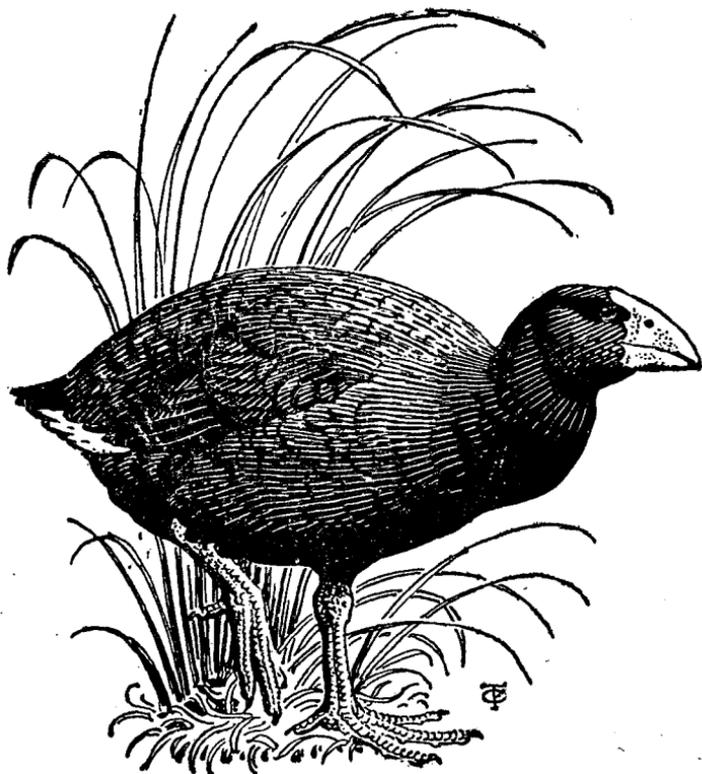


# NOTORNIS



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*Volume Nine, Number Two, September, 1960*

# NOTORNIS

*In continuation of New Zealand Bird Notes*

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# NOTORNIS

VOLUME NINE, NUMBER TWO

SEPTEMBER, NINETEEN SIXTY

## ADELIE PENGUIN ROOKERIES IN THE ROSS SEA REGION

By H. J. HARRINGTON

Most of the Adelie Penguin (*Pygoscelis adeliae*) rookeries that are known in the Ross Sea were visited in the 1955-1956 season, and briefly described by Austin (1956, *Bird Banding*). A record of any additional work carried out until the end of March, 1959, and known to the writer, is given in the following notes. Work done in the 1959-60 season is not discussed. Emperor Penguin rookeries were discussed in an earlier note (*Notornis* VIII, No. 5, July, 1959, pp. 127-132), but the discovery of Emperor Penguin and Adelie Penguin rookeries on Beaufort Island can now be recorded. A previous unpublished radiocarbon date is given for the Adelie Penguin colonisation of Beaufort Island. The location of skuaries is mentioned, along with records of nesting sites of the Snow Petrel (*Pagodroma nivea*) and Wilson's Petrel (*Oceanites oceanicus*) in the Cape Hallett district. The writer wishes to stress that he is not an ornithologist, and that visits to penguin rookeries were incidental to geological work with the New Zealand Geological Survey Antarctic Expedition, 1957-58, and the New Zealand Geological and Survey Antarctic Expedition, 1958-59.

*Hallett Station:* This large rookery was discovered by the ice-breaker, U.S.S. *Edisto*, in the 1955-1956 season. It is on Seabee Hook, which is a low spit projecting into Moubray Bay from the cliffs of Cape Hallett 70 miles south of Cape Adare. In the 1956-1957 season when the joint United States-New Zealand I.G.Y. station was built, the rookery was examined by the biologist Dr. Carl Eklund while *en route* to Wilkes Station (pers. comm.). A photograph of the rookery and observations made in the 1957-1958 season have been published by Harrington and McKellar (*New Zealand Journ. Geol. Geophys.*, Vol. 1, 1958, pp. 571-6). They collected a flattened frozen body from the base of the 15 inches thick surface accumulation of bodies and guano, and its age, determined at the Nuclear Sciences Division, D.S.I.R., by the radiocarbon method using pieces of bone, is  $1210 \pm 70$  years. From this age they inferred that the rookery was first colonised about 400 to 700 A.D.

When Hallett Station was built a large area was levelled by heavy machinery, and there was some difficulty in preventing the birds from re-invading the building area. It has been feared that this operation might damage the structure and stability of the rookery. However, Captain J. Cadwalader, U.S.N., who was at the station when it was built, informed me that there were then few birds nesting on the lower scree slopes of Cape Hallett at the eastern end of Seabee Hook, but that in the following year nests were spread much higher on those slopes. Apparently the birds displaced from the station area had the common sense to move and were not permanently driven away. In the 1957-1958 season it was noticeable in fact that no birds attempted

to re-occupy the station site, and the oil drum fence that had been built to keep them out was not needed. Similarly, they did not occupy tractor roads through the rookery. In the 1958-1959 season, Dr. W. Sladen spent a few days at this rookery during a visit by the U.S.S. *Staten Island*.

Antarctic Skuas (*S. skua maccormicki*) at Cape Hallett nest on a large triangular beach at the eastern end of Seabee Hook. By the end of the 1957-1958 season nearly all the adults and most of the chicks reared in the 1957-1958 season had been ringed, mainly by Mr. W. Ingham, a geophysicist with the first over-wintering party. The adults were guarding eggs and week-old chicks in mid-December, 1957. The chicks commenced their first short flights about 9th February and were all flying strongly by 19th February.

It is probable that some Skuas nest on the flat bare rocky areas on the top of Cape Christie, 6 miles away across Moubray Bay and Edisto Inlet. Scattered Skua nests and Wilson's Petrel nests were found also on Honeycomb Ridge, 20 miles to the north of the station on the west side of Moubray Bay. Snow Petrel and Wilson's Petrel nests also abound on the cliffs of Cape Christie and Felsite Island and on other cliffs and bare rock areas along the western side of Edisto Inlet, and there is a large Snow Petrel breeding area with accompanying Skua nests on the warm and lovely granite ridges surrounding Crater Cirque at the junction of the Tucker and Whitehall glaciers 28 miles S.S.W. of Hallett Station. Some scores of nests were seen under rock slabs, and the total population may be very large for a dense and large cloud of Snow Petrels flying towards it from feeding areas in the pack ice was observed by the writer in the 1958-1959 season from the deck of an ice-breaker lying about 25 miles off the mouth of the Tucker Glacier. The chicks were in adult plumage, but were not flying in mid-January, 1958.

Of all the stations in the Ross Sea, Hallett Station is the most attractive for ornithological and other biological work. Access to some of the breeding areas around the station is difficult after the sea-ice breaks up early in January, but would be improved if a helicopter or a small ice boat were stationed there. Topographic maps of the district compiled by E. B. Fitzgerald, are in course of publication by the New Zealand Geological Survey (D.S.I.R.) and the Lands and Survey Department.\*

*Cape Crozier:* The Cape Crozier Adelie Penguin and Emperor Penguin rookeries were visited by G. Caughley (biologist) and M. Robb from Scott Base early in the 1958-1959 season before the departure of the Emperor Penguins and their chicks. In early January, 1959, Dr. W. Sladen and R. Penney flew to the larger Adelie rookery by helicopter from the U.S.S. *Staten Island* to do some banding, and in mid-January the writer and other members of the New Zealand Geological and Survey Antarctic Expedition travelled overland to Cape Crozier from Scott Base. During this visit no Emperor Penguins were seen save a lone chick bobbing about on a small ice-floe near the shore. The Emperor Penguin rookery is on sea-ice which forms during

\* Since these notes were written, a summary of some of the results of a 1959 study of the penguins and skuas at Hallett Station has been provided by the biologist B. E. Reid in *Antarctic II*, 6, 1960, 211-213. He has estimated the population of the penguin rookery as 100,000 adult birds. The topographic map compiled by E. B. Fitzgerald has also been published.

winter in deep narrow gashes or inlets in the slowly moving face of the Ross Ice Shelf. Every few years an old gash must be abandoned as it moves seawards, and a new one must be adopted as its entrance opens and becomes accessible from the sea. Wilson and Cherry-Gerrard in their narratives of work done by the first and second Scott expeditions, have given good accounts of the troublesome and changing obstacles on the final approach to the Emperor Penguin rookery formed by the cliffs of Cape Crozier and the chaos of crevassed and shattered pressure ridges where the Ross Ice Shelf forces against the base of the cliffs. In daylight it can be easy to avoid descending the cliffs by approaching the rookery through the pressure ridges, but for regular visits during a prolonged examination it would be preferable and time-saving to have a heavy hammer, some light crow-bars or pitons and 500 feet of climbing rope to establish fixed ropes down one of the less steep faces on the cliffs.

The Adelie Penguin rookeries at Cape Crozier are easily accessible overland. The larger western rookery is indeed very large and densely populated, and might contain half-a-million or more adult birds. It spreads inland for nearly a mile on snow-free hillsides and shallow gulches which rise to a height of several hundreds of feet above sea-level. The penguins have fairly easy access to the site *via* a short boulder beach. Not all the available bare rock area is used by the penguins, possibly because parts of it are too far from the beach. The eastern rookery a few hundred yards away is much smaller, the population being only a few tens of thousands of birds, though the area available for colonisation is many square miles in area. Access is difficult for the penguins *via* the surf on steep low rock cliffs, and this eastern rookery must be regarded as an "overflow" from the main site. At it the layer or surface crust of guano and bodies is thin and patchy, whereas at the lower end of the main rookery it is many feet thick. This great thickness is caused partly by the funnelling of traffic through the lower part of the rookery, but even so it indicates that the main colony is no younger than those at Hallett and Beaufort Island, and might be older. A search in the deposit for bodies or bones that could be dated by the radiocarbon method was unsuccessful because the guano deposit is decomposed to a featureless brown humus. Survey stations established by B. Alexander have provided ground-control for compiling maps of this rookery from U.S. Navy air photographs.

