

# THE BREEDING OF THE STORM PETREL

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## PART II

(Continued from page 101)

(Plates 49-51)

IN the first half of this paper (antea, pp. 85-101) I summarized some of the results of three seasons' work on the Storm Petrel (*Hydrobates pelagicus*) at Skokholm, Pembrokeshire, dealing chiefly with the pre-egg and egg stages of the reproductive cycle of this pelagic bird. Reference was made to previous work on this species carried out by Lockley (1932); methods of investigation were outlined; and I also discussed the problems of the age at which the Storm Petrels breed, and of the "ineffective" birds which occupy burrows but which for various reasons have no breeding responsibilities. In the introductory sections I described the burrows and discussed the question of birds returning to the same burrows in successive years.

This second part covers the life of the chick, thus completing the review of the period which the species spends on land.

### The Chick Stage

This section deals chiefly with parental attentiveness, the size and frequency of feeds, and the development of the fledgling. To

continued....

put these matters into their correct perspective, a table of fledging-periods precedes them.

#### THE FLEDGING-PERIOD

Table V gives the fledging-periods of thirty-two chicks, calculated to the nearest twelve hours.

TABLE V—THE FLEDGING-PERIOD OF THE STORM PETREL (*Hydrobates pelagicus*)

Burrow No.	Year	Chick hatched	Chick departed p.m. night	Fledging period (days)
1	1954	24 July	28 Sept.	67
5		11 Aug.	9 Oct.	60
9		21 July	19 Sept.	61
11		31 July	1 Oct.	63
12		11 Aug.	11 Oct.	62
14		8 July	6 Sept.	61
16		15 Aug.	16 Oct.	62.5
28		13 Aug.	13 Oct.	62
33		25 July	27 Sept.	64.5
1		1955	28 July	26 Sept.
5	13 Aug.		17 Oct.	66
6	5 Aug.		3 Oct.	60
8	7 Aug.		6 Oct.	61
9	23 July		17 Sept.	56.5
11B	10 Aug.		12 Oct.	64
12B	29 July		27 Sept.	61
14	27 July		26 Sept.	61.5
17A	9 Aug.		9 Oct.	62
17B	7 Aug.		10 Oct.	64.5
19	7 Aug.		9 Oct.	63.5
20	5 Aug.		9 Oct.	66
28	29 July		29 Sept.	62
33	1 Aug.		4 Oct.	65
6	1956		31 July	5 Oct.
11B		4 Aug.	3 Oct.	61
12B		6 Aug.	4 Oct.	60
15		6 Aug.	7 Oct.	63
17B		24 July	28 Sept.	67
20		9 Aug.	20 Oct.	73
24		26 July	1 Oct.	68
28		2 Aug.	28 Sept.	58
33		4 Aug.	28 Sept.	56

Average fledging period  $62.8 \pm 3.5$  days

Lockley's six fledging-periods ranged from 54 to 68 days, with an average of 61 days.

#### BROODING OF THE CHICK

Table VI presents the information obtained from twenty-five nests concerning brooding of the chick by its parents. The sexes are indicated where known, otherwise the presence of an adult bird is shown by a cross. Symbols in brackets show where the adult was sitting alongside the chick, and not covering it.

TABLE VI—BROODING OF THE CHICK OF THE STORM PETREL (*Hydrobates pelagicus*)  
Burrow

No.	Year	Adult present on day												Later
		1	2	3	4	5	6	7	8	9	10	11	12	
5	1954	X	X	X	X	X				X	X			
9		♂	♀	♀	♂	♀	♂	♀		♂				(♂, 13th)
11		♂	♀	♀	♂	♀	♂	♀					(♀) (♀)	
14		X	X	X	X	X	X		X		X			
16		X	X	X	X	X	?	X	X	X				
28		♀	♂	♀	♂	♂	♀		♀	♂	♀	♂		(♀, 13th)
8	1955	X	X	X	X	X		X						
9		♂	♂	♀	♂	♀	♂	♀						
11B		X	X	X	X	X								
12		X	X	X	X	X	X	X			(X)			
14		♂	♀	♂	♀	♀	♀	♂	X					
17A		♂	♀	♂	♀	♂	♀	♀				♂		
19		♀	♂	♀	♂	♂	♀	♂						
24		X	X	X	X	X	X			X				
28		♂	♀	♂	♀	♂	♀				♀			
33		♀	♂	♀	♂	♀	♂	♀	♂					
6		1956	X	X	X	X	X	X	X	X	X	X		
11B	X		X	X	X	X	X		X					
12B	X		X	X	X	X	X			X				
15	X		X	X	X	X	X					X	(X)	
17B	X		X	X	X	X	X		X		X			
20	X		X	X	X	X		X		X				
24	X		X	X	X	X		X	X			X	X	
28	X		X	X	X	X	X	X	X					
33	X		X	X	X	X	X	X					(X, 16th) (X, 13th)	

