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REMARKS ON THE BREEDING
CONDITIONS AND MOULTING OF THE
COLLARED LEMMING (DICROSTONYX)

BY

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WITH 27 FIGURES IN THE TEXT

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INTRODUCTION

The Collared Lemming, as is well known, plays an important part in the animal world of the Arctic, as this small rodent mainly accounts for the fact that several carnivorous animals, i. e. such valuable fur animal as the Polar Fox, can subsist in great parts of these inclement districts. It is thus obvious that the considerable fluctuations in the number of individuals of the Lemming can also effect the occurrence of several animal forms. The cause of these fluctuations, which extend over a period of four years, has been much discussed, but the question is still far from being settled. For the solution of this problem it is of decisive importance to know the biology of the Collared Lemming f. i. the number of litters per year and the number of young per litter.

A thorough investigation of the reproduction of the Collared Lemming—and a similar investigation has already been undertaken on some species—is made by means of mass examinations of the animals i. e. of pregnant females and mature males throughout the year. As far as I know, such an investigation has not been made regarding this species. It goes without saying that, under these circumstances, records on the breeding conditions of the Collared Lemming published by arctic travellers will be of great interest. Besides, we have been able to add to these scattered records our own observations on the Greenland Collared Lemmings, which have been kept in captivity during the years 1936—42¹⁾. Even under such circumstances they yielded several litters per year, and altogether this material adds to our knowledge to the reproduction of the Collared Lemming.

Previous Observations.

If the literature is gone over, we find that the records given are very different.

EDWARD A. PREBLE 1902, p. 56, writes on *Dicrostonyx richardsoni*

¹⁾ This treatise is written by MAGNUS DEGERBØL, but as the observations on the breeding conditions are based upon animals, which were entrusted to the care of U. MØHL-HANSEN, Taxidermist at the Zoological Museum of Copenhagen, his name is given as joint author. The photos reproduced are taken by MØHL-HANSEN.

from the Hudson Bay Region: "Three young to a birth seems to be the usual number. Every litter we found consisted of three, and in each pregnant female we secured were three embryos. The breeding season seemed to be nearly over (mid-August), however, so that pregnant females were not common. One captured on the Barren Grounds August 12th, besides containing the usual three small embryos, was suckling three young." (This shows that two litters are, at least in some cases, brought forth during the short Arctic summer).

In the same year HERLUF WINGE writes on the Greenland Collared Lemming—based upon observations made by the Swede KOLTHOFF, 1900,—“in burrows excavated in August both half-grown and newly born young were found. The litter generally consisted of three, sometimes of two, several times of four and once of five young.”

The following year KOLTHOFF published additional observations on the Greenland Collared Lemming (p. 10):

“As regards the reproduction of the Greenland Lemming the young are found to be of two ages, and compared with the young born in captivity the older young, which at our arrival to Mackenziebukten were of almost the same size, proved to be about five weeks old. It is obvious that this Lemming brings forth two litters, the first litter being born in the latter half of June, and the second one about five weeks later, at the end of July or beginning of August. In captivity pregnancy lasts about 18 days, and mating takes place again about 16 days after the birth of the first litter. The usual number of a birth was three, more seldom four, and in a single case five.”

As stated above, KOLTHOFF brought some animals with him to Uppsala, where they gave birth to several litters. “On March 9th two females had young. The first litter, however, died immediately, and the young were carried out of the burrow by the mother. The second litter, which consisted of three young, lived. On April 20th another litter was brought forth by a third female. Also here the number of young was three, and all of them lived. Already before the young could see, they would try to get out of the burrow, but they were at once brought back by the female. After about 14 days, they got their eyesight, and now could not be kept in the burrow.”

“All older animals captured emaciated and died towards the autumn after one year's captivity, and the females died 4 to 6 weeks after having given birth to their second litter. This tends to show that these animals, like many of our Swedish small rodents, only live for two years. Of the young born in captivity some lived till late in the summer of 1902. Several died from accidents.”

In the same year, 1903, J. A. ALLEN and BUXTON write about *Dicrostonyx* collected in northeastern Siberia: “The young, at least of

Lemmus hudsonius alascensis, are born every month in the year. Six is the usual number brought forth at a time."

When speaking of *Lemmus hudsonius alascensis* Allen and Buxton undoubtedly mean *Dicrostonyx huds. alas.* Stone which is now called *D. rubricatus rubricatus* (Richardson). That this species should bring forth young during all the months of the year sounds very surprising. This piece of information is entirely isolated in the literature on the subject and is not quoted elsewhere (c. f. however p. 18).

