Plate II — Royal Penguins during the guard stage: the heavy-billed male stands by while the female feeds the chick.

ASPECTS OF BREEDING BEHAVIOUR IN THE ROYAL PENGUIN
Eudyptes chrysolophus schlegeli

By JOHN WARHAM
Zoology Department, University of Canterbury

SUMMARY

The breeding cycle begins in late September, when the mature males come ashore after their winter at sea to occupy their nesting sites, and ends in early April, when the breeders return to sea following their annual moult. This cycle of nesting and moult is outlined and the main patterns in a complex sign-language of display and posturing are described.

1. INTRODUCTION

This paper is the second in a series to deal with the behaviour of all the *Eudyptes* penguins on their breeding grounds. That on the Rockhopper Penguin *(E. crestatus = chrysocome)* has already appeared (Warham, 1963). The present observations were made between 19 December 1959 and 12 March 1961 while the writer was biologist with the Australian National Antarctic Research Expedition (A.N.A.R.E.) at Macquarie Island. Other work on the present species done during this period but not reported on here formed part of a long-term A.N.A.R.E. programme to investigate the population ecology of the bird under the direction of Dr. R. Carrick. In 1960 this mainly involved the flipper banding of large numbers of chicks. 6,683 were so marked at four different colonies while in 1961 many hundreds of these and other banded birds were re-sighted at their natal colonies or elsewhere. Information resulting from this large-scale banding is being incorporated in the long-term study (Carrick, in preparation) and some has been recently published (Carrick and Ingham, 1970).

There are few previous accounts of this sub-species, the most valuable being those of Falla (1937) and of Carrick (1964). Useful comparative data on the typical race are to be found in Matthews (1929), in Gwynne (1953) and in Downes, Ealey, Gwynne and Young (1959).

The Royal Penguin breeds only at Macquarie Island. Although birds of this species in adult plumage appear on other sub-Antarctic islands such as Campbell Island in the summer (where partnerships may be established between birds of opposite sex — personal observations), the Macquarie Island population shows a high degree of endemism. Nest sites and mates are retained from year to year and young birds show a marked tendency to return to their natal colonies.

Eudyptes c. schlegeli is a medium-sized penguin standing about 40 cm high. Adults have long, orange-coloured, non-erectile plumes which arise on the centre of the forehead and droop over the back of the head and behind the eyes. Like other Eudyptids, Royals show a marked sexual dimorphism in body and bill size. When feeding chicks and thus unencumbered with extensive fat deposits adult females weigh about 4.0 kg whereas their mates average about 4.5 kg. The bills of 10 adults of both sexes measured by A. Gourin (A.N.A.R.E. records) were 65 - 70 mm long (mean 66.4 mm) in the males and 55 - 64 mm long (mean 57.8 mm) in the females and their bills were

31 - 34 mm deep (mean 32.8 mm) in the males and 28 - 32 mm deep (mean 29.4 mm) in the females. These size differences are usually readily apparent in pairs at their nesting sites — Plate II.

The Macaroni Penguin *(E. c. chrysolophus* differs mainly in having black cheeks and throat, areas that in the Royal Penguin are white or pale grey. Judging from the data given by Downes *et al* (1959) Macaronis may also have slightly smaller bills. A very small proportion of the breeders at Macquarie Island also have black throats and cheeks. Such birds are rare. Their under flipper patterns are similar to those of *schlegeli* and the two types interbreed. Conversely, at Heard Island a few white-faced birds are found among the typically dark faced Macaronis (Downes *et al, loc cit*). Birds showing various intermediate conditions between the white faced and dark faced forms are plentiful at Macquarie.

Royal Penguins are colonial when breeding and they occupy about 46 small (< 1,000 nests), medium-sized (1,000 - 10,000 nests), and large (> 10,000 nests) colonies. Precise delimitation of colony boundaries is difficult as in some areas, e.g., at Upper Nuggets and South West Point, breeding groups are more or less contiguous although the young nevertheless tend to return to their own particular " sub-colony."

These breeding aggregations may be along the shoreline and almost down to high water or inland and up to nearly 500 feet above sea level. They tend to occupy open and fairly flat ground with a sandy substrate or one where the rocks and pebbles are fairly small. Occasionally, as at Aurora Point, nests may be located among coastal talus comprising rocks several metres across. Often there is some admixture with Rockhoppers but the latter tend to lay among the more broken rock debris and between tussocks on the slopes above the talus so that where the two species are adjacent the Royals nest closer to the sea than the Rockhoppers.

The world's largest breeding group of Royal Penguins is at the south eastern end of the island at Hurd Point where the birds are spread out across a triangular area of rather flat sand and small rocks estimated by Ainsworth (in Falla, 1937) to cover about 16 acres. The landing places here lie on two sides of a triangle whose base is the bottom of a steep tussock-clad slope. This colony occupies much the same area as that visible in J. F. Hurley's photograph taken between 1912 and 1914. The main difference is that the western edge of the colony was closer to the sea when the earlier picture was taken compared with the situation today, a difference also evident when another photograph taken by Hurley and reproduced by Mawson (1915, vol. 2, p. 226) is compared with those taken by me in 1960. This difference is probably due to the " erosion " of the bird's nesting and resting area above the beach by Southern Elephant Seals *Mirounga leonina.* Several harems comprising about 150 animals are visible in the 1960 photographs, none at all in the earlier ones. Some of the effects of seals on the penguins are discussed in section 2g below.

The smallest colony noted during my stay was one of about 60 nests. It was situated on the seaward side of the main King Penguin *Aptenodytes patagonicus* colony at Lusitania Bay — Plate III. There were two groups of about 30 nests, each lying one either side of a shallow water course. This colony was evidently an innovation of the 1960/61 season, being absent the previous year.

