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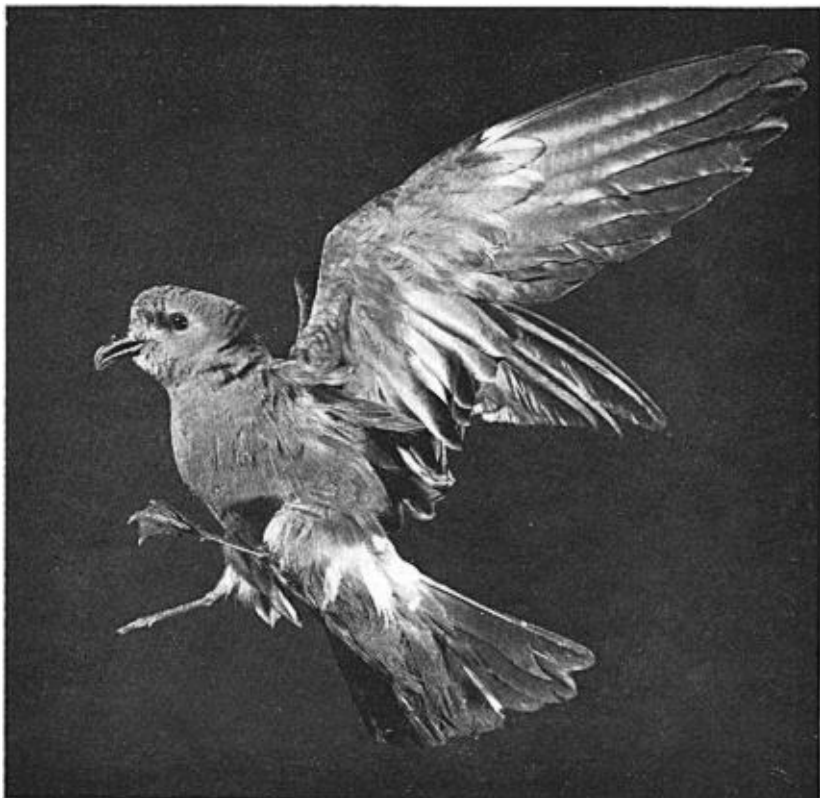
THE STARVATION THEORY IN ALBATROSSES

BY L. E. RICHDALE

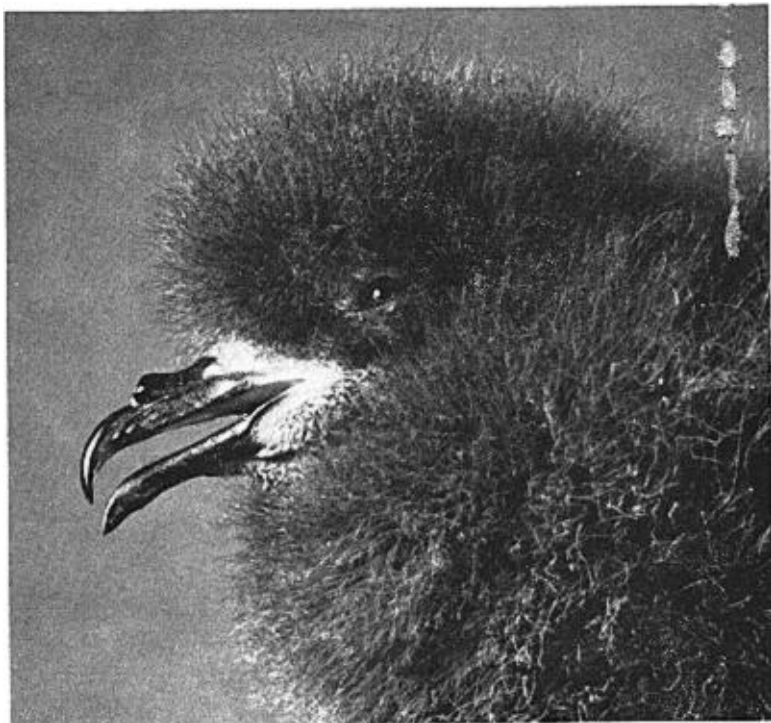
FROM November 1936 to September 1952, an annual study was made of the subspecies of Royal Albatross (*Diomedea epomophora sanfordi*) breeding at Taiaroa Head, Otago Peninsula, New Zealand. The breeding area overlooks the entrance to the Otago Harbour and is 20 miles by road from the city of Dunedin. A total of 22 breeding birds, 5 of which have disappeared, have been available for study in the 16 seasons involved. The birds are known intimately as individuals and are banded both with aluminium and celluloid bands. The first two fledglings reared, one in 1938 and the other in 1939, were watched in considerable detail. In 1938, I was on the breeding area on 118 days and in 1939, on 124 days. Particular attention was paid to the second half of the chick's period in the nest when it was alleged that the parents would desert the chick.