Skua nests at Cape Crozier are concentrated near the upper ends of Adelie Penguin rookery, but solitary nests were found as far south as the top of the cliffs above the Emperor Penguin rookery. In mid-January a few Skuas were hatching eggs, but most were guarding chicks up to a week or a fortnight old.

*Beaufort Island:* In mid-January, 1959, a large new Adelie Penguin rookery was discovered on a beach below the south-western cliffs of Beaufort Island. A distant photograph of these cliffs has been published by Harrington (1958, p. 601). Captain J. Cadwalader informed me that the possibility of a rookery occurring there was first raised by Dr. W. Sladen, who noticed possible guano stains on the lower parts of the cliffs when passing the island in the U.S.S. *Staten Island* in mid-January. He sent a signal to Captain Cadwalader in the U.S.C.G. *Northwind* asking for an inspection by helicopter. Captain Cadwalader confirmed the existence of a large rookery, and Mr. R. Penney was

landed there, made a preliminary examination and banded a group of birds. On 23rd to 25th January, E. B. Fitzgerald (Surveyor), Dr. Charles Johnson (U.S. Geological Survey), G. Caughley (biologist, Scott Base) and the writer were landed there for 48 hours from the U.S.S. *Arneb* by courtesy of Captain Cadwalader. The rookery is of about the same size as that at Hallett Station, and mainly occupies a beach half-a-mile long and up to 400 yards wide formed by progradation of storm-wave beaches parallel to the base of the cliffs. A small part of it is on a remnant of a 100ft. moraine bench at the foot of the cliffs, and it was probably the guano stain on it that was first noticed by Sladen.

A pit was dug by Johnson and the writer through one of the main beach hummocks occupied by the birds, and disclosed a little over 2ft of guano and bodies. This deposit was not frozen hard like the Hallett deposit, and was wet and stinking and nearly as decomposed as the deposits at Cape Crozier. However, after some searching the body of a chick suitable for radiocarbon dating was found 3 inches above the base of the deposit. Its bone material was dated by the Nuclear Sciences Division, D.S.I.R., and the result, 1150  $\pm$  45 years, indicates that this rookery was first colonised at about the same time as the Hallett rookery, that is no later than 800 A.D., and possibly as early as 400 A.D. It is interesting to note that the thicknesses of the guano deposits at Adelie Penguin rookeries provide a rough measure of their relative ages.

The skuary at Beaufort Island is on a sloping shelf above the cliffs, 600ft. to 1000ft. above the rookery. Some birds were sitting on eggs, and others had not laid eggs. The breeding dates of this Skua colony therefore appear to be about the same as at Cape Bird, a week or two later than at Cape Crozier, and a month later than at Cape Hallett.

It was suspected that there might be another contemporary or abandoned penguin rookery on a 25ft. bench on the north side of the island. A photograph of this bench taken from an ice-breaker, has been published (Harrington, N.Z. Journ. Geol. and Geophys., Vol. 1, 1958, p. 600). An attempt to visit it during the 1959 landing was foiled by weather and lack of time, but subsequently Mr. Stephen O. Wilson of the United States Antarctic Program, has informed me by letter that he observed an Emperor Penguin rookery on that bench while passing it on the U.S.S. *Glacier* on 5th November, 1956. The writer did not observe Emperor Penguins on it, or in the adjacent sea, when passing the island on the U.S.S. *Glacier* on 12th December, 1958, but probably by that time the birds had departed to the open sea. If the birds nest only on the bench, and not on the adjacent sea-ice, the rookery must be a small one. Emperor Penguin chicks observed on ice-floes in McMurdo Sound by Captain Cadwalader may have come from Beaufort Island, or from Cape Crozier, or from an undiscovered rookery.

A detailed map of Beaufort Island has been prepared from Mr. Fitzgerald's ground surveys and U.S. Navy aerial photographs and is about to be published by the Lands and Survey Department. The site of the Adelie Penguin rookery has been named Cadwalader Beach. At its northern end there are fine warm camping sites, or a site for a small hut, adjacent to a fine stream of snow-melt water. Access by sea is normally easy, but can be difficult if pack ice has accumulated along the shore.

*Cape Bird:* The three smaller rookeries at Cape Bird were visited by Caughley, Fitzgerald, Johnson and the writer following the visit to Beaufort Island. The colonies are distributed along a coast several miles long which nearly everywhere seems suitable for penguin occupation. The southern rookery seems to be expanding and flourishing, and is on a large 100 ft. moraine bench some distance inland. At its southern end Caughley located the group of birds that had been banded by Austin in the 1955-1956 season, and did further banding. The middle rookery is on a low gravel fan at the lower seaward end of a broad valley draining from cliffs below the Mt. Bird ice-cap a mile inland. In recent years it has suffered the disaster of being nearly washed away by a flash flood, probably caused by the sudden eruption of a sub-glacial stream from the ice-cap. Only a few remnants of the rookery remain perched on gravel patches a foot or so above the present outwash fan. This flood seems to have occurred since the visit by Austin, and possibly in the 1957-1958 summer. Many of the displaced birds may have moved to the southern rookery. Judging from the thickness of remnant patches of guano the middle rookery had been occupied for only, say, 400 years, but this could not be confirmed because no material suitable for radiocarbon dating was found. Nevertheless this general area may have been colonised for as long as the Hallett and Beaufort Island rookeries, for areas of weathered guano were found at places that have not been inhabited recently. At one place, on a 5 ft. beach to the south of the middle rookery the old biological deposit was not obvious, because the surface gravel had weathered clean, but it showed up as a distinctive brown layer when a shallow trench was scraped out with an ice axe. Long abandoned rookeries might be found at other sites in the Ross Sea region in the same way. The northern rookery is on a slope of glacial outwash where the edge of the ice-cap descends to sea-level at Cape Bird. The total population of all three Cape Bird rookeries seems to be comparable with the population at Cape Hallett and Beaufort Island, say roughly somewhere between 70,000 and 200,000 adult birds.

Skua nests at Cape Bird are as usual close to the penguin rookeries, but are found at many other places on bare rock areas to heights of 400ft above sea-level, and particularly on the top of the white trachyte headland a mile south of the southern rookery. At the time of our visit a few Skuas were guarding chicks, most were sitting on eggs, and a few had not yet laid eggs.

*Cape Royds:* The small Cape Royds rookery has been visited frequently in recent seasons, mainly by sightseers calling at the Shackleton hut, but also by biologists including G. Caughley and R. Penney in the 1958-1959 season.

Near it there is an old abandoned rookery marked on the Shackleton expedition's detailed map of Cape Royds.\*

*Koettlitz Glacier Moraine:* In his book on the first Scott expedition, Armitage records that he observed a concentration of Skuas while travelling from Hut Point to the Blue Glacier across the rough hills of moraine lying on the ice of the lower part of the Koettlitz

\* Since these notes were written, full-time work by two biologists in the summer 1959-1960 on the penguins and skuas of the Cape Royds district has been reported by E. C. Young in *Antarctic II*, 6, 1960, 225-228. The population of penguins is about 1300 adult birds.

Glacier at the head of McMurdo Sound. These birds may be living on the shell-fish which are found stranded on the surface of sea-ice in McMurdo Sound, or may be flying further afield for feeding, but there is also a slim chance that they might be "farming" an undiscovered penguin rookery in that district.

*Franklin Island:* At the south-west end of Franklin Island a very large Adelie Penguin rookery occupies a beach similar to Cadwalader Beach at Beaufort Island. Since it was discovered by Borchgrevink in 1900 this colony seems to have been visited only once, by the biologist R. Barwick, who landed from H.M.N.Z.S. *Endeavour* in the 1957-1958 season (see Brodie, New Zealand Journ. Geol. and Geophys., Vol. 2, 1959, pp. 108-119).

*Inexpressible Island, Terra Nova Bay:* A small Adelie Penguin rookery on Inexpressible Island near the northern end of Terra Nova Bay was found by the Northern Party of Scott's second expedition in the 1911-1912 summer. It has been described by Levick, who was surgeon to the Northern Party, in his book on penguins. The U.S.S. *Glacier* spent two days at Terra Nova Bay in December, 1958, and several helicopter flights were made, but the rookery was not observed. High-level oblique aerial photographs of the district have been examined by the writer, but the rookery could not be located on them.

*Wood Bay and Mt. Melbourne:* Borchgrevink early in 1900 found an Adelie Penguin rookery towards or at the head of Wood Bay, on a beach similar to that at Cape Adare, but apparently no-one has since been sufficiently far into Wood Bay to re-observe it. The writer has observed on a U.S. Navy aerial photograph, that a light-coloured area, similar to guano staining, is visible near sea-level on the northern slopes of Mt. Melbourne on the southern side of Wood Bay. If a rookery exists there, it is possibly not the one recorded by Borchgrevink. In an earlier note (*Notornis* VIII; No. 5, July 1959, pp. 127-132) it was suggested that there may also be an Emperor Penguin rookery on the bay ice of Wood Bay.

*Possession Islands:* The Possession Islands are a cluster of 9 small islands and stacks which are erosional remnants of a large volcano, lying off the northern entrance to Moubray Bay and Hallett Station. They are clearly visible at times from the Station, and on the north-west and largest island (Possession Island, *sensu strictu*) Sir James Clark Ross in 1841 discovered an Adelie Penguin rookery, which apparently spreads well inland to a height of 300ft. and is very large. Access to the rookery is from a long boulder beach on the south-west coast of the island. The colony has been visited since then by Borchgrevink in 1900 and by Austin.