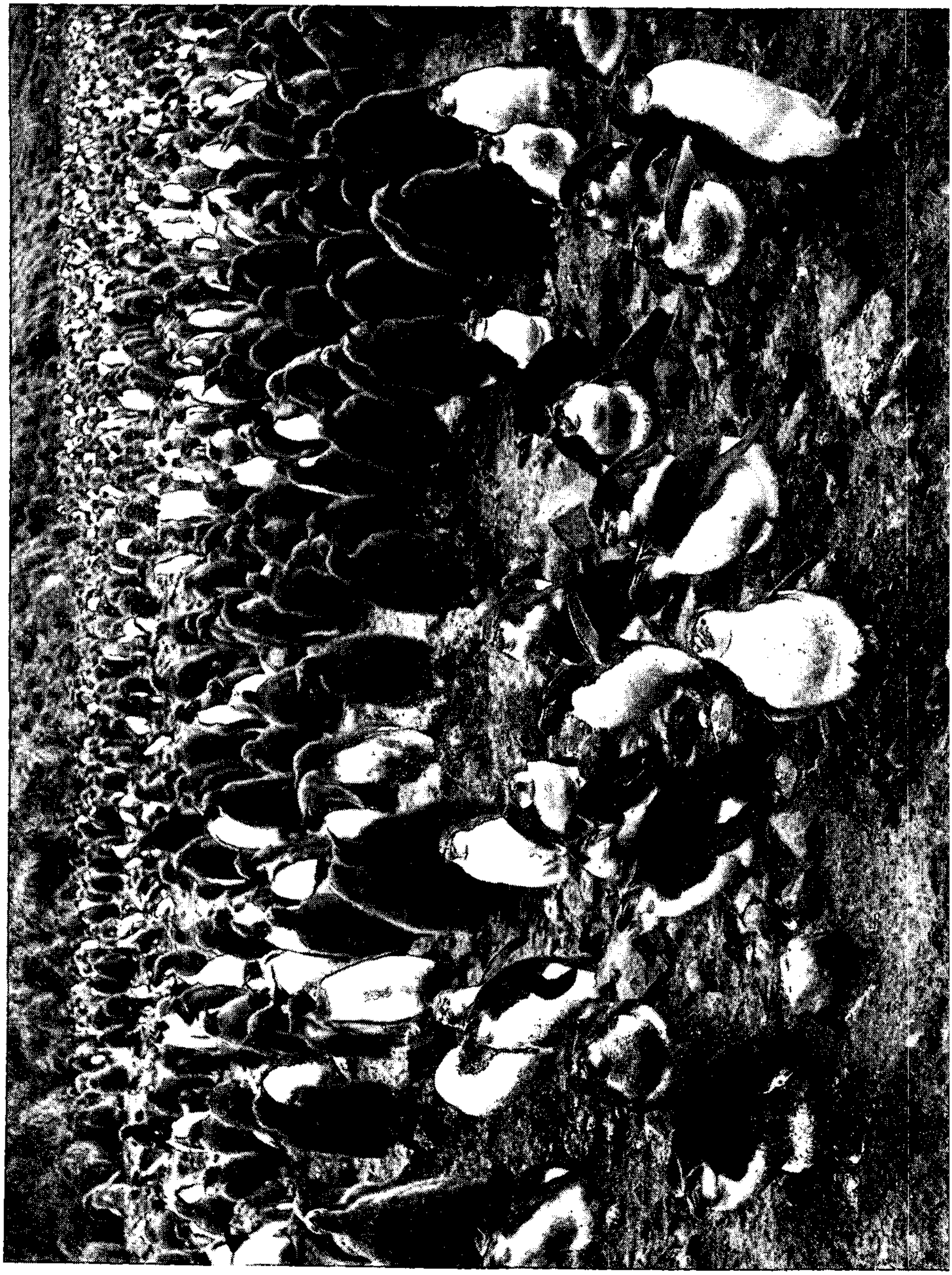

Plate III — Part of a small colony at Lusitania Bay on 31 October 1960. Note the "Macaroni type" bird standing with an egg in the centre of the picture. King Penguins in the background.

Access routes to the inland colonies follow the drainage patterns, the birds making their way to and from their landing places along permanent streams. Where such routes reach the sea and near the main landing areas at coastal colonies, quite large assemblies or "clubs" form. Most of the birds in these appear to be immatures or non-breeders as noted by Falla *(loc. cit)* and these sites are occupied throughout the breeding season, but by a changing clientele. That at Nuggets Beach, where Nuggets Creek reaches the sea has often been figured and sometimes described, in error, as a breeding colony.

2. THE BREEDING CYCLE

a. *General Outline*

Royal Penguins spend the winter at sea, returning to their nesting colonies from mid-September onwards, the males being the first ashore. The breeding cycle is highly synchonised and there seems to be little variation in the dates of the main events at a particular colony from one year to the next. Egg-laying takes place between about 10 and 30 October and after a few days the male departs leaving his mate to undertake the first incubation shift which lasts about 14 days. He then takes over for a similar span while the female feeds at sea. Both are present when hatching occurs between 21 November and 10 December. The chick, sole survivor from a two-egg clutch, is guarded by the male for 10 - 20 days during which time the female brings food for it, while the male fasts. The chick then enters a creche and the male goes to sea. Thereafter both parents feed their chick. Most of these leave for the sea in late January closely followed by the breeding adults who have to fatten up in preparation for their annual moult. They return to their nests after an absence of nearly five weeks and fast for a month while acquiring their new plumage. They leave the island from about the end of March; and after about 15 May no Royal Penguins are to be seen on or from the island until the following spring, as the successful breeders are the last category of the population to moult.

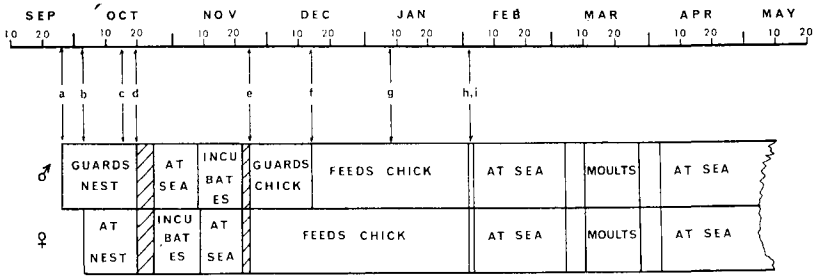

FIGURE 1 — Diagramatic cycle of successful breeders from arrival to departure after moult.

a: Male returns.
b: Female returns.
c: First egg laid.
d. Second egg laid.
e: eggs hatch.
f: chick enters creche.
g: chick starts to feather.
h, i: chick and parents depart.

(Cross hatching indicates periods where adults change duties frequently.)

This annual cycle, as shown by a typical breeding pair, is outlined diagrammatically in Figure 1 which may be compared with similar figures presented by Downes *et al* (1959) for the Macaroni and by Warham (1963) for the Rockhopper.

b. *The Occupation Period*

The majority of the breeding birds return to Macquarie Island during the second half of September. A few arrive earlier and there are A.N.A.R.E. records of birds at Lusitania Bay as early as 3 September and at Hurd Point about 6 September. One would expect to find atypically early arrivals at the biggest colonies as these provide a bigger potential population to draw upon but although the breeding timetables are quite rigid there appear to be some variations in chick development between colonies and these may be reflected in differing mean dates of arrival, but I have no data on that.

Events at the medium-sized Flat Creek colony on the west coast in 1960 illustrate the general pattern of colony growth during this occupation period:—

10 September	No birds present.
14 September	14 birds in two groups near centre of colony.
16 September	38 birds in loose group in centre of colony.
19 September	c. 400 birds scattered over whole area.
22 September	Many single birds, no pairs, colony perhaps ¼ full.
27 September	Colony almost full of single birds.
30 September	Some pairs now present.
2 October	Many pairs now present.
6 October	Colony full of pairs and copulation seen.