In a comprehensive work on the American Collared Lemmings (*Dicrostonyx*) 1919 GLOVER M. ALLEN writes on the different subspecies: p. 537. *Dicrostonyx groenlandicus* (Traill): "The Polaris Expedition discovered a nest with four young on August 11th, at Thank God Harbor (Robeson Channel), but no doubt this is a late date. FIELDEN found nests in June and July, containing from three to five young, somewhat fewer than the average for *rubricatus*". On p. 517 he adds about *D. hudsonius* (Pallas): "A young one, taken on May 1st, at Richmond Gulf, Hudson Bay, is but 86 mm long, and must have been born in March or April. It is in the summer pelage which is doubtless the older phylogenetically." On page 533 ALLEN writes of *D. exsul*: "But four specimens were taken by Mr. DIXON during his brief stay at St. Lawrence Island. One of these was a subadult female, containing four embryos, June 24th," and on p. 522 it is said of the Alaskan Collared Lemming (*rubricatus*): "The young seem to be born in late June and early July. Mr. DIXON found well-developed embryos in specimens as follows:—

June	7.	one	with	five	embryos
—	10.	-	—	eight	—
—	13.	-	—	seven	—
—	14.	-	—	eleven	—
July	8.	-	—	five	—

The average of these five is seven young to a litter, which seems to be greater than in the case of the more boreal Greenland Lemming or Richardson's Lemming. MACFARLANE records (1905 p. 736) "five embryos in each of two females from Mackenzie taken June 26, 1865."

In 1928 ANTHONY in "Field Book of North American Mammals", p. 405 only writes: "The young are born in early summer and usually number three to a litter."

In 1929 G. M. ALLEN and M. COPELAND discuss the question in "Mammals from the MacMillan Expedition to Baffin Land". Journ. of Mammalogy, vol. 5, 1929, and arrive at the result: "Judging from the size of the skins also, there must be either more than one litter of young in a year or much variation in the time of their birth..."

“Additional observations on the times when young are born, and when they acquire winter or adult summer pelage are much desired.”

ALWIN PEDERSEN in “Polardyr”, Copenhagen 1934 (p. 93) gives more detailed particulars on the Greenland Collared Lemming: “When the Lemming has selected its mate, it lives with her for some time, how long cannot be said, but when the young are born at the end of May or the beginning of June, the female is alone with them. Five young to a birth seems to be the usual number, seldom less. The young are blind and naked at birth, but already after a month they can shift for themselves,” and he adds: “In some years the Lemming has a second litter in the middle of August, but usually only three to a birth. Further, it seems as if the Lemming propagates, also in early spring when it is still living under the snow, and already at the beginning of April I have found Lemmings, which were at most one month old. A closer examination showed that they were born in winter nests situated on the ground under the snow¹).

In his itinerary from July 22nd, 1922, PETER FREUCHEN writes: “Found seven apparently full-grown foetuses in a lemming. There were other females, but these had not nearly so many.” (Report of the Mammals collected by the Fifth Thule Expedition to Arctic North America, vol. II, No 5. (p. 82) Copenhagen 1935.

As to the Collared Lemming of the old world reference is only to made to a treatise by FLEROV, 1933. He writes: “Junge werden zwei mal im Jahre geworfen; im Frühjahr und am Ende des Sommers, ihr Zahl is 6—9.”

From this extract of the literature dealing with the Collared Lemming it appears that most authors are of opinion that this animal breeds once or twice during the summer, while one of them thinks that it also brings forth a litter of young in early spring. Some authors state that the usual number of young per litter is 3, others that it averages 7 and even may be as high as 11 (*rubricatus*). That the litters may follow very closely upon each other appears from the fact that one animal has been found with embryos, while at the same time suckling 3 young.

¹) Later on in 1942, ALWIN PEDERSEN, without additional material, comprised his observations on the Greenland Collared Lemming in the following words (p. 15): In den guten Lemmingjahren, in denen es leichter war, der Fortpflanzung des Lemmings zu folgen, habe ich 3 Bruten feststellen können. Die erste wurde März—April, die zweite Mai—Juni und die dritte Juli—August gezeitigt. Die Jungen der ersten Brut waren Anfang Mai selbständig und erlangten, falls nicht schon früher, so doch spätestens Anfang Juli die Geschlechtsreife and pflanzten sich demnach in ihrem ersten Lebensjahre fort.”

Our own Investigations.

Breeding Conditions.

Under these conditions an opportunity to make observations on the Collared Lemming in captivity would naturally be of great interest. When the Danish Three-Years' Expedition to East Greenland returned in September 1936 with seven live animals, I therefore applied to the leader, Dr. LAUGE KOCH, and asked him to hand over these animals to me, to which request he very kindly agreed.

In order not to keep the animals together in case of accidents, they were divided into two batches, one of which, consisting of three individuals, was entrusted to MÖHL-HANSEN, whereas I myself took charge of the four remaining ones. It thus happened that three of my own animals perished by an accident in the spring of 1937, and the facts relating to the breeding conditions, which will be given in the following, are consequently based upon observations of the other batch of animals.

Whereas during the passage from Greenland and also later on the animals got on very well with each other, one of them was bitten dead in the spring of 1937. It turned out to be a male, and the animals left at that time were a male and a female.

To begin with the breeding conditions of this pair in 1937 it may be stated at once that five litters were brought forth in the course of the summer, the interval between each litter being about a month.

