The White-faced Storm Petrel

or

Takahi-kare-moana

(*Pelagodroma marina maoriana*, Mathews).

PART III.*

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THIS part begins with a discussion on the status of the chick when about to leave the island. The time ashore of 38 chicks and the amount of down still adhering at departure is noted, while an endeavour is made to explain the varying times individual chicks stay ashore. Then come some remarks about the alleged " starvation " period in petrel chicks, followed by the daily weights and wing measurements of a number of chicks during the last few days ashore. The weights, wing and bill measurements of nearly 100 chicks are compared statistically with those of 100 adults. In conclusion, departure dates of 105 chicks are tabulated in class intervals of three days.

DEPARTURE OF CHICKS.

As I was able to discover the hatching and departure dates of 38 chicks it was possible to work out the limits of the length of time the chicks were in the burrow. The period varied considerably from 52 days to 67 days, with an average of 57·45 days. The standard deviation was 3·16 days and the PE_m ·34. Lockley (1932, p. 210) dealing with six chicks of the British Storm Petrel (*Hydrobates pelagicus*) has noted a similar state of affairs. His birds ranged from 54 to 68 days in the burrow for an average of 61 days. Gross (1935, p. 395) found that his oldest chick of Leach's Petrel (*Oceanodroma leucorhoa leucorhoa*) at the time he left the nesting colony, was 50 days old, and he considers that it might have stayed several weeks longer in the burrow. Roberts (1940, pp. 167 and 173) states that the only Wilson's Petrel chick (*Oceanites oceanicus*) which completed the cycle during his observations was 52 days in the burrow.

In the table below is given the time ashore for the 38 chicks, broken up into class intervals of three days with the number of chicks departing in each interval. There is also included the condition of the plumage of the chicks when they set out.

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* Parts I and II of this paper have appeared in vol. 73, pp. 97–115 and pp. 217–232 of the *Transactions*.

TABLE XVI.

Time Ashore of 38 Chicks in Class Intervals of 3 Days.

Class Interval in Days.	No. of Chicks.	No. of Chicks and Condition of Down.				
52–54	5	1P	2Ts	2T		
55–57	15	4Ts	4T	4ND1	3ND2	
58–60	13	6T	4ND1	1ND2	1ND4	1ND5
61–63	4	1T	1ND1	1ND2	1ND5	
64–66	0					
67–69	1	1ND6				

KEY TO SYMBOLS:

P means patches of down.
Ts „ traces of down.
T „ a trace only.
ND1 „ 1st day without down and so on.

A number in front of a symbol indicates number of chicks concerned.

It will be noted that those chicks which left early had far more down on them than those which left late. The last section in the above table indicates quite plainly the progressive disappearance of the down as the chicks grow older. One chick, as already mentioned on page 226, Part II of this paper, remained at the nest for the unprecedented period of 67 days and was still ashore six days after the down had gone. I can offer no reason for this except that, as already explained, it seemed to be a somewhat tardy chick. On its 58th day, when the average chick departs, it scaled the enormous weight of 84 grams. Perhaps this heavy weight kept it ashore. Its parents still continued to feed it, for on the 61st day after a three-day fast it received 9 grams of food, two nights after that 15 grams, then 6½ and one on the following nights. Missing two nights, it then received 7½ grams on the last night, and departed weighing 58 grams. It was only 55 grams at 9 p.m. on its last complete night when I discovered it just outside the burrow, and guided by similar behaviour by other chicks, formed the impression that it intended leaving. I was therefore greatly surprised next morning to find it back in the burrow, and, moreover, to discover that it had received a meal. My opinion is that the parent arrived and fed at the psychological stage of the intended departure of the chick, thus destroying its inclination to go.

Some observers have expressed the opinion that the time in the burrow is increased by irregular feeding during the chick's life ashore. Lockley (1932, pp. 210–211) believes that the discrepancies are due to a number of associated factors, such as food supply, parental attention, and temperament. Roberts (1940, p. 174) too, believed that irregular feeding prolongs the time ashore.

After a careful study of the whole problem I have not been able to arrive at any very definite conclusion. Tables VIII and X, and Graphs III and IV, already publised in Part II of this paper, give details of the feeding of several chicks ashore during the whole period.