*Cape Adare:* This large rookery is on a large triangular boulder beach, similar to those at Cape Hallett, Beaufort Island and Franklin Island. It is a very large rookery, comparable in size with the main rookery of Cape Adare. Borchgrevink and the Northern Party of Scott's second expedition both built huts on the beach, and both published maps and photographs of the beach and rookery. It was also described by Levick in his book on penguins. In recent seasons Sladen was landed there early in 1959. It is possible that there are other undiscovered rookeries in the Cape Adare district, near the head

of Robertson Bay. It seems, that except possibly at Cape Adare, none of the rookeries in the Ross Sea region occupy all the bare-rock space available for colonisation.

*Balleny Islands:* Commander Price Lewis, Jnr., captain of the U.S.S. *Staten Island*, has informed me verbally that he spent some days cruising in the vicinity of the Balleny Islands in January, 1959, while *en route* to Wilkes Station, and that a large number of Adelie Penguin rookeries were discovered there during helicopter reconnaissance flights in company with Dr. W. Sladen. Chin-strap Penguins (*Pygoscelis antarctica*) were observed, this being the first record of their occurrence in the Ross Sea sector of the Antarctic.

#### ACKNOWLEDGEMENTS

Most of the field work was made possible by sea and air transport generously provided by the U.S. Navy and the United States Antarctic Program scientists in the best spirit of international co-operation and assistance. Captain E. S. McDonald, Captain J. Cadwalader and Commander Price Lewis took a special interest in the geological and surveying work from which these notes on penguins are a by-product. Thanks are also extended to many Antarctic biologists for discussions about wild-life matters, and for a free exchange of views and information, particularly Drs. W. Sladen and R. Goldsmith, and Messrs. G. Caughley, J. Dearborn, H. Dewitt and R. Penney.

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## KEAS AT ARTHURS PASS

By J. R. JACKSON

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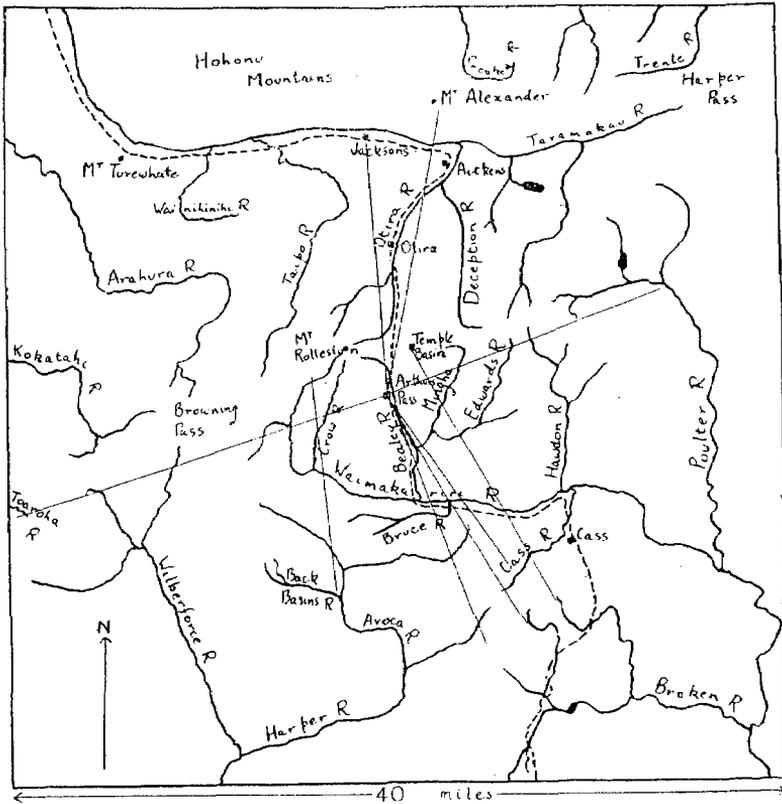
### INTRODUCTION

In the years 1956 and 1957, 213 Keas (*Nestor notabilis*) were banded in Arthurs Pass National Park. There were 224 recoveries of 115 different birds, 94 recaptured and 130 by sight. For a sight record the band number was read either with the naked eye or through binoculars\*. Where relevant I have included observations made in 1958, 1959 and 1960. The field work was done during 5 days in 1956 and 53 in 1957 well distributed through the year as the first line Table 3 shows.

The area studied is east of the alpine divide in Canterbury (see map). Up to 4500ft. is a forest of mountain beech (*Nothofagus cliffortioides*) and above is alpine tussock grassland and rock to the permanent snowfields above 6500ft. The highest peak is Mt. Rolleston (7453ft.) and all the dividing ridges rise to about 6000ft.

Previously I spent 7 years on the West Coast, where the Keas' range is in a different environment, in the Westland forest, a mixed forest with totara (*Podocarpus hallii*), miro (*Podocarpus ferrugineus*), rata (*Metrosideros lucida*) and *Dracophyllum traversii*, important trees for the kea. The Westland forest is found over Arthurs Pass in the Otira Valley.

\* Below "seen" indicates a sight record.



Distant Recoveries ————— Main West Coast Road - - - - -

This account describes territory, food and an estimate of population. Mating and nesting behaviour, productivity and mortality, and sheep killing will be dealt with elsewhere.

METHODS

Most of the Keas have been caught and banded at Arthurs Pass township (2420ft.) or three miles away at Temple Basin (4500ft.) in winter time when they are hungry and easily attracted with butter as bait; indeed the refuse in the rubbish dumps has already attracted them as scavengers to these places. I have also made several trips further afield especially to the Crow Valley and the Edwards Valley, where some idea of their dispersal from the Arthurs Pass-Temple Basin area has been obtained.

The Keas were caught both by hand and with a snare. To snare them a semicircle of stones, like a fireplace, is made and the snare and the main bait laid on the floor. This prevents the Keas from taking the main bait except by walking over the snare. Outer baits

are put on the semicircle, prominent stones nearby and about me to keep a large group of interested Keas about, for then they are more bold.

A Kea soon learns that if it takes the main bait it may be snared but that the outer baits can be taken with impunity. This introduces a bias, compensated by the many sight records of Keas taking outer baits. A more serious failure has been the missing of many adult females as they seldom wander far from their nests.

For example, the pair 26967 ♂ and 35007 ♀ have their nest half-a-mile horizontally and 2000ft. above Arthurs Pass. 26967 was banded in 1956 and has since (until 31/12/59) been seen on 29 days at Arthurs Pass. 35007 has been seen at Arthurs Pass on the occasion when she was banded in 1957 and once later the same winter.

In summer it is necessary to search a wide area until a flock of young Keas is found. A deer carcass is a good magnet. In a few days Keas will have found it and at daybreak and nightfall the flock will return to feast.

### TERRITORY

In 1957 I established the territory or location of seven pairs of Keas. This territory is centred about the nest and the nearby roost. They feed within one or two miles of their nest, except that occasionally in winter, and in summer if they fail to nest, they may forage further afield. In the early afternoon on most days throughout the year the hen will be in the tree-tops close to the nest, sunning herself. The cock will be further away but within earshot.

A pair of Keas will join a flock while it is in their territory or that of neighbouring pairs, but the pair will return to its own roost each night. When I have camped by a nest I always see the hen. So on each of eleven occasions in 1957 when I camped by the nest at the head of the Crow Valley I saw the hen 34254 and usually a second bird was about, sometimes identified as 34259, her mate. On three brief visits of an hour or so I failed to see them by the nest. On one of these occasions, 12/7/57, they joined a flock in a neighbouring territory, 3 miles away. I did not see them on both 26/10/57 and 15/11/57, a season when adults are timid and usually seen flying at 4 a.m. about daybreak and not later in the day.

A pair does not mind other Keas within 25 yards of their nest. If there are chicks in the nest, visiting Keas are intensely interested in the chicks' calls.

Yet a frequent call is the territorial call, also used as a threat to a man walking along the road, or even a railcar passing by. A pair perched in the tree-tops high on the valley walls will see another family flying along the valley below them, or the neighbouring hen flying into her nest across the valley, when they will give the "Kua-ua-ua-ua" call.

A similar call, "kuer" is used by a Kea flying in search of its mate in the tree-tops, to elicit a response. Or as a Kea settles to roost "kuer" draws replies from its neighbours and shows all is well.

On one occasion I saw an aerial chase. The pair, 34259 ♂ and 34254 ♀, and a third Kea, 35040 ♀, were in the open near the nest. 34254 flew into the forest to the nest. 35040 sidled up and chickened to 34259. 34254 immediately flew out and the three birds took flight

to a perch 200 yards away. Floating down the valley out of the mist came a fourth Kea, presumably 35040's mate, and when close to the perched Keas they all took flight. A hectic aerial chase of the two cock birds followed for two or three minutes. All the birds settled together for several minutes, flew away quietly and were lost.

### FOOD

Young leaves and buds of forest trees form the main food of Keas. At all seasons they spend much time in the tree-tops (at Arthurs Pass in mountain beech) steadily and slowly picking buds; or they may strip a twig of leaves, rest and preen, vary their activity by walking along the branches instead of over the leaves, and sample bark, moss and the lichen (*Usnea*). Or they may turn their attention to soft rotten twigs in which they find grubs and beetles. Only once, possibly a displacement activity, have I seen them ripping up slightly decayed wood. Several Keas were lined along a log while I was below it, ready to catch any Kea which jumped down and took a bait. The Kea opposite me would take possession of the log a yard on either side of the bait and eye the bait and me. Some, fearful of jumping down close to me as I waited to catch them by hand, would turn their attention to the log, rip it up as a Kaka (*Nestor meridionalis*) does solid timber and after a minute or so run back and jump down.

After examining the crown of a tree a Kea glides silently two or three feet above the tree-tops to another tree. After some hours in the trees the flock, or pair, of Keas rises with the "kea" flight call and may fly to an alpine meadow, or a grassy bank by a stream. There they will eat the leaves of the herbs and grasses, roll the moss off stones or roll stones over looking for grubs or succulent roots. In autumn and spring they root out the large *Celmisias* (as *C. coriacea* and *C. spectabilis*) and eat the roots.

