The White-faced Storm Petrel or Takahi-kare-moana (*Pelagodroma marina maoriana*, Mathews)

*PART II.

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FOOD AND RELATED TOPICS.

THIS species rarely regurgitates its food when handled as is the habit of the Titi Wainui *(Pachyptila turtur)* and as it is illegal to kill the birds for investigation, I was not able to collect much evidence of the food supply. One parent, however, did vomit some food which was later examined by Professor B. J. Marples. It contained a large mass of Euphausids about ½ inch long, two lumps of material, which might have been portions of a squid, about 10 mm. wide, two lenses about 2 mm. across, and one Barnacle cypris larva.

In Table VIII is given the hatching dates of eleven chicks, the quantity of food received each night as determined by the difference between the evening and the following morning weights, and also the nights on which the chicks were not fed. Those weights indicated by an asterisk represent the amount of food given to the chick by a brooding parent during the day, the process occurring several times for the first few days. The amount of food as shown by the table varies from 0 to 25 grams, but it must be remembered that these weights, owing to the method used, will be slightly less than the actual weights.

As the chicks in the early stages are frequently fed during the day, the first 4-day class interval in Table XII indicates very little difference between morning and evening weights. This table also shows a gradual increase in the amount of food given per meal up to the 17–20 days interval where it remains till the 37–40 days interval. After this it drops somewhat to rise again a little at the 53–60 days interval when most of the chicks are leaving. I cannot, however, consider the figures in the last two intervals as they represent eight records of one chick which was exceptionally late in leaving. On the night before it left this chick received 7½ grams of food, and in fact, was fed on five of these last eight nights. It should be remembered when reading the above statements that the difference between morning and evening weights taken on the same day is much greater when feeding has been heavy.

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* Part I of this paper appeared in Vol. 73, Part 2, pp. 97–115 of the *Transactions*.

KEY TO TABLE VIII.

* means amount of food given to chick during the day by a guarding parent.

† means full moon.

NF means not fed during night.

— i.e., a minus sign, prefixed to a figure indicates that the morning weight was less than the previous evening weight.

TABLE VIII.

Nights Fed and Amount of Food, in Grams, Given to Eleven Chicks, 1941-42.

	Hatching Date.	Dec. 26	27	28	29	30	31	Jan. 1	2	3†.	4
16R	Dec. 25	1½	1½	*¾	NF	6¾	3¾ *¾	5	7	NF	5¾
56R	Dec. 26		2	3	2¼	2¼	2¾	NF	NF	7½	12
68R	Dec. 27				½	6	1	11¼	NF *1½	3¼	8½
71R	Dec. 27				NF	3½	NF	NF	6¼	NF	2¼
78R	Dec. 27				*2		*1½ *0	NF	1½	1¼	5
99R	Dec. 28				2½ *1¾	—½	5¼	—¼	3¾	2½	12¼
69	Dec. 27		*¾	*3	3¾	NF	10½	NF	12¼	4½	4½ *2¾
45R	Dec. 24		2¼	2¾	NF	NF	10½	2½	7¼	6	4¼

TABLE VIII (Continued).

	Hatching Date.	Jan. 5	6	7 8 9	10	11	12	13	14	15	16
16R	Dec. 25	11¼	1½		14½	NF	7	5	7	14½	NF
56R	Dec. 26	NF	NF		NF	5½	7	NF	15	4	NF
68R	Dec. 27	4½	NF		1½	6½	NF	NF	18½	8½	NF
71R	Dec. 27	4¼	NF		1½	2	NF	6	11½	3	NF
78R	Dec. 27	5	4		7½	1½	3½	NF	1½	5½	8½
99R	Dec. 28	9½	NF		5¼	2	NF	10	12	1	NF
69	Dec. 27	8	NF		4½	NF	11	17	5½	NF	NF
45R	Dec. 24	NF	6¾		7½	NF	10	4½	5½	3½	4

TABLE VIII (Continued).

	Hatching Date.	Jan. 17	18	19	20	21	22	23	24	25	26
16R	Dec. 25	3½	4	4	12½	8½	NF	14½	NF	6	13½
56R	Dec. 26	5	14	4	6	10	2½	4½	13	NF	3
68R	Dec. 27	7	13½	3	4	4½	11	6½	NF	NF	2½
71R	Dec. 27	7	15	5½	4½	14½	0	NF	NF	6	7½
78R	Dec. 27	11	11	3	7	11½	10	5	3½	NF	5
99R	Dec. 28	NF	6½	12	10½	12½	NF	10½	0	15	NF
69	Dec. 27	5	9	9½	3	13	6½	10	2½	½	NF
45R	Dec. 24	—½	8	3	0	10	7½	NF	8‡		
17W	Dec. 22	14½	NF	NF	17	5	6	4	3	NF	4½
4GC	Dec. 23	11½	2½	6½	3½	4	6	4½	2½	½	NF
3GC§	Jan. 3										2

‡ Chick lost due to depredations of a Titi Wainui.

§ Began weighing 3GC after 45R disappeared.

TABLE VIII (Continued).

	Hatching Date.	Jan. 27	28	29	30	31	Feb. 1†	2	3	4	5
16R	Dec. 25	NF	4½	12½	NF	11	2	1	4	NF	11½
56R	Dec. 26	5½	9½	NF	NF	6	14½	2	10½	1½	NF
68R	Dec. 27	4	11	NF	NF	5	1½	NF	4	3½	NF
71R	Dec. 27	7	20	12½	NF	4	4	3½	NF	0	NF
78R	Dec. 27	6½	4	10	1½	NF	NF	6	11	8½	NF
99R	Dec. 28	4½	13½	1	NF	3½	14½	NF	NF	4	6
69	Dec. 27	8	8½	1½	6	NF	2	9	NF	5½	5
17W	Dec. 22	11	6½	NF	6	NF	NF	7	NF	5	NF
4GC	Dec. 23	12½	8	NF	NF	11½	NF	5½	NF	4½	NF
3GC	Jan. 3	2	11½	6½	NF	NF	NF	17	NF	4	NF

TABLE VIII (Continued).