As far as is known, the subspecies at Taiaroa Head breeds only in two other places—the Forty-fours and the Sisters, islets of the Chatham group, which are approximately 600 miles east of New Zealand. A second subspecies, *Diomedea epomophora epomophora*, inhabits Campbell and Auckland islands which lie approximately 370 and 190 miles, respectively, to the south of New Zealand. There is possibly a third subspecies breeding in the interior of Tierra del Fuego (Murphy, 1936: 577).

Three major papers have been published on my observations at Taiaroa Head (1939: 467–488; 1942: 169–184, 253–264; and 1950: 1–92). Further, for the Campbell Island race, Sorensen (1950a: 1–39) has given an account of a five-year study on that island (1942 to 1946). He has also told us something of the Light-mantled Sooty Albatross, *Phoebastria palpebrata* (1950b: 1–30). The foregoing papers are vital in the discussion of the problem which is the main purpose of the present treatise. The term 'petrel' is used here to cover any species of the Procellariiformes.



LEACH'S PETREL (*Oceanodroma leucorhoa*) photographed by Robert C. Hermes at Machias Seal Island, Maine, in July of 1953. The exposure was made indoors, using a Speed Graphic camera and a wet-battery-operated Dormitzer, operating 2 lights at 200-watt capacity and 1/5000 second flash duration.



DOWNY YOUNG OF LEACH'S PETREL, photographed at Machias Seal Island, August 1952, by Robert C. Hermes.

For generations the view has been held in many quarters that the young of several kinds of seabirds such as gannets, penguins, and petrels are abandoned in the nest by their parents and are left for a relatively long period without food. The length of the period is seldom clearly stated, but the inference always is that the desertion period is not a normal inattentive period by the parents. The fledglings are said to subsist on a heavy store of fat, and it is only by fasting that the young birds can reduce their excessive nestling weight to flying weight. These ideas have had almost universal acceptance and, in fact, are still widely held. There have been dissidents in connection with albatrosses (Filhol, 1885: 44-50; Matthews, 1929: 567-568; Richdale, 1939: 483-488, and 1942a: 260-262), but even in 1951, so strong is the force of tradition, there is evidence that the findings of these workers have not been accepted (Rankin, 1951: 166-168).

INTERVAL BETWEEN BREEDING PERIODS

Up to the end of the 1950-51 season, I have been able to analyze 57 attempts made by Royal Albatrosses to breed at Taiaroa Head since 1935-36 and the effect of these attempts on the return or non-return of the birds in the following season. In all, 17 successful attempts have been made to rear chicks and, in every instance, the parents concerned failed to appear on the breeding area the following season. This suggests that the breeding interval lasts two years. For the Campbell Island Royal Albatross, Sorensen (1950a: 27-30) was able to watch the behavior of 13 mated pairs which succeeded in rearing chicks. Not one of these parents was seen on the breeding grounds in the following season. Sorensen concludes, "Breeding takes place every second year unless the egg or very young chick is lost."

Of the 40 mated pairs at Taiaroa Head which experienced nest failure, all returned to the breeding area in the following season. All but three of these 40 mated pairs bred again shortly after arrival. For Campbell Island, Sorensen observed the same pattern of behavior for birds experiencing nest failure.

The conclusion from the foregoing evidence is that in two races of Royal Albatrosses successful parents breed every second year and that, if nest failure is experienced, breeding usually occurs in the following season.

We do not have such precise data for the Wandering Albatross (*Diomedea exulans*). Matthews, who spent some time at South Georgia at the end of the nesting cycle of the Wandering Albatross,

makes the following significant statement (1929: 568): "The adult albatrosses do not breed every year, as they do not finish feeding their young until the new season's eggs are laid (by other birds) and incubation has started. Consequently, there must be an interval of at least one season between consecutive matings of any one bird."