For a few short weeks in January nectar flows and the Keas feast. At daybreak they fly to a favourite patch of mountain flax (*Phormium colensoi*) or to a rata tree and feed for several hours. Both of these important blossoms are unreliable. Not infrequently the flax over large areas fails to flower, and rata is notorious for its blossom being ruined by heavy rain. If so the Keas turn to smaller flowers as *Celmisia discolor*. They pick the whole flower, chew it and spit it out.

Then the berries ripen. Snow totara (*Podocarpus nivalis*) is the most important fruit. In a good year it is the main food from January until it is buried in snow. During the winter the plants alongside a stream are often uncovered, when they are searched again. Next September or October in the thaw, a few shrivelled berries remain and are again an important food. However, totara fails in wet seasons, for it is wind-pollinated. In the alpine meadows are several other fruits as *Leucopogon fraseri* which is always taken, *Pentachondra pumila* which is sampled but usually not eaten extensively, and *Coprosma repens*. The snowberry (*Gaultheria antipoda*) is eaten when the others fail. It is perhaps significant that the favoured berries are large (to

$\frac{1}{2}$  inch diameter) and red (*Leucopogon* is orange) and the less favoured snowberry white and the Kea is the only animal which takes these fruits\*.

I have not seen Keas feeding on seeds, though Potts (1882) records them as feeding on kowhai (*Sophora tetraptera*) seeds. In captivity they are adept at removing the seed coat from peas, or apple pips, or the stone from the kernels of plums and eating the cotyledons. This skill would seem to have little importance in the wild as there are few large seeds.

In winter, green droppings of bile indicate that many juvenile Keas are starving. At this season Keas feed at a lower altitude and often on the forest floor. They take such unattractive berries as *Coprosma pseudocuneata*, neglected by Blackbirds (*Turdus merula*). When snow falls to low levels they find some food as the mosses around shelter boulders and plants in any small trickle of water. Keas are not seen above the bushline now, except around the ski-huts where they congregate.

At Temple Basin (4500 ft.) and 1500 ft. above the low bushline of Arthurs Pass (the pass) table 4 shows a rapid turnover of Keas, almost complete from one three-week period to the next, indicating that at this altitude the climate is too hard. This can be seen by the small fraction of Keas recovered and by comparing the numbers released with the numbers entered in first horizontal row of diamonds, comparing those released with those seen next time, i.e. on 31/8/57 twenty were released; five had been seen a week earlier on 25/8/57 and two were seen a fortnight later on 13/9/57. One of these two Keas had been seen on 25/8/57. Now the week 25/8/57 - 31/8/57 was fine and many people were at a ski school, so less turnover than usual might be expected. At the beginning of winter the Keas take a month or so to find the well-supplied dumps at Temple Basin so very few will be seen there during April, May and early June.

On a fine day the Keas enjoy the snow. One will take a puddle from the Black-backed Gulls (*Larus dominicanus*), others will join it and tread the mud but soon tire. The Keas may then fly on to the snow and wrestle, rolling over and getting well covered in snow. In the different conditions of a thaw they will wash in the puddles like Blackbirds. When feeding among snow Keas frequently eat snow though flowing water is close at hand.

In early spring Keas spend much time high on the alpine grasslands 1000 ft. or more above the bushline and feed on the smaller grasses and herbs.

In all its feeding the beak is used carefully and slowly. The upper mandible is a lever and the lower a gouge. The lower scrapes forward, if necessary with the tongue a little ahead pushing the food into the hollow of the upper mandible, where it is tested, if liked rolled into the cup of the mouth and consumed.

\* The Paradise Duck (*Tadorna variegata*) feeds on *Leucopogon* growing on the river flats at lower altitudes.

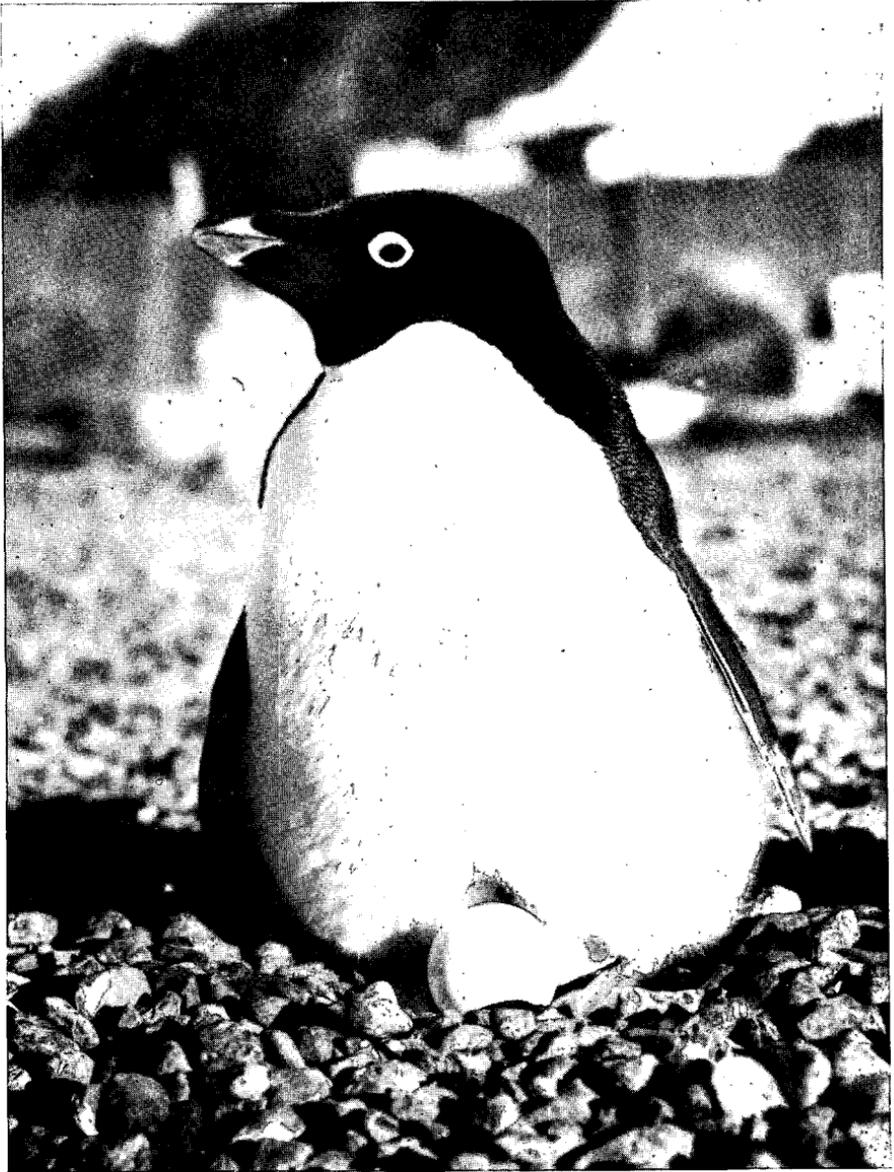
TABLE 1

*A Kea's Year*

January	A plentiful supply of nectar and berries. Last eggs being laid. The main fledging period. First year birds in flocks c. 20.
February	Feeding on berries. Last eggs hatching.
March	Much time spent on steep faces. Adults moulting, so feathers about the roost.
April	<i>Celmisia</i> being rooted out. Flocks descending in the forest.
May	Last chicks being fledged. Larger flocks breaking up into parties of c. 6 Keas.
June	First year birds becoming hungry and flocks constantly moving. Feeding on <i>Coprosma pseudocuneata</i> berries.
July	Heavy falls of snow cover much ground and Keas feed in the forest and on the forest floor. First eggs laid (corresponds to Marriner, 1908).
August	In fine weather Keas high in the alps feeding on grasses. Gathering into larger flocks.
September	Weather less settled. During the frequent spells of bad weather most Keas of the winter scavenging. First year Keas beginning to moult.
October	Peak of laying. Adults very shy and quiet. Flocks dispersing. Some first-year birds wander 15 miles.
November	Mature second and third-year birds may leave the location where they spent the winter and move several miles to a permanent territory.
December	Earliest fledglings I have noticed. Most adult females are either with a clutch or building a nest.

## MOVEMENTS

Keas are essentially forest birds and their conspicuousness gives a deceptive impression of the extent to which they are found above the bushline. Once I saw a pair rolling stones on a steep face at 6000 ft. and the adult Keas from the Mingha Valley have crossed the 6000 ft. ridge to the ski-huts at Temple Basin on several occasions. However, this is not normal as shown by the fact that all the totara berries may have been stripped from the bushes at the bushline, but 500 ft. up they will be untouched and remain until next spring. Again, the nest by the Crow hut is less than two miles from Arthurs Pass, but separated by a 6000 ft. ridge. The pair of this nest has not been seen at Arthurs Pass but was seen on the Bealey face of Mt. Rolleston (Arthurs Pass is 3 miles down the Bealey Valley) on 1/2/58, a season when they failed to nest. Confirmation of this avoidance of altitudes above 5000 ft. is found in the dispersal from the Bealey Valley. Few banded Keas have crossed the ridge from the Bealey into the Crow Valley, and to my knowledge none over Mt. Rolleston into



[Photo by A. J. Heine

IX — Adelie Penguin (*Pygoscelis adeliae*) at Cape Hallett, Antarctica, mid-December, 1957.