	Hatching Date.	6	7	8	9	10	11	12	13	14	15
16R	Dec. 25	5½	7½	NF	2½	6	3	4	17½	NF	NF
56R	Dec. 26	8	1½	NF	5	4	4	NF	3½	4½	11
68R	Dec. 27	0	8	½	18	NF	NF	25	9½	NF	7
71R	Dec. 27	NF	2½	NF	7	8	NF	15½	NF	NF	7½
78R	Dec. 27	4	NF	2½	4	4	1½	3½	3½	4	2½
99R	Dec. 28	5½	4	4	15	NF	NF	5	7½	5½	8½
69	Dec. 27	NF	17	1	NF	NF	5½	16	1	0	NF
17W	Dec. 22	7½	NF	5	6	NF	8½	3½	NF	4½	5
4GC	Dec. 23	7½	2½	4½	3	9½	5½	1½	8	5	3½
3GC	Jan. 3	2½	8	3	4½	NF	NF	NF	7½	8½	½

TABLE VIII (Continued).

	Hatching Date.	Feb. 16	17	18	19	20	21	22	23	24	25
16R	Dec. 25	NF									
56R	Dec. 26	NF	6½	3	NF	NF	NF	—½			
68R	Dec. 27	2½	5	1½	1½	NF	7½	NF	7½	NF	NF
71R	Dec. 27	18	NF	14½	NF	7	5½	6	17	NF	NF
78R	Dec. 27	12½	0	2	10	0	2	7	4	NF	NF
99R	Dec. 28	5½	1½	1½	1½	—½	NF	NF	0	NF	
69	Dec. 27	NF	1½	NF	NF	NF					
17W	Dec. 22	NF	8½	NF	NF						
4GC	Dec. 23	3	—½	NF							
3GC	Jan. 3	21½	NF	1½	18½	6½	7	1½	7	4	NF

TABLE VIII (Continued).

	Hatching Date.	Feb. 26	27	28	Mar. 1	2	3†	4
16R	Dec. 25							
56R	Dec. 26							
68R	Dec. 27							
71R	Dec. 27	9	NF	15	6½	1	NF	6½
78R	Dec. 27	NF						
99R	Dec. 28							
69	Dec. 27							
17W	Dec. 22							
4GC	Dec. 23							
3GC	Jan. 3	3	NF	NF	NF	NF	NF	

TABLE IX.

Weights of 651 Meals Given to 16 Storm Petrel Chicks in Class Intervals of 5 Grams.

Class Interval.	No. of Meals.	Percentage.
No meal	205	31.5
0 to 4.9 grams	197	30.2
5 to 9.9 grams	161	24.7
10 to 14.9 grams	65	10.0
15 to 19.9 grams	20	3.1
20 to 24.9 grams	2	.3
25 to 29.9 grams	1	.2

The data in Table IX were compiled by weighing five chicks to the end of January, 1941, and eleven to the middle of March, 1942, and these results give some indication of the amount of weighing carried out on this species alone. In addition, over thirty other chicks were weighed during their last ten days or so ashore. That large meals are by no means the rule will be shown by the table where something like a little over 80% of the meals given weigh between 0 and 9·9 grams.

The following table deals with two sets of chicks, those hatched in 1940–41 and those in 1941–42. In the former year I had to leave the island long before they were mature, while in 1941–42 I did not commence to watch two of them till the second half of their period ashore. It will be seen from Tables VIII to X that the number of times a chick is not fed is considerable, this phenomenon occurring in both seasons. The range in 1940–41 varied from 21 to 59%, and in 1941–42 from 16·4 to 41·2%. The average for the latter and more conclusive year was 29·3%, including the nights at the very end when a chick was left unfed just before it departed. I managed to weigh the chick at nest 28 on 27 occasions, on no fewer than 16 of which indications were that it had not been fed. In spite of this, however, the average weight of food received per meal was the highest for all the 16 chicks. Chick 51 was weighed 26 times, was unfed 10 times and received 79·5 grams altogether, which gives an average of five grams. Chick 28, only a day older, received a total of 84 grams.

Continuing, chick 71R was weighed 63 times, was unfed on 23 nights, yet it showed an average meal of 7·48 grams when fed, this figure being the greatest for the 1941–42 season. Conversely, chick 78R, which was weighed 55 times, missing only nine nights, or 16·4%, averaged 4 95 grams per meal. To sum up, there seems to be evidence that chicks which remain unfed for many nights make up the deficiency when the parents do arrive. While chick 5b appears to be an exception, it must be taken into consideration that it was a small chick and was weighed only up to 22 days of age, at which stage it might be expected that the rations would not be very substantial (see Tabe XI).

TABLE X.

Data Relative to the Irregularity of the Feeding Process.

Nest	Days in Burrow	Amount of Down at Departure	Nights When Not Fed: No. of Times Not Fed	DNF*	No. of Days Weighed	Percentage of Days Not Fed	Quantity of Food Received: No. of Nights When Fed	Amount Received in Grams	Average in Grams for Each Night Fed	Average Per Day in Grams
	1940-41									
3b			6		29	21	23‡	136	5.91	4.69
3			11		32	34	21‡	135.5	6.45	4.23
5b			9		22	41	13‡	57.25	4.4	2.6
28			16		27	59	11‡	84	7.64	3.11
51			10		26	38	16‡	79.5	5.00	3.06
	1941-42									
16R	53	P	13	3	50	26	37	249.25	6.73	4.98
56R	62	T	17	0	55	30.9	38	226	5.95	4.11
68R	61	ND1	18	2	56	32.2	38	244.5	6.43	4.37
71R	66	ND6	23	0	63	36.5	40	299.25	7.48	4.75
78R	60	ND1	9	3	55	16.4	46	227.75	4.95	4.14
99R	60	ND2	14	1	55	25.4	41	245.75	6.00	4.47
69	55	ND2	17	3	51	33.3	34	228	6.71	4.47
45R			5		26	19.2	21‡	117	5.57	4.5
17W	59	ND1	14	2	34	41.2	20‡	138	6.9	4.06
4GC	58	ND1	7	1	33	21.2	26‡	136.5	5.25	4.13
3GC	59	ND4	15	5	37	40.5	22‡	148	6.73	4.00

* DNF = Days not fed after last meal ashore (included in previous column).

