to Dr. R. Carrick for useful criticism of the final draft, and to Dr. D. L. Serventy for assistance and advice in the earlier stages of preparation.

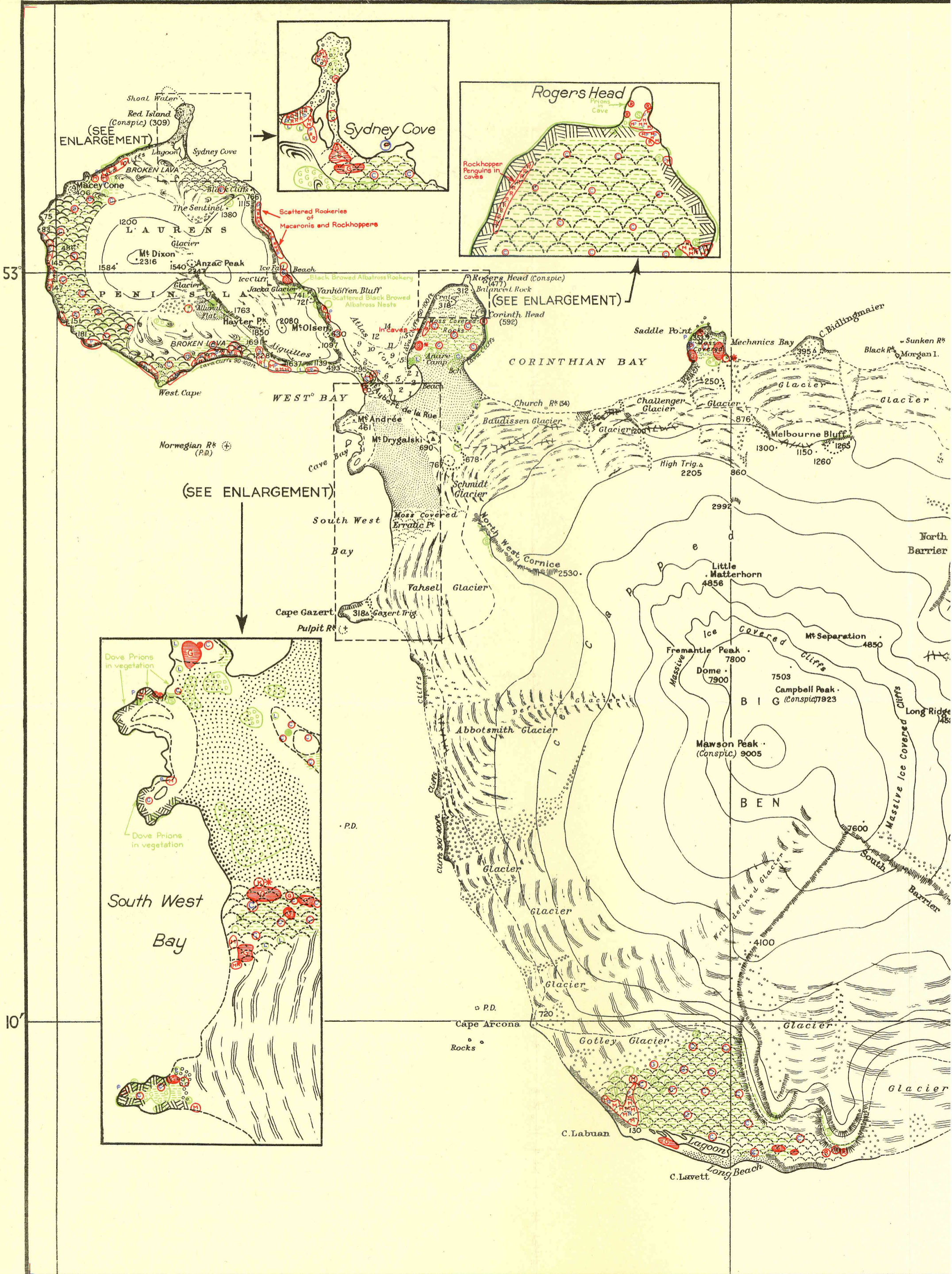


PLATE 67—The foot of the Jacka Glacier.