The number of litters was in all:

Litters:	about 13. April	3	young
	— 13. May	2	—
	— 13. June	7	—
	— 13. July	5	—
	— 13. September . . .	5	—

The reason why the dates of the births cannot be given with certainty is that, in order to make conditions as natural as possible, the animals were kept in rather large boxes, the bottoms of which were filled with soil, and here they were left in peace without being subjected to daily control. This we did in the hope that we would by this very means succeed in making the animals breed. On the other hand, these conditions made it impossible to prove what took place in the soil, so that the date of the birth of the young had to be decided according to their size at the time, when they were observed for the first time.

The first litter of young were seen for the first time on April 18th. The young were then blind, but rather well-haired and with a marked dark median line. From our subsequent experience they may then be

supposed to have been about five days old. On April 27th their eyes opened, and as this happens about a fortnight after birth, we arrived at the result that they were born about April 13th. The young now ran about in the burrows, and though they were still suckling, they also on their own accord ate willow-leaves and the like. The suckling frequently takes place above ground, and the mother then sits on her hind legs only. As late as May 1st the young seemed to suckle, but after that time they did not do so any more. The whole of the family live in the same nest.

On May 15th the earth is entirely removed from the box, and it then turns out that the nest contains two small young, a couple of days old. As a precautionary measure the male and the older young are removed, but a week later, on May 22nd, one of the two small young was found dead, but still fresh, whereas the other one was not to be found. The old male was then returned to the female.

On June 20th a couple of small young are again seen, about a week old. These represent the third litter, and during the following days more and more young are visible above the ground. In order to ascertain their exact number they were, on July 5th, taken away, as soon as they appeared and put into a separate box. There were six in all, but a week later it proved that there was still one young left with the parents, or in other words, the litter had consisted of seven young.

On July 18th the fourth litter was observed, the young, judging by their size, having likewise been born about the 13th.

On September 12th the old male was found to have been dead for a couple of days. In order to avoid a possible infection all the animals were on the following day moved into new boxes. The old female was then very big, and as soon as she had been removed to the new box, she eagerly began to collect materials for a nest. On the following morning, September 14th, an investigation of the nest showed that the female had brought forth her fifth litter in the course of the night; this litter also consisted of five young. As contrasted with what has been stated elsewhere, these young already proved to be hairy along the back. The hairs were very dark, still a black stripe was distinguishable along the spine. The belly was pink and only sparsely haired.

From this examination it appears that in the course of the summer of 1937 one female with the same male gave birth at any rate to twenty-two young, distributed over five litters. With the exception of the month of August, when no young were proved to have been born, the litters succeeded each other with intervals of about one month. It is perhaps a question, whether no young were born in the month of August, or whether they may possibly have perished without being observed. That the female almost on the very day of the month again brought

forth a litter in September might point towards a possible birth also having taken place in August.

We will now proceed to mention conditions in the year of 1938.

Bearing in mind what had happened in the spring of 1937 the animals were, as far as possible, sorted out in pairs on March 6th. This was done in order to avoid possible fights between rivalling males. A start was then made with four presumed pairs, including the old female from 1936. Most of the other animals were dead, among others the six young from the June litter, which had been taken away from the parents at an age of three weeks. One pair had, however, been handed over for anatomical purposes (MEINERTZ 1941).

As early as the beginning of April 1938 one of the young animals brought forth three young, which must, however, have been born about medio March. On April 12th these young were subjected to a closer examination, and one of them was killed and skinned. As the change of coats will be dealt with later on in this treatise, it shall only be mentioned here that though the parents had not changed into the complete winter pelage, the young acquired it at once and also the characteristic double claw, which makes part of it.

On April 18th the nest was examined, and a second litter was found, this time consisting of four young. As the last examination of the nest had taken place on April 14th, this means that the present young may at most be four days old and probably a day younger. Here we again find the very dark greyish-black back which, however, is not darker than that the black median line is clearly visible. The hairs on the back are already rather long. The line dividing it from the light, only slightly hairy belly is sharply defined. (One young was killed and preserved in alcohol; cf. p. 12).

A month later, about medio May, the same pair again brought forth four young.

Also the old female from 1936, which had given birth to five litters in 1937, with a young male brought forth a couple of litters in May and June 1938.

In the spring of 1939 the stock consisted of seven animals, of which however only one pair brought forth two litters. In the course of the autumn and winter several of the old animals died, so that at the beginning of the spring of 1940 there were in all only five live animals. These bred several times in the course of the summer, the stock in the month of August totalling 17 individuals. As in the preceding years a number of these animals died in the autumn of 1940 and during the following winter.