The present information on dates of return agrees reasonably well with that given by earlier observers. Thus Ainsworth found (in Falla, 1937) that the first birds at Nuggets in 1912 came ashore on 15 September. The breeding timetable is about a month earlier than that of the typical race in the more severe climate of Heard Island and in Gwynne's table (1953, p. 27) the 8 and 9 November given as laying dates for Macquarie are presumably errors for 8 and 9 October.

The first arrivals are males and although these may group together initially, they soon spread out to stand at their nest sites, collect stones and await their mates. These appear about 8 days later. New arrivals usually land in small parties and just as they do later during their almost daily emergences when feeding chicks, the birds hasten to escape the pluck of the sea and then stand about preening, swishing their tails from side to side, and shaking their feathers free from water before slowly wending their way up to their breeding places.

With the arrival of the female there is much activity, greeting ceremonies are frequent and there is a great deal of nest-making, much fighting and copulation. Both members of a pair appear to remain at or near the nest site until the eggs appear and incubation proper begins.

c. *Egg Laying and Incubation*

The first and smaller of the two eggs comprising the clutch start to be laid about 8 October and the second egg appears from 4 to 6 days later. The mean date for the laying of the eggs is, however, later, being around 16 October for the first egg. This is seldom incubated but one or other of the pair stands over it and they change guard fairly often at this time.

Incubation proper begins with the arrival of the second egg and one or other of the adults adopts a more prone position, tucking the eggs into the highly vascularised brood patch which both sexes possess and which, because of the thickness of the ventral plumage, forms a kind of pouch within which the eggs are held while being partly supported by the sides of the feet. After some days the male leaves for the sea and according to Carrick (1964) some of them may not leave until 10 days after egg laying. By the time that the males do depart they have been ashore without food for about a month.

The colonies are quieter now as the females are less aggressive than their mates and with only one bird to each nest and that one engaged in continuous incubation, there are fewer occasions for bickering.

This genus seems to be unique among birds in laying a small first egg in a two-egg clutch. Gwynne (1953) measured 13 clutches of *c. chrysolophus* at Heard Island and gives a mean size for the first egg of 70.6 x 49.1 mm (range 66.0 - 82.4 x 45.3 - 52.7) and for the second a mean size of 80.9 x 58.7 mm (range 78.1 - 88.0 x 54.8 - 61.7). The mean weights of the eggs were 94.0 g (range 78.9 - 105.4) and 154.5 g (range 128.2 - 171.4).

No eggs were measured by me and the data in the literature for *schlegeli* e.g. those given by Falla *(loc. cit)* and Schonwetter (1966) are unsatisfactory as dimensions for first and second eggs are lumped together. However Soucek (in Gwynne, 1953) gives the mean weights of first and second eggs as 102.8 and 162.2 g respectively and their mean lengths as 68.7 and 80.7 mm.

It will be seen from Figure 1 that in this species, as in other Eudyptids so far studied, it is the female who undertakes the first incubation shift. This occurs despite her having been ashore without food for nearly three weeks and having produced two eggs in that time. Carrick and Ingham (1967) emphasise the importance of adequate fat reserves in the hens if these are to withstand the stresses of egg production and of fasting for nearly 5 weeks from their arrival until their mates take over at the end of a 19-day incubation stint. These workers state that hens lighter than 4.8 kg on arrival rarely lay but that some hens weigh as much as 6.3 kg at this juncture.

With the start of laying, eggs begin to be found outside nests. Such eggs are seldom retrieved but tend to get displaced downhill if not taken by predators. Relaying does not seem to occur and if both eggs are lost, nesting fails for that year. So many eggs are found out of the nests that some observers have concluded that the birds deliberately kick out the first egg. Losses are not however, confined to these eggs; many second eggs are lost too. Naturally the smaller ones predominate if only because they are subject to

risk for 4 to 6 days longer than the large ones and furthermore the risk during these days is greater than it is later as the birds not only fail to sit properly but also change guard frequently. That both eggs may be viable is shown by the fact that two may be hatched in the same nest, although if two young are ever reared, this must be most unusual.

I can find no eye-witness accounts of a Royal Penguin ejecting one of its eggs and Gwynne (1953) who discusses this matter in connection with incubation of Macaroni and Rockhopper eggs, evidently did not see this either, although he clearly believed that it happened. Similar losses are experienced by other members of this genus but more work seems necessary to determine the causes; how much loss is due to the way in which the birds stand over the first egg so that it can be easily dislodged during the disorders so common at this stage of the breeding cycle when there are pairs at every nest and the colonies are crowded; how much is due to deliberate actions of the birds (in the absence of human influences), and how much is due to infertility and to other factors.

With such vast numbers of birds in view, one often comes across anomalous behaviour.. Some penguins may sit on three eggs, the extra ones probably being strays captured from higher nests. Some eggs get coated with mud during rain and then dry out to become cemented to the ground where they resist all the efforts of the sitting birds to turn them with their bills, while sometimes penguins may be found sitting on nests in running water with their eggs warm on top but cold below.

d. *The Chick Stage*

I have no information on which egg hatches first if both survive, but usually both parents are present at the hatch and according to Carrick (1964) the female is present for about a week before this event. Hatching occurs from 33 - 36 days after the laying of the second egg (A.N.A.R.E. data collected by A. Gourin and S. E. Szordas); for 35 days according to Carrick. The latter is the same period as determined by Gwynne (1953) for the typical race.

The male remains at the nest for a further three weeks after the hatch during the so-called " guard stage." Initially he treats the chick rather like an egg, tucking it into his brood pouch. Feeding of the chick at this stage seems to be the sole responsibility of the female but I have few observations on the male's behaviour during the first few days of the chick's life nor were data collected on the frequencies with which meals were provided by the female although these seemed to be of the order of two visits every three days. On each visit a succession of meals is given by regurgitation (Plate II).

Growth is rapid during the guard stage. When alarmed the chick burrows beneath its guardian but soon can only get its fore-parts concealed while its posterior protrudes from beneath the parent's legs. The chick's rear is then well protected by the adult's heavy bill. During the guard stage the main activity between parent and chick apart from brooding is the preening of the latter by the former.

As the chick grows it becomes more mobile and venturesome and the end of the guard stage is marked by the appearance of small groups of three or four chicks away from the nests. These creches begin to form from about 15 December, the date varying somewhat between colonies but the earliest creches are generally seen at the larger colonies. Even on 15 December in 1960 some adults were tending two chicks but as none had been marked it was not certain that they were true siblings or whether a chick from another nest had been accepted by the on-duty male. It is more usual for the males to repel chicks that are not their own. The latter may assist their parents, striking with bill and flippers.

By about 30 December most breeding males are spending their days at sea and both parents now feed the chick. No data were gathered on the frequency of feeds at this time nor on how the parents share these duties but both appeared to forage independently. They brought large quantities of *Euphausia* and some cephalopods. According to Carrick and Ingham (1967) euphausids constitute the main food.