A description of chick 69's growth curve, which is considered a normal one, compared with that of 71R's, which is more unusual, has already been given. 69's two highest weight peaks (Graph III)

were not quite as high as 71R's (Graph IV). As shown in Table X, 71R received an aggregate of 299.25 grams of food for an average of 7.48 grams per meal during its 67 days ashore. This was also the highest for all chicks under observation. Chick 69 received only 228 grams for an average of 6·71 during its 56 days ashore. The first chick, to my knowledge, was unfed for 23 nights and the second on 17 nights. These figures are relatively high (see Table X). If the total days weighed is divided into the total food received it will be found that 71R averaged 4·75 grams, and 69, 4·47 grams

Chick 78R is rather a conflicting case. It received only 227·75 grams for an average of 4·95 grams, the lowest of all the chicks under consideration. Yet in spite of this it was unfed on only nine nights, being easily the lowest of all chicks under review. Its daily average when all weighings were included was 4·14 grams, not much less than those of 71R and 69 given above. Staying ashore for 60 days, it left the day after its down disappeared. This chick's greatest weight was only 78 grams, but it was much lighter than the others in 1941–42 during the first 14 days, presumably due to the fact that it was the chick raised by foster parents. During 1940–41, however, an apparently normal chick (3b) was similarly low in weight.

It was unfortunate that chick 17W was weighed only 34 of its 59 days ashore. In that period it was 14, or 41·2% times unfed. 17W received on an average 6·9 grams per meal and 4·06 grams for each day weighed. It was a splendid chick with plenty of vigour. Irregular feeding did not seem to affect it at all.

Chick 16R was situated in a shallow burrow, open to the light, and the chick could be observed from the outside. It left with more down on it than any of the others, and possibly, because of its proximity to the outside world, left the burrow early. After the chick's departure the empty burrow was visited several times, presumably by a parent, seeming to indicate that perhaps it had not expected the chick to leave so early. This chick missed meals on 13 nights, and received 249.25 grams of food for an average of 6·73 grams per meal, being an average of ·75 grams lighter per meal than that received by chick 71R. Its daily average was high, being 4·98 grams.

In summing up, it seems difficult to be certain that irregular feeding prolongs life in the burrow. I feel convinced, however, that the individuality of a particular chick is an influencing factor. This is borne out by my researches on the Royal Albatross (*Diomedea epomophora sandfordi*). In 1941-42, five chicks were reared and departed when 220, 229, 230, 246, and 247 days old respectively. All were perfectly normal chicks, yet the last to depart was on shore nearly four weeks longer than the first one to fly. Moreover, the chick that was ashore for 247 days was the first to hatch and the last to fly. Of the five chicks that departed in preceding seasons (Richdale, 1942, p. 170) the one on shore for the shortest period stayed 229 days, while the oldest remained for 251 days. The last chick to leave was easily the biggest of all ten, while the oldest in 1941–42 was probably the smallest. The only explanation I can offer for this great disparity is individuality of the chick concerned.

TABLE XVII.

Amount of Down Left on 94 Chicks on Day each Departed.

Amount of Down.	Chicks Under Observation.	Chicks Caught After Leaving Burrow.
Patches	1	3
Traces	6	10
Trace	14	6
1st day without down	10	35*
2nd „ „ „	5	
3rd „ „ „	0	
4th „ „ „	1	
5th „ „ „	2	
6th „ „ „	1	
	40	54

* These chicks were free of down when found.

The above table gives some idea of the amount of down left on chicks when they depart. The first column deals with chicks I was weighing daily, while the second is a record of those chicks found on the surface at night after they had left the burrow. Many of them had no down, but, of course, I had no idea exactly when it had disappeared. To sum up, it would seem from the first column that about 60% of the chicks do not leave till either only a trace of down is left or the day it has all gone. There are a few, however, that leave with a considerable amount of down still adhering. Roberts (1940, p. 174) remarks that the chicks of Wilson's Petrel occasionally fly before all the down is gone, especially if the chicks have been starved.

The question now arises as to whether there is a starvation period at the end of the chick's term ashore or whether the parents continue feeding to the end. According to the history of chick 71R, given above, the indications are that they are fed to the end. In order to throw some light on the problem I weighed as many chicks as possible night and morning during their last ten days ashore, with the results shown in the tables below.

The much-discussed question of a starvation period at the end of a Petrel chick's life ashore has been studied in Storm Petrels by others. In the Royal Albatross (1939, p. 483, and 1942, pp. 178 and 260–1) and in Diving Petrels (1943, p. 44) I have shown that it does not appear to exist. Similarly in *Pelagodroma*, but if it should occur at all it is of very short duration.

Lockley (1932, p. 211) appears certain that the British Storm Petrel abandons its "nestling in the same callous way as does the Shearwater." Ainslee and Atkinson (1937, p. 246) say that when a Leach's Petrel is nearly fledged "it appears to be intentionally neglected as in the case of the Manx Shearwaters."

After noting the remarks of the above writers, the careful observations of Roberts make interesting reading. He states (1940, p. 168) that the parents of Wilson's Petrel feed their chicks at intervals even when fully fledged and this is decidedly my experience with *Pelagodroma*. Further, he says quite definitely that there is

" no voluntary desertion " by the parents. In the text below I have stated my reasons why I believe this to be the case in *Pelagodroma* also. Roberts further notes (*op. cit.*, p. 174) that the burrow is sometimes visited *after* the chick has flown, but he could not say whether the visitation was by the adults or by the chicks. Below, I have also referred to this phenomenon.