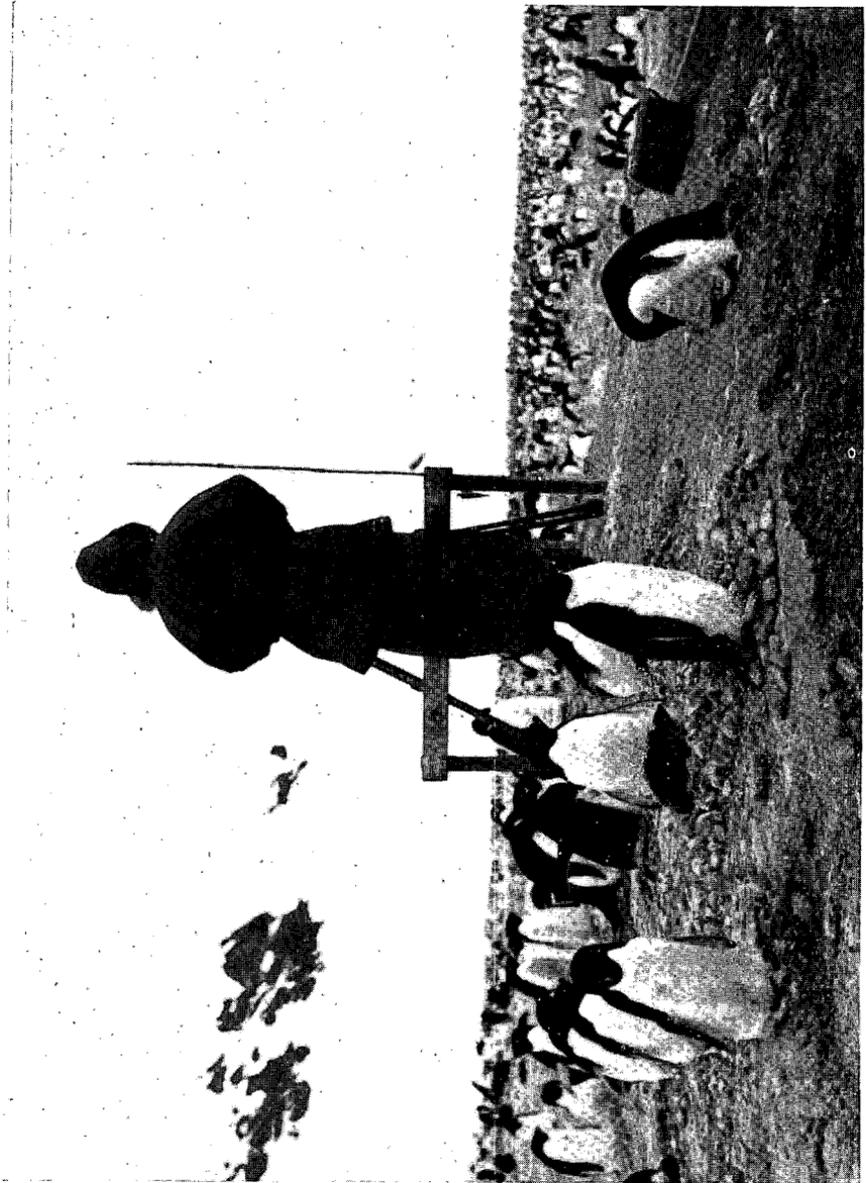
[Photo by H. J. Harrington

X—Adelie Penguins at Cape Hallett showing nests of pebbles, chicks and the squabbling and pecking that keep the rookery continually in movement and noisy uproar.



[Photo by H. J. Harrington

XI — Adelie Penguins at Seabee Hook, Cape Hallett. Nests and young birds, a few weeks to two months old.



[Photo by A. J. Heine

XII—The rookery of Adelie Penguins at Cape Hallett with Brian Fitzgerald at work. N.Z. Geological Survey, Antarctic Expedition, 1957 - 1958.



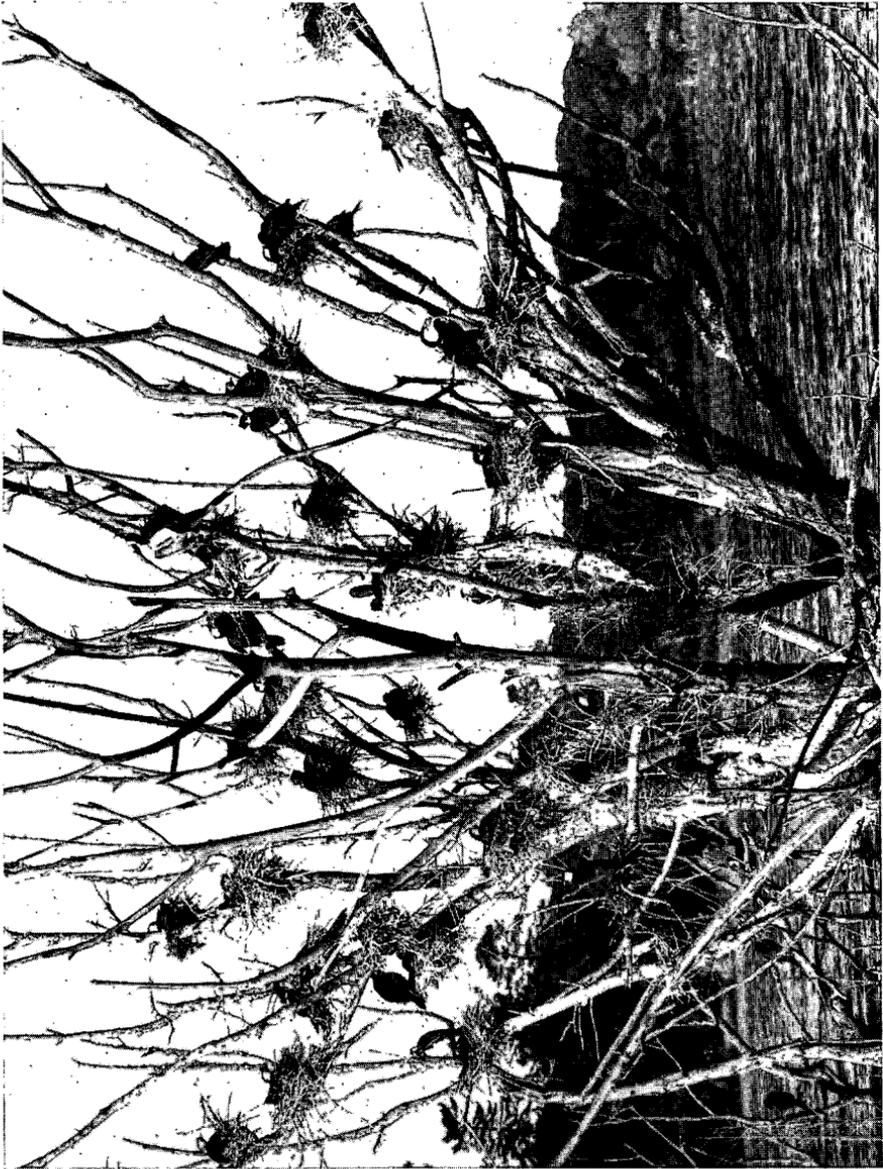
[Photo by F. O'Leary

XIII — White-headed Petrel (***Pterodroma lessoni***) found ashore alive at Lyall Bay, Wellington, on 22/6/60.



[Photo by F. C. Kinsky

XIV—This Black-billed Gull (*L. bulleri*) in the well-known colony at Rotorua was found brooding one very small chick and a bright yellow electric bulb on 21/12/59.



[Photo by F. C. Kinsky

XV—A battered willow laden with the nests of Little Shags (*P. melanoleucos*) on the edge of the mixed colony of shags at L. Pupuke, Takapuna, September 1958 (c.f. *Notornis* VIII, 20-25).



[Photo by M. F. Soper

XVI — Black Swan (Pen). She has just returned to the nest and is shown swelling and arching her neck, an action accompanied by hissing as she sights the eggs (v. p. 61).

the Rolleston Valley or beyond to the Taipo Valley. They have flown down the Bealey Valley into the main Waimakariri Valley and wandered up and down the Waimakariri Valley and over its Ice Age distributary channels into other valley systems. These facts have to be kept in mind in considering movements in terms of straight-line mileages.

The first-year Keas at Arthurs Pass in winter have been drawn certainly from eight miles, and perhaps from fifteen miles. The surrounding countryside is stripped almost completely of first-year Keas; I have frequently failed to find them; for they are almost all around the ski-huts or in the townships. Later when they disperse from Arthurs Pass they may fly out 15 miles in any direction, giving a possible movement of 30 miles.

In winter, away from Arthurs Pass-Temple Basin only adults can be found still on their territory, though occasionally they may wander, certainly five miles, possibly fifteen miles and be away all day.

TABLE 2

*Records of Distant Recoveries*

(assumed to be from Arthur Pass when a banded bird has been seen but the number not read)

	<i>From</i>	<i>To</i>	<i>Distance</i>
34251	Waimakariri Falls, 2/2/57	Back Basins Hut, 24/6/57	13½ miles
—	Arthurs Pass, /9/56	Black Stream, /7/57	16 ..
26785	Arthurs Pass, 4/8/57	Jacksons, 10/8/57	14 ..
—	Arthurs Pass —	Poulter Hut, /10/57	16 ..
—	Arthurs Pass, /10/57	Cass, /10/57	12 ..
26957	Temple Basin, /8/56	Craigieburn Ski Field 16/3/58	16 ..
—	Arthurs Pass —	Head of Toaroa Valley /10/59	20 ..
At least 2 among		Aickens Face, Mt. Alexander	
6	Arthurs Pass —	22/11/59	15 ..
26934	Arthurs Pass, 22/9/56	Craigieburn Range, Mt. Algidus Station 16/12/59	16 ..
35088	Arthurs Pass, 28/9/58	Zit Saddle, Toaroa Valley /2/60	20 ..
—	Arthurs Pass —	Pinnacle Creek, Kokatahi Valley /2/60	20 ..
—	Arthurs Pass —	Brian O'Lynn, Haupiri Valley 14/5/60	23 ..

26926 ♂ and 269\_\_ ♀ (the Edwards roche moutonne pair) were seen at Arthurs Pass, five miles from their nest, on the morning of 26/10/57, and later that afternoon at Temple Basin.