‡ Not weighed during whole period ashore.

P = Patches of down.

T = Trace.

ND1, etc. = No down for 1 day, etc.

When, however, the total amount of food received is divided by the total number of weighings, including the nights unfed, it will be noted, as shown in Table X, that the amount is remarkably uniform. In 1941–42, all the eleven chicks averaged between four and five grams per night, while in 1940–41 the two oldest received this amount also. The three youngest received a less amount according to age, which, as already explained, is as expected.

Grouping all 16 chicks together there were 97 occasions on which they missed a meal for one night only, 34 occasions when there was a span of two nights, eight occasions for a span of three nights, three occasions for four nights, and two for five nights. Two of the two nights, three of the three nights, and one of the five nights occurred at the end after the chick had been fed for the last time ashore. As

mentioned earlier, chick 28 held the record for the highest percentage of nights unfed, while it also experienced the long-fast period of five days during which time it dropped from 38 grams to 20½ grams, being on the last day 14 days old. During the next 13 nights it missed eight more meals, and when I left the island at that stage it had been unfed for the last three consecutive nights.

This phenomenon of the irregular feeding of the chick has been noted in other species of Storm Petrel by other workers. Lockley (1932, p. 211) states that he had long been aware that adults will sometimes omit to visit the nestling British Storm Petrel *(Hydrobates pelagicus)*. During the first 21 days of October, i.e., at the end of one chick's life ashore, his chick was not visited on more than seven occasions. His method of arriving at this conclusion was to place sticks across the entrance.

Gross (1935, p. 395), dealing with Leach's Petrel *(Oceanodroma leucorhoa leucorhoa)* weighed a chick at intervals for the first 46 days and noted considerable irregularity. He considers that this was due to spasmodic feeding. Ainslee and Atkinson (1937, pp. 244–245) observed a similar thing in the same species. They give an excellent table which indicates that four chicks under study were not visited every night, while on many other nights only one bird entered the burrow. It is just possible from my observations on *Pelagodroma* that occasionally one of these birds may not have been a parent. Ainslee and Atkinson *(op. cit.,* p. 245) think that this irregular feeding may be due to two causes. First, to the relative amount of food available and accessible in the surface waters during the day, and second, to the prevailing weather conditions, especially rough weather.

With my birds, weighing, as I did, 11 chicks night and morning during their whole life ashore, I have not been able to come to any definite conclusion. Certainly, on rough nights there were few birds about, but I think that the absentees were largely unemployed birds. A glance at Table VIII will indicate that all chicks were fed on some nights, yet, again, on other nights most of them were not fed.

A comparison of the weather conditions with the number of chicks fed on certain days may prove of interest. On January 13, which was 10 days after the full moon, five out of eight chicks were fed. The night was very windy and wet and there were plenty of birds about. On the 14th all of the eight were fed, averaging 9·5 grams each, which, according to the standards in Table IX. is a large amount. Birds in the air were very plentiful. Next day seven were fed, even though it was very windy, but on the 16th only two of the eight received a meal. All day there had been a heavy wind which subsided towards evening, making the night calm throughout, but there were very few birds present. On January 17, nine of the ten chicks were fed. Though the night was very wet there was not much wind, but few birds were present, indicating that the parents had reached the island, but the unemployed section had stayed away. The 18th was beautifully calm with few clouds, and nine chicks were fed.

On January 25, a clear, calm night with a small moon to midnight, only five out of nine chicks were fed, and there were very few

birds in the air. Next night, which was wet but calm, only six out of ten were fed. The following two nights, which were calm and overcast with the full moon four days away, nine and ten chicks were fed respectively. It will be seen that as the moon increased in strength more chicks were fed, and that, moreover, all four nights were calm.

The 30th was a clear, calm night with a moon, when only three chicks were fed, and not a single bird was heard calling. The following night was seven-tenths overcast yielding a fair amount of light, with a strong south-west wind, yet seven chicks were fed.

On February 8 seven chicks received a meal after a heavy south-west wind all day, followed by a calm at sunset; similar to conditions which had prevailed on January 16 when only two chicks were fed. On February 10, which was cloudy, dark and calm, only five of the ten were fed, averaging 6·3 grams. February 17 was another dark, calm night when only five out of nine chicks received food.

Whatever may be the cause of irregular feeding it does not appear that either rough weather or bright moonlight nights always keeps the parents away. Calm, dark nights may also yield a low percentage of feeding. It will probably be found useful to compare some of Lockley's researches on the Manx Shearwater *(Puffinus puffinus puffinus)*. In May and June, 1939, he found (1942, p. 126) on the evidence of six ringing returns that some of his birds at least were feeding in the Bay of Biscay 600 miles away, while at the same time they had nests and eggs at Skokholm. Perhaps my breeding Storm Petrels which do not return to Whero on successive nights, especially when incubating, feed a considerable distance from land. It may be that the rough weather in these distant parts keeps birds from land when it is calm and dark over their nesting area.