It was not till my field work had been completed and written up that I was able to read Dr. Brian Roberts' excellent work on Wilson's Petrel, and I was very interested to see how many of his findings coincided with mine on *Pelagodroma*. Besides those opinions just mentioned I note that he believes that Storm Petrels have only one coat of down; certainly *Pelagodroma* has only one coat.

TABLE XVIII.

Details of Feeding of Chicks during their last 10 Days Ashore.

Day record taken	10th	9th	8th	7th	6th	5th	4th	3rd	2nd	last
No. of records	15	18	21	23	29	31	33	33	35	38
No. of times a chick unfed	3	5	3	9	12	18	13	22	28	33
Percentage of times unfed	20	27.8	14.3	39.1	41.4	58	39.4	66.7	80	86.8
Percentage of times unfed in class intervals of two days		23.9		26.7		49.7		53		83.4

TABLE XIX.

Number of Days each of 33 Chicks stayed Ashore after their last Meal in the Burrow.

	No. of Chicks.	Remarks.
Fed on last night ..	5	
Missed a meal on 1 night	6	
" " " 2 nights	6	
" " " 3 "	9	
" " " 4 "	3	
" " " 5 "	3	58, 55, 59 days ashore.
" " " 6 "	0	
" " " 7 "	1	63 days ashore.

The above tables will show that while some chicks are fed on the last night, the majority will miss from one to three meals immediately before they depart, while one chick which stayed ashore for 63 days, missed seven meals. These conflicting results are difficult to interpret with confidence. It must be remembered, however, that chicks miss on the average approximately one-third of their possible meals so there arises the problem whether these last nights were missed casually or whether the parents had decided to abandon the chicks. I incline to the former alternative, for this reason. At a number of nests after the chicks were gone I placed a palisade of sticks across the burrow entrance. In most cases the sticks, or rather one stick, was pushed inwards showing that a Storm Petrel had entered. These events were happening, too, after the unemployed birds had left the island, and there were very few Storm Petrels about, even on dark nights. All the evidence seems to point to the return of a parent though I did not actually catch one. For example, at 16R nest the chick was gone on February 17, 1942. During both of the next two nights the sticks were knocked inwards but not again during my stay on the island up to March 12.

My impression is that chicks do not come to the mouth of the burrow till either the night they go or the night before. At least, without exception, that has been my experience. When they do decide to leave they usually begin to emerge before it is properly dark and long before any adults have appeared over the island. Further, they do not seem to be deterred by moonlight nights or by rough weather, a behaviour in distinct contrast to that in particular of the unemployed section of the adults. Leaving the burrow, they sit round for a few minutes on open ground and do not scamper off if approached with a torch; usually they are very docile and easily picked up. Very soon they commence moving up the vegetation with wings beating quickly and from this preliminary activity most likely take off into the air.

TABLE XX.

Average Weight of 32 Storm Petrel Chicks during their Last Eight Days in the Burrow.

Days Before Leaving.	Weight in gms.	Days Before Leaving.	Weight in gms.
7	71.6	3	62.4
6	69	2	59.3
5	66.7	1	56.1
4	63.5	0	52.8

The weight 7 days before departure varied from 52½ to 100 grams, while on the last day it was from 43 to 67½ grams. The 100-gram chick weighed 64 grams on departure, while the heaviest chick on the last day (67½ gms.) weighed only 68 grams 7 days before departing, indicating that it had been fed several times in between.

The above table shows a gradual falling off in weight during the last eight days, but, as indicated elsewhere, this does not necessarily mean that feeding had ceased. Actually some of the chicks were fed on the last night in the burrow.

TABLE XXI.

Departure Weights of 92 Chicks in Class Intervals of 5 Grams.

Class Interval in gms.	Frequency.	Percentage.
65 to 69.9	2	2
60 „ 64.9	4	4.5
55 „ 59.9	18	19.5
50 „ 54.9	34	37
45 „ 49.9	27	29.5
40 „ 44.9	6	6.5
35 „ 39.9	1	1

The above table gives some idea of the departure weights of 92 chicks. It will be observed that 86% set out when weighing between 45 and 59.9 grams.

In order to ascertain the growth of the wing and its length on the day of departure a number of chicks was measured daily during the last ten days in the burrow. The results are given in the table below.

TABLE XXII.

Increase in Growth of Wing of 20 Storm Petrel Chicks during Last 10 Days in Burrow, Divided into Two-day Class Intervals.