Successful Royal Albatrosses at Taiaroa Head are on the breeding area occupied with reproductive duties for practically 12 months. For example, the mean pre-egg stage lasts 32.5 days, the mean incubation time is 79.27 days, and the mean period the chick is ashore is 236 days with a range from 216 to 252 days. Sorensen's work shows that a comparable pattern seems to be followed by the Campbell Island race. From the evidence available in the literature, it appears that the chick stage in the Wandering Albatross is longer than that in the Royal Albatross, being as long as 9 and 10 months. It would seem to me, therefore, that Matthews is correct in asserting that Wandering Albatrosses normally breed every two years.

HISTORY OF STARVATION THEORY TO 1938

The earliest reference that I have been able to find concerning the starvation theory is by Hutton (1865: 276-281) and is written from notes received from Mr. R. Harris who was a surgeon in the British Navy. Harris arrived at the Prince Edward Islands in September 1832, and apparently stayed until January 1833. He reached Kerguelen's Land at the end of January and apparently remained there until 6 December 1833. He made observations on the birds and passed information on to Hutton, who published the following concerning the Wandering Albatross.

"At a certain time of the year, between February and June, Mr. Harris cannot exactly say when, the old birds leave their young, and go to sea, and do not return until the next October, when they arrive in large numbers. Each pair goes at once to its old nest; and, after a little fondling of the young one, who has remained on or near the nest the whole time, they turn it out, and prepare the nest for the next brood. . . . While the old birds are away, it is difficult to imagine how the young ones obtain food; for Mr. Harris assures me that no old birds are seen near the islands for months together. Strange as this may appear, its very strangeness is in favour of its truth, as no one would think of inventing such a story; and its correctness is further corroborated by the abundance of Albatrosses found at sea from April to October, inclusive, and their comparative rarity, especially of the old white ones, during the rest of the year which I believe to be the case."

Harris' statement that the old birds are absent for months and Hutton's statement that albatrosses are numerous at sea from April to October can, in the main, be explained. This is the period of the chick's last three quarters of its life as a nestling. As the chick begins

to develop, 'unemployed' albatrosses gradually leave the breeding grounds for that season, hence the impression that the breeding grounds have been deserted by *all* adults. This phenomenon has occurred at Taiaroa Head in each of the 16 seasons I have been working there. Further, Hadden has observed it on Midway Islands (1941: 213). That adult albatrosses are not numerous or are not noticed on the breeding grounds as the chicks begin to grow and, further, that they are more numerous at sea in that season is not proof that the chicks are being starved.

As a result of Hutton's article came a letter to *The Ibis* from Mr. C. J. Andersson of Cape Town, South Africa, dated 8 December 1865. Mr. Andersson wrote (1866: 324).

"I believe I have got a clue to the mystery about the young Albatross; I mean as to how they are supported during the absence of their parents, and while they are yet unable to fly. . . . I said one day to an intelligent master of a sealing-vessel, from whom I have obtained many valuable data about seawowl—'what do you know about the Albatrosses? how are the young, for instance, fed after being abandoned by their parents?' 'Why, of course,' was his prompt reply, 'they live *on their own fat*.' 'On their own fat!' I exclaimed; 'how do you prove that?' 'Because,' answered he, 'in the first place they are excessively fat at this season; secondly, they could not possibly in many instances get down to the water without being able to fly, and that they can't do'. . . . Perhaps you will smile at this; but if other animals, I would ask, can live for several consecutive months on their own fat, why not birds?"

In Andersson's letter we have the first mention that I have been able to find of young albatrosses living "on their own fat." The evidence, however, is hearsay with no quantitative data to support the assertions.

After several subsequent references to the starvation theory, for example, Buller (1888: 197) and Chapman (1891: 521), we come to a statement which, as far as I can ascertain, has been the major influence in perpetuating the belief of a starvation theory in albatrosses. It was published by Buller (1905: 131–133) who has taken the story from "The English Illustrated Magazine" in which appeared an article written by Mr. James Buckland. No date is given.

"The nestling is fed assiduously until it becomes so grossly fat that it exceeds a full-grown bird in weight. It is then deserted by its parents October has dawned before they return.