It will be seen that in nineteen of these nests the chick was not left until the seventh day, and in only one instance was it left before the sixth day. This differs to a surprising degree from Roberts' (1940) findings with Wilson's Petrels (*Oceanites oceanicus*), whose young were not brooded after the second day. The temperature-regulating mechanism of Wilson's Petrel chicks began to function at the age of 48 hours, coinciding with the end of brooding. It may be that this mechanism functions later in the Storm Petrel, but I have not cared to follow Roberts' rather drastic method of collecting data on this subject, by inserting a thermometer into the body-cavity immediately after death. More delicate methods of reading the temperatures of the chicks were not available.

At the nine nests where the sexes of the brooding adults could clearly be distinguished, males were present on 34 days and females on 38 days. There were 56 one-day shifts, 5 two-day shifts, and 2 three-day shifts, including one day when both parents were covering the chick.

I have never found an adult in the nests after the 16th day, but Lockley once found a parent present when the chick was 33 days old.

#### THE FREQUENCY OF FEEDING

The chicks were first weighed at twenty-four hours old, then every forty-eight hours until the first interval in brooding, when

twice-daily weighings commenced. Since brooding was often resumed after the first interval, it was possible to establish that, during the day, the young bird received small feeds, sufficient to maintain its morning weight, although the main feed was given on the return of the foraging bird at night. There was a fairly steady rise in weight during brooding, and feeding appeared to be very regular and frequent at first. The only gaps I have recorded were in exceptional circumstances, such as the single occasion when both birds remained together in the nest, and neither was able to collect food.

The frequency of feeding after the end of brooding has been analysed for a sample of twenty nests. The results of this analysis are summarized in Table VII.

TABLE VII—FREQUENCY OF FEEDING AT 20 NESTS OF THE STORM PETREL  
(*Hydrobates pelagicus*)

Nights	11-20	21-30	31-40	41-50	51-60
Nights available	200	200	200	200	193
Feeds given	186 (93%)	168 (84%)	170 (85%)	166 (83%)	128 (66%)

The important features emerging from this table are the high frequency of feeds in the early part of the chick's life, and the sharp fall towards the end of the fledging-period.

Intervals of more than one night between feeds are comparatively rare until the chick is about 50 days old. Many of the gaps may be caused simply by the failure of both parents to find food, or by both having travelled too far from the colony in search of food. I can suggest no adequate explanation for the few longer gaps of up to three nights, nor for the fast of six nights undergone by one chick between its 46th and 52nd days. My records give little indication that weather-conditions play an important part in preventing the parents' return, with the possible exception of gales of force 8 (37 knots) or more. There were only two sustained overnight gales of this strength whilst I had a reasonable number of chicks under observation; on 5th-6th October 1955 only one chick out of eight was fed, and on 27th-28th September 1956 only two out of nine. Moonlight has no inhibiting effect on visits, such as that described by Ralphs (1956) for the Manx Shearwater (*Procellaria puffinus*).

After the 50th day, feeding gradually becomes more irregular, and gaps of up to four or five nights are not uncommon in the final stages. There seems to be an increasing "loss of interest" in the chick, and some parents cease to visit the nest before the chick has departed, though in general it is not possible to speak of a "desertion-period" in this petrel. The intervals between the last feed and final departure of the chick at thirty-two nests were: none at four nests, one night at eleven nests, two nights at nine nests, three nights at three nests, four nights at three nests, five nights at one nest, and seven nights at one nest. The two longest

periods were both at nests where the chick apparently had difficulty in finding its way to the open air; in one a long and tortuous passage, and in the other a vertical climb of some six inches from the floor of the burrow to the tiny exit, had to be negotiated.

At three burrows I was able to discover, by means of lattices, that the nest was visited on one occasion after the chick had gone.

#### THE SIZE OF FEEDS

The weighings at 1730-1800 and at 0800-0830 hours\* showed clearly the occasions when the chick had been fed during the night. Even the smallest feeds, resulting in no increase, or at times a small loss of overnight weight, appeared as a flattening of the downward curve when the results were plotted on graph-paper.