Class Interval in Days Before Leaving.	Average in mm.	Class Interval in Days Before Leaving.	Average in mm.
9–8	135.64	3–2	151.5
7–6	141.91	1–0	155.67
5–4	147.67		

As the difference from day to day was slight, and owing to the liability to small errors in measurement, especially upon live birds, I thought it desirable to group the measurements into class intervals of two days. The variation in length for the last day ranges from 147 to 167 mm., although 17 records appear between 153 and 158 mm., with one at 147 mm., a second at 166, and a third at 167 mm. There seems to be no reason for these differences for both chicks representing the extremes of range left the day they were free of down, the first being 56 days old and the latter 60 days. In the following table the wing is compared statistically with that of 100 adults whose breeding status was unknown; the data were obtained on Whero during the 1941–42 season. From the results it would appear that the chicks do not attain their full wing length till after they have left the burrow, as the difference is just significant.*

TABLE XXIII.

A Comparison of the Wing Measurements of 20 Storm Petrel Chicks the Day Each Left the Burrow with that of 100 Adults taken on Whero in the 1941-42 Season.

Type of Bird.	Mean. mm.	σ mm.	PE_m	Range. mm.
Adult	158.61	4.8	.32	149–170
Chick	156.45	2.81	.42	147–167
Difference ..	2.16	± .52		

Comparing the weights of 94 chicks when they leave the burrow with those of adults caught at night just as they reach the island it will be seen that the chicks are significantly heavier. The reason for this is difficult to discover.

TABLE XXIV.

A Comparison of the Weights of 100 Adults Caught on Whero at Night as They Arrived and 94 Chicks on the Night They Left the Burrow.

Type of Bird.	Mean gms.	σ gms.	PE_m	Range. gms.
Adult	47.19	3.97	.26	40 to 62
Chick	51.77	5.61	.39	35 to 68
Difference ..	4.58	± .35		

* Before allowing that a difference between means is significant I have followed the ruling that it must be at least four times the value of the probable error of the difference.

Forty of these chicks, being ones under observation, were weighed the night they left the burrow, while 54 were weighed when caught on the island after having left the burrow. Of course, it is not known whether they had left the burrow that night or on an earlier night. Table XXV notes a difference of 3·12 grams on the average between the weights of the two types of chicks. This would seem to indicate, as this difference is barely significant, that, at least, some of the chicks probably spend one night ashore after leaving the burrow.

TABLE XXV.

A Comparison of the Weights of 54 Chicks Caught on the Surface After Leaving the Burrow and 40 other Chicks Weighed on Their Last Night in the Burrow.

Type of Bird.	Mean	σ	PE_m	Range.
	gms.	gms.		gms.
Caught on surface	50.53	5.1	.46	35 to 62
Taken from burrow	53.65	5.96	.63	42 to 68
Difference ..	3.12		± .78	

In order to ascertain if the bill of the fully fledged chick were smaller than that of the adult, as it appeared to be on sight, I measured 96 chicks and 100 adults. The results, shown statistically in Table XXVI, indicate that the bill of the chick does not attain its ultimate length till after it has taken wing.

TABLE XXVI.

A Comparison of the Bills of 96 Fully-fledged Chicks and 100 Adults, all taken on Whero.

Type of Bird.	Mean	σ	PE_m	Range.
	mm.	mm.		mm.
Adult	16.14	.65	.04	14½ to 17¾
Chick	15.33	.52	.035	14 to 16¼
Difference ..	.81		± .05	

On February 15, 1942, the first chick left the burrow, and by the time I entered my last record on the morning of March 12, 98, to my knowledge, had set out. Thirty-nine of these were in burrows I was observing while 59 were accounted for on the surface after having left the burrow. In addition, six chicks under observation were still ashore when I left, and I estimate that the last of these departed on March 30. It will be readily observed from a study of the hatching dates that the Storm Petrel's season is somewhat prolonged, a feature which is confirmed by the period of 44 days required before all the chicks leave the island.

In the table below, chicks under observation and chicks caught on the surface are given separately, the departure dates being grouped into class intervals of three days each. It will be noted, too, that the departures are spread out fairly evenly over a considerable period, although 91% fall into the 23-day period from February 18 to March 13. If, however, I had been able to catch some surface birds after March 12 the above percentage would have been reduced a little.

TABLE XXVII.

Departure Dates of 105 Storm Petrel Chicks placed in Class Intervals of 3 Days.

Dates of Class Intervals.	Chicks in Burrow Under Observation.	Chicks Found on Surface After Leaving Burrow.	Total.
Feb. 15 to Feb. 17	3	1	4
„ 18 „ „ 20	6	5	11
„ 21 „ „ 23	7	6	13
„ 24 „ „ 26	5	1	6
„ 27 „ Mar. 1	3	7	10
Mar. 2 „ „ 4	5	15	20
„ 5 „ „ 7	5	13	18
„ 8 „ „ 10	5	5	10
„ 11 „ „ 13	2	5	7
„ 14 „ „ 16	2		2
„ 17 „ „ 19	1		1
„ 20 „ „ 22	1		1
„ 23 „ „ 25	0		0
„ 26 „ „ 29	1		1
„ 29 „ „ 31	1		1

N.B.—The departure dates after March 12 have been estimated.