The chicks start to replace their down with feathers in the first half of January and the creches begin to break up as the chicks become stronger. The huddles re-form in the face of any large-scale threat such as the near approach of a man. From about 25 January the creches are no longer seen and the young birds wander quite extensively or may stand on their nests if no big-crested pre-breeders are in occupation. Occasionally the big chicks may pick up stones and add these to the nest and at this time chicks are often seen dancing about on tiptoe while beating their wings violently. During these gyrations they seem unaware of the pecks they receive from bystanders with whom they collide.

By the end of January most chicks have moulted their down and many have fledged. The main body of them has gone by the end of the first week of February. My latest sighting was on 19/2/61, when an adult was feeding a well-feathered chick at Aurora Point.

Although no chicks were marked for this purpose it seemed that in the post-guard stage a chick is fed only by its own parents and then only on the nest. Typically on returning to its nest a breeder displays with forward or perhaps vertical trumpeting after which one or more chicks soon separate from a creche and teeter across to the nest, peeping loudly and waving their flippers. One of these is then fed on the nest site but if a second appears this is pecked vigorously and so repelled. With Rockhopper, Snares *(E. atratus)* and Fiordland Crested Penguins *(E. pachyrhynchus)* parents have only been seen to feed their own chicks on or close to the nest site (Warham, 1963 and unpublished).

Chicks seem to have an excellent sense of position as those displaced during mass banding operations were later being fed at nests many yards from their release points. Their ability to pick out their own from many thousands of similar nests suggests some sort of imprinting by features on the horizon or an ability to pick out the voices of their parents from a considerable distance and amid a great torrent of sound, or both. A similar ability to return to nests after displacement has been recorded of other young sea-birds, e.g. the gannet *Sula serrator* (Warham, 1958).

Plate IV — The guard stage at a typical rocky site. Note the reasonably level ground with Rockhoppers higher up.

Variations in the states of development of chicks between colonies were not investigated quantitatively but some differences were rather obvious. Thus on 16/1/61 the young birds at the medium-sized colony about two miles north of Hurd Point were seen to be markedly more advanced than those at the much larger colony at the Point itself. Many chicks on the smaller colony were almost feathered and their yellow eyestripes were well defined; at the larger many still had quite extensive down on their backs. Rather similar differences had been noted between the chicks at these two colonies the previous season. There also appeared to be differences between the Flat Creek colony and that at Bauer Bay a few miles to the north, the Flat Creek birds being slightly larger at a given date. Finally my notes include several references to the condition of chicks in the Nuggets colonies where those being reared high up and far inland seemed to be less well developed than those at the colony closest to the sea.

Such differences might be due to a number of factors such as differences in the mean ages of the breeding birds at the various colonies as established by Coulson and White (1958) for the Kittiwake *Rissa tridactyla* but it seems more likely that due partly to the tendency of the young to return to their natal colony and of breeders to retain their nest sites and mates from year to year, a degree of genetic isolation develops between colonies that may be reflected in their time tables and perhaps even in their feeding patterns and movements as in the colony-specific dispersal of European Cormorants *Phalacrocorax carbo* studied by Coulson and Brazendale (1968).

e. *Adult Moult*

The departure of the chicks is quickly followed by the return of the adults to sea where they feed up and put on subcutaneous fat in preparation for their annual moult. Birds that have bred successfully start to re-appear ashore during the first week of March. Like other " pre-moult fats " these are noticeably obese and their dorsal feathers soon start to show the dull bronzing that precedes the fall of the old feathers.

Sixteen adults of mixed sexes weighed on average 6.6 kg on arrival as compared with a mean weight of 4.0 kg for five that had moulted. The comparison emphasises the value of sub-dermal fat as an energy reserve during the moult, a time when feeding is impossible.

Breeders return to their nests where they are joined by their mates. Numbers at the medium and large colonies reach a peak around the second week in March, after which there is a steady decline and a mainly one-way traffic of moulted birds down the creeks and beaches to the sea.

Loss of feathers does not begin immediately the birds reach their nests but from 4 to 6 days after that. From 15 to 19 days elapses from the loss of the first to the last feather but when the body feathers have been replaced those of the tail are still very short and further feather growth continues for 5 to 7 days before departure. In their grey-blue and white coats the moulted birds look very dapper and slim, while the rather brownish cast of the colonies as seen from a distance has now been replaced by a bluish

tone. During calms the shed feathers lie thickly on the ground but a wind piles them up into drifts and swirls them into the air like snow scurries. The colonies are fairly noisy during the moulting period, for although the birds are much less active now, many still display and there are some squabbles between neighbours.

The breeders' final disappearance to sea after from 24 to 29 days ashore is preceded by an orgy of bathing either out beyond the breakers as at Nuggets Beach and Bauer Bay or in small rock-walled embayments such as occur at Hurd Point and Flat Creek. Sometimes groups of moulted birds return to the shore and even climb back to the colonies but such visits appear to be only brief and they may arise when moulted birds get caught up with bands of pre-moult fats on their way inland. In those few instances where I was able to watch closely, the birds of a pair completed their moult at different times and neither arrived nor departed together.

By the beginning of April the colonies are thinning out and they are half empty by the middle of that month. Some birds are still ashore in early May and on 11 May 1960 there were still 56 on Nuggets Beach. The last Royal Penguins seen ashore that season were on 13 May and as the first seen ashore the following spring was on 12 September, the species was absent for almost exactly four months.

f. *Immatures*

Adolescence in the Royal Penguin lasts a long time. Carrick and Ingham (1967), from data on 11 successive age classes found that a few five-year-olds lay (though none fledged a chick), that most seven-year-olds come ashore at egg laying but that some are eleven years old before they breed. These workers also established that the birds come ashore progressively earlier and stay longer with increasing age.

Although two-year-olds and some three-year-olds may be recognisable by their smaller sizes and shorter crests, it is the yearling class that is readily identifiable without reliance on marked birds. Yearlings are smaller and slimmer than the adults and have rather small heads and bills. These latter are dull and brownish rather than reddish brown as in the adult but the irides can be almost as bright as the reddish-brown eyes of the adults. Yearlings have very short crests and their cheeks tend to be greyish rather than white. Very occasionally wholly dark cheeked and throated "Macaroni" types are seen.