This method of detecting feeds proved most satisfactory, but gave, in itself, no indication of the actual amount of food received. For this reason I undertook, during the 1956 season, a series of some forty weighings at midnight, in addition to those of the early evening and morning. These records established that there was a fairly constant relationship between the weight of feeds and the rate of overnight increase, and made it possible to work out the actual size of feeds represented in my earlier growth-curves. The chart derived from the results of the midnight weighings, and upon which my calculations of feed-size are based, is reproduced as Fig. 2.

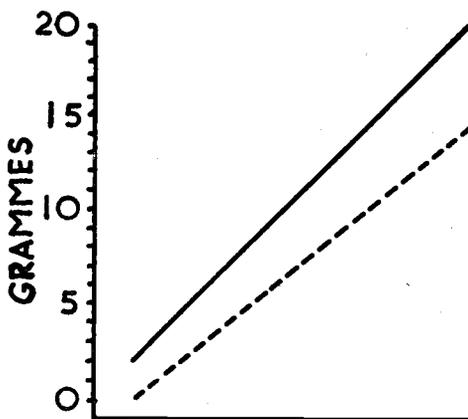


FIG. 2.—RELATIONSHIP BETWEEN ACTUAL SIZE OF FEEDS AND APPARENT INCREASE IN WEIGHT IN STORM PETREL (*Hydrobates pelagicus*) CHICKS FROM 1730 TO 0800 G.M.T.

The unbroken line represents the actual weight of food given to the chick; the broken line gives the increase in weight between the 1730 and 0800 weighings. Thus a feed of 12 gm. results in an overnight increase of 8 gm., etc.

\*All times G.M.T.

The weight of food received by my chicks during a single night varied between two and twenty-three grammes, but feeds of more than fifteen grammes were rare, and at some nests this figure was never exceeded. Probably all feeds of more than 10-12 grammes are the result of visits by both parents on the same night, and in practice, at the time of the midnight weighings, food totalling as little as six grammes in weight was given as two separate feeds. The visit-recording machines used in 1954 suggested that feeding by both parents occurs on nearly half of the nights when the chick is fed.

Some of the bigger feeds caused surprising percentage-increases in the weights of the young birds. The largest feed given to a chick of under ten days old weighed eleven grammes, the same as the chick's body-weight at the time the feed was received. Other large feeds, even as late as the fortieth day, resulted in sudden increases of over 50% in weight. Feeds of average size weighed from 30-40% of the chick's body-weight, just after the end of brooding, and only about 10% near fledging-time.

Table VIII shows the average size of feeds given to twenty chicks. The fledging-period is divided into ten-night stages, but a few feeds given to unbrooded chicks between the 6th and 10th nights, and feeds received in the chicks' last five nights in the nest, are also averaged.

TABLE VIII—AVERAGE SIZE OF FEEDS GIVEN TO TWENTY CHICKS OF STORM PETREL (*Hydrobates pelagicus*)

Nights	6-10	11-20	21-30	31-40	41-50	51-60	Last 5 nights
No. of feeds recorded	40	186	168	170	166	128	44
Total food received (gm.)	237	1208	1126	1112	1134	730	196
Average Feed (gm.)	5.9	6.5	6.7	6.5	6.8	5.9	4.5

The average feed is evidently of very uniform weight through most of the fledging-period. The smaller feeds of the last few days may reflect both the decline of the urge to collect food, and the fewer occasions on which feeds from both parents are likely to coincide. At some nests, only one parent may still be bringing food at this time.

Although rough weather seems to have little effect on the frequency of feeds, there is some indication that it influences their size. My figures are as yet inadequate to show this clearly, but twenty-two feeds given after a day of rough seas and winds of force 7 or more, averaged only 4.7 grammes.

The total weight of food given to each of twenty chicks from the eleventh night has been estimated, and ranges between 242 and 292 grammes, with an average of 270 grammes. Allowing an estimate of about 40 grammes for food given in the first ten days

and nights of the chick's life, the average amount of food required to bring a Storm Petrel chick from hatching to fledging would be some 310 grammes (11 ounces).

#### THE NATURE OF THE FOOD

Storm Petrels feed their young by regurgitation, with a pre-digested grey pulp probably derived from a wide variety of small surface-dwelling marine animals. They will also take offal thrown overboard from trawlers. This solid food is given to the chicks from the earliest stages, but may at first be liberally diluted with the strong-smelling yellowish oil, so frequently emitted by captured birds. The faecal matter of the young contains very little solid material in the first two or three days.