THE ADULTS.

A certain amount of information concerning the behaviour of the adults will already have been gleaned by the reader. Its habits contrast sharply with those of the Kuaka (*Pelecanoides urinatrix*). The length of time one bird incubates before being relieved by its mate is longer, and, as I mentioned previously, the egg may be left cold for a time. Almost immediately the chick is hatched the parent leaves it alone and the offspring may be compelled to fast during its life ashore up to five days. Moonlight, and more particularly wild nights, also seem to affect the return of the parent Storm Petrels to some degree. All four of the other species of petrels under observation on the island have been seen off shore in the day-time, but I have never once seen a Storm Petrel. The position, however, is different round the Alderman Islands near the shores of the Bay of Plenty, where Falla (1928, p. 283) has noted that *Pelagodroma* may be seen off the land late in the afternoon and early in the morning. Lockley (1932, p. 207) has never seen a British Storm Petrel by day within 10 miles of Skokholm, and neither did Ainslee and Atkinson (1937, p. 241) see a Leach's Petrel near land during their stay on North Rona.

On being handled the adults are usually very docile, although there was one which always used to bite my finger whenever I put my hand into its burrow. Frequently, when the chicks are handled, they cough up a quantity of reddish coloured liquid, a feature which has also been noted on the Chathams by Fleming (1939, p. 406). The adults, on the other hand, do this only very occasionally.

On March 4, 1942, I found a parent, No. 292, with its chick in the daytime, a most unusual occurrence, as the chick left on the night of March 7. The chick, of course, had been fed. At 9.10 p.m. on March 7 I caught the second parent, No. 315, outside the burrow, and to my surprise it coughed up food, the only time that a Storm Petrel had ever done this. In the morning the chick was gone.

Unemployed birds, when wandering about the surface of the island, appear sometimes to enter the burrows of breeding birds. Such an incident occurred on January 26, 1942, when I found one bird with the chick and a second adult, which proved to be a stranger, with its head out of the burrow. Sladden and Falla (1928, p. 283) when referring to *Pelagodroma* on the Alderman Islands, note that about 11 o'clock in January many of the birds are crowding at the entrance of burrows and that by midnight most of them are underground. This was my experience on Whero and my interpretation is that practically all of these birds are unemployed, some of which may enter burrows not their own. Gross (1935, p. 386) and others have expressed the view that Storm Petrels flutter round over the island calling to their mates in the burrow. I do not think this is the correct interpretation, for I am of the opinion that those birds calling out belong to the unemployed group. Breeding birds are too preoccupied with the serious business of life.

TABLE XXVIII.

Number of Birds Caught Nightly Arranged in Class Intervals of 5 Nights.

Date. 1941–2	No. of Birds.	Date.	No. of Birds.
Dec. 23 to Dec. 27	112	Jan. 31 to Feb. 4*	1
Dec. 30 to Jan. 1	0	Feb. 5 to Feb. 9	25
Jan. 2 to Jan. 6*	7	Feb. 10 to Feb. 14	44
Jan. 7 to Jan. 11	53	Feb. 15 to Feb. 19	28
Jan. 12 to Jan. 16	108	Feb. 20 to Feb. 24	5
Jan. 17 to Jan. 21	114	Feb. 25 to Mar. 1	2
Jan. 22 to Jan. 26	54	Mar. 2 to Mar. 6*	0
Jan. 27 to Jan. 30	0	Mar. 7 to Mar. 11	1
		Total	554

* Full moon—Jan. 3; Feb. 1; March 3.

While on the island in 1941–42 I had intended ringing every Storm Petrel that could be caught in order to obtain some idea of the distribution of the species, but owing to the pressure of other work I had to abandon the more ambitious scheme and content myself with those birds within the *Muehlenbeckia* area, on which the tent stood. No other birds except occupants of burrows under observation and chicks caught on the surface were ringed. The above table will show to some degree how the numbers fluctuated according to the state of the moon and also according to the time of the year. The total includes 448 birds which were actually ringed plus 106 other records representing birds caught a second or third time.

During the first four nights on the island I caught 112 birds, but except for the night of January 4 the project was temporarily abandoned till January 9, when in the three nights of that class interval I caught 53 birds. Hereafter I was able to collect Storm Petrels each night, but the gathering of them was of an incidental nature as there were other species to attend to and the nights were short. It is evident that the dark nights of December and January were favourable to the presence of a large number of birds, and I am convinced that most of these were unemployed. It will be observed, too, that after the full moon on February 1 the numbers

of Storm Petrels had considerably decreased, while after the March 3rd full moon I managed to get only one bird in the last eight nights I was on the island. Of course, by this time many of the chicks had departed and their parents were no longer on the island, while probably all the unemployed had left for that year.