26785 ♀ adult, was banded at Arthurs Pass 4/8/57 and shot at Jacksons, 14 miles away 10/8/57. Probably her nest was near Jacksons and she flew this fourteen miles up the Taramakau Valley and the Otira Valley, over Arthurs Pass and down the Bealey Valley to Arthurs Pass township and back in one day. This 28-mile flight would be little further than that of the pair from the Edwards roche moutonne.

Many Keas have been seen at both Arthurs Pass and three miles away at Temple Basin in one day. 34251 was seen three miles up Back Basins Creek on 26/6/57 and that evening at Back Basins hut where the creek joins the Avoca River.

On 11/10/58 a pair of Keas flew from by the Bruce hut across the Waimakariri Valley, two and a half thousand feet above the river to Mt. Bealey, a distance of three miles in one flight.

All the above are voluntary flights. Rather different are movements of birds caught in storms as a Kea I saw at Greymouth on the morning of 17/4/55 after a night of strong north-east winds and rain. This bird may have been blown eight miles from the Paparua Mountains, but more probably sixteen miles from the Hohonu Mountains. The bird was lost in the clouds over Boddytown, when flying in the direction of the Hohonu Mountains.

Such loss of direction by Keas must be infrequent as they are adapted to live in a region of high winds and storms. A family enjoys playing on the gusts which precede a storm two or three minutes away, and only takes shelter from the rain. Young Keas soon become highly experienced in using the winds to best advantage.

The population estimates of table 3 contain evidence that in late winter Keas are coming into Arthurs Pass from one and a half times the distance of early winter. For instance on 23/6/57 89 was the population and on 3/8/57, 156. If these populations are for similar areas it is necessary to take the square root of the ratio to obtain the ratio of distances

and

$$\sqrt{\frac{156}{89}} = 1.3$$

or more accurately

$$1.32 \pm 0.23$$

or if, as below the area is regarded as a valley of constant width

$$1.75 \pm 0.61$$

One and a half is included in these estimates.

TABLE 3  
Recaptures at Arthur's Pass, 1957

date, D	23 VII	14 VII	3 VIII	24 VIII	31 VIII	14 IX	5 X	26 X	17 XI	15 XII	D
population, P	89	112	156	106	135	108	111	20	4		P
standard SE error	26	20	27	12	36	25	36	-	3		SE

5	1	4	10	10	5	10	5	2	1	2
18	1	8	3	13	5	4	1	2	2	
28	2	5	4	14	2	0	0	1	20	
	46	0	4	7	6	0	0	0	31	
		19	1	3	2	0	0	19	27	
			29	2	3	1	0	44	19	
				31	2	0	0	28	4	
					21	1	0	17	5	
						2	1	5	2	

Total different keas  
101

number captured = R  
 and  $SE = \left( \frac{A \cdot N \cdot N - R}{R^2} \right)^{1/2}$

The horizontal part of the table gives the results of calculations from recapture data recorded in the triangular part of the table. For instance, along the diagonal vertically below 31/8/ and running from NE to SW we read for the week-end 31/8/, 19 different birds were captured or seen; there were no recaptures of 23/6/ birds, 5 of 14/7/, 3 of 3/8/, and 10 of 24/8/. Along the NW-SE diagonal we read that 5 31/8/ birds were seen on 14/9/, 5 on 5/10/, 2 on 26/10/ and none later and also that 19 were released.

TABLE 4  
Recaptures at Temple Basin, 1957

D	23 VII	13 VII	3 VIII	25 VIII	31 VIII	13 IX	5 X	26 X	17 XI	15 XII	D
P	112	65		109	780	187	66	-	-	-	P
SE	30	20		27	770	124	60				SE

15	2			5	1	2	1	0	0	1	
7		1		5	0	0	0	0	0		
		3	2	3	0	0	0	0	0		
			4	4	0	0	0	0	0		
		24	3	2	0	0	0	0	0		
			21	1	2	0	0	0	0		
				22	0	0	0	0	0		
					11	0	0	0	11		
						5	0	0	5		
							0	0	0		
								22	20		
										24	
											N

Total different keas  
75

## POPULATION

I have estimated the number of Keas which are attracted to the settled areas of Arthurs Pass-Temple Basin in a winter

1. by internal analysis of 1957 results

and 2. by comparison of 1956 and 1957 results both calculated from the Lincoln index after Dowdeswell, Fisher and Ford (1940) and with standard errors calculated with the formula given by Bailey (1951) (see tables 3-6). Unfortunately, one premise of the method is not obeyed, namely that there be no migration into or out of the area, so the results may be too large but alternative methods of estimation show that this error is small.

By internal analysis for Arthurs Pass-Temple Basin the largest monthly total is 201 with a standard error of 33 and by the comparison 327 with an error of 60. The latter is for a longer period of time and requires correction for births and deaths. If my estimate of the annual survival rate,  $2/3$  is used

$$\begin{aligned} \text{then 1956 population} &= 2/3 \quad (327 \pm 60) \\ &= \quad \quad 218 \pm 40. \end{aligned}$$

Independent evidence for this rate will be presented elsewhere. A comparison of 201 and 218 suggests that few Keas move far, so far that they do not return to feed in winter.

If this population is thought of as part of that within a 15-mile radius of the centre, Arthurs Pass-Temple Basin (the approximate distance of the furthest recoveries) it can be checked by a third method. If the facts are simplified by assuming that all Keas at the centre are banded and none at the circumference, and that the proportion of banded Keas decreases linearly with distance from the centre, then doubling the number banded will give the population as approximately 450 Keas. Actually comparison of the population estimates with the total number of birds identified shows that nearly all are banded at the centre (see tables 3-5) and table 2 shows the small number banded at the circumference. The results I have show a more rapid decrease of proportion than linear, so 450 is a low estimate.

TABLE 5

*Recaptures at Arthur's Pass and Temple Basin, 1957*  
*Total Different Keas 161*

D	23.VII	14.VIII	3.VIII	24.VIII	31.VIII	14.IX	5.X	26.X	17.XI	15.XII	D
P	131	140	201	161	181	152	104	24	4	-	P
SE	19	19	33	16	34	27	27	-	3		SE

TABLE 6

*Recaptures at Arthur's Pass and Temple Basin, 1956 and 1957*

1956		1957	
327		-	
60			
49	25	159	
A	167	49	N

Now taking 450 Keas as the population for a circle of 15-mile radius gives a density of  $\frac{2}{3}$  Kea per square mile (approximately 1 Kea per square mile); if for a circle of 10-mile radius  $1\frac{1}{2}$  Kea per square mile. Confirmation can be obtained from the density of nests which I have found to be about 1 nest per 4 square miles.

(a) In the Crow Valley where there were in 1957 two pairs, 2 miles apart. The width of the valley is two miles so the territory is 4 square miles, and in this territory live the adult pair and juvenile birds.

and (b) In the Edwards Valley (excluding the East Edwards Valley which I have not investigated) there were nests at the bottom gorge, at the forks, at the roche moutonne, and by the hut. Besides, I found two other adult hens, not definitely located. So there were four (perhaps six) nests in 14 square miles.

In the Bealey Valley my impression is of a greater density, caused no doubt by the large winter-carrying capacity.

Now from the theory advanced so far the results for Arthurs Pass and Temple Basin; and Arthurs Pass-Temple Basin and the adjusted result from 1956 and 1957 might be expected to be the same, not merely that, but each monthly estimate the same. Actually the tables show a small and fairly static population early in the winter and a larger population in early August when there is more movement. Several of the estimates for early winter both for Arthurs Pass and for Temple Basin are approximately 100. The hundred at Arthurs Pass can be thought of as the population within the rectangle 3 miles up and 3 miles down the Bealey Valley (the distance of single flights and the distance adult pairs have frequently been found away from their nests when in flocks in neighbouring territories) or 6 miles in length and 2 miles across the valley. This is a population of 100 Keas in 12 square miles or a density of 8 Keas per square mile. When Temple Basin is combined with Arthurs Pass the rectangle is 9 miles long so the number of Keas might be expected to be one and one half times as many. Actually Table 5 shows 131 on 23/6/57 which is to

be compared with 89. When further similar comparisons are made it is found that the population for the combined area is rather less (average value 1.37) than one and a half times the population for Arthurs Pass, so 8 Keas per square mile is an overestimate.

Certainly the results show that in a good year between 100 and 200 Keas can be seen at Arthurs Pass and Temple Basin, and further that the density of Keas is between one and eight per square mile. The weight of evidence suggests the true value is nearer the lesser value and indeed the greater value is for the Bealey Valley where my impression is of a great density.

#### THANKS

I wish to thank the Arthurs Pass National Park Board for permission to band Keas and continued interest in the project; Mr. R. Cleland for continually watching the Keas at Arthurs Pass; Mr. L. Angus for showing me how to snare Keas; Dr. B. I. Hayman for help with the statistics; Mr. E. G. Turbott for several discussions about the paper; and many friends for reports and observations.

#### BIBLIOGRAPHY

- Bailey, N. T. J. (1951), 'On Estimating the Size of Mobile Populations from Recapture Data,' *Biometrika* 38, 293-306.  
 Dowdeswell, W. H., Fisher, R. A., and Ford, E. B. (1940), 'The Quantitative Study of Populations in the Lepidoptera,' *Annals of Eugenics* 10, 123-36.  
 Marriner, G. R. (1908), 'The Kea, A New Zealand Problem.'  
 Potts, T. H. (1882), 'Out in the Open.'



## A MIXED SHAG ROOST AT CLEVEDON

By *W. L. MOISLEY*

On 28/3/60 I noticed that an evening shag roost near my home, known for some years, but not studied, contained four species of shags. The roost is in a small plantation of exotic pine trees on a short steep face above a tidal creek lined with tall mangrove. Flat grassland stretches back from the trees. The birds fly in from the sea about  $1\frac{1}{2}$  to 3 miles distant and from the nearby river and maze of mangrove-bordered creeks. This roost shows no sign of ever having been used for nesting.