In the spring of 1941 only seven animals were left. They thrive, but did not breed, and in the spring of 1942 the stock had decreased to

three animals, which at any rate were in their second year, and which could not be estimated to live longer than the remainder of the year 1942. This estimation proved to be correct, for in the month of June the animals died without having given birth to young, and so the stock which in 1936 had arrived in Denmark was extinct. Table 1 summarizes the number of individuals and their breeding conditions during these years:

1937		1938		
Litters of same pair of parents		New pair born in 1937		Same female as in 1937
Date	Number of young	Date	Number of young	Date
About April 13. . .	3	Medio March	3	May
- May 13. . .	2	- April	4	June
- June 13. . .	7	- May	4	
- July 13. . .	5			
- Sept. 13. . .	5			
1939	1940	1941	1942	
7 animals at beginning of the year; one pair breeds several times	5 animals at beginning of the year; several litters brought forth. Number of individuals at the beginning of August 17	7 animals left; do not breed	3 animals left; die in month of June	

From the preceding it will appear that, like the Lemmings brought home by KOLTHOFF, the Collared Lemmings examined here have given birth to young in the earliest spring: March and April. When comparing these observations with the formerly quoted remarks by ALWIN PEDERSEN on the Greenland Collared Lemming and by ALLEN on the Labrador Collared Lemming, it can be maintained that the Collared Lemming under natural conditions may already bring forth its first litter of young below the snow in the winter or early spring of the arctic regions. This also appears from the extremely interesting circumstance that the young, which are born at this early period, after their first dark coat change into winter pelage with the appertaining double claw, even if the parents have not acquired the full winter coat. It is evident that these early litters are of great importance to many beasts of prey, and here we have part of the explanation that e. g. "fox years" coincide with

“lemming years” i. e. that in the years when the number of Lemmings culminate there are also an unusually great number of foxes. This is i. e. conditioned by a good state of nutrition before and during the period of pregnancy of the polar fox, when the litters are particularly large, and the young may all be kept alive. The rutting season of the polar fox in Northeast Greenland is in March and the beginning of April, and the young are then born in May. On the other hand most authors, with the exception of a few older ones as OTHO FABRICIUS, deny the possibility of more than one annual litter of polar foxes, even in good lemming years.

That the Collared Lemming may bring forth young during the late winter and earliest spring is in itself not surprising, seeing that also several arctic animals, such as polar bears and ringed seal breed during the winter. The period of reproduction of the mammals is not, like that of the plants, bound up with the short arctic summer.

Further, it also appears from the observations communicated above that from a physiological point of view there is nothing to prevent even the Greenland Collared Lemming from bringing forth monthly litters throughout the summer. How often it actually breeds in the arctic regions undoubtedly depends upon several conditions which are not always fulfilled in these inclement regions, and this in its turn makes possible the great fluctuations in the occurrence of this animal. When conditions are hard, reproduction is reduced to a minimum, possibly to once or twice in the course of the year, and the number of young to a litter is small; but in other years there are, as we now know, a possibility of the bringing forth of a very large number of young.

When, judging by the sizes of the young, the opinion has been set forth that only two litters per summer have been ascertained in the arctic regions, the explanation may naturally be that there have only been two litters in the years in question, but it may also be that, already after less than a couple of months, the young are of very nearly the same size and colour as the old ones, even though their growth may still go on for a long time.

Conditions of Growth.

Based upon the material produced above we will then give the following summary of the growth of the young:

1 day old. Killed 14.5.1938. Preserved in alcohol. The measurements of this alcohol specimen are: Head and body 35 mm, tail 4.5 mm, hind foot 5.5 mm. The animal has a dark back and a light-coloured belly, with a well-marked and straight boundary line between these two parts. This difference in colour partly depends upon the skin itself being of a

different colour, dark-pigmentated along the back, light-coloured on the belly, partly upon the fact that the back itself is covered with rather long, nearly black hairs which are, however, not more closely set than that the dark skin is visible everywhere. The longest hairs are to be found along the dorsal median line and may here be as much as 1.5 and 2 mm in length. On the belly there are only very few scattered light-coloured hairs. This difference in colour is also to be found on the tail, which is dark on the upper- and light-coloured on the under side.



Fig. 1. 2 young about 3 days old. From 2nd litter 1937. The sharp line dividing the dark back and the light-coloured belly is very pronounced.

The vibrissae are comparatively long, up to 2—3 mm; most of them are light-coloured. There are claws on the toes and digits, though there seems to be no claw on the thumb, which appears as a wort-like elevation. On the lateral side of this thumb there is a larger semi-circular formation, which is the inner hindmost pad. Apart from the large toe pads this is the only pad to be found on adult animals (TULLBERG p. 237). For comparison it may be noted that the specimen is practically of the same size as five embryos from Kap Tobin, Scoresbysund, 20.7.1927 (C. N. 5643). Even on these embryos many dark hairs are visible along the back by means of a slight magnification; however, these hairs are essentially shorter than on the one-day old individual. Also on the embryos vibrissæ and claws are visible.

3—4 days old. Killed 18.4.1938 (second litter 1938). The age appears from an examination of the mother animal, which took place 14.4.1938, but at that time she had not given birth. Length of head and body 43 mm; tail 7.8 mm; hind foot 7.5 mm. These measurements were taken on the fresh animal, but exactly the same measurements remained, after the animal had been in alcohol for nearly four years.

The weight of the alcohol specimen is 6 gram. Also on this specimen there is a sharp line of demarcation between the dark back and the light-coloured belly. This animal, however, has a distinct dark stripe along the spine, and the hairs on the back are now so dense as to cover the skin completely. The colour of the back is then determined by the hairs, which are up to 3 mm in length. They have now grown out so far from the skin that the lower yellowish-brown band constitutes a large part of the hair. The animal has a greyish tinge, wherever this band becomes visible.