"And now I have arrived at the remarkable feature in the domestic economy of the wandering Albatross . . . a feature so extraordinary that the long list of natural-history wonders may be searched in vain for a parallel. How does the young bird receive food during the absence of its parents? *It does not receive any!* During the whole time—a period often longer than four months—it lives solely on its own fat! In this there is no assumption whatever. Naturally, the nestling is incapable of flight. . . . That being the case, the conclusion is incontrovertible."

The foregoing remarks by Buckland appear to refer to the young Wandering Albatross on the islands to the south of New Zealand, but could well be referable to the Royal Albatross on Campbell Island or to both species lumped together. Buckland's story, as quoted by Buller, gives the impression that he was on Auckland, Campbell, and Antipodes islands around the turn of the century. Presumably, he was a passenger on one of the Government steamers servicing the depots for castaways on those islands. At that time the two species had not been differentiated properly. Buckland's description of a fledgling, however, is that of a Wandering Albatross. Where Buckland acquired his amazing story of the starvation of the young albatross for fully four months is difficult to say. It closely resembles the published accounts of Hutton and Andersson already given. Like those accounts, Buckland gives no quantitative data on which the reader may form his own opinion.

For the Royal Albatross, the earlier accounts of the starvation theory in that species are really referable to the Wandering Albatross. For example, Buller (1905: 141) includes Harris' story, which applies to the Wandering Albatross, in his discussion of the Royal Albatross. Oliver (1930: 156) did not notice that fact and has stated for the Royal Albatross: "After a while the young is deserted by the parents and it must then undergo a period of fasting until it is able to fly." Murphy (1936: 581) then quotes Oliver and concludes, "it appears that this species has the same custom as the Wandering Albatross and other Procellariiformes with regard to abandonment of the well-grown nestling young."

The chief exponent of the starvation theory in the Royal Albatross as a direct result of what was happening at Taiaroa Head was R. A. Falla, Canterbury Museum, Christchurch, New Zealand. Audiences in Christchurch from the end of 1937 to well into 1938, listened to Falla's account of this amazing natural phenomenon. Others took up the theme and appropriate recitals appeared in the popular press. An example from *The Press* of Christchurch of 25 May 1938 follows: "Later on, when its [Royal Albatross chick] body feathers are well grown, but long before it can fly, its parents will give it a last feed and go away and leave it. By this time it will weigh about twice as much as an adult, and for a period of weeks, at any rate, it will have neither food nor drink, growing its feathers and wasting away until its weight is down to a level at which it can fly."

The foregoing résumé of the starvation theory in albatrosses represents majority opinion up to the time the first Royal Albatross chick was being reared at Taiaroa Head in 1938. There was, however,

a minority opinion also. On 10 September 1874, a French scientific expedition arrived at Campbell Island. Dr. Filhol, the naturalist, had become interested in the accounts of Harris, Hutton, and Andersson as already narrated. On 14 September, Filhol killed an albatross chick, found food in its stomach, and concluded that it was still being fed and was not subsisting on its fat (1885: 46). Then he decided to find out how the chicks were fed. Hutton had suggested that the chicks might go down to the sea at night for food and return in the morning. Filhol, however, pointed out that the chicks could not fly at that stage nor could they walk through the thick vegetation to the sea. Filhol then asked some sailors to maintain a continuous watch at several nests. Of the results he writes (p. 47):

“Trois jours après je fus informé qu'un vieil Albatros était près de l'un d'entre eux et qu'il lui dégorgeait de la nourriture. Je vérifiai immédiatement ce fait, que je reconnus être exact, et nous eûmes souvent par la suite l'occasion de voir les parents venir auprès de leurs petits. . . . Ainsi la question relative à la manière dont étaient nourris les jeunes Albatros se trouvait être résolue de la façon la plus simple pour l'époque à laquelle nous étions à Campbell.”

Therefore, as long ago as 17 September 1874, and only some nine years after Hutton and Andersson had published their stories, the starvation theory in albatrosses was repudiated. Subsequent writers have either overlooked or ignored Filhol's observations. The fledglings watched by Filhol would have been about three or four weeks from flying. Another point has to be mentioned. Although Filhol believed he had been watching the Wandering Albatross, he was really investigating the Royal Albatross which is the chief species breeding on Campbell Island. Harris, Hutton, and Andersson, however, were discussing the Wandering Albatross, but I am not sure, as stated farther back, which species Buckland was discussing.