I have never been able to persuade a chick to vomit, but adults carrying food will cough it up when handled at night. They do this so readily and so vigorously that it is not easy to catch the sample. The few samples I have taken have not been subjected to microscopical examination, but obvious among them, and among many regurgitations not secured, were the headless remains of small fish about two inches long.

These fish occur so frequently that I am inclined to consider them the staple diet at this time of year, and tentatively suggest that the late breeding-season of the Storm Petrel may be timed to take advantage of the late summer abundance of sprats and small fry. This enormous supply of food is exploited also by other seabirds, notably Kittiwakes (*Rissa tridactyla*), whose "circuses" are a feature of the summer and early autumn off Skokholm, and contributes to an interesting food-chain involving mackerel and other piscivorous fish, pursued in their turn by the smaller cetaceans and by Gannets (*Sula bassana*).

I have not been able to watch a parent feeding a chick, but once, by shining the beam of an electric torch into a hole where a chick was uttering the peeping hunger-cry, interrupted the process. The adult was standing rather erect before its half-grown chick, which was pecking vigorously, in an upwards direction, at the parent's chin, and peeping all the time with apparent excitement. The parent was too disturbed by the torchlight, and did not respond to these advances. The feeding process must be very similar to that of the Fulmar (*Fulmarus glacialis*), the chick taking the food direct from the parent's throat.

#### THE EFFECTS OF PARENTAL NEGLECT

My experience with Storm Petrel chicks leads me to conclude that prolonged underfeeding has more serious effects on the chick's development than the occasional intervals, usually of less than three nights, between long series of adequate feeds. Chicks receiving considerably less than the average amount of food (say, 290 grammes or less in the fledging-period) tend to be retarded in the development of their plumage, though the effects of fairly short spells of underfeeding may be corrected in a subsequent

period of normal feeding. The fledging-period may not be unduly prolonged by underfeeding, but some of these chicks leave at low weights, and must be at a disadvantage in learning to fend for themselves at sea.

Some Storm Petrels are more efficient parents than others, and two pairs which bred both in 1955 and in 1956 in my burrows (Numbers 20 and 24) leave much to be desired in this respect. In both years their chicks were underfed, retarded in development, and three of these are known to have departed at low weights. (The fourth was still in the nest when we evacuated Skokholm in late October 1955.)

The effects of underfeeding might best be studied after the known death of one parent, as in the remarkable case of the Manx Shearwater chick studied by Ralphs (1957), which was reared almost entirely by one bird. However, only one of my breeding birds has died when with a chick, and this was too late in the fledging-period to affect the chick's development (Burrow 8, 1955). At Burrow 17A in 1956, where one bird lost its mate before the egg hatched, the chick died when left unbrooded on the second day.

The minor intervals between feeds no doubt cause the chick some discomfort, but do not retard its growth, whilst the longer gaps of the last ten days or so occur when development is virtually complete. The unusual interval of six nights between feeds, at Burrow 20 from the 46th to 52nd days of the 1956 chick's life, had more interesting consequences. This chick had already been rather poorly fed, and was ill-prepared for a long period of starvation. (Far longer starvation periods, of up to twenty days, were recorded by Roberts for snowbound Wilson's Petrel chicks.) Its weight declined from 40 to 27 grammes in seven days, following the usual pattern of steadily smaller decreases on each succeeding day. By the fourth evening it appeared very weak, and on the sixth seemed to be moribund, with eyes closed and little sign of movement. The following morning the chick had been fed, and was remarkably lively. Obviously survival had been aided by a general slowing of the metabolism, similar to that described by Lack (1956) for chicks of the Swift (*Apus apus*) under comparable circumstances. This Storm Petrel chick remained some ten days behind normal chicks in plumage development, and particularly in the loss of its nestling down, although the growth of its primary feathers was not so much retarded. It eventually departed at a rather low weight after the record fledging-period of 73 days, but survived to be captured by a fishing vessel off Belle Ile, W. France, in late December 1956.

#### GROWTH-CURVES BY WEIGHT

In Fig. 3 is given a growth-curve obtained by plotting the average evening weights of 32 chicks, at five-day intervals through the fledging-period, with the addition of the average weights at 24 hours old, and on the evening before departure.