Fig. 2. Young about 12 days old. From 1st litter 1937.

The colour of the belly is still determined by the skin, the short hairs being so scattered that the skin is visible everywhere. The upper side and tip of the tail is dark; also here the hairs are so scattered and short that the colour of the skin is decisive. The soles of the feet are still more or less naked, but many fine hairs are on the point of sprouting.

About 10 days old. Skinned. Dead 22.5.1937 (second litter, consisting of two). Length of body 48.5 mm.

Also here the colour of the back is very dark, nearly black on account of the dark hair tips. Below these tips follows a narrow yellowish-brown band, which passes gradually into a lighter greyish-white part, the actual basal part again being darker. Some hairs are entirely black throughout their whole length. The hairs on the belly are now longer, but only laterally they are able to cover the skin. The front teeth are hidden in the gums, but on the upper jaw there are a couple of dark spots, where the front teeth should be. The soles are now partly covered by long hairs.

About 12 days old. A young belonging to the first litter, 1937; born on April 13th, photographed on April 25th, 1937. It may be noted that the eyes of the animal are not yet open.

About 14 days old. Killed 14.5.1938. Preserved in alcohol. Head and body 53 mm, tail 10 mm (with hairs 14 mm), hind foot 10.5 mm. All measurements taken on the animal in alcohol. The eyes are open. The points of the front teeth have come through, protruding about $\frac{1}{2}$ mm. The soles are densely haired. The pads are remarkably large, the hindmost pad being somewhat larger than the thumb and projecting as a fairly large cylinder. The pads of the toes below the third and the fourth digits are extremely pronounced; they lie like a pair of whitish balloons, or rather egg-shaped formations, which are separated by a groove from

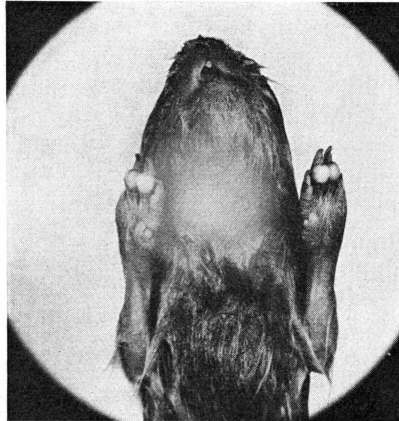


Fig. 3. Young about 14 days old. Notice the large pads. Killed on May 14th, 1938.

the nail above. The height of these pads is greater than the actual height of the nail. (fig. 3).

The coat is long and dense. The hairs of the back may attain a length of some ten mm. The back is very dark, but the reddish-brown belt of the hairs is very pronounced.

In spite of the fact that this animal dates from the month of May, it would undoubtedly have acquired a complete double claw, if it had been allowed to live (cf. p. 17).

About 3 weeks old. Young from the first litter in 1937; born April 13th, phot. May 2nd 1937. (fig. 4, cf. fig. 2).

3—4 weeks old. Killed 12.4.1938; length of body 82 mm, length of hind foot 14 mm.

This specimen, which is partly in its winter coat, has been briefly mentioned on an earlier occasion (p. 9). The pelage is dense, long and thick; the hairs are up to 12—13 mm in length. Many of the hairs of the back are greyish-white; others have black tips, which through a reddish-brown belt pass into a whitish one; the lower part is of the colour of soot. All in all, the back is greyish-black with a distinct black

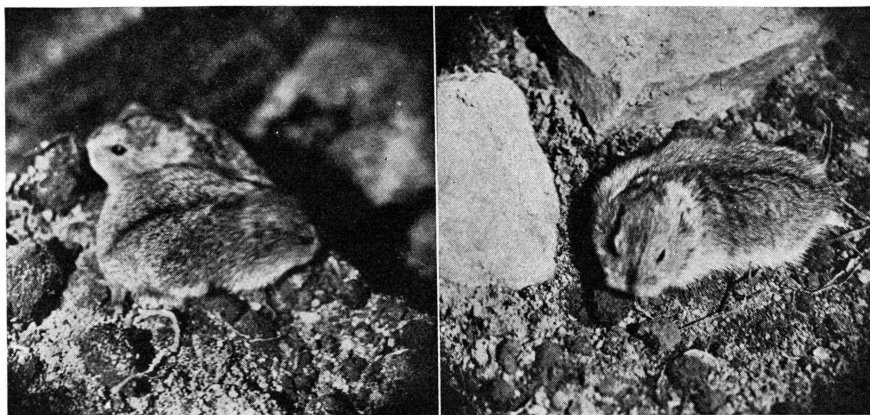


Fig. 4. Young about 3 weeks old. From 1st litter, born on April 13th. Phot. 2.5.1937.

median line; flanks and belly are whitish-grey. The most surprising fact is, however, that in spite of the parents being only partly in winter coat, the young had strong double claws on their third and fourth digits, this



Fig. 5. Young about 3 weeks old. From 1st litter, born about April 13th. Phot. 2.5.1937.