Roberts (1940, pp. 167–169) also found that Wilson's Petrel *(Oceanites oceanicus)* suffered irregular feeding at the nestling stage. In his case the blocking of burrows by snow was responsible for some of the chicks not being visited.

TABLE XI.

Average Weight and Number of Meals Given Daily to 16 Storm Petrel Chicks, Grouped in Class Intervals of Four Days.

Class Interval in Days	No. of Meals	Average Weight in Grams	Class Interval in Days	No. of Meals	Average Weight in Grams
1– 4	25	2.79	37–40	27	5.44
5– 8	34	5.00	41–44	24	5.79
9–12	30	5.71	45–48	28	8.02
13–16	23	5.42	49–52	30	6.18
17–20	34	8.31	53–56	26	3.94
21–24	32	7.83	57–60	12	5.33
25–28	43	7.77	61–64	2	12.00
29–32	33	6.85	65–68	3	4.70
33–36	28	6.62			

To construct Table XI the nightly meals, worked out as already explained, were put down in columns according to the age of the 16 chicks concerned. Thus the first column recorded the weight in grams of the food received by each chick on the first day after the

hatching; the second column the amount received by each on the next, and so on. These columns were then grouped into four, the totals of each set of four columns found and divided by the number of nights when feeding occurred. I could see no point in taking the average of the average of each four columns owing to the number of times when no feeding occurred.

The actual transference of the food from the parent to the chick I have not yet been fortunate enough to witness. Several times at different burrows I stationed myself to watch the feeding, but each time my effort was frustrated owing to the adults hiding their heads in the back of the burrow.

Both birds must feed the chicks on occasional nights as indicated by some of the heavy meals. Falla (1934, p. 248) records that he has never found two birds in the burrow at night, and this was my experience till January 26, 1941. Arriving at Nest 28 at 1.30 a.m. I found the head of bird A protruding from the burrow, and on feeling inside I also found bird B. That night the unusually heavy amount of 14½ grams of food was given to the chick, indicating that large meals mean that both parents have been in attendance. This chick had not been fed during the two previous nights.

In 1941–42 I visited the various nests nightly till all the parents were ringed. On 92 occasions a single bird was found and ringed, while on many other occasions, before the second bird of a pair was discovered, the first one already ringed was caught again. Only five times were two birds found together in the burrow at night while a chick was being fed. Though not many visits were paid to the burrows of unemployed birds, pairs were found together far more frequently at night, there being eight occasions when a pair was discovered, while five such pairs were side by side in the burrows during the daytime. To sum up, it would appear that two birds may be found together with a chick sometimes. This behaviour contrasts sharply with that of the Kuakas *(Pelecanoides urinatrix)*, both parents of which are usually found in occupation at night. The only one of the above five chicks which was being weighed at the time both parents were found with it received 11 grams of food which was above the average.

Further evidence that sometimes both parents feed the chick on the same night seems to be substantiated by the following incident. From January 13 to 16, 1941, the chick at No. 3 nest had not been fed. On the night of January 17, when the moon did not rise till midnight, the chick received 18 grams, advancing from 25½ to 43½ grams overnight. Arriving at the nest at 10.15 p.m. when it was quite dark, I noticed an adult entering in characteristic fashion. By 10.20 p.m. it had vanished from sight and I blocked the entrance. At 11 p.m. the sticks were discovered to have been pushed out, indicating that in some cases at least the parents do not stay long in the burrow for the feeding process. Blocking the burrow once again, I left to return next morning, when I noted that the sticks were again pushed in, indicating that the second parent must have entered. My earliest record of a bird returning home is the one just given, but the arrival may occur any time up to 2 a.m. The average homecoming time is near midnight.

WEIGHTS AND MEASUREMENTS OF A GROWING CHICK.

In Table XII below are given the 9 a.m. and 9 p.m. weights of ten chicks during the whole of their life in the burrow. In working out the data for the table all the weights concerned were put down in columns representing the age of the chick, so that each column contained 20 weights, two for each day. The ten morning and the ten evening weights were then totalled separately and so on for each day. Dividing the columns into class intervals of four days, I then took the average of each four-daily totals. By the use of this method any tendency for extremely low or high individual weights was smoothed out. Owing to the considerable frequency of non-feeding on many nights and to the irregular size of the amount of food transferred on other nights, a daily graph would reveal many peaks and hollows. Each class interval, therefore, represents an average of 40 cases, except the last three, which represent 29, 7, and 4, respectively. This is due to the varying age at which the chicks depart.

It will be noticed from the table that the peak weight of 65·20 grams at 9 p.m. is reached during the 33–36 day interval. At this stage, though the chick is still covered with comparatively thin down, the feathers are well developed. From now on, in the ten chicks under consideration, the weights remain more or less on a plateau, though there is a slight slope downwards. The quantity of food given on the average per meal after the 40th day, however, takes a decided drop. On averaging the weights of 32 chicks (Table XX, Part III of this paper) for their last eight days ashore, there is found to be a steady fall in weight. Table XXI indicates that 86% of the chicks leave weighing between 45 and 60 grams. To sum up, it would seem that the chicks retain a comparatively heavy weight to within about four days of departing, when many of them drop considerably during a fast period of varying length up to seven days in extreme cases. As against this some chicks are fed on the night before they leave.

TABLE XII.

9 a.m. and 9 p.m. Weights of 10 Storm Petrel Chicks from Day of Hatching to Last Day Ashore.

Class Interval in days	9 a.m. weight gms.	9 p.m. weight gms.	DW* gms.	Class Interval in days	9 a.m. weight gms.	9 p.m. weight gms.	DW* gms.
1– 4	13.43	12.87	.56	37–40	66.01	62.45	3.56
5– 8	19.48	17.94	1.54	41–44	61.30	59.33	1.97
9–12	27.57	26.51	1.06	45–48	64.50	61.54	2.96
13–16	37.68	35.73	1.95	49–52	66.22	64.84	1.38
17–20	44.78	41.59	3.19	53–56	65.65	63.14	2.51
21–24	52.73	49.56	3.17	57–60	62.82	60.41	2.41
25–28	63.04	59.34	3.70	61–64	62.14	59.07	3.07
29–32	66.16	62.62	3.44	65–68	65.62	60.12	5.50
33–36	69.14	65.20	3.94				

* DW = Difference between evening and morning weights.