Reference to Tables VII and VIII will show how well the curve corresponds to the frequency and size of feeds, with the steep increase in weight until the 20th-25th day (from 5.7 to about 30 gm.), the more gradual increase from the 20th to 50th days (about 30 to 42 gm.), and the final decline to the departure weight (33.6 gm.) on the 63rd day.

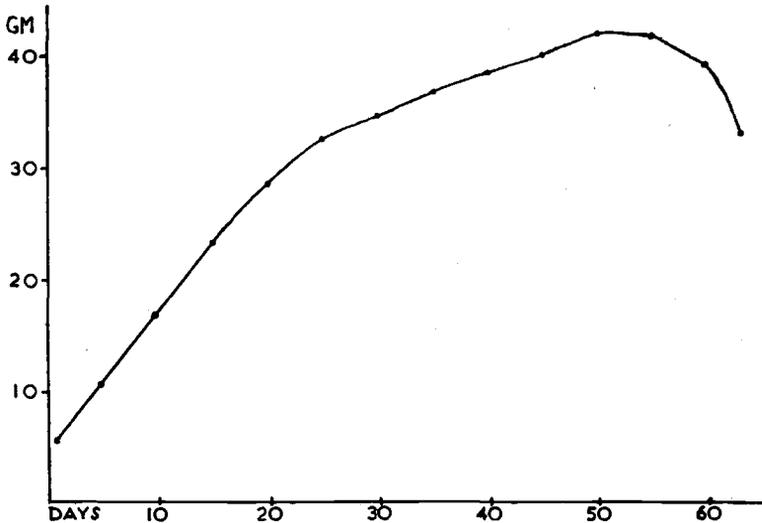


FIG. 3.—AVERAGE GROWTH-CURVE OF 32 CHICKS OF STORM PETREL  
(*Hydrobates pelagicus*)

The average weight of 50 adults was 28 grammes. Many chicks will achieve twice this figure immediately after a feed about the 50th day, and a few exceptionally well-fed young have had evening weights of over 50 grammes at this time. The excess weight at departure is presumably in the form of reserves of carbohydrates, designed to carry the juvenile over its first few days at sea, until it can feed itself adequately.

Fig. 4 shows the actual growth-curves of two chicks, constructed by plotting all the evening weights and then drawing the curves by eye. The unbroken line is the growth-curve of the chick in Burrow 11B, 1956, an extremely well-fed bird; the broken line is that of chick 11, 1954, which was indifferently fed.

The well-fed chick's growth-curve rises steadily to a high peak, and since the requirements of development are quickly met, the peak occurs earlier than is usual, and is followed by a longer decline to a normal departure-weight. The poorly-fed chick, on the other hand, has a much flatter curve, with a later and less obvious peak. The period of declining weight is shorter, the departure-weight well below normal, and the fledging-period is a few days longer.

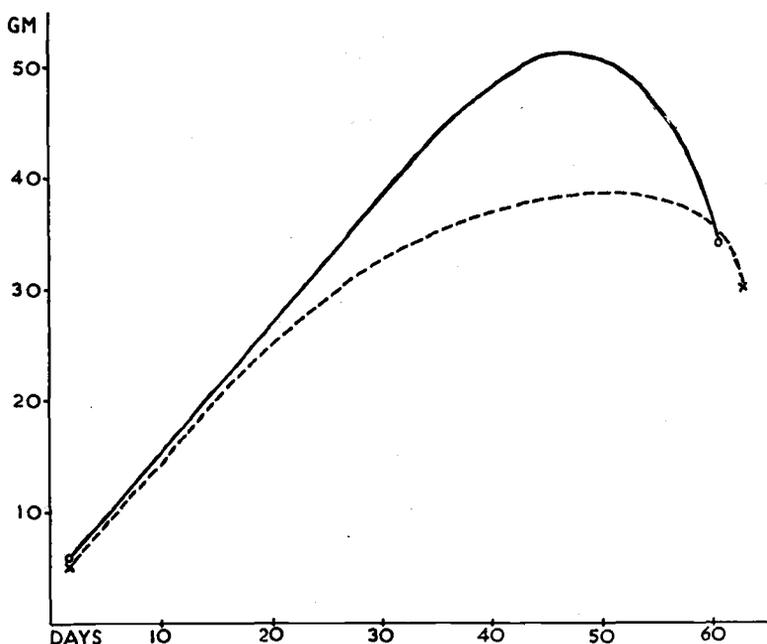


FIG. 4—GROWTH-CURVES OF 2 STORM PETREL (*Hydrobates pelagicus*) CHICKS. The unbroken line shows the curve of a well-fed chick, and the broken line that of a poorly-fed one.