Yearlings start coming ashore in late November, about a fortnight later than the two-year-olds. Their numbers increase slowly but by about 20 December they are numerous although tending to stand at the edges of the colonies or in the "clubs" above the landing places. They are rather timid and during mass banding operations tend to congregate with the chicks rather than with the adults. According to Carrick and Ingham *(loc. cit.)* individual yearlings do not stay ashore for long at this time of the year. Nevertheless, presumably because their landfalls are not tightly synchronised, in 1960 and 1961, yearlings were seen from about the third week of November until the third week of February. Evidently individual birds come ashore in December and then return to sea to put on

Plate V — During the moult many immatures stand in "clubs" near the breeding colonies. Aggressive encounters such as that seen in the foreground occur whenever these penguins are assembled together.

weight in readiness for their moult and by the last week of January many have started to shed feathers and some have moulted. Three yearlings before the moult averaged 5.0 kg in weight compared with a sample of 8 moulted ones with a mean weight of 3.5 kg.

In the absence of the breeding birds during their fattening up period at sea, yearlings and other immatures penetrate to all parts of the colonies. Thus at Flat Creek on 19/2/60 only the centre of the colony was occupied but the yearlings were outnumbered by rather longer crested birds probably mostly two-year-olds. Most of the yearlings had moulted and left by that date.

Few data on older classes were gathered but big-crested non-breeding birds became noticeable in the post-guard stage. Thus at Hurd Point on 11/1/61 there were many big-crested birds wandering about either singly or in groups and there were far more birds of this type present at that date than yearlings. During this re-occupation period pairs formed and stood around on nests as if owning them, and the males in particular attacked creched chicks. It may be that in this species, as in the Rockhopper, one consequence of the female's taking the first shift on the egg is that the male gets the first spell with the chick and is able to guard it from attack by aggressive but adolescent 'big crests,' the males of which may be powerful enough to interfere with the breeding females when these try to feed their chicks, but which are not powerful enough to interfere with the established males.

It is mostly about this time that groups of penguins in adult plumage are found climbing above the highest colonies and onto the open plateau. Some, like the group of six on 7/1/61 found wandering about several hundred feet above the uppermost of the two colonies above Sandy Bay, almost reach the top of the island.

g. *Some Mortality Factors*

Apart from the prodigality involved in laying two eggs only to raise one chick, there is a very heavy mortality of chicks on the island. Carrick and Ingham state that at their study colony of 2,000 laying pairs only about 750 young are fledged each year.

Many factors are concerned in these losses which start at the egg stage. Not only are eggs lost accidentally but Southern Skuas *Stercorarius skua lonnbergi* and Wekas *Gallirallus australis* may take developing eggs and cause nesting failures. Skuas will pester sitting birds at the fringes of the colonies until they over-reach and allow the egg to be uncovered for long enough to allow the skua to get it. Attempts are made to take small chicks in the same way although I never saw a successful capture. Possibly Southern Giant Petrels *Macronectes giganteus* also get peripheral chicks as they take the larger ones of King Penguins at Lusitania Bay and many fledglings are killed and eaten near the colonies during the young Royals' departures. These birds seem particularly vulnerable during their progress from the inland colonies downstream and giant petrels are often encountered in the stream beds and half hidden by overhanging tussocks feeding on the dead and dying. Others sit offshore in flocks waiting for suitable victims.

Southern Elephant Seals also cause some mortality when they haul out into coastal colonies. Birds with eggs or chicks will not

Plate VI — Elephant Seals cause casualties when they encroach onto breeding sites. This animal caused deaths to both adults and chicks during an intrusion shortly after hatching.

normally shift when confronted by a seal but attack it with their bills. In the result the harassed animal may sweep around in alarm, flattening and killing the birds beneath it (Plate VI).

Elephant Seals may also prevent and hinder the access of breeding penguins to coastal colonies. Thus after a southerly gale on 19-20/10/60 very heavy seas pounded the beach at South East Bay where the seal harems were forced high up the beach and up to the edge of the penguin colony there. Jammed tightly along the shore for several days the seals constituted a severe hazard to the incoming birds. The penguins would cluster on the seaward side of the seal barrier looking for an opening. If one succeeded in getting through, those behind might find their passages more difficult as the first bird through often alerted the seals. Although no penguin was seen to get bitten or squashed a few very near escapes were witnessed and some birds did return to sea; their nest reliefs may well have been delayed or aborted.

New Zealand Fur Seals *Arctocephalus forsteri* also appear to inflict some casualties as birds with breasts pierced apparently by seal canines are occasionally found on the beaches. These seals have increased here as elsewhere in sub-antarctic New Zealand, so that casualties due to them may be expected to increase. Sea lions *Neophoca hookeri* are rare at Macquarie and Leopard Seals *Hydrurga leptonyx* not numerous and losses to seals of all kinds seem unlikely to be very important causes of mortality at the present time.

3. DISPLAY BEHAVIOUR

The displays used by the Royal Penguin are evidently very similar to those of the Macaroni Penguin as described by Matthews (1929) and by Downes *et al* (1959) and the actions of the occasional black-throated birds at Macquarie showed no obvious differences between those of their light-throated neighbours or mates. None of the above authors describe the displays completely and Downes *et al* fail to distinguish between the trumpets used during greeting and recognition at the nest and the actions involved in head swinging, both being referred to as "mutual epigamic display" or "ecstatic display."

There are many variations in the postures and movements described in the following sections, variations due to individual idiosyncrasy and variations due to the intensity of the birds' reactions to the stimuli triggering off the display: many displays are incomplete and are performed in silence. Such individual variations probably provide important clues for individual recognition. It is easy for the human observer to learn to recognise particular birds by peculiarities of voice and posture, so that it would be most surprising if a highly aggressive and mate-specific bird such as this did not utilise these peculiarities in identifying its mate.

a. *Displays of a Sexual Nature*

1. *Mutual Allopreening.*

Mated birds frequently preen each other's heads, necks and napes, turning their heads to one side so that they can reach each other simultaneously. Parents and feathering chicks behave similarly and allopreening is common too between members of temporary partnerships. It then appears to indicate that the female has been

accepted, at least temporarily, by the male and her intrusion within his " individual distance " tolerated. Mutual preening occurs between members of opposite sexes from one year old onwards and also between chicks (sexes unknown) while in the creches. It is seen whenever and wherever numbers of Royal Penguins are ashore.

2. *Nest Forming.*

The bird squats on its belly with its flippers extended and resting on the ground. By pressing backwards with its feet the penguin rotates on its axis and so tends to form a hollow beneath it by the combined actions of belly and feet. This behaviour occurs at both rocky and sandy sites. In the first situation little is usually achieved and the feet may be seen pressing unavailingly against stones or boulders, but at sandy sites appreciable hollows result and the birds may incubate with the sand banked up around them. Nest forming is seen mainly before egg laying, occasionally during the re-occupation period and again, but not very often, during the moult.

3. *Stone Carrying.*

The first males to arrive after the winter at sea soon start to carry stones to their nests and this activity continues in some degree throughout the breeding season and during the moult. Substantial accumulations may result and during the winter these mark the sites of the now abandoned nests. At the Bauer Bay " sandy rookery," where there are no stones, beakfuls of sand are collected and deposited around the rims of the nests. Some birds here and elsewhere also collect tussock grasses and line their nest hollows with these, but for most pairs away from the edges of the colonies, such materials are not available.