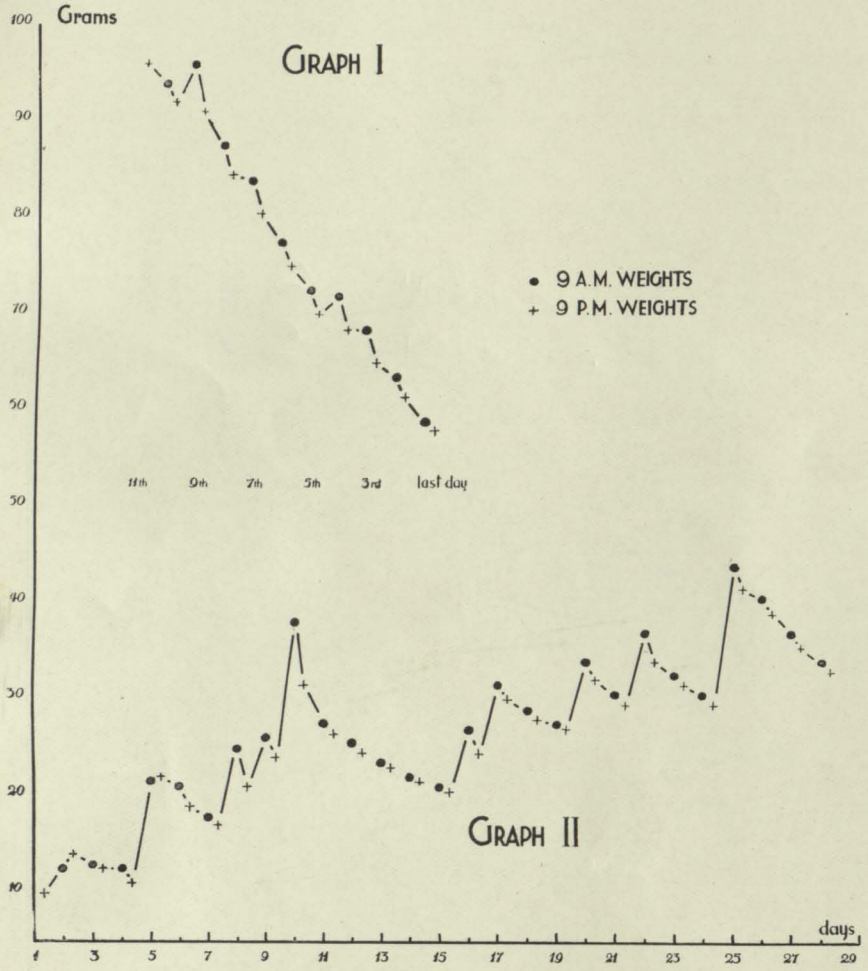
Graph II gives the 9 a.m. and 9 p.m. weights of chick 28, clearly demonstrating the peaks and hollows caused by irregular amounts of food and also the nights when not fed. This chick experienced the greatest percentage of nights unfed of all the 16 chicks under detailed observation, and during its first 27 nights ashore on no less than 16 of them it was not fed. The peaks in the graph after the 9th day all indicate meals followed by periods of fast and a consequent drop in weight; the five-day fast after the 10th day is clearly shown, being sharp at first and then sloping off gradually. It was unfortunate that this graph could not have been continued for the full period, but I had to leave the island.

Fluctuations similar to those in Graphs II to IV were found by Roberts (1940, pp. 166–167) when working on six chicks of Wilson's Petrel in 1935. His initial period of steady gain in weight lasted about two weeks after which there was a protracted period of fluctuation. With my birds as shown by Graphs III and IV and Table XII the initial gain lasted for nearly four weeks before the fluctuations set in. Gross (1935, pp. 396–397) dealt with one specimen of Leach's Petrel, which was weighed every second day after ten days. It appeared to take about four weeks before the advent of the plateau of fluctuations.

In Graphs III and IV similar records to those of chick 28 are given of chicks 69 and 71R taken in 1941–42, but represent, with the exception of a short break, the full period of these chicks ashore. Chick 71R was unusual in that it stayed ashore for the extra long period of 67 days. Up to the 23rd day its progress was very slow, but on that day its weight rose, only to drop again almost immediately. On the 34th day it scaled 84 grams which was very heavy for this stage, and then occurred a huge depression, difficult to explain, before once more rising to 84 grams at the 59th day. Above all, these fluctuations occurred at a time in its life history when the majority of chicks had left their burrows. Finally, the graph indicates that on the last night before leaving the burrow it received a meal of 7½ grams.

Graph III, representing chick 69's weight, I should think is a normal one. The initial rise is a steady one to the 27th day when there is a plateau followed by a depression of much less depth than that of 71R. A high peak representing 80 grams is reached on the 47th day. During the next eight days there is a steady drop, even though meals were received on these days, while on the last three days this chick was left unfed and departed weighing 50½ grams.