The next rebuttal came from Matthews (1929: 567-568), who was discussing the Wandering Albatross at South Georgia. He remarks, “When the down is shed the parents desert the young, which . . . haunt the old neighbourhood for some days.” Then he continues, “The adult albatrosses . . . do not finish feeding their young until after the new season's eggs are laid (by other birds).” Little notice was taken of Matthews' conclusions, which, presumably, he had made from personal experience. It is a pity, however, that he has not recorded in print more details of his observations.

THE ROYAL ALBATROSS AT TAIAROA HEAD

In the first half of May each year, Royal Albatross chicks at Taiaroa head become 100 days old and they are still completely covered with white down (Richdale, 1939: fig. 9). At this stage, the young birds

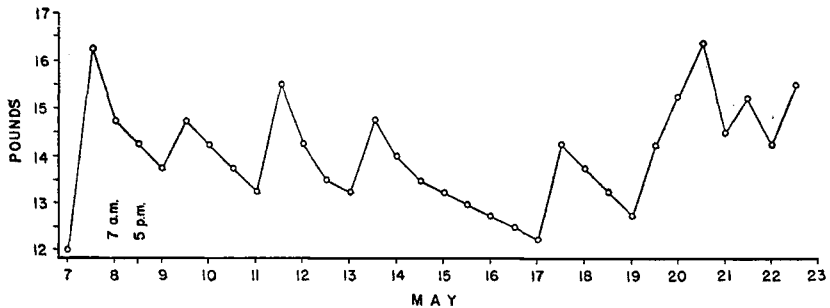
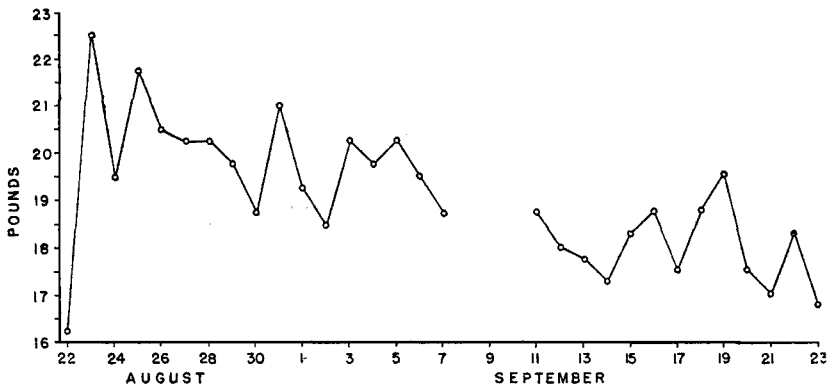


FIGURE 1 (above). Daily weights, taken at 6 p.m., of the 1938 Royal Albatross chick's last 33 days as a nestling.

FIGURE 2 (below). Daily weights taken at 7 a.m. and 5 p.m., of the same chick, in the watch period in May.

have somewhat more than 4 months to remain at the nest. The starvation theory suggests that the end of this 100-day period is approximately the age at which albatross chicks are deserted by their parents and subsist for the remaining period at the nest on their own fat.

A reference to figure 2, which gives the weights, taken twice daily, of the 1938 chick for 16 days from 7 May to 22 May, would show that the chick lost weight when not fed. Further, the chick was left unfed for four and one quarter days from 13 May to 17 May during which time its weight fell steadily from $14\frac{3}{4}$ to $12\frac{1}{4}$ lb. Counting from 17 May, the chick still had 131 days to live on the breeding area. Just what would have happened to this chick if the parents had ceased to feed it? This chick ultimately reached a peak weight of $22\frac{1}{2}$ lb. when 199 days old, and it weighed approximately 16 lb.

when it flew at 231 days of age. Also, at 100 days of age, the middle toe and claw, tarsus, bill, and wing were still growing (Richdale, 1939: 486-487).

Figure 1 gives the daily weights, taken at 6 p.m., of the 1938 chick for its last 33 days ashore. In that period, the chick was known to have been fed at least 14 times, but in spite of receiving food there was a gradual decline in weight. It may be observed that on one occasion from 23 August to 26 August inclusive, the chick was fed on each of 4 consecutive days yet, when weighed at 6 p.m., it showed no advance. Weekly weights for the same period taken of the 1939 chick at Taiaroa Head and for two individual chicks at Campbell Island (Sorensen, 1950a: 35) show the same phenomenon of falling weight whilst the chicks were still being fed.