In the period after the full moon on February 1 and up to February 19 very few chicks had set out, so that perhaps the birds caught between these dates, numbering 97, were nearly all parents. For a similar period after the moon of January 3, 275 birds were accounted for in a span of 13 days, as against 18 in the first period. Thus it would appear from the above that two-thirds of the adult population might be unemployed birds. This depletion of the numbers of birds after the moon of February 3 was very noticeable while I was working, for they did not return as they had done after the moon of January 3.

In 1940–41, 298 birds were ringed in the *Muehlenbeckia* with either canary or celluloid rings, 46 of these birds being obtained in 1941–42 in the same area. Though the celluloid rings seemed to be still thoroughly intact, the aluminium rings all showed evidence of considerable wear and in some cases the ring was only just holding on. I should say, therefore, that many of the rings came off, so that the number of returns should have been greater. In 1941–42, I used heavier rings, which should prove more satisfactory and stay on longer.

TABLE XXIX.

Population Statistics of Storm Petrels on Whero, 1940-41 to 1941-42.

Description of Birds.	1940-41	1941-42	Totals.
Breeding birds ringed	63	128	
Breeding birds not ringed	63	50	
Other adults ringed	298	448	
Birds which deserted eggs	48	28	
Unringed parents of chicks found on surface		108	
Total ..	472	762	1234
Chicks ringed in burrow	10	40	
Chicks ringed on surface		54	
Total ..	10	94	104

In the above table "breeding birds ringed" means those parents actually found in charge of a burrow on any part of the island. Some of the parents were not caught while in other cases the egg was deserted or some mishap overtook the chick before the adults could be ringed; this class is therefore called "breeding birds not ringed." Those picked up at night on the *Muehlenbeckia* area whose breeding status was not known are classified as "other birds ringed." Whenever deserted eggs were found it was assumed that two birds could be implicated, and these are described as "birds which deserted eggs." In 1941-42, 54 chicks were picked up on the surface of the island at night after leaving the burrow, hence the class of parent "unringed parents of chicks found on surface."

It is interesting to review the Storm Petrel population of 1200 birds as given in my Whero paper (1942, p. 91). At least a portion of the 1940-41 total of 472 birds must have been present in 1941-42, in which season the existence of 762 adult Storm Petrels was definitely known. The *Muehlenbeckia* area represents about one-quarter of that

part of the island where Storm Petrels are found, and moreover, many of the birds inhabiting that portion were not caught. This was partly due to the fact that I had not the time to devote to the catching of the birds, and also to the fact that the density of the vegetation would enable a considerable number to evade me. It should be borne in mind, too, that the *Muehlenbeckia* was probably the most densely populated area. Taking due consideration of all the factors concerned it does not seem at all improbable that the Storm Petrel population of Whero is at least 1800 birds.

The castings of the Skua (*Catharacta skua lonnbergi*) indicate that a large number of Storm Petrels are eaten by this predaceous bird. When and how they fall victims I have not been able to discover, for the Petrels arrive a long time after dark and leave again long before the first glimmer of light appears in the eastern sky. Only once during the whole six weeks on Whero in 1940–41 did I find evidence of a Skua having eaten a Storm Petrel on the island itself. In the extended trip of 1941–42 I again saw a Skua only once with a Storm Petrel, but on this occasion the Skuas having no family did not frequent the island very much.

It is interesting to note here that Murphy (1918, pp. 142–143) on South Georgia found that Wilson's Petrel "enjoys absolute immunity from the aggressiveness of the Skua," while at the same time other species are relentlessly attacked. Roberts (1940, p. 175) states, "Wilson's Petrels are almost the only birds in the Antarctic immune from the attacks of the Skuas." It has not been possible for these observers to give a definite reason for this phenomenon.

Storm Petrels, however, seem to suffer considerable molestation from the actions of a larger petrel, the Titi Wainui (*Pachyptila turtur*), which ousts them from their burrows. Altogether, between December 29, 1941, and January 25, 1942, I came across eight examples. On five occasions the egg had been scraped out, on two occasions a young chick was ejected. One of these chicks was dead, while the other appeared to be, but was revived and placed under a bird which was still present although its egg had disappeared. This chick survived to leave the island. In the eighth case a chick 32 days old was ejected and although I did not find it again I do not think it could have perished.

TABLE XXX.

Fate of 33 1940-41 Nests in the 1941-42 Season.

	Total.
No. of nests at which no sign of occupation ..	9
" " " " " Titi Wainuis laid an egg	4
" " " " " Titi Wainuis excavated	2
" " " " " Kuakas hatched a chick	2
" " " " " Storm Petrels laid again	16
	33

From the above table can be gleaned some idea of what happened at 33 nests in a succeeding year. It will be seen that sixteen burrows were occupied again by Storm Petrels, but as I was not certain that the ringed birds retained their rings, an interpretation of the identity of the birds in occupation in 1941-42 is somewhat difficult.