#### DEVELOPMENT OF PLUMAGE AND SOFT PARTS

My notes on development were taken with one overriding consideration in mind. I hoped it would be practicable to compile a chart of growth, whereby the age of any chick might be determined with reasonable accuracy. A chart such as this would make it possible to estimate the timing of the breeding-season at any colony, and would also allow work on problems connected with the chick stage, without any preliminary disturbance of the adult birds. The only alternative, if one is to avoid the probability of desertions in the egg-stage, is to accustom the adults to regular observation from the time of their earliest visits to the colony.

The most I can claim for my results is that I can age about 80% of chicks to the nearest five days. The remaining 20% or so consists of underfed and retarded birds.

A few general remarks on the plumage and on my methods are a necessary introduction to the description of development. Storm Petrel chicks, like those of many other Tubinares, have two generations of nestling-down. The protoptiles (first generation) share a common shaft with the mesoptiles (second generation), and the latter succeed the former by continuous growth. The true feathers, as they emerge, carry both downs on their tips, until

the downs are eventually sloughed off. The division between the two downs takes the form of a slight whitish thickening of the shaft and a narrow interval which has no barbs. Both downs are of a medium silver-grey colour, rather paler on the under-parts. Some chicks are a little darker in shade than the majority. *The Handbook's* description, "greyish sooty-brown", is certainly misleading, for there is little or no element of brownness. (I suspect that this description was made from foxed skins; the same error occurs in respect of other sea-birds.)

The wing-measurements quoted are taken, with a stopped rule, from the carpal joint to the tip of the longest primary feather, and represent the chord of the natural curve of the wing. Other measurements were taken with dividers. Twenty-four series of measurements were obtained, including those of four chicks which were noticeably retarded. These four will be referred to separately in the description of growth which now follows. Photographs of some of the stages appear on plates 49-51.

*1st day* (plate 49, centre). On hatching, the chick is closely covered with down 5.7 mm. in length, except on most of the crown, and an area round the eyes, the lores, and the chin, which are almost bare. The nostril-tube, the base of the bill, and the legs and feet are hardly pigmented, pinkish-grey in colour. The bill has a black tip, ending about 1 mm. before the nostril-tube on the upper surface, but extending about 2 mm. nearer the gape at the sides. There is a small white egg-tooth near the tip of the upper mandible. The eyes are closed.

*2nd day*. In a few chicks the eyes are "slit", and in one they were half open. Storm Petrel chicks may not be born blind, as has been stated, but merely unable at first to bear the light, when taken out for examination.

*5th day* (plate 49, bottom). The eyes of some chicks are now wide open. They are dark brown in colour, as in the adult.

*6th to 9th day*. The second down breaks through on the back and scapulars. Egg-tooth disappears about the 6th day.

*10th day*. The eyes of all chicks are now wide open on examination. The unpigmented soft parts are noticeably greyer in colour. The baldness of the crown is now obscured by a growth of short down, and by the lengthening down around it.

*11th to 15th day*. The second down appears on the forewing. In most chicks this occurs on the 12th or 13th day, and it is a valuable feature for ageing the chicks.

*16th to 19th day*. The sheaths of the primary feathers emerge on the forewing.

*20th day* (plate 50, top). The bill is now almost black, the legs dark grey. In most chicks the tips of the primaries are emerging from the sheaths. The tarsus measures 17-19 mm.

*25th day*. The primaries are now 3-8 mm. out of sheath in normal chicks, but only just emerging in retarded ones. Normal wing-measurements are 34-39 mm.

*30th day*. The wing measures 43-50 mm. in most chicks, up to 40 in retarded ones. The bill is now jet black in most, the legs are darker. The rectrices are emerging from sheath.

*35th day* (plate 50, centre). Normal wing-measurements 54-63 mm.; retarded birds about 49-50. The down has gone from the tips of the primaries, and is becoming patchy on the wing-coverts. (From this time the retarded birds may be up to ten days behind in the loss of their down—compare the bottom photographs in plates 50 and 51.) The bare face is beginning to be covered by the tips of emerging feathers.

*40th day*. Wing-measurements 66-75 mm.; about 60 in retarded birds.

Some or most of the down has gone from the head, and it is becoming very patchy on the back. Healthy chicks are now becoming increasingly active within the burrow, and loss of down is probably hastened by abrasion, particularly in low and circumscribed holes. The legs are now quite black. The tarsus is up to normal adult length at about 22 mm.