being characteristic of the old Collared Lemmings in winter pelage, but unknown in young animals (figs. 6 and 7). As to this HINTON observes (1926, p. 139): "The claws of the two central digits (III and IV)

are extraordinary structures, subject to a remarkable seasonal change; in young specimens and in adults in full summer pelage, they do not differ greatly from those of other Lemmings." For those who are not cognisant with the appearance of this peculiar formation I add the continuation of HINTON: "But in winter they are very large, sometimes



Fig. 6. Young about 3—4 weeks old. Animal to the left was killed 12.4.1938, animal to the right 12.5.1938.

exceeding half an inch in length, and have the appearance of being double, each of the two fingers seeming to bear two enormous claws, one on top of the other, which are separated at their tips by a more or less deep notch."

A live animal of the same litter and the same age: phot. 12.4.1938 is seen on fig. 7.

Of the same age, 3—4 weeks old, and the same size, but born a month later 12.5.1938 and with the same parents, is another specimen which also has a "double claw" on the third and fourth digit, but the coat is here rather greyish with a yellowish-brown tinge, i. e. more like the summer pelage. The hairs are considerably shorter than in the pre-

ceding animals, about 8 mm long on the back. The belly is whitish-grey (figs. 6, animal to the right, and 8).

It is rather an interesting phenomenon that the young, as late as the month of May, acquire a double claw, whereas this formation is very incomplete in the parents. See also p. 14 and fig. 3. This decidedly goes to show that the young, which in Greenland are born under the



Fig. 7. Young of the same litter and the same age i. e. phot. 12.4.1938, like animal to the left on fig. 6.

snow in late winter or early spring, are from the start supplied with this double claw, before they have had an opportunity to dig. Therefore, in this case there can be no question of acquired qualities; the phenomenon is undoubtedly hormonally determined.

This being settled there can hardly be any doubt that also nest-young from the first litters under natural conditions acquire a double claw. That this is indeed the case appears from the *Dicrostonyx* material preserved in the collections of various zoological museums, which I have had the opportunity to examine. In the Zoological Museum of Copenhagen a skin is found of such a medium-sized young with a double claw

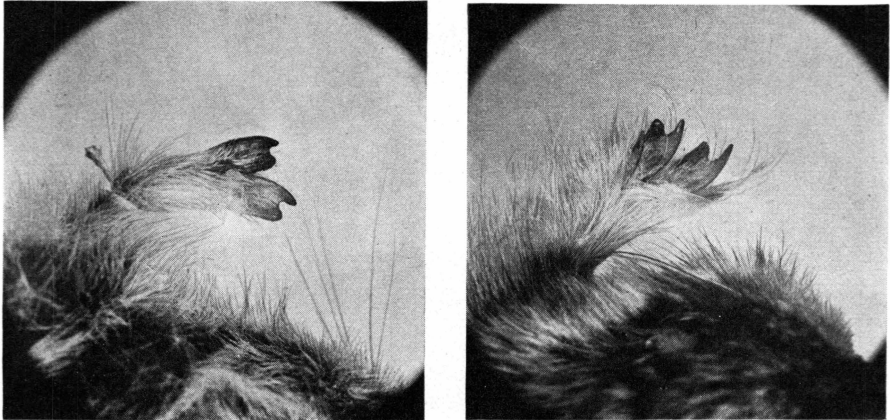


Fig. 8. Fore limbs with double claw, from the animals of fig. 6. In spite of the fact that the parents had not acquired the full winter coat, the young nevertheless developed a double claw.

from Liverpool Land in East Greenland, killed June 1st, 1928. The animal must be born at the beginning of May, which in these arctic regions must be regarded as early spring.

It may still be mentioned that a couple of similar specimens from East Greenland are found in the British Museum, London (Myggbukta C. G. and E. G. BIRD) from May 23rd and 25th (1937), respectively. Also in these animals the belly is whitish; their measurements are: head and body 78 and 80 mm, tail 5 and 10; hind foot 7 and 13.5; ear 3 and 3, both are ♂♂. A couple of other animals from the same locality and of a similar size, head and body 75 and 77 mm respectively; from June 1st and June 2nd 1937, however, have no double claw. These latter animals are in a more advanced summer coat.

That the Collared Lemming may bring forth young, also during the winter, appears from three young, which are preserved in the Carnegie Museum, Pittsburg¹⁾. They come from Coral Inlet, Southampton Island and were killed on January 29th, 1930; length of head and body 80, 81 and 81 mm respectively, that is, these animals must be born about January 1st; they have very pronounced foot pads, or rather double claws.

A little more than a month old. Two young from the first litter 1937, born about April 13th, photographed on May 15th, fig. 9 (cf. figs. 2, 4 and 5).

¹⁾ For the permission to examine these animals and for all kindness to me during my visits to the museums, I beg Mr. HINTON and Mr. HARRISON MATTHEWS, the British Museum, and Mr. DOUTT, Pittsburg, to accept my most cordial thanks.



Fig. 9. Young fully a month old. From 1st litter 1937, born about April 13th. Phot. 15.5.1937.