In my first albatross paper (1939: 484-485), I have given in detail the visits of the 1938 parents to their chick from 7 May to 24 September which is two days after the chick flew. Actually, for the second 100 days that the 1938 chick was at the nest, it was fed on 79 per cent of the days and for its final 31 days it was fed on 55 per cent of the days. From when the chick was left unguarded by its parents at the age of 42 days until it was 100 days old, it was fed on 48 per cent of the days. Instead of being deserted at the end of the first 100 days when the feathers were beginning to grow rapidly, the chick was fed more frequently. Around 200 days of age, when the feathers had completed their rapid growth and when the bill, tarsus, and toe had attained maximum growth (Richdale, 1939: 486-487), the parents then reverted to less frequent visits.

At 6:30 a.m. on 17 September 1938, I was fortunate enough to witness and photograph (1939: fig. 12) the second last meal ashore received by the first chick reared at Taiaroa Head. Three days later, a nearby resident saw the last meal ashore being given, evidence which I corroborated by actually weighing the chick (see figure 1). The chick flew on 22 September. Somewhat the same situation obtained with the 1939 chick. By the device of daily weighing, it was found that the second chick was fed twice on 23 September and again on 24 September. Its weight rose from $21\frac{1}{2}$ lb. at 9:30 a.m. on 22 September, to $25\frac{1}{4}$ lb. at 8:30 a.m. on 24 September. Then the weight dropped to 22 lb. at 6 p.m. on 26 September. The chick flew some time on 27 September.

Five other fledglings mentioned in table 1 followed the same pattern as the first two. One of these five later chicks (1942b) was observed being fed at 11 a.m. on 29 September and was found to have flown some time before 8 a.m. on 30 September, which means that it flew

at some period within 21 hours of being fed. The time of the last observed meal ashore given to the last five fledglings noted in table 1 may not have been the last one. An additional meal may have been given unnoticed, and this applies particularly to the 1941 and 1950 chicks. Further, records for the last five chicks, noted in the table, were all made by sight, as the device of weighing was not used. The foregoing information, involving seven fledglings, should be sufficient to show that Royal Albatross chicks at Taiaroa Head are fed to the end; there is no starvation period.

TABLE 1
RELATION OF OBSERVED LAST MEAL ASHORE TO DEPARTURE OF
ROYAL ALBATROSS FLEDGLINGS AT TAIAROA HEAD

<i>Chick</i>	<i>Time of last known meal ashore</i>	<i>Time of departure</i>	<i>Days ashore</i>
1938	8:30 a.m., 20 September	Between 5 p.m. and 6 p.m., 22 September	231
1939	24 September	27 September	243
1941	11 a.m., 2 October	7 October	251
1942 (a)	28 September	2:30 p.m., 30 September	247
1942 (b)	11 a.m., 29 September	before 8 a.m., 30 September	246
1945	11 October	5 p.m., 13 October	252
1950	5 p.m., 10 September	14 September	232

Further evidence is available. More recently, and since I made my discoveries, Sorensen (1950a: 24 and Table IV) has found that Royal Albatross chicks on Campbell Island do not undergo a starvation period. Sorensen remarks, "The theory propounded by some early writers that chicks are deserted by the parents, and have to undergo a period of fasting before they can fly, has no foundation in fact." Sorensen made weekly weighings of several chicks from hatching to departure, so that his views are based on his own quantitative data.

An interesting point which has not yet been definitely proved is that a parent may arrive at the nest after the chick has flown. The mother of the 1938 chick was said to have been observed sitting on the nest at 1:30 p.m. on 24 September. This visit was approximately 44 hours after the chick had flown and 4 days 5 hours after it was last observed being fed. The female was not observed by me but by a nearby resident, who saw the bird rise and fly off. It would seem that the chick departed in an inattentive period by the parent and had the chick stayed longer the parents would presumably have continued to visit it.