*45th day* (plate 50, bottom). Wing-measurements 75-90 mm. ; 66-72 in retarded chicks.

*50th day* (plate 51, top). Wing-measurements 90-104 mm. ; 78-85 in retarded chicks, which can now usually be distinguished by large amount of down, lack of gloss on the new feathers, and "dejected" appearance (as in plate 51, bottom). In normal chicks, there is now little or no down on the upper-parts, except for a tuft on the nape or rump, or a few wisps on the inner wing-coverts. Down remained thick on the under-parts in most birds.

*55th day*. Wing-measurements 105-112 mm. ; 92-99 in retarded birds. Many chicks now have only wisps of down still attached to the nape, rump, throat, or belly. The only thick area on any normal chick is on the belly.

*60th day* (plate 51, centre). Wing-measurements 114-118 mm. ; 104-110 in the retarded. Most healthy chicks have little or no down remaining.

On departure (56th to 73rd day) the majority of fledglings are downless, though some still have considerable tracts on the belly. The plumage closely resembles that of the adult, though the white wing-bar formed by the tips of the greater coverts is much more prominent than in any of the thousand or so adults I have handled between April and September, and may be a valid means of distinguishing juveniles at sea during the autumn. The average wing-length of 24 juveniles at departure was 116.5 mm. (110-120), compared with an average of 117.5 (112-122) in 39 adults caught between April and September.

#### BEHAVIOUR OF THE CHICK

Until about the 30th-35th day, the chick's normal attitude in the nest is a completely relaxed position with the bill resting on the ground and the wings drooping. For the first few days it appears quite incapable of raising its head, though evidently it must do so when fed.

At first the faeces are deposited indifferently in any part of the nest, but as the chick becomes stronger they are often squirted into one particular corner or latrine. They are not enveloped in a gelatinous sac, and there is no nest-sanitation by the adults.

The only note given by chicks is a prolonged and sibilant "pee-pee-pee", used at feeding-time and also as a fear-note by chicks not accustomed to being handled. (This call, in a louder form persists as a fear-note in the adult; see Appendix.)

From about the 35th day, chicks become more active, and will roam about the burrow, though usually soon returning to the scrape. They squat in the nest with the head and wings in a more upright position. The chicks I weighed regularly seldom made any attempt to move away when I opened the nest, but most of the strange chicks I was ringing in September would scuttle out of reach whenever possible.

In the last few nights before fledging, many chicks will go to the entrance of the burrow, and there exercise their wings more or

less vigorously. On the final night, they leave the hole and make their way to some eminence near-by—shuffling along, since their legs are set too far back for upright walking, with the aid of their wings, and climbing almost sheer surfaces with the aid of both wings and bill. From the summit of a rock or wall, often after much hesitation and wing-flapping, they launch themselves in the air, and fly out to sea, alone.

#### CHICK MORTALITY

Thirty-seven chicks have hatched out in my burrows in the three years, and four of these have died in the nest, all within 48 hours of emerging from the egg. Two (Nos. 9 and 11A, 1956) died as a result of the flooding of their nests in very heavy rain; one (No. 17A, 1956) as a consequence of the earlier death of one of its parents; and one (No. 4, 1954) from unknown causes.

The only other death known to me, and for which I can suggest a cause, was that of a very late chick in 1955, which was not due to fledge until about 20th November. This had been dead for at least two weeks when I was able to revisit Skokholm and examine the nest on 19th November, and had probably been deserted prematurely by its parents. This must be a common fate of November chicks. However, these probably number under 1% of the total number of chicks in any one year.

Fledglings must be at their most vulnerable to predators about the time of departure. Those Great Black-backed Gulls (*Larus marinus*) which are practised in the art of catching shearwaters at night, undoubtedly take a small toll of Storm Petrel fledglings; and the chief scourge of adult petrels, the Little Owls (*Athene noctua*), must find the fledglings particularly vulnerable. Fortunately, this species was eliminated at Skokholm in the spring of 1954, and has not been able to recolonize the island.

#### ACKNOWLEDGEMENTS

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### Appendix—Comments on the B.B.C. recordings of Storm Petrels

At the request of the Editors of *British Birds*, I am giving in this appendix my comments, in the light of my experience, on the Storm Petrel recordings made by Mr. Ludwig Koch, which are now in the B.B.C. Library.

*B.B.C. Library No. 15091 (Front), Band 2: "The colony"*.