After it had been noted that the birds came in to roost from late afternoon to dusk, counts were made and notes taken for the six days March 30 to April 4 and on April 14, 18 and 19. In this I was assisted several times by H. R. McKenzie and on separate occasions also by Messrs. A. Blackburn, F. M. Brookfield and W. W. Renouf. Some of my observations were made from in the top of a totara tree, where I could command the bend in the creek and the face of the crescent of pine trees. The birds could see me but did not mind. Perhaps they thought I was another kind of shag with an odd choice of roosting tree. Most of the watching was done from a large hide I made in the mangroves, while I did some close study from a rough hide of branches right under the birds. Notes of the weather and tides were kept but the roosting was not affected by them.

The counting was exciting as dusk approached. Fifteen to twenty birds of perhaps three or four species would come in at once,

but some would miss their footing and swing out of sight again over the mangroves. The method was to count the whole lot in, write down the figure, count the outgoing birds, then check them back in until the first figure was reached. It was fast work. The writer could not see all the birds readily, so the busy caller sounded like an announcer at a football match.

For the dates given above the nine counts for each species are appended. For the sake of clarity the two phases of the White-throated are shown separately, the broken coloured ones being included in White-throated.

**BLACK SHAG.** (*Phalacrocorax carbo novaehollandiae*).

Counts: 51, 56, 54, 88, 88, 84, 83, 81, 83. This species always arrived first, sometimes forty or so being present when I got there at 3 p.m., but some would still come in right up to dark. About 15% were immature. At first only a few showed the white flank patch but by the end of the period over one-third of them had it.

**PIED SHAG.** (*Phalacrocorax varius varius*).

Counts: 8, 9, 12, 4, 7, 5, 9, 3, 3. The Pied were usually the second species to arrive and were seldom among the late ones. There were usually 2 or 3 immature.

**WHITE-THROATED SHAG.** (*Phalacrocorax melanoleucos brevirostris*).

Counts: 64, 62, 68, 61, 75, 91, 91, 89, 76. The true type prevailed but quite a large proportion had the extra long white area from throat to breast or were patchy. Some immatures were seen but when a bunch of birds, including Little Black, flew up the creek and could only be seen as they crossed the short space between the mangroves and the far end of the crescent of pines there was little time to make sure which was which. Those coming nearer to us we could be sure of. To be on the safe side, we changed over eight or so of our Little Black tally each time to allow for immature White-throated with no white throat. This I am sure was sound practice. White-throated and Little Pied together were nearly always the third arrivals in regard to the first in of species.

**LITTLE PIED SHAG.** (Pied phase of White-throated).

Counts: 27, 30, 33, 14, 20, 20, 26, 25, 27. These figures represent the usual proportion of Little Pied to White-throated Shags about the coast here.

**LITTLE BLACK SHAG.** (*Phalacrocorax sulcirostris*).

Counts: 13, 21, 28, 26, 33, 29, 38, 39, 31. Some immature were detected by their somewhat brownish appearance. This was nearly always the last species to start coming in.

**ODDLY COLOURED BIRDS:** One Black Shag had a white patch covering all of its side under the wing and another had a similar patch about  $2\frac{1}{2}$  by 1 inches. These were not connected with flank patches.

A Little Pied Shag, seen from the pine-tree hide at ten feet, had a yellow bill, dark eyes, white head, neck, breast, belly and upper wing coverts, black primaries and secondaries, broken white on upper tail coverts and rump, black upper and lower surfaces of tail, black feet. In poor light the white upper wing coverts looked like white stumps of wings. Another bird was coloured much the same but with two

black shafts from the back up to each side of the base of the neck. A third had a whitish head with a thin dark strip from the fore-crown right back down to the centre of its back, its under surface being all dirty yellow.

#### ROOSTING HABITS.

The Black Shags used mostly the higher perches and kept to the outer surface of the clump of trees, spreading the full length of the crescent, about 150 yards. They did not use the lower branches down towards the creek. They were the easiest to count because they flew in higher than the others. No shags used the side of the plantation away from the creek.

The Pied Shags kept to one end and at lower than mid-height, on or very near the surface of the pine face. The smaller shags occupied perches from low kowhai trees on the creek bank up to one third of the height of the pine face, some on outer branches but many penetrating the trees to the second line of pine trunks in the plantation. These small shags, White-throated, Little Pied and Little Black, make a curious cooing noise "keh-keh-keh" when landing and when moving from branch to branch. This I heard from my hide only a few feet below them. Often two would hold an animated conversation, making the above noise and a clicking sound.

Preening is begun by arranging the primaries and secondaries of the folded wings. In between preenings the birds relax, and with the bill slightly open there is a constant rippling movement in the throat. Another form of relaxing is to bend the neck well back and rest the bill on the upper breast. When sleeping the bird folds its head over on the upper part of its back in an awkward looking manner.

#### DAYTIME HABITAT.

Some of the Black Shags came from up the river but most would live in the lower river area and the estuary. It is thought that the roost would account for the whole population of the Wairoa (Clevedon) River, its estuary and the nearby coast.

The Pied represented only a small part of the local birds. Several other of their roosts are known. On April 14, H. R. McKenzie saw 20 feeding in the river only a mile from the roost, but there were never 20 seen at the evening roost.

The White-throated and Little Pied work mostly about the mouth of the river and the estuary. From a high vantage-point on the west side H.R.McK. and I saw so many of these that we were sure the roost was not drawing its numbers from beyond the estuary.

The Little Black seem to range more widely. They have not yet been seen in the estuary during the day, though they could frequently be there.

On one occasion I set out on the east side to see where the birds spent the day. On eight dead pine trees by the river, three-quarters of a mile west of the roost, I found 83 Black, 8 Pied, 64 White-throated, 15 Little Pied and 30 Little Black. This corresponded so closely with the roost numbers that I concluded that the fishing had been good and they were just waiting for bed-time. On April 14, in the early afternoon, H.R.McK. saw about 45 Black Shags on the same trees but no others. No doubt in both cases they would later fly up the creek to the roost.

## SHORT NOTES

### LONG INCUBATION PERIOD OF BLACK SWAN

Using a boat I visited the nest of a pair of Black Swans (*Cygnus atratus*) on 12/8/59; and though it was not possible to see the nest properly, the pen was covering at least three eggs. On 15/8/59, when I approached from dry land, there were five warm eggs and the pen was incubating. There were still five eggs at 4 p.m. on 27/9/59, and five newly hatched cygnets at 1.30 p.m. on 28/9/59. These dates give a minimum incubation period of 44, perhaps 45, days, which is rather longer than any given in the literature. Delacour and Scott (Waterfowl of the World 1, 60) allow 34-37 days; and for no species of swan is a period of more than 42 days given.

Delacour's statement that Black Swans never voluntarily leave the nest unattended is not correct. On a number of occasions the cob was seen to collect the pen; and both birds would leave and feed together for 1 to 1½ hours before the cob escorted her back again. The cob never set.

When returning to the eggs the pen went through a most interesting display (v. Plate XVI) whereby the neck was bent sharply into the shape of an inverted staple, immediately on sighting the eggs. This was accompanied by prolonged hissing and a marked swelling out of the neck feathers making the neck twice its usual thickness. At first it looked like a threat display, but the angle is different. In threat display the curve is more C-shaped and directed forward. In this display the neck, shaped like an inverted U, was pointed down.

M. F. SOPER



### THE COOT COLONY AT LAKE HAYES

In a previous account, Soper and Small (*Notornis* VIII, 93) give details of Australian Coots (*Fulica atra australis*) breeding in the Arrowtown district. The colony has been periodically observed since two pairs of birds were first noticed in October, 1958, and some interesting information has been obtained.

A count made in April, 1959, revealed about forty birds, a considerable increase on the four first observed in the previous October. By winter this number had further increased to seventy-two. According to Coward (*The Birds of the British Isles*), Coots are capable of rearing as many as two clutches each season; the second one is not necessarily a re-nesting due to loss or desertion. It would appear that the Coots at Lake Hayes have done this.

A count in January, 1960, showed a reduction in number to thirty-two birds, with a tendency to move away from the lake. The Coots appeared to be feeding exclusively on beds of aquatic weeds, crow-foot (*Ranunculus fluitans*) and milfoils (*Myriophyllum spp.*). Little or no calling was heard. Calling had been a significant feature of breeding the previous season, both during incubation and after; gradually tapering off as the young approached adult size. Holiday-makers moving in small boats around the willow-lined shore of the lake caused the Coots to move to another part of the lake, but it is doubtful whether this would have influenced the tendency to move away to other areas. By April the number was further reduced to sixteen. Recent counts, however (2/6/60), show an increase to fifty-two birds.

M. M. SMALL

## KAKAPO CAVES

From 12th to 19th February, 1960, I was fortunate enough to join Marshall Small and Ralph Adams, of the New Zealand Wildlife Service, in a search for the Kakapo in the Tutoko Valley.

This valley has always appealed to me because of its similarity to the site of previous Kakapo finds at George Sound (Hall-Jones, 1960). Both areas have sub-alpine slopes with maximum exposure to the sun, and possibly of even greater importance, both areas are almost totally devoid of deer.

The latter finding is unusual in Fiordland and one naturally wonders as to whether there has been some competition for food between these two vegetarians, with survival of the bird in only deer-free areas. Certainly our party confirmed this remarkable lack of deer and only on one occasion were a few foot-prints seen. The favourite deer foliage, *Nothopanax* spp., was in abundance.

Two stoat nests were found, but although both contained a multitude of assorted feathers, no Kakapo feathers were identified.

An unexpected find was that of a dead chamois at the foot of Mount Grave. This species has not previously been reported in this area.