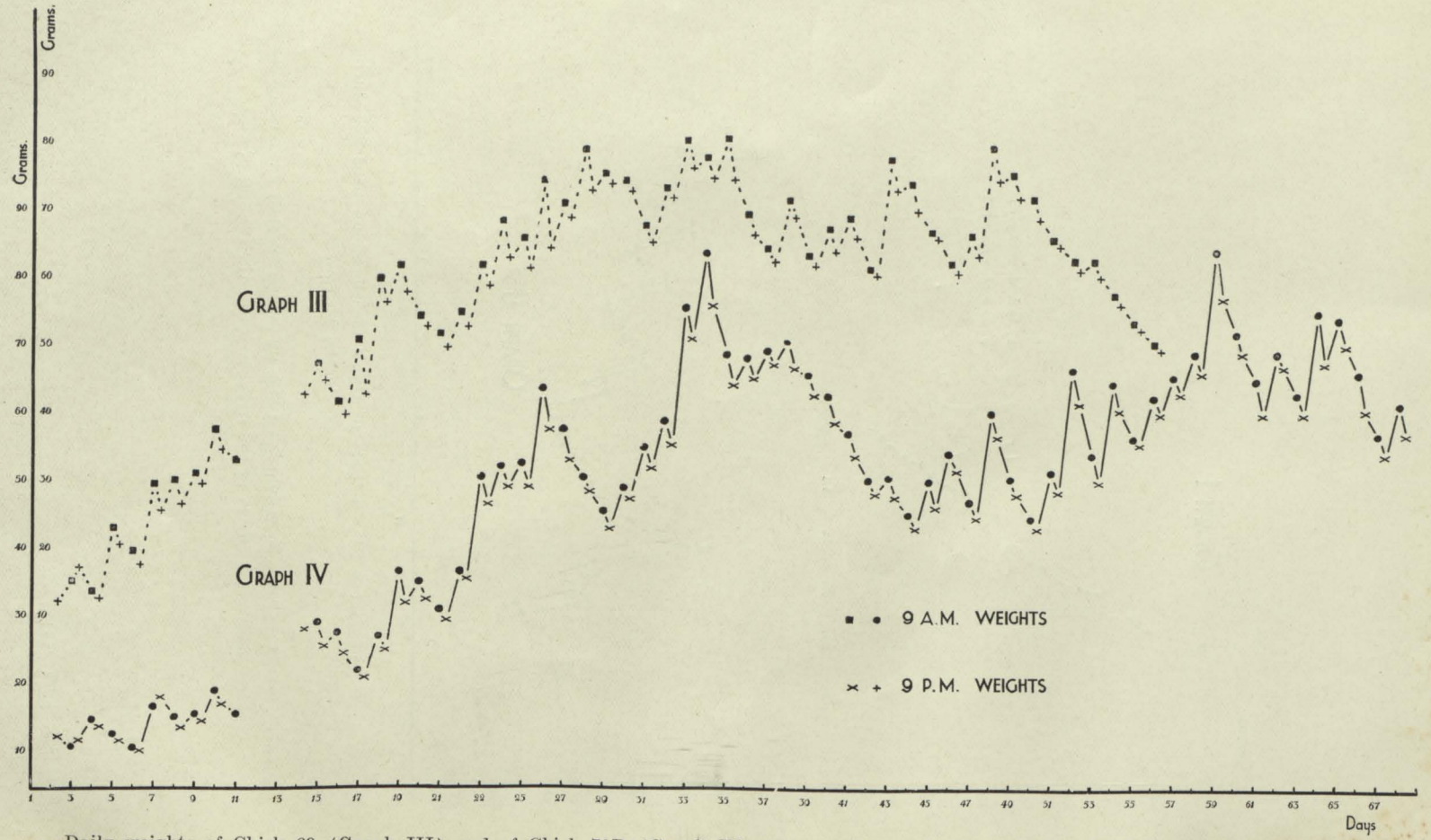
Some of the weights and the increases in weight are interesting. Of the ten chicks which were weighed daily during their life ashore, the one at 16R attained the heaviest weight of 85½ grams at 51 days old; the night before it weighed 68 grams. During the next three nights it was not fed at all and at the end of this period it disappeared at the comparatively heavy weight of 67½ grams when only 53 days old. It still retained a fair amount of down, and on the



GRAPH I: 9 a.m. and 9 p.m. weights of Chick mentioned on page 226 during its last eleven days in the burrow.

GRAPH II: 9 a.m. and 9 p.m. weights of Chick 28 during its first 28 days ashore, showing plainly the effects of the irregularity of the feeding process.

[*To face page 226*]



Daily weights of Chick 69 (Graph III) and of Chick 71R (Graph IV) taken at 9 a.m. and 9 p.m. from hatching to day they left the burrow

night when it rose to 85½ grams it was seen at the mouth of the burrow. Possibly its departure was premature.

I have records of three other chicks which were weighed only towards the latter part of their period and which were exceptionally heavy. The first was 100 grams at 9 p.m., nine days before it left. Next morning it was 102 grams, while thereafter, for the remaining seven nights it was unfed, and left weighing 64 grams; this was an exceptionally long starvation period. The second, estimated to be 38 days old, was the phenomenal weight of 100 grams when found at 9 p.m. A reference to Table XII will show that the average weight of 10 chicks for this time and age was only 62.45 grams. Next morning this chick was 107 grams, and when I left the island 13 days later it weighed 74 grams at 9 a.m., having dropped from 80 grams the morning before. In the whole of that period of 14 days there were only four nights when it was not fed. The final chick was 96 grams when weighed at 9 p.m., 11 days before it left, and departed weighing 58 grams. Throughout those 11 days when feeding occurred on only four nights, which were interspersed among the nights unfed, the results show that in the aggregate the surplus of morning over evening weight was only six grams of food. The weights of this last chick have been plotted in Graph I and give a good idea of what may happen just before a chick leaves the burrow. If the chick in question had been weighed only once a day, say at 9 p.m., the results, as shown by the crosses which gradually descend, would have given the impression that the chick had not been fed for the last 11 days. It would have been concluded that the chick had been deserted by its parents so that it might drop weight before flight. The graph, however, indicates that this chick was fed on the 9th, 7th, 4th, and 3rd last nights, respectively.