The carrying of stones and substitute objects, such as bones, to the nest is a common activity of the male following a changeover at the nest and many males hurry to and fro collecting stones before they finally set off for the sea. Desultory stone carrying is seen on the beaches and in the streams and other approaches to the colonies. It is an activity best developed in the male birds.

4. *Quivering.*

Bending down into the nest, beak towards its feet, chick or egg, the bird shakes its head rapidly through a narrow arc while moving the head and neck from one flank of its body to the other. Chattering cries may accompany these actions. Incubating females commonly quiver when their mates add stones to their nests. Pairs may also display together in this way when standing in nests. Single birds often quiver after returning to eggs or chicks after a change of guard and quivering is often followed by bowing and head-swinging. Quivering was not seen away from the nest.

5. *Bowing.*

This starts with downwards movements of the bill and head into the nest. At the same time a series of deep throbbing cries is uttered, the body shaking with each throb. Bowing often follows quivering and is the usual prelude to head swinging although many bows do not develop further. The flippers are kept to the sides.

Bowing is done by lone birds or by mated pairs: the latter often reach over the rim of the nest with their beaks together, throbbing loudly. Bowing takes place throughout the breeding season and is used by both sexes but seems to be restricted to the nest site.

6. *The Shoulders-hunched Attitude* (Figure 2).

Before a bird of either sex takes over from its mate at the nest it adopts a constrained posture in which the body is erect but the head bowed so that the bill points downward. The shoulders are peculiarly hunched with a kink forming at the back of the neck. The flippers are held stiffly forward, their long axes at about 30° to the vertical and with their inner surfaces more or less parallel to one another.

FIGURE 2 — The shoulders-hunched attitude used at nest relief.

A bird walking onto its nest after a short absence uses this attitude: one that has been to sea usually goes first into a greeting ceremony with its partner but adopts the shoulders-hunched posture before it takes over on the eggs or chick. Both relieved and relieving birds posture, the one on departing and the other as it steps into the vacated position. Often they use a peculiar mincing gait as they change over. Lone birds may use this display when returning to their nest sites, even though these are empty and a similar posture follows coition. Away from the nest the attitude is seen when two adolescents come together at the start of temporary associations. It appears to have submissive as well as sexual elements and has some components in common with the slender walk described below.

7. *Trumpeting* (Figure 3).

A bird of either sex on rejoining its partner at their nest after a substantial absence switches from the slender walk when a few yards away and hurries forward with neck outstretched and flippers still extended and breaks into loud sustained brayings. Its partner responds with similar cries, reaching out from the nest, and neighbouring pairs also copy, stretching out towards the newcomer. As the latter reaches its nest and pushes up to its mate the din

increases as both birds stand upright and throw their heads back so that their bills are vertical and release a great volume of trumpeting sounds, while their flippers move up and down in time with the calls. Their pectoral muscles ripple and swell as the sound pour forth; the calls being given both on expiration and on inspiration. The penguins' heads may move slightly but they are not wobbled or swayed as in the quite distinct head swinging display. If the relieving bird has been away for a long time these ceremonies may be repeated several times before a nest relief occurs and this activity may stimulate vertical trumpeting in neighbours, although the latter usually relax sooner than the re-united partners.

FIGURE 3 — Forward trumpeting: the male (right) greets its mate (left) while a neighbour (centre) joins in.

The noise associated with this display is very considerable and is perhaps most noticeable at night when the general level of sound at the colonies is reduced. Some birds still come ashore after dark and the full ceremonial follows their arrival: sudden bursts of calling in the night indicate that a recent arrival is being saluted by its mate and neighbours.

This display is seen most often during the guard stage of the chicks as the females are coming ashore almost daily then, but it occurs also when the birds are re-united at the moult. It is essentially a mutual display and vertical trumpeting in particular is seldom used by lone birds. Singletons returning to their unoccupied nests generally adopt the shoulders-hunched posture, stand still for a few seconds and then switch to bowing, to forward trumpeting or to head swinging.

Forward trumpeting with beaks and necks outstretched and flippers raised and perhaps moved in time with their calls, accompanies the return of Royal Penguins to their nests after being shifted from them by the passage of a man through the colony: the din that follows mainly arises from the brayings of the birds returning to their nests or moulting sites, to the threatening that occurs as they sort themselves into their correct places, and to the head swinging displays that follow once the nest sites are re-occupied.

Forward followed by vertical trumpeting seems to comprise a greeting and recognition ceremony, the incoming bird being recognised by its partner some yards away from the nest while neighbours too appear to know it.

8. *Head Swinging* (Figure 4).

This is the most frequently performed and most obvious Royal Penguin display. It is used by both sexes and by lone birds or by pairs. The action starts with bowing, then the head is swung back so that the neck is vertical, the flippers are raised and the bill and foreneck are swung from side to side so that the bill almost touches the carpal joint at the end of each stroke. Some birds swing the head so far back that its arc of movement lies behind the upraised flippers. The latter are not waved up and down but move only slightly. Head swinging is accompanied by a series of raucous cries given with the bill open. The sounds are different from those used during trumpeting and have a more pulsing pattern perhaps as a result of the head movements. There is much variation from bird to bird in the sounds used and in the speed and extent of head swinging: some birds swing with a slow deliberate rhythm, others have very jerky actions. Some birds do not raise their flippers or raise only one; and often the performance is given in silence. If one bird is sitting or brooding it may not rise when the other begins displaying but may respond with head swingings while still seated. There is a tendency for the females, even when standing, to call without swinging their heads. In the Rockhopper the display is restricted to male birds (Warham, *loc cit*), and when Royals perform this display it is usually the males that are the initiators.

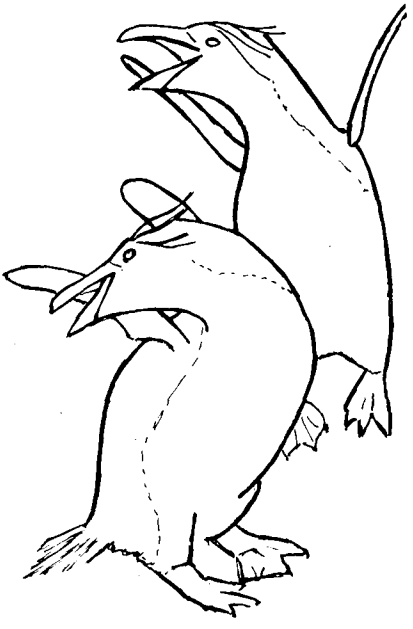

FIGURE 4 — Mutual head-swinging between a mated pair.

Head swinging occurs throughout the breeding season and again during the moult. It is not restricted to the nesting colonies but may be used occasionally whenever the birds are ashore. Immatures and even yearlings may give this display but much less frequently than do fully crested birds.