As for the 1939 chick, which I found missing at 10 p.m. on 27 September, it also appeared to have departed in an inattentive period. The night of 27 September was a clear, moonlight night, so that I could not have missed the chick, if present. Moreover, on returning to the breeding area at 7 a.m. next day, I again failed to find the chick. At 9 a.m., a nearby resident saw the 'chick' at the nest, but did not check the bands as he was unaware that the real chick had flown. The resident's 'chick' was obviously one of the parents. The possibility that the bird was another adult is ruled out, because at this date (28 September) no adults, other than parents feeding chicks, had ever been observed on the breeding area in my many years of watching. Further, in 1939, the only parents using the breeding area were those of the chick under discussion. For Campbell Island, Sorensen (1950a: 24) states, "Frequently, too, parent birds have been noted to visit the nest after the departure of the chick." Unfortunately, Sorensen gives no evidence in support of his statement that parents return to the nest after the chicks have flown.

In summary, by direct observation supported by the weighing of the chicks, Royal Albatross fledglings at Taiaroa Head are fed to the end of their fledgling period and appear to fly in a normal span of inattention by the parents. The same situation obtains at Campbell Island as recorded by Filhol (1885: 46) and Sorensen (1950: 24 and Table IV). In the second 100 days of life, fledglings may be fed on 79 per cent of the days, but the visits may drop to 55 per cent for the remaining 30 days or so.

EVENTS SINCE 1938

When it was realized that the 1938 Royal Albatross chick was fed to the last, it was argued that the starvation theory still applied to the Wandering Albatross. Early in November 1950, a party of New Zealanders was on Antipodes Island some 400 miles southeast of New Zealand. While there they saw Wandering Albatross fledglings around 8 months old being fed by adults. Mr. Turbott of the Auckland Museum, New Zealand, wrote as follows in the *Auckland Weekly News* of 24 January 1951.

"It was long believed that albatross chicks were deserted by their parents during their last few months on the nest, although the study of the royal albatross has shown that this was an error. On several days we were to see well-grown chicks receiving their meal, indeed it was an attraction of any visit to the 'tops' that without warning a near-by chick might be fed."

The chicks which Turbott saw being fed would have had at least 4 weeks if not 6 weeks to go before flying. His observations merely show that the chicks had not been subsisting "on their fat" since

'June' and not that they would continue to be fed to the end of their nestling life. All the same, I find it difficult to believe that there is any difference in feeding habits between the chicks of the Wandering and Royal albatrosses at this late stage. I would suggest, therefore, that the thesis of a starvation period in the Wandering Albatross is as invalid as it is for the Royal Albatross.

It is now necessary to discuss a recent supporter of the starvation theory in the Wandering Albatross (Rankin, 1951: 166-168). Rankin was at South Georgia in the 1946-47 season and made his last visit to the albatrosses before the parents had ceased to guard their chick continuously, so that he had no opportunity to test out the theory at first hand. Rankin writes as follows concerning the alleged abandoning of the young by the parents.

"That they do so is certain because of observations made on other albatross at Tristan da Cunha and elsewhere, and it is also a common habit with many of the Tubinares and other sea-birds. If a nestling continued to be fed by its parents it would be content to remain indefinitely at the nest, happy and carefree, with no inducement to go out into the wide world. Drastic and cruel as it may seem, it is only by cutting off supplies and completely abandoning the young bird that it is compelled to fend for itself. . . .

"Somewhere around that time [June] or even in July the moment comes when the parents abandon it and then for another four months the youngster will remain alone in the nest, existing on the reserves built up in its body. . . .

"By finishing with their family cares in June or July the parents have a clear four or five months before the beginning of the next breeding season, so *it is possible for them to reproduce every year.*" [Italics mine.]

If Rankin's statements are true then the Wandering Albatrosses at South Georgia behave very differently from those on Antipodes Island. It seems to me that this writer has allowed himself to be influenced far too much by the literature. His own words show that he realizes "there has been some controversy" (p. 166).

Finally, there is the work of Sorensen (1950a: 19, 28-30) who weighed two Campbell Island Light-mantled Sooty Albatross chicks weekly from hatching to the week before departure. His observations point to the absence of a starvation period and that the chicks flew in an inattentive period by the parents. At the end of the third last week at the nest, one chick weighed 6 lb. 7 oz. and the other 7 lb. 11 oz. At the end of the second last week, the figures were 7 lb. 3 oz. and 7 lb. 13 oz. respectively, showing clearly that the chicks had been fed. The next week the chicks had flown. A graph (p. 19) illustrates that feeding continued at least until the chicks were last weighed.