The chick at 78R which was reared by foster parents had a very bad start. At seven days old it was only 10 grams at 9 p.m. When, at 13 days of age, it had advanced to 25 grams at 9 p.m., it thereafter maintained a gradual improvement till it grew into a very fine chick, keeping a steady weight throughout, without manifesting the big fluctuations shown by some of the other chicks. Its percentage of nights unfed was easily the lowest of all, being only 16.4%.

The chick at 68R did not seem to make much headway between 36 and 48 days old. This period was characterised by light meals and a number of nights when it was not fed. On the 44th night it weighed 47 grams, next morning rising to 65 grams, but on the 47th night was down to 49 grams again. It was on this night that it received the largest meal I have known any chick to get, both in the 1940–41 and in the 1941–42 seasons. This amounted to 25 grams, causing the chick to register 74 grams next day. From now on its morning weights remained steadily in the 60's till the final day when it was 56½ grams. Ainslee and Atkinson (1937, pp. 245–246) have also noted what they call this occasional "startling increase in weight" when dealing with Leach's Petrel.

In the table below is given a summary of the weekly average measurements and weights of 10 Storm Petrel chicks from day of hatching to their final days ashore.

TABLE XIII.

Average Weekly Measurements in Millimetres and Weights of 10 Storm Petrel Chicks.

Feature	1st day	8th day	15th day	22nd day	29th day	36th day	43rd day	50th day	57th day
Bill	8.4	9.38	10.72	12.15	13.25	14.21	15.0	15.33	15.7
Nostril to tip ..	4.86	5.5	6.44	7.34	8.37	9.37	9.92	10.21	10.38
Wing	12.32	14.8	25.99	39.75	65.38	92.66	118.0	132.5	158.0
Toe and Claw ..	13.18	15.21	20.81	26.62	32.31	35.04	36.04	36.37	36.54
Claw	2.29	2.95	3.28	4.03	4.82	5.04	5.25	5.25	5.29
Tail	—	—	—	4.25	17.42	32.33	53.5	66.83	78.17
Weight (grams)	11.2	19.75	31.58	45.5	55.47	62.35	59.95	65.1	61.15

EFFECT OF THE MOON.

The effect of the moon on the Storm Petrels is interesting and will be studied from two angles—first of all as it effects adults feeding their young, and secondly as it influences the unemployed population. On ordinary dark nights these small petrels fill the air like a cloud of butterflies, while at the same time they emit the dominating noises of the night. They are the commonest species on the island and are found everywhere, including the interior of the tent. In 1940–41 I ringed just under 300 individuals, and in 1941–42 just over 400 on the square chain which contained the tent.

In Table XIV below I have divided my time on the island, both in 1940–41 and in 1941–42, into 5-day intervals, where possible using as the centre the period beginning a day before the full moon and ending four days later. This was the span giving the maximum moonlight in mid-summer. The number of times chicks could have been fed coincides with the number of times I weighed them each morning. The " number of times fed " indicates the occasions when the morning weight was greater than that of the previous evening. Those occasions when the chicks were not fed after their last meal ashore are not counted as I consider that this occasion in feeding occurs whatever the state of the moon. The purpose of the table is to discover the effect of the moon when the parents are actually feeding, not when they have ceased.

From the following table it would appear that in the main there is a tendency for parents not to come home on moonlight nights. It would also appear that the period containing the date of the new moon, and hence the darkest nights, holds the record for the greatest number of nights on which chicks were fed. It will be noted that the period January 12 to 16, 1941, which happened to be the brightest of the four similar periods I experienced, there being only a few rain squalls during the whole time, gives only 23% of nights on which chicks were fed. That from January 2 to 6, 1942, was not

a great deal less bright, but as many of the chicks had not long hatched and some of the parents were in the burrows all day, this factor may account for the high percentage of meals given (73). The full moon periods of January 31 to February 4, and March 2 to 6, 1942, were both quite cloudy, and consequently I was unable to test out properly the effect of the moon. Even so, the percentage was the lowest for the month.

TABLE XIV..

Effect of the Moon on the Feeding of Chicks. The Central Five-day Intervals Include the Day of the Full Moon.

Class Interval	State of Moon	No. of times chick could have been fed	No. of times fed	Per-centage
1940-41				
Dec. 30 to Jan. 1		5	5	100
Jan. 2 to Jan. 6		17	15	88
Jan. 7 to Jan. 11		32	26	81
Jan. 12 to Jan. 16	Jan. 13, Full moon	49	11	23
Jan. 17 to Jan. 21		50	31	62
Jan. 22 to Jan. 26		50	39	78
Jan. 27 to Jan. 29*	Jan. 28, New moon	30	17	57
1941-42				
Dec. 28 to Jan. 1		33	23	70
Jan. 2 to Jan. 6	Jan. 3, Full moon	40	29	73
Jan. 7 to Jan. 11		16	12	75
Jan. 12 to Jan. 16		40	27	68
Jan. 17 to Jan. 21	Jan. 17, New moon	50	47	94
Jan. 22 to Jan. 26		49	35	72
Jan. 27 to Jan. 30		40	28	70
Jan. 31 to Feb. 4	Feb. 1, Full moon	50	33	66
Feb. 5 to Feb. 9		50	35	70
Feb. 10 to Feb. 14		57	40	70
Feb. 15 to Feb. 19	Feb. 16, New moon	52	44	85
Feb. 20 to Feb. 24		26	22	85
Feb. 25 to Mch. 1		69	39	65
Mch. 2 to Mch. 6	Mch. 3, Full moon	60	33	55
Mch. 7 to Mch. 11		37	25	68

* Last day chicks weighed.

The periods containing the new moon are very high in 1942, but the one in 1941 is somewhat low. There were, however, only three nights under observation and during the last two of these heavy storms which raged might have kept the birds away. One chick in the period January 12 to 16, 1941, was not fed during the whole five nights which, not taking into account the period between the final feeding and the ultimate departure, is the longest spell I have known, while another was unfed for four nights.