REFERENCES

- ARDLEY, R. A. B., 1936. The birds of the South Orkney Islands. "Discovery" Rep., 12, 349.
- BAGSHAW, T. W., 1938. Notes on the habits of the gentoo and ringed or antarctic penguins. Trans. zool. Soc. Lond., 24, 185.
- BIERMAN, W. H. and VOOUS, K. H., 1950. Birds observed and collected during the whaling expeditions of the "Willem Barendsz" in the Antarctic, 1946-47 and 1947-48. Ardea, 37 (special number) 123 pp.
- CHITTLEBOROUGH, R. G. and EALEY, E. H. M., 1950. Bird ringing at Heard Island during 1949. Emu, 50, 102.
- CLARKE, W. E., 1906. On the birds of the South Orkney Islands. Ibis, ser. 8, 6, 145. Also in Rep. Sci. Results Voyage "Scotia" 1902-1904, 4, 219.
- DOWNES, M. C., 1952. Arctic terns in the sub-antarctic. Emu, 52, 306.
- DOWNES, M. C., 1955. Size variation in eggs and young of the macaroni penguin. Emu, 55, 19.
- DOWNES, M. C. and GWYNN, A. M., 1955. Penguin marking at Heard Island, 1951 and 1953. ANARE Interim Rep. no. 8, 12 pp.
- DOWNES, M. C., GWYNN, A. M. and HOWARD, P. F., 1954. Banding of giant petrels at Heard and Macquarie Islands. Emu, 54, 257.
- DWIGHT, J., 1925. The gulls (Laridae) of the world; their plumages, moults, variations, relationships and distribution. Bull. Amer. Mus. nat. Hist., 52, 63.
- EALEY, E. H. M., 1954a. Ecological notes on the birds of Heard Island. Emu, 54, 91.
- EALEY, E. H. M., 1954b. Analysis of stomach contents of some Heard Island birds. Emu, 54, 204.
- EDMONDS, S. J., 1955. Acanthocephala collected by the Australian National Antarctic Research Expedition on Heard Island and Macquarie Island during 1948-50. Trans. Roy. Soc. S. Aust., 78, 141.
- FALLA, R. A., 1937. Birds. Brit. Aust. N.Z. Ant. Res. Exped., 1929-31, Rep., ser. B, 2, 288 pp.
- GILCHRIST, A., 1952. Occurrence of the snow petrel at Heard Island. Emu, 52, 201.
- GWYNN, A. M., 1953a. Some additions to the Macquarie Island list of birds. Emu, 53, 150.
- GWYNN, A. M., 1953b. The egg-laying and incubation periods of rockhopper, macaroni and gentoo penguins. ANARE Rep., ser. B, 1, 29 pp.
- HAMILTON, J. E., 1939. The leopard seal, *Hydrurga leptonyx* (de Blainville). "Discovery" Rep., 18, 239.
- HOLGERSON, H., 1945. Antarctic and sub-antarctic birds. Sci. Results Norweg. Ant. Exped. 1927-28 et seq. No. 23, 100 pp.
- HOWARD, P. F., 1954a. ANARE bird banding and seal marking. Vic. Naturalist, 71, 73.
- HOWARD, P. F., 1954b. Banding of the black-browed albatross at Heard Island and Macquarie Island. Emu, 54, 256.
- HOWARD, P. F., 1956. Banding of giant petrels at Heard Island and Macquarie Island—II. Emu, 56, 401.
- JOUANIN, C. and PREVOST, J., 1953. Captures de manchots inattendus en Terre Adélie et considérations systématiques sur *Eudyptes chrysolophus schlegeli* Finsch. Oiseau et Rev. Franç. Ornith., 23, 281.
- KEITH, K. and HINES, M. P., 1958. New and rare species of birds at Macquarie Island during 1956 and 1957. C.S.I.R.O. Wildl. Res., 3, 50.
- von KELER, S., 1954. The Mallophaga from *Eudyptes chrysolophus* (Brandt) and *E. cristatus* Miller. Proc. R. ent. Soc. Lond., (B), 23, 47.
- LAW, P. G. and BURSTALL, T., 1953. Heard Island. ANARE Interim Rep. No. 7, 32 pp.
- LEARMONTH, N. F., 1955. Sea Birds of Portland, Victoria. Emu, 55, 100.
- MATTHEWS, L. H., 1929a. The natural history of the elephant seal, with notes on other seals found at South Georgia. "Discovery" Rep., 1, 233.
- MATTHEWS, L. H., 1929b. The birds of South Georgia. "Discovery" Rep. 1, 561.