Head swinging commonly follows any disturbance such as the swoop of a skua low overhead, a bout of threatening between neighbours or even the noise of other birds displaying nearby. The display's main function seems to be that of advertising the bird's ownership of a territory.

9. *Coition.*

Most acts of coition seem to be initiated by the male. He crowds up to one side of his mate reaching towards her nape with his bill and with rapidly flickered flippers beats a tattoo on her back. She may then subside and allow him to mount. He treads up and down, gripping on with his feet and claws and dibbling with his bill round his mate's cheeks and neck while his dangling flippers continue to pat her flanks. His tail is at first swept from side to side as he gradually works backwards but it is eventually depressed to enable the cloacae to make contact. Both remain still for a few seconds during consummation, then the male descends and stands motionless for perhaps half a minute in a statuesque form of the shoulders-hunched posture. The prone female also remains motionless. Mutual preening, head shaking and body stretching may then follow as both relax.

Coition among the breeders ended as the eggs began to be laid but some acts of copulation between birds without eggs or chicks were seen as late as 16 December and on 26/12/60 an unbanded male made the flipper-patting preliminaries to a lone chick almost certainly not its own.

b. *Aggressive Displays*

Most Royal Penguins resist any close approach by penguins other than their mates and by other moving objects, and by means of various intimidatory movements try to keep strangers out of pecking range. The usual response is for the bird to reach forward towards the intruder; and lowering its hyoid and canting its head to one side, it emits a short burst of staccatto cries (Figure 5). It may bob its head up and down a little and hiss explosively and often raises its flippers ready for use. Such threats are usually effective but if the intruder comes close enough to be reached the territory owner strikes out hard with its chisel-tipped bill and flails out with its flippers. The attacked bird then either pulls back or defends itself with similar actions. During disputes between neighbours sitting birds jab at each other with opened beaks (Plate V) and these may get interlocked. In such instances a tug-of-war may develop and both sexes may take a hand in the conflict, the females reaching over their mates to spar with their opponents. In some fights the rights of other neighbours may be infringed upon so that a pair may find itself under attack from several quarters simultaneously. Although actual combat often takes place, particularly at periods when both sexes are ashore, and the pecking seems severe, no instances

in which birds were killed were seen. However, penguins with eyes missing or damaged were occasionally encountered and such injuries may have been the result of fighting.

Other displays mainly of a sexual nature described above often contain elements of threat. Thus a bird may switch abruptly from the " shoulders-hunched posture " to lunge at another bird. Forward trumpeting, too, seems to have threatening aspects and may lead to fighting — c.f. Richdale's note on the " open-yell " as a threat in *Megadyptes antipodes* (Richdale, 1951).

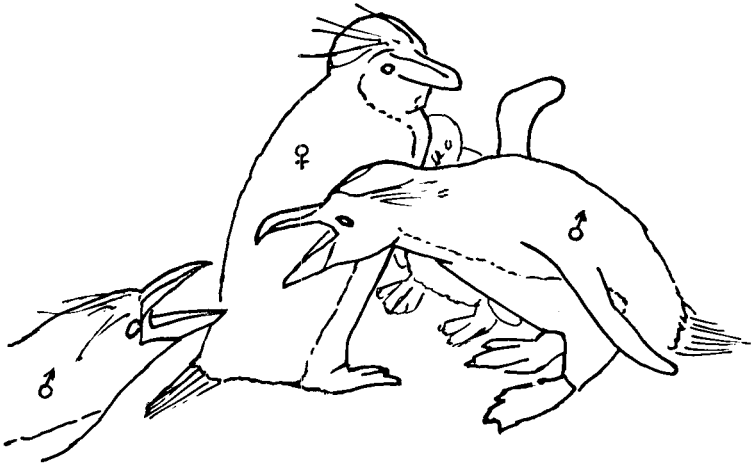

FIGURE 5 — Aggressive threatening between neighbouring males.

Acts of aggression are continually taking place at the breeding colonies and such acts, often apparently unprovoked, may be seen whenever two or more of these birds are joined together, even in the surf of the landing beaches where it seems pointless, if not actually dysgenic. The males are more pugnacious than the females and old established males seem to stand at the top of the peck order with yearlings and lastly chicks at the bottom.

c. *Postures Suggesting Fear*

1. *The Slender Walk*

Birds returning to their nests or moulting places, which they can usually only do by penetrating between other nesting or moulting birds, adopt a special posture. The head and neck are bowed, the body held fairly upright but the feathers are sleeked and the flippers are held stiffly forwards and roughly parallel to one another. The bird appears to be making itself as slim and inconspicuous as possible. It hurries through the throng, seeking the most open leads and dodging pecks without retaliating. When hemmed in it stretches up with its head high as if to keep its eyes beyond the range of the angry birds' beaks but presses on until a clearer space is reached. Here it pauses to perform the " stare around " before hurrying to its nest, mate or moulting place.

2. *The Stare Around.*

This is used during pauses in attempts to pass to and fro among assemblies of penguins. The bird stops suddenly and abandoning its submissive attitude, abruptly swings its head high with the beak somewhat raised to look over its shoulder, holding this posture for a second or so before jerking its head stiffly from side to side, pausing at the completion of each movement. The bird seems to be getting its bearings and it may then revert to the slender walk as it pushes on towards its goal.

3. *The Submissive Attitude.*

Incubating females are occasionally assaulted by other penguins usually of the opposite sex. Females make no attempt to retaliate but crouch down with their bills pressed to the ground even when their attackers peck viciously at their napes and backs. One female turned its beak completely underneath its body, hiding it effectively.

Such incidents were usually the result of disturbance by the observer. For example, a bird squatting in the submissive attitude on 29/10/60 in the hollow between three nests was pecked by the occupants of each. Then the nearest of the sitting birds suddenly got up and moved forward to cover an exposed egg nearer to me whereupon the crouching bird at once took over the vacated egg and settled down. Harmony was then restored. Evidently two incubating birds had shifted from their nests when approached and one of them had then sat down on the other's egg leaving the latter dispossessed. No such incidents were seen after the eggs had hatched, but submissive behaviour seemed to be the rule during incubation when the females were on duty. One result was that the eggs were covered and shielded from damage; whereas, had the penguins responded by threat and attack, the eggs might well have been destroyed in the subsequent fracas. The submissive attitude seems to be analagous to that adopted by the Kittiwake (Cullen, 1957), the Australian Gannet *Sula serrator* described by Warham (1958) and some other sea-birds.

4. *Wing Shivering.*

Many Royal Penguins shiver their wings through very narrow arcs when closely approached by man. Most do not flee but the action seems to be due to nervousness and soon stops once the observer moves away. Whether wing shivering occurs in response to other more natural dangers, such as the approach of a skua, was not determined.