Close to the foot of Grave Couloir, we located two caves which had recently been inhabited by Kakapo. In both cases, a tunnel allowed one to wriggle into a larger chamber about two to three feet in height and of similar diameter.

We were surprised to find that in both cases the floor was dust-dry, in spite of very heavy rain the previous night, during which our river rose several feet. Both caves contained Kakapo droppings almost entirely composed of Tutu seed as described by Williams (1960). Other contents included small fragments of moss and fern, and in the second cave, a prune stone! The latter probably originated from the nearby Pawnbroker Bivouac Rock, which is occasionally used by climbers.

Although not of the dimensions of previous finds at George Sound, a shallow depression at the entrance to one of the caves was probably a dusting or scratching hole.

At the foot of Mount Tutoko we located two similar caves, this time containing several Kakapo feathers. One was approached by an ill-defined track. It is interesting to note that in all four cases the caves were found under large isolated rocks.

Nearby, there was an unusually prolific growth of Tutu, dissected by several tracks. Along these runways we found a number of Kakapo droppings and feathers. It would appear that the Tutu berry forms an important part of the Kakapo's diet during this part of the year.

No nocturnal watches were kept, and although no Kakapo were actually seen or heard, we gained the impression that there were at least a few of the species alive in this valley.

Another notable feature of the valley was the complete absence of calls of Weka and Morepork. The large number of trees in berry probably accounted for the frequent flocks of Kereru seen during the expedition.

J. HALL-JONES

## REFERENCES

- Poole, A. L. 1951 — Preliminary reports of the N.Z.-American Fiordland Expedition, N.Z.D.S.I.R. Bulletin 103, Govt. Printer, Wellington.  
 Williams, G. R. 1956 — The Kakapo (*Strigops habroptilus*, Gray), *Notornis* 7 (2): 29-56.  
 Williams, G. R., 1960 — The Birds of the Cleddau River Area, *Notornis* 8 (7): 185-188.  
 Hall-Jones, J., 1960 — Rare Fiordland Birds, *Notornis* 8 (7): 191-192.

## RIFLEMEN IN EXOTIC PINE - FORESTS

On 30/6/60, Mr. O. Secombe and I saw a Rifleman (*Acanthisitta chloris*) in Matea Forest, east of Kaingaroa Forest. It was in a mature stand of *Pinus radiata* at least half a mile into the pines and one and a half miles from the nearest podocarp forest of the western Ureweras. Riflemen occur to my knowledge in beech, podocarp, scrub-hardwood and hardwood forest from sea level to over 4,000 feet and are reported from patches of scrub (Oliver, "New Zealand Birds," 1955), but as far as I can ascertain they have not been reported previously from pine forest. The species can therefore be tentatively added to the list of endemic birds that can adapt to this new habitat.

For those who are not familiar with the bird-life of the Central North Island pine forests, the native birds in Kaingaroa during the winter together with the approximate number of times an observer can expect to contact the species in a ten-hour day are listed below:

Whitehead (40), Tomtit (25), Grey Warbler (25), White-eye (20), Fantail (18), Robin (15), Bellbird (<1), Morepork (<1). In addition, Fernbirds, Pipits, Kingfishers and Harriers occur within the forest perimeter but not in the pines; and Tuis, Kakas and Yellow-crowned Parakeets can be found up to the forest boundary but have not penetrated inside.

It is significant that most of the successful colonizers of the pine forests are the insect-eaters; and that one of these, the Whitehead, attains a degree of abundance seldom reached in indigenous forest.

GRAEME CAUGHLEY

Riflemen were observed by me, on several occasions, in Karioi State Forest, during November, 1959, but only in stands of unthinned, mature *Pinus radiata* (planted 1927). These stands are confined to the lower block of the forest, adjacent to the Waiouru-Ohakune main highway at c. 2150 feet a.s.l. No more than two Riflemen were seen at any one time; and, more often than not, they occurred singly. This would appear to be an isolated group, as no birds of this species were observed, between August and November, 1959, in other compartments of exotics within this forest.

C. N. CHALLIES



WHITE-WINGED BLACK TERNS IN THE AUCKLAND PROVINCE  
AUTUMN 1960

During the autumn of 1960 four distinct White-winged Black Terns (*C. leucopterus*) are known to have been present in the Auckland province, viz.— one in the Manukau Harbour, two in the Firth of Thames and one in the Bay of Plenty.

(a) An adult in breeding dress was seen by numerous observers during March and April over one or other of the Puketutu pools. If the same individual has now frequented upper Manukau, especially Harania Creek and the vicinity of the Favona Causeway for some years — and there are good grounds for believing that only one bird is concerned — it has now assumed breeding plumage for six successive years, possibly seven, without migrating (v. *Notornis*, Annual Locality Reports). It is,

of course, possible that two or more of these terns have paused in Manukau on their northward passage; but never have two been seen together. General behaviour and faithfulness to certain feeding grounds at certain seasons suggest that the many sightings in upper Manukau over nearly eight years are of a single individual. It was already in breeding dress at Harania Creek on 22/1/60. Its last reported appearance was at Spoonbill Pool on 27/4/60 when it was hawking flies at dusk over the shallows in which many hundreds of Pied Stilts were standing.

(b) The White-winged Black Tern which was first reported at the Miranda pools in February, 1959, has stayed in the vicinity for more than a year and a half. Its estimated age when first seen was about eight months and it remained a very pale bird throughout 1959. Little change was observable in its plumage till mid-February, 1960, when the upper wing surface was appreciably darker and small patches of black were showing under the wing. By 2/3/60 the characteristic pattern of the wing of an adult in breeding dress was outlined and the sides of the body were blackening, though the black areas on the head were only slightly enlarged. On 16/4/60 it was virtually in full nuptial plumage. However, it may still have been immature, as it did not migrate. For although it was not present over the pools in the morning on 12/6/60, it was seen there in the evening by Mr. W. W. Renouf. There is no shortage of suitable feeding waters among the creeks and marshes of the Firth of Thames. As a general rule, where Stilts can find food, so can a White-winged Black Tern.

This individual was seen on several occasions by many observers during August, 1960, as it flitted among the numerous pairs of Pied Stilts which were nesting around the pools.

(c) On 16/4/60 a second White-winged Black Tern was found at Kaiaua, a few miles north of the Miranda pools. It was resting, a distinctly smaller tern, among White-fronted Terns (*S. striata*) well down on the stony foreshore. It was easily approached; and when disturbed, flew in the manner typical of the species, before resettling. It was in the pale plumage of a juvenile rather less than a year old. Fortunately since 1952 we have had considerable experience of White-winged Black Terns in this state of plumage. Mr. and Mrs. J. Prickett also saw it.

(d) On 8/3/60 at the mouth of the Tarawera River in the Bay of Plenty, a White-winged Black Tern was the 'odd man out' in a mixed flock of c. 100 White-fronted (*S. striata*) and four Black-fronted Terns (*C. albobristatus*) which were grouped on the beach. It was discovered by Mrs. H. M. McKenzie, and closely watched by Miss G. Hatch of Honolulu and H.R.McK. Its plumage was at an interesting stage of transition. The wings were dark above and patchy below; black patches were emerging on the sides of the body, while on the head the black was spreading from the three areas which are permanently dark. As adults generally appear to be in full breeding dress by the end of February in New Zealand, this may have been a second year bird, assuming nuptial plumage for the first time. The adjacent Matata lagoon is just the type of habitat which seems to attract stray White-winged Black Terns in New Zealand. Messrs. M. J. S. Black and W. J. Brown report that they watched this tern at Matata on 12/3/60.

H. R. MCKENZIE

R. B. SIBSON

### BACK NUMBERS OF "NOTORNIS"

Members are reminded that back numbers of *Notornis* and the earlier *N.Z. Bird Notes* are obtainable from the Society. Enquiries about costs and the parts still held in stock should be made to:— Mrs. Hetty McKenzie, Box 45, Clevedon, Auckland.

Other publications available are: *Checklist of New Zealand Birds, 1953* (10/6); *The Takahe* (5/-); *Identification of Albatrosses* (1/-); *Reports and Bulletins, 1939-1942*, with Index (12/-), Index Alone 1/6. These precede Vol. I of *N.Z. Bird Notes* and record the first three years of the Society's work.

As there is a steady demand for back numbers of *Notornis* and especially for the earlier *N.Z. Bird Notes* (1943-1950), members are asked to offer to the Society, for gift or sale, past numbers which they no longer need.

### FIELD STUDY COURSE AT FAREWELL SPIT

A course for a limited number of active ornithologists who are especially interested in shore-birds is being arranged under the leadership of Mr. B. D. Bell, for the period between January 21 (assemble at Nelson) and January 30, 1961.

Those wishing to attend must apply to Mr. Bell, Wildlife Branch, Dept. Internal Affairs, Wellington, before the end of October. As numbers have to be restricted, preference will be given to applicants from the South Island.

The fee will be about £5. Please indicate if you will have a car available.

### CHRISTMAS CARDS

Once again the Society is indebted to Mrs. Avis Acres, who has painted two Christmas Cards. The birds depicted are Whitehead and Wrybill.

### DONATIONS RECEIVED FOR YEAR ENDING 31/3/1960

£5, H. S. R. Cameron; £4, Miss McDougall; £2, S. L. Lobb; £1, W. J. Broun, J. C. Davenport, G. Jacquierey, K. A. King, E. St. Paul, B. Sladden, Mrs. E. J. Trollope; 10/-, L. J. Bunce, P. Dorizac, J. A. Fagan, D. Galey, F. C. Kinsky, Mrs. O. McCulloch, A. Nuttall, C. F. Parsonson, Mrs. M. A. Robinson, V. M. Rutherford, Mrs. O. Sansom, K. A. Wodzicki; 7/6, M. Fitzgerald; 5/-, Mrs. M. Black, M. J. S. Black, Mrs. G. Syme, L. L. Taylor; and smaller amounts totalling 18/6.