TABLE XXXI.

Sixteen Nests where One or Both Occupants had been Ringed in 1940-41, and their Occupants in 1941-42.

Nest.	1940-41	1941-42
30	Both marked	Not identified
51	" "	" "
1bx	" "	" "
3m	6 and X	Both unmarked
5b	10 and 91	" "
7ma	13 and 72	" "
11a	23 and 76	" "
17w	34 and X	" "
13	29 and 78	" "
52	44 and X	44 and unmarked
54	11 and X	40 " "
3mc	31 and X	31 " "
17e	56 and 32	56 " "
20	74 and 26	74 " "
1MN	68 and X	68 " "
16	33 and 67	33 and 67

Evidence in the above table is too scanty to furnish grounds for a decision as to whether Storm Petrels remain paired as a rule for many seasons and whether they come back to the same burrow. The pair at No. 16 nest has remained together for two seasons at least. A number of others have been found in the same burrow in the second year, but it is not known for sure whether the mate is the same. Six burrows in which ten of the occupants were marked in 1940–41 contained unmarked birds in 1941-42, but owing to the unsatisfactory rings used any interpretation of this is difficult.

There is one interesting case, however, which will give a lead for future observation. It will be noticed that at nest 54 in 1940–41, a bird marked No. 11 and an unmarked mate were in occupation. In 1941–42, bird No. 40 and an unmarked bird occupied this burrow. Now, No. 40 was, in 1940–41, the owner of a neighbouring nest only 2 feet 6 inches away, at which in 1941–42 there was no sign of occupation. This is the first evidence of a change of site by one bird at least.

Of the eight birds found again in 1941–42 and marked the previous year, all were found back at the same spot. This would seem to indicate that, as is the custom with other Petrels on Whero, they keep to their own particular part of the island.

Since the manuscript of this paper was written I have spent a further two months on Whero in 1942–43, though it is not possible to include much of the data collected during that trip. Suffice it to say that there is a tendency for many of the birds to pair up again in the same burrow. There were some birds, however, in the same burrow, but with an unringed partner, where both had been ringed the year before. Further, there are at least two cases where a single bird and a mated pair have occupied a fresh burrow, but I have not yet found a "divorce."

Roberts (1940, pp. 155 and 158) gives evidence that Wilson's Petrel, which was breeding on the Argentine Islands where he was working, returns annually to the same burrow and to the same mate.

My failure to retrieve a number of pairs in the same season robbed me of the opportunity to glean much information regarding the laying dates of the same female in a second season. The pair at No. 16 nest hatched their chick on January 5, 1941, and in the following season on December 24. At nest 20, birds 74 and 26 hatched a chick on January 7, 1941, while 74 and an unringed bird hatched another chick on January 6, 1942. At a third nest (17E), 56 and 32 hatched a chick on January 16, 1941, while 56 and an unmarked bird did so on January 22, 1942. The information is somewhat meagre, but to me there seems to be a tendency for early layers in one season to lay early each season, and similarly for late laying to be an individual characteristic. I have found this principle to apply with *Megadyptes* (unpublished) and with the Royal Albatross (1942, p. 171).

As regards external parasites, Storm Petrel chicks seem to be much freer than the other Petrels on Whero. Fleas and ticks do not appear to worry them, though feather lice are quite plentiful. On at least three of the other species, Kuakas, Titi Wainuis, and Mutton Birds (*Puffinus griseus*), ticks and fleas are quite numerous.

TABLE XXXII.

Weights and Measurements of 100 Adult Storm Petrels taken on Whero, Dec. and Jan., 1941-42.

Feature.	Mean.	σ	PE_m	Range.
	mm.	mm.		mm.
Bill	16.14	.65	.04	14½ to 17¾
Wing	158.61	4.8	.32	149 to 170
Tail	80.73	2.99	.2	73 to 87
Toe and Claw	36.66	1.52	.1	33 to 41
Claw	5.4	.44	.03	4 to 6¼
	gms.	gms.		gms.
Weight when caught	47.19	3.97	.26	40 to 62
Weight next day after being kept all night	41.32	3.16	.21	36 to 49
Difference in weight	5 .87		± .26	

In the above table two sets of weights are given. The first represents those taken just as the birds reached the island, while the second shows the weight of another set of 100 birds taken the day after they had been in a box all night. The difference is quite significant.

TABLE XXXIII.

Measurements of *Pelagodroma* made by Other Observers.