Change of Pelage.

A typical feature of the Collared Lemming is the acquirement of a white winter coat. The only other animal of *Simplicidentata*, which shows a similar characteristic, is *Lemnus obensis novosibericus* Vinogradov from the New Siberian Islands. As to this change of coat in the Collared Lemming opinions have varied greatly, older authors in particular having maintained that the autumn change of coat took place through a change of colour in the hairs themselves. After the exhaustive description of the phenomenon given by VON MIDDENDORFF (1851) the general opinion is, however, now that the change is made by two moults, one in autumn, the other in spring; it is brought about by the rapid growth of new hairs and the more gradual shedding of the old ones (HINTON).

This moult is very pronounced in the spring, when it is easily observed that the long white winter hairs fall off and are replaced by new short summer hairs. At that time of the year the thrown-off winter hairs are lying about everywhere. It is, however, much more difficult

to make out the autumn change of coat; here it has in fact been impossible for us to observe any moulting in the animals in question.

First a brief explanation of the autumn change of coat. As formerly mentioned, our observations began with seven animals, which in September 1936 were brought home from East Greenland.



Fig. 10. Collared Lemming standing on its hind legs. Phot. 12.10.1936.

In most of the animals, particularly when crouching, it was still possible to distinguish a faint dark stripe along the spine; as no such stripe exists in the adult Collared Lemmings from Greenland, it appears that the animals represented were comparatively young, from the summer of 1936. This is confirmed by the fact that the only pair, which did not perish by accident in the winter of 1936—37, lived until the autumn of 1937 (the male) and the summer of 1938.

The pelage of the Collared Lemming is extremely soft and thick; the animal feels like a small hairy ball, fine and surprisingly light, but the actual body only constitutes a small part of it. As has also been observed elsewhere, it resembles in its manners, particularly when sitting on its hind legs only (fig. 10), and its broad-bellied shape a small



Fig. 11. Collared Lemmings. The ear is marked by a circular reddish-brown patch on the hind margin of which a greasy area is visible with posteriorly directed longer hairs. Behind the ear-patch a semi-circular light-grey region.
 Phot. 12.10.1936.

Bobak, the Marmot of the arctic regions in miniature. When the animal is in its summer coat, the muzzle region round the nares is of a light flesh colour. The upper side of the muzzle along the nasal ridge and half way up to the anterior rim of the eyes is black, which is particularly marked, when the animal is seen from above. From the posterior rim of each eye a black line passes to the nape, where it merges in the dark median stripe. Thus the back part of the head forms as it were a triangle, the point of which turns backwards and is somewhat more pronounced and in particular darker than the greyer cheeks and the grey forehead. The area round the vibrissæ and on the lips is yellowish-brown. The ears are concealed beneath fur, but are marked by a pair of well-defined reddish-brown circular spots, which in the middle of the posterior margin has a dark, as it were greasy area or triangle, the hairs of which project a little more posteriorly.

Behind the ears there is a lighter and grayer semicircular belt, which becomes more pronounced, when the head is bent somewhat forwards, which movement also makes the ear-patches stand out more clearly. In this manner a more or less marked design becomes visible on the nape reminding of a pair of spectacles and bearing some resemblance to the design characterizing the cobra (fig. 12).

The total impression of the animal in summer pelage is then that the back side is greyish-black with a faint reddish-brown tinge. It is characteristic of the Greenland Collared Lemming that the hairs on the flanks and the upper part of the breast are rusty-red. The hairs on the tail are



Fig. 12. Collared Lemming. Phot. 12.10.1936. Behind the ears there is a lighter semicircular belt, and in front of this the dark ear-patches are standing out clearly, reminding of a pair of spectacles.

stiff, yellowish-white and so long that they are seen to project distinctly from the body.

As late as the first week of October all the animals were in summer pelage; but the autumn change of coat gradually began. This change of coat took place in two ways, though the difference was not sharply defined. In some animals the long white winter hairs spread from the flanks towards the back, standing out clearly from the summer pelage, whereas in others the summer coat along the back generally became more and more light-coloured, though also here the flanks first changed into winter pelage.

A few examples will illustrate this. In one of the larger animals the long white winter hairs appeared rather suddenly about October 10th,

and in the course of a few days they covered the shoulders and the haunches; in front of each ear an almost circular whitish-grey area became visible which, however, did not yet join the median line, but anteriorly formed a point reaching the eye. On the back 3—4 small white spots were visible, being of the size of the head of a pin. The dark stripe along the spine was still there. During the following three weeks this animal did not undergo any noteworthy changes. About November



Fig. 13. Autumn change of coat. Specimens in various transitional stages of change of pelage often present a very peculiar appearance. Phot. 29.10.1936.

1st the white areas were still separated from each other by the rusty-red tinge of the flanks, and also the rusty-red ear-patches were still there.

In other individuals the change progressed more rapidly (figs. 13—14). In the animal on fig. 13 the white areas on shoulders and haunches joined about November 1st, thus taking the place of the rusty-red colour along the flanks. The line bordering the summer pelage of the back is sharp, but very uneven in its course, and the dark ear-patch is very striking. Specimens in various transitional stages of change of pelage often present a very peculiar appearance. In the animal on fig. 14 the light-coloured shoulder areas have joined in a narrow belt across the forepart of the body, where upon the whole the change of pelage is particularly advanced.