REASONS FOR STARVATION THEORY

In conclusion, it may be well to attempt an examination of the causes which may have contributed to the birth of the starvation theory and then secondly to its ready acceptance in spite of a dearth of quantitative data in its support. I feel that if a member of each main group of the whole petrel family had been studied in the same detail as has been the case with the American Song Sparrow, *Melospiza melodia euphonia* (Nice, 1937 and 1943) and the English Robin, *Erithacus rubecula melophilus* (Lack, 1939, 1940, and 1943) the starvation theory would have been stillborn and perhaps not even conceived. As it is the starvation theory entered the world when practically nothing was known of the breeding biology of petrels. All that was available were casual observations recorded from hurried visits by people, scientific and otherwise, to petrel habitats. These observations, by scientific and lay people alike, were unconsciously influenced by preconceived ideas developed from watching or reading about birds in their home lands. Petrels were made to fit in with these ideas; the net result was inaccuracy. We still know very little about the petrel family. Much more intensive field study is required before all the erroneous ideas, still too prevalent, can be eradicated.

'Unemployed' birds in the several species of petrels which I have studied gradually leave the breeding area for any given season as the chicks begin to grow. The breeding area then appears deserted. This feature impressed me very much on a recent visit (1952) to Whero Island where I was studying the final two months of the nestling stage of the Sooty Shearwater (*Puffinus griseus*). On examining several hundred burrows in the daytime not a single adult bird was found. At night scarcely any adults seemed to come in. All this was in great contrast to the intense activity of earlier months. Yet, the chicks were being fed. The position on the albatross breeding area is much the same. The 'unemployed' birds gradually leave as the chicks grow and the parents spend little time ashore. For this reason, unknown to early observers, there was a tendency to assume that the albatross chicks had been deserted.

It was known by early writers that petrel chicks became very fat, so that they were heavier than their parents. For some reason, which I cannot trace, it was assumed that these chicks could not reduce their weight unless they were starved, but no statistics were forthcoming to prove the assumption. A glance at figure 1 will show that the 1938 Royal Albatross chick at Taiaroa Head reached its peak weight on 21 August and while still being fed gradually lost weight until it flew on 22 September. Comparable results were

obtained for the 1939 chick. Sorensen's data for the Campbell Island Royal Albatross (1950a: 37) and for the Light-mantled Sooty Albatross (1950b: 19) support my findings. Elsewhere (1942a: 172, 261), I have shown how a Diving Petrel chick (*Pelecanoides urinatrix*) in its last 23 days in the burrow fell in weight from just over 180 grams to less than 120 grams. In all that time it missed a meal on only one night (11 nights before leaving), and I actually saw it being fed on the night it left the burrow. These examples show that nestling petrels can drop weight without having to fast.

A third factor which has led to thinking on an insecure foundation has been assumption that the large albatrosses breed each year. It was known that fledglings tended to be present when adult birds returned to prepare for the new breeding season. Further, it was assumed that no bird could begin breeding again while still attending a chick. Here was a dilemma from which the starvation theory allowed convenient escape. If the chicks could be starved for 4 months or so, the parents could secure the necessary rest. It all sounded so plausible. Matthews (1929: 568), however, was the first observer who suggested that the birds nested once in every two years. From my own evidence already given, I have shown that if successful in rearing a chick, Taiaroa Head Royal Albatrosses breed every two years. Sorensen (1950a: 19) has found this true for the Campbell Island birds. As far as I know, we have yet no proof, on a study of marked birds, that Wandering Albatrosses successful in rearing a chick breed every year. This species, however, is longer attending its chick than is the Royal Albatross, so that I would be very surprised if it were found to breed annually.

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SUMMARY

Because the behavior of 'unemployed' petrels on the breeding area as the chicks began to grow was not understood, because it was assumed that petrel nestlings had to fast to acquire flying weight, and because the large albatrosses were thought to breed annually, the idea of a starvation theory arose. These assumptions held sway because of a lack of detailed research in petrel habitats. The starvation theory does not apply to the Royal Albatrosses either at Taiaroa Head or at Campbell Island. I would suggest also that, in spite of contrary opinion, it does not apply to the Wandering Albatross either at Antipodes Island or South Georgia. From Sorensen's observations, Light-mantled Sooty Albatross chicks are fed for the full term of their nestling life.

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