Authority.	Locality.	No. of Cases.	Bill.	Wing.	Tail.	Tarsus.	Toe.
Murphy (1936, p. 767)	Tristan da Cunha	3	16–16.2 (16.1)	150–153 (151.7)	71–75 (73)	40–42 (41.2)	33–35 (34)
Oliver (1930, p. 99)	Kermadec Is.		18	153	70	40	
Fleming (1939, p. 405)	Chathams	6	16–17 (16.6)	151–156 (154) Renewal of primaries	69–76 (74)	38–41 (40)	34–37 (35.5)
Falla (1937, p. 213)	off Tasmania	1 ♀ Juv.	15.5	154	75	41	37

In the above table the available measurements given by other observers have been considered. It will be observed that the average of my tail measurements (Table XXXII) is much greater than those in Table XXXIII. Owing to the awkwardness of measuring live birds with dividers I used a ruler, one end of which was placed at the base of one of the centre pair of rectrices where it left the skin. With the tail closed the reading was taken at the tip of the longest tail feather. When working I was aware that my measurements were longer than those recorded by others, a fact which caused me to measure most carefully.

My wing measurements are also a little longer. These were taken from the carpal flexure to the tip with the wing flattened and straightened along a ruler.

* * * * * *

Note 1:

After my 1942–43 trip to Whero, extending from December 1 to January 26, I gathered some important information bearing on the laying dates and the incubation period of the Storm Petrels. Details of the methods by which I arrived at my deductions must await a supplementary paper. Suffice it to say that according to my calculations the centre of the peak laying dates occurred on November 12, in 1942–43. As this season was six days later than usual, the normal peak for an average season would be November 6. From these and similar data concerning the hatching dates which are known to me, the average incubation period appears to be 55 or 56 days.

Note 2:

In the section on the chick in Part I of this paper colour numbers and letters as used in Radde's Colour Chart were given. A list of the colours referred to in the text, with their respective numbers, appears below. The darkest shade of each colour is given the letter 'a' and the lightest the letter 'v.'

21. Blau. Zweiter Uebergang nach Violet.
29. Carmin. Erster Uebergang nach Zinnober.
31. Neutralgrau.

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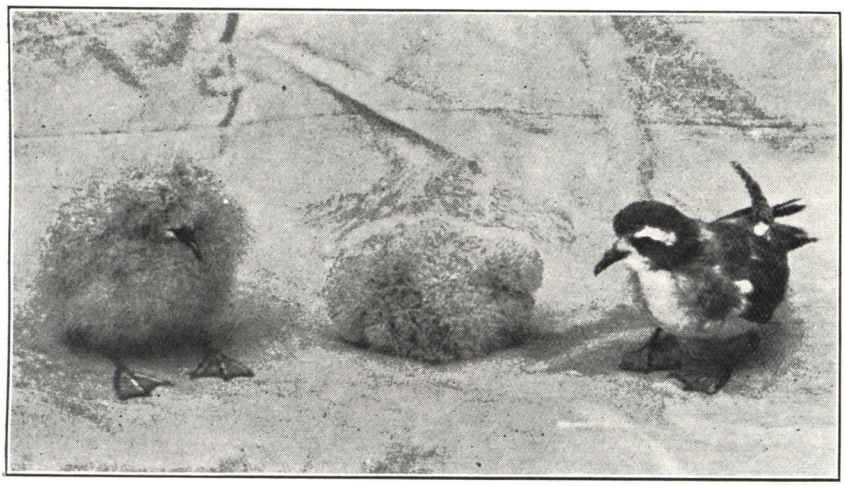

FIG. I.

14/2/42. Chicks of three distinct ages.
Left, 42 days old. Middle, 16 days. Right, 54 days.

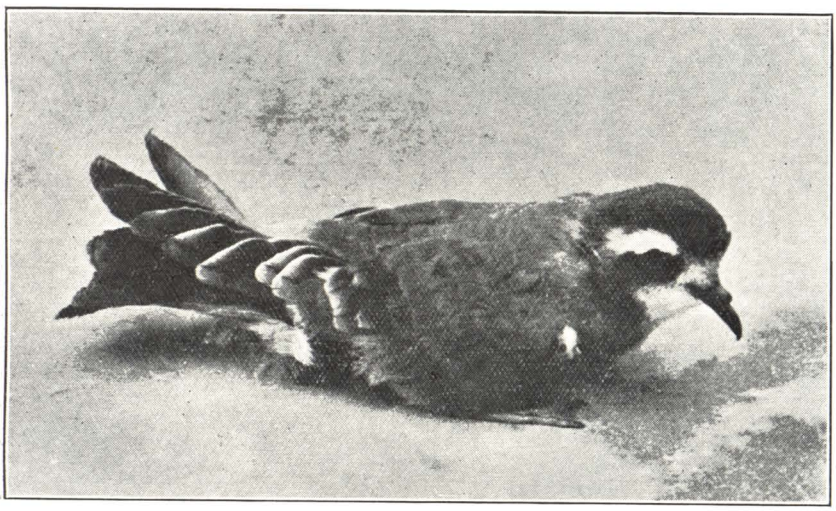

FIG. II.

17/2/42. Storm Petrel chick, 57 days old, fully fledged, showing distinctive juvenal plumage.

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