5. *Flipper Flicking.*

Quick flicks of a single flipper are used in circumstances where the bird seems doubtful of the situation in which it finds itself and undecided as to whether it should fight or flee. Non-breeding penguins often use these movements towards neighbours when they stand among established breeders: similarly, penguins away from their nests that are closely approached by man or other intruders may jerk a flipper in their direction even though they are beyond striking distance.

d. *Unclassified Postures*

1. *The Head Shake.*

A Royal Penguin usually concludes a display or definite phase of activity by shaking its head quickly through about 60 degrees so that the plumes become a blur. It does not call but makes swallowing movements immediately afterwards. Head shaking nearly always follows a period of excitement; birds emerging from the sea after a tussle with the breakers shake their heads before they start to preen; one that has just found a quiet spot after being buffeted by higher-status birds shakes its head before relaxing; chicks newly banded shake their heads and stretch themselves before they disperse after release, and so on. The head shake action appears to act as a kind of "signing off" ceremony. At the same time it serves to remove particles from the bill and to spray aqueous droplets, presumably the saline secretions of the nasal glands, to either side.

2. *Comfort Movements.*

Royal Penguins frequently yawn and stretch themselves. They raise their heads, open their bills and draw themselves up to their full height pressing their flippers to their sides, then relax and shake their heads. They scratch the sides of their heads as they balance on one foot and bring the other up over the flipper to scratch with the central claw. Some open their bills, shake their heads and make sneezing sounds.

Preening is important and much time is devoted to the care of the body surface. The feathers are oiled from the preen gland and the back of the head rubbed upon this. Incubating birds and the males during the guard stage of the chicks often rise to stretch themselves and to beat their flippers and during the moult this flickering of flippers often catches the eye as one looks across a colony: it seems to be infectious. Many loose feathers are dislodged in the process. The whole of the body and tail is shaken from time to time with the feathers fluffed. This behaviour is common during rain and snow storms and serves to remove moisture lodged in the feathers.

Mobs of bathing birds are seen off all the large colonies. The penguins float on their sides and, splashing with their flippers, corkscrew around removing the filth accumulated during their spells ashore. Convenient rocks are covered with those that have bathed and need to preen before departing. Temporary partnerships form here and mutual allopreening occurs while some may display with mutual head swinging.

Royal Penguins drink copiously from fresh water when they are ashore. Most of this they get from the streams by which they climb to the inland colonies or which drain past many of the coastal ones but they also drink rainwater lodged in their feathers during showers and sip from the filthy pools that collect between their nests after rain.

In bad weather the birds on the colonies turn their backs to the wind. On the infrequent warm days it is mainly the downy chicks that are seen to pant: they were seen to do this on 26/12/59 when the shade temperature rose to 52°F; the adults mostly seemed unaffected.

4. ACKNOWLEDGEMENTS

I am grateful to fellow members of the 1960/61 ANARE team for help in the field and to Dr. R. Carrick for making my stay at Macquarie Island possible.

5. REFERENCES

CARRICK, R., 1964: Breeding biology of **Eudyptes.** **In** A New Dictionary of Birds. Ed. A. L. Thompson, London.

CARRICK, R., & INGHAM, S. E., 1967: Antarctic sea-birds as subjects for ecological research. Proc. Symposium Pacific-Antarctic Sciences, 11th Pac. Sci. Congress Tokyo, 1966. Jap. Ant. Res. Exped, Sci. Reps. Special Issue No. 1: 151-184.

COULSON, J. C., & WHITE, E., 1958: The effect of age on the breeding biology of the Kittiwake **Rissa tridactyla.** Ibis, 100: 40-51.

COULSON, J. C., & BRAZENDALE, M. G., 1968: Movements of Cormorants ringed in the British Isles and evidence of colony-specific dispersal. Brit. Birds, 61: 1-21.

CULLEN, E., 1957: Adaptations in the Kittiwake to cliff nesting. Ibis, 99: 275-302.

DOWNES, M. C., EALEY, E. H. M., GWYNNE, A. M., and YOUNG, P.S., 1959: The birds of Heard Island. ANARE Sci. Rep. (B), i: 1-135.

FALLA, R. A., 1937: Birds. Rep. B.A.N.Z. Antarctic Res. Exped. 1929-31, (B), 2: 1-288.

GWYNNE, A. M., 1953: Egg-laying and incubation periods of Rockhopper, Macaroni and *Gentoo Penguins.* ANARE *Sci. Rep.*, (B), 1: 1-29.

MATTHEWS, L. H., 1929: Birds of South Georgia. Discovery Repts., 1: 561-592.

MAWSON, D., 1915: The home of the blizzard. London.

RICHDALE, L. E., 1951: Sexual behavior in penguins. Kansas.

SCHONWETTER, M., 1960-66: Handbuch der Oologie. ed. W. Meise. Berlin.

WARHAM, J., 1958: The nesting of the Australian Gannet. Emu, 58: 339-369.

WARHAM, J., 1963: The Rockhopper Penguin **Eudyptes chrysocome** at Macquarie Island. Auk, 80: 229-256.

CARRICK, R., & INGHAM, S. E., 1970: Ecology and Population Dynamics of Antarctic Sea Birds. **In** Antarctic Ecology, 1: 505-525. Ed. M. W. Holdgate. London & New York.

★

SHORT NOTE

AN IMPRESSIVE ASSEMBLAGE OF ALBATROSSES

At 0845 on 28/2/71 M.V. Karepo passed about one and a half miles off a large foreign fishing vessel of the factory type working in the Canterbury Bight. The position at this time was 44.55 South, 172.00 East, with wind NE 15 knots; fine clear weather; air temperature 14.5 C and sea temperature 15.5 C. About four miles from the fishing vessel the numbers of albatross about the ship increased rapidly. The increase continued until we were at our closest point of approach when we estimated that there were at the very least five thousand albatross in the area; possibly more, as many groups of birds could be seen at extreme range.

Birds close enough to be identified included adult and immature Black-browed Mollymawks, Buller's Mollymawks, White-capped Mollymawks and tentatively Salvins Mollymawks and Grey-headed Mollymawks. Royals and Wandering Albatrosses were noticeable only by their small numbers. Four birds that could have been either old Wanderers or Royals were seen. It is doubtful if there were fifty of these larger birds in the area. There were very few other species about, not more than forty Giant Petrels; fewer than ten Cape Pigeons; and possibly fifty other dark petrels, of which those seen clearly were Sooty Shearwaters.

The fishing vessel was engaged in trawling at the time; and whilst the birds were thickest close to her, the rest seemed to be loafing about the area, possibly waiting for the trawl to be lifted. Rafts of up to one hundred mollymawks were not unusual and one raft was estimated to contain one hundred and fifty mollymawks and two Wanderers. Whilst these factory ships seen about the New Zealand coast invariably have large followings of mollymawks, this is by far the greatest number I have so far encountered.

— JOHN JENKINS