This recording consists chiefly of the protracted churring song used by the birds to advertise their presence in the burrows (*antea*, p. 95). The singing bird(s) seem to be at some distance from the microphone, and the purring is sometimes almost lost in the background noises of the record. There are remarkably few of the "tchick" or hiccoughing notes which are usually introduced singly into the song at regular intervals of a few seconds. The recording is confused by the presence of a bird, nearer the microphone, which is not singing, but frequently uttering an alarm-note (not referred to in the text of my paper), written "up-cherrk". This note is used when the bird senses danger from the noise of men, etc., outside its hole. It closely resembles the "terr-chick" note often used in the display-flight (*antea*, p. 96).

*B.B.C. Library No. 15016 (Back), Band 1: "Call Note"*.

This band is almost entirely of an extraordinary "pee-pee-pee", very rapidly repeated. I have very seldom heard this noise except from a very frightened bird, and I call it the "fear-note". It is sometimes given by birds caught in nets, or in the hand by birds not accustomed to being handled. Exceptionally (in my experience) it is emitted when some squabble has arisen between two birds in a hole, probably by the one that is getting the worst of the scuffling. (Hungry or frightened chicks used a similar, but quieter, noise—see page 382.)

*Band 2: "Alarm Note"*.

This is a fairly straight-forward recording of the alarm-note mentioned in discussing the first record. Some snatches of the peeping fear-note come in also.



Adult and egg



Chick one day old

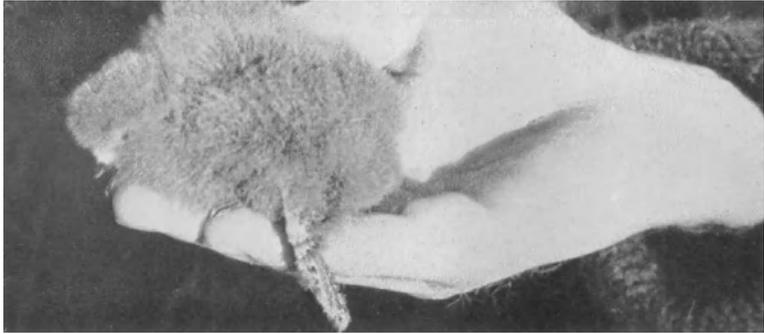


Chick five days old

Angela Davis

STAGES IN THE GROWTH OF YOUNG STORM PETRELS (*Hydrobates pelagicus*)  
 SKOKHOLM, PEMBROKESHIRE, 1954-1956

At one day old (*centre*) the chick is closely covered with soft silver-grey down, except for an area on the crown (shown here), round the eyes and on the lores and chin, which are almost bare; like the legs and feet the base of the bill is pinkish-grey, but the tip is black; the eyes are closed. By the 5th day (*bottom*) the eyes of some chicks are wide open, but not the one here; note the shape and pattern of the bill; the egg-tooth disappears about now. (*Top*) Note the large size of the single egg compared with the adult, and the lack of nesting material. (see pages 371-384).



Chick about 45 days old

Angela Davis

STAGES IN THE GROWTH OF YOUNG STORM PETRELS (*Hydrobates pelagicus*)  
SKOKHOLM, PEMBROKESHIRE, 1954-1956

By the 20th day (*top*) the bill is almost black, the legs dark grey; and the tips of the primaries begin to emerge from the sheaths, which are clearly visible here; the bald crown is now obscured by short down. By the 35th day (*centre*) the down is becoming patchy on the wings, and the bare face is getting covered. By the 45th day (*bottom*), or a few days earlier, nearly all the down has gone from the head and wings and it is becoming increasingly patchy on the back; note the white edges to the greater coverts (see page 381).



Chick 50 days old



Chick 60 days old



Retarded chick 43 days old

Angela Davis

STAGES IN THE GROWTH OF YOUNG STORM PETRELS (*Hydrobates pelagicus*)  
SKOKHOLM, PEMBROKESHIRE, 1954-1956

By the 50th day (*top*) there is little down above, but on the *under-parts* it remains thick. By the 60th day (*centre*) most healthy chicks have practically none left, except for a few tufts on the belly. The young leave the hole between the 56th and 73rd day, the late-goers being underfired and retarded chicks that from the 35th day onwards may be as much as 10 days behind. Compare the downy and "dejected" appearance of the 43-day old retarded chick shown here (*bottom*) with the normal chick of 45 days opposite (plate 50, bottom) (see page 382).