- MAWSON, Patricia M., 1953. Parasitic Nematoda collected by the Australian National Antarctic Research Expedition: Heard Island and Macquarie Island, 1948-51. *Parasitology*, 43, 291.
- de MEILLON, B., 1952. The fleas of sea birds in the Southern Ocean. ANARE Rep., ser. B, 1, 11 pp.
- MILON, P. and JOUANIN, C., 1953. Contribution à l'ornithologie de l'île Kerguelen. *Oiseau et Rev. Franç. Ornith.*, 23, 4.
- MOSELEY, H. N., 1892. Notes by a naturalist on H.M.S. "Challenger". John Murray, London. (Heard Island, p. 187).
- MURPHY, R. C., 1936. Oceanic birds of South America. 2 vols. American Museum of Natural History, New York.
- MURPHY, R. C., 1938. Birds collected during the Whitney South Sea Expedition. XXXVII. On pan-antarctic terns. *Amer. Mus. Nov.*, No. 977, 17 pp.
- MURPHY, R. C. and HARPER, F., 1921. A review of the diving petrels. *Bull. Amer. Mus. nat. Hist.*, 44, 495.
- OLIVER, W. R. B., 1954. Avian taxonomy. *Emu*, 54, 190.
- ORNITHOLOGICAL SOCIETY OF NEW ZEALAND, 1953. Checklist of New Zealand birds. Auckland.
- PAULIAN, P., 1953. Pinnipèdes, cétacés, oiseaux des îles Kerguelen et Amsterdam. *Mém. Inst. sci. Madagascar, sér. A*, 8, 111.
- RAND, R. W., 1954. Notes on the birds of Marion Island. *Ibis*, 96, 173.
- RANKIN, N., 1951. Antarctic Isle. Collins, London.
- RICHDALE, L. E., 1944. The titi wainui or fairy prion, *Pachyptila turtur* (Kuhl). *Trans. Roy. Soc. N.Z.*, 74, 32; 165.
- RICHDALE, L. E., 1951. Sexual behaviour in penguins. University of Kansas Press, Lawrence, Kansas.
- ROBERTS, B., 1940a. The life cycle of Wilson's petrel, *Oceanites oceanicus* (Kuhl). *Brit. Graham Land Exped. 1934-37, Sci. Rep.*, 1, 141.
- ROBERTS, B., 1940b. The breeding behaviour of penguins, with special reference to *Pygoscelis papua* (Forster). *Brit. Graham Land Exped. 1934-37, Sci. Rep.*, 1, 195.
- ROUTH, M., 1949. Ornithological observations in the antarctic seas, 1946-47. *Ibis*, 91, 577.
- SCLATER, P. L., and SALVIN, O., 1880. On the Steganopodes and Impennes collected during the expedition. *Rep. Sci. Results Voy. "Challenger", Zool.*, 2, 117. Also in *Proc. zool. Soc. Lond.*, 1878, 650.
- SERVENTY, D. L., and WHITTELL, H. M., 1952. The correct name of the crested penguin. *Emu*, 52, 63.
- SLADEN, W. J. L., 1953. The Adélie penguin. *Nature, Lond.*, 173, 952.
- SORENSEN, J. H., 1950. The light-mantled sooty albatross at Campbell Island. *Cape Exped. Ser. Bull.*, no. 8, 30 pp.
- WHITTELL, H. M., 1937. Adélie penguin in Western Australia. *Emu*, 37, 65.
- VANHOFFEN, E., 1912. Tiere und Pflanzen der Heard Insel. *Dtsch. südpolar Exped. 1901-03*, 2, 267.
- ZUMPT, F., 1952. The ticks of sea birds. ANARE Rep., ser. B, 1, 9 pp.



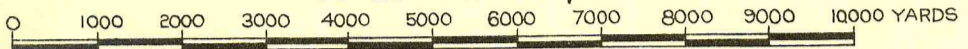
DISTRIBUTION OF BIRDS HEARD ISLAND 1951

Prepared by
AUSTRALIAN NATIONAL ANTARCTIC
RESEARCH EXPEDITION 1951

Ice fall shewn thus
Contours(1000 ft intervals)
Sand

Azorella covered rocks shewn thus
Glacial Moraine
Moss covered lava

SCALE IN YARDS



KEY

- | Sphenisciformes | Procellariiformes | Miscellaneous |
|---|---|--|
| Gentoo Penguin (<i>Pygoscelis papua</i>) | Giant Petrel (<i>Macronectes giganteus</i>) | Sheathbill (<i>Chionis minor</i>) |
| Macaroni Penguin (<i>Eudyptes chrysotophus</i>) | Cape Pigeon (<i>Daption capense</i>) | Southern Skua (<i>Stercorarius skua lombergii</i>) |
| Rockhopper Penguin (<i>Eudyptes chrysocome</i>) | Dove Prion (<i>Pachyptila desolata</i>) | Dominican Gull (<i>Larus dominicanus</i>) |
| King Penguin (<i>Aptenodytes patagonica</i>) | Fairy Prion (<i>Pachyptila crassirostris</i>) | Antarctic Tern (<i>Sterna vittata</i>) |
| Ring Penguin (<i>Pygoscelis antarctica</i>) | Kerguelen Diving Petrel (<i>Pelecanoides urinatrix</i>) | Heard Island Cormorant (<i>Phalacrocorax atriceps nivalis</i>) |
| | South Georgian Diving Petrel (<i>Pelecanoides georgicus</i>) | |
| | Wilson's Storm Petrel (<i>Oceanicus oceanites</i>) | |
| | Black Browed Mollymawk (<i>Diomedea melanophris</i>) | |
| | Light Mantled Sooty Albatross (<i>Phoebastria palpebrata</i>) | |

Note:-The symbols indicate only the known nesting regions of species, and are intended to give only approximate indication of the numbers of birds in these regions.

* These nesting sites now abandoned.