In spite of the evidence given in the above table it is surprising the number of chicks which are fed on bright, clear, moonlight nights, and in the field I had formed the opinion that the adults get in somehow. On these moonlight nights there are no Storm Petrels flying about and not a single cry is heard. Occasionally a dark object flits across the sky and lands on the ground—a parent has come home.

A full moon in a cloudless sky marked the night of January 3, 1942, yet all eight chicks weighed next morning had been fed. Two nights later there was a heavy north-west wind accompanied by rain all night, resulting in only three of the eight chicks being fed. From these observations it will be seen that the effects of weather possibly had an influence on the results in Table XIV.

On February 3, 1942, two nights after the full moon, nine of the ten chicks weighed were fed. The early part of the night was dull, but by 10 p.m. the moon began to show up, causing the few Storm Petrels that were flying about to disappear. It remained light and calm all the night. On January 11, 1941, two days before full moon, a bright moon shone till 2 a.m. and on this occasion all the five chicks were fed.

At midnight on January 13–14, 1941, I had an interesting experience. The full moon was shining brightly in a clear sky as I approached nest 51 to discover an adult flitting about over the burrow. Landing near the mouth of the burrow it took some time in getting through the opening. A complete silence pervaded the island and there were no other birds in sight at the time. On weighing the chick next morning I found it was the only one of the five that had been fed. An additional five chicks which were not weighed but across whose burrows I had placed a palisade of sticks had not been visited either. Thus of the ten chicks under observation during this exceptionally bright night, only one was fed.

TABLE XV.

Average Weights of Meals Given to Storm Petrel Chicks at Various Periods.

Occasions When Weights Taken	No. of cases	Average in grams
After missing 1 meal	82	6.4
After missing 2 meals	29	7.94
After missing 3 meals	3	11
After missing 4 meals	2	13.37
After missing 5 meals	1	6.5
1st meal after a fast	102	6.72
2nd meal after a fast	100	6.69
3rd meal after a fast	65	4.93
4th meal after a fast	43	7.58
5th meal after a fast	28	6.44
6th meal after a fast	15	5.1
7th meal after a fast	12	5.65
8th meal after a fast	10	5.6
9th meal after a fast	8	3.56
10th meal after a fast	5	5.1

The preceding table has been made out to check up whether the average weights of food given are influenced by periods of fast and by successive meals. From the top part of the table the indications are that heavier meals are given as the length of the fast increases. As regards successive meals, the first two after a fast of one day are much the same and then there is a considerable drop. The fourth meal rises again after the light third meal, while the fifth, too, remains high, and then there is another fall. The actual cases for these later meals are somewhat few for reliable inferences.

From January 12 to 16, 1941, a bright moonlight period, out of the possible 25 meals for five chicks, only six were given. On January 17, all five chicks were fed with substantial amounts varying from 6½ to 12½ grams, the aggregate amounting to 47¾ grams, or an average of 9·55 grams. This must surely represent a recuperative quantity. During the previous five nights the six meals given weighed ½, 1, 2, 3, 8, and 18 grams respectively, the last amount being given to a chick which had not been fed for four consecutive nights.

As a rule rough nights appear to keep the adults away, but there occurred on March 7, 1942, the exception that proves the rule. On that night a sudden heavy wind prostrated two Pararas *(Pachyptila vittata)* on the vegetation outside the tent. This was the heaviest wind I had ever experienced on the island, and although the peak period of intensity lasted only ten minutes, it was severe all night. In spite of these rough conditions eight of the eleven chicks that were being weighed were fed that night. Incidents like this and other occasions when feeding occurred on moonlight nights incline me to the opinion, in spite of evidence to the contrary in Table XIV, that parents endeavour to get home somehow. While weighing the chicks in the field I formed the impression that some of the parents gave extra heavy meals to the chicks when the moonlight nights were approaching. For example, when full moon occurred on February 1, chick 71R from January 25 to 29 received 6, 7½, 7, 20, and 12½ grams respectively. On January 30 it was not fed, and for the next five nights it received only 11½ grams altogether.

The influence of moonlight nights on Storm Petrels has been noted by several other writers. Regarding the British Storm Petrel, Lockley (1932, p. 211) states that they shun the land to some extent on very bright moonlight nights, but that they are not so particular as the Manx Shearwater. In my case the position is reversed, for it is the Mutton-bird *(Puffinus griseus)* which does not object to the moon, whereas the White-faced Storm Petrel does. Gross (1935, p. 387) records that on a night of full moonlight and a clear sky very little activity on the part of Leach's Petrel is noticeable. The birds fly in from the sea to their nests as quickly and as silently as possible. There is only an occasional petrel call. This describes very well the conditions on Whero on moonlight nights, and I would suggest that the birds Gross saw coming in were mainly parents, the unemployed having remained at sea.

Ainslee and Atkinson's records (1937, pp. 242–243) for Leach's Petrel made on North Rona, however, are a little different from

Gross's. They say that the amount of calling on moonlight nights is up to the average and give the impression that there is very little reduction in the number of birds on such nights.

Campbell (1907, p. 188) spent a night on Mud Island hoping to see large numbers of *Pelagodroma* come in from the sea. He was very puzzled at the scarcity of birds that night during which a bright moon was shining, and it seems obvious that the moon had kept the birds away. He had estimated that there were 5000 burrows (1933, p. 87). Nearly 30 years later, on January 14, 1933, he was again on Mud Island on a "magnificent pearly moonlight night," and this time he noted that "birds were in the air in all directions" (*op. cit.*, p. 89). He did observe, however, that the petrels were silent, and that they left the island very early, i.e., before 2.20 a.m.

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