Fig. 15 shows a couple of animals in which the change of coat takes place in such a manner that the back becomes more and more evenly



Fig. 14. In the autumn the whitening usually starts low down on the flanks and extends gradually upwards and forwards. Phot. 1.11.1936.

winter-white all over; however, the sides of the neck are almost entirely white (November 1st, 1936). Some of these latter animals for a short time assume a yellowish tinge, particularly across the shoulder region and along the line between the back and the belly, almost with a tinge of the same colour as the belly of *Mus musculus spicilegus*. It might look as if it were here a case of an actual change of colour, the animal for a time acquiring quite a different tinge from what it otherwise has.

In order somewhat to elucidate this point I cut off the coloured tips of hairs from a patch on the back of the animals, so that now only the dark basal parts were left. After some weeks — this was in a period when the change of coat progressed slowly — a number of long, scattered white hairs began to appear in the dark spot. From this it is evident that the change of pelage, also in the autumn, at any rate in parts takes place by the growth of new hairs.

The above-mentioned yellowish tinge might then be thought to be brought about by a mixture of the white-winter hairs and the coloured summer hairs. These summer-hairs vary very greatly in colour and are on an average three-coloured. The tips are black, then follows a yellowish-brown band, which passes into a greyish-white belt. The lower half of the hair is again dark, of the colour of soot. These belts may also vary in length; the yellowish-brown part may for instance be of the same length as or longer than the black hair tip, but may also be quite narrow, as a matter of fact only a transitional stage between the dark



Fig. 15. Autumn change of coat. Sometimes there is an even mixture of white and dark hairs; the result is a pale grey. Phot. 1.11.1936.

and the light-coloured parts; in other hairs the black tip is greatly reduced, in some it is even entirely wanting, that is, the tip at any rate is reddish-brown. Many of the longer, more outstanding hairs have a very long, black, or very dark-brown tip, or are black throughout their whole length. Add to this that the intensity of the pigment varies very much, more particularly in the yellowish-brown part. There is consequently nothing to prevent a yellowish tinge, as the result of a mixture of these summer-hairs and the sprouting white winter hairs. However, this is not sufficient fully to explain the phenomenon, for very many of the hairs have a yellowish-brown tip, as if the yellowish-brown band has spread to the tip, or rather as if the black tip has become bleached and assumed a brownish colour.

That the summer hairs may at any rate remain for a very long time or are shed at a very late period, appears from another little experiment. In an animal in full summer pelage the hindmost part of the back was dyed yellowish-brown by means of argentic nitrate. As the animal at a later period acquired its winter coat, the yellowish-brown spot was still visible in the greyish-white winter pelage. The animal was then killed and skinned. An examination of the coloured spot showed that the latter essentially consisted of summer hairs, where the black tip and the yellowish-brown belt were still visible through the

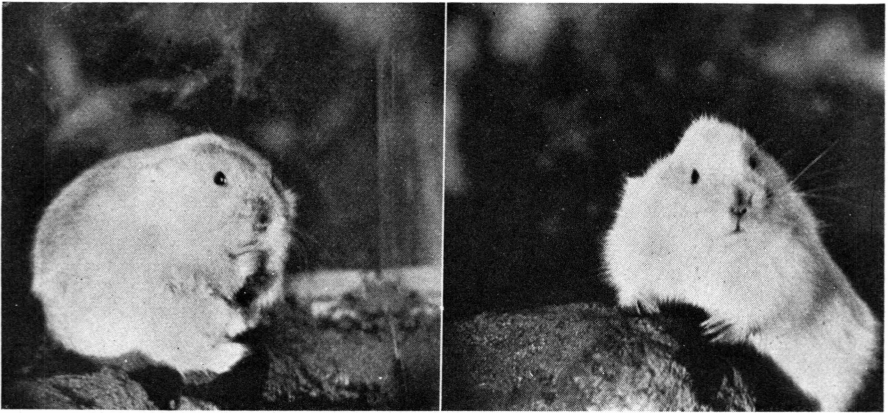


Fig. 16. Collared Lemmings in full, or very nearly full winter pelage. Phot. 28.1.1937.

yellowish argentic nitrate colour, the white belt of the hair having a yellowish tinge. A number of white winter hairs had appeared in this patch, but curiously enough there were otherwise not many coloured summer hairs in the white winter pelage.

It thus seems as if the autumn change of coat is brought about by the sprouting of new fine winter hairs, but the old summer hairs are retained for a very long time, being possibly re-coloured or bleached.

The change of coat may progress with greater or smaller rapidity, partly dependent upon the outside temperature. In periods of mild weather the process may be slow, whereas it may be hastened by a severe frost period. The outside temperature, however, is not the only deciding factor.

As to the physiology of the shedding of hairs very little is known. SCHWANITZ, who in 1938 has made experiments on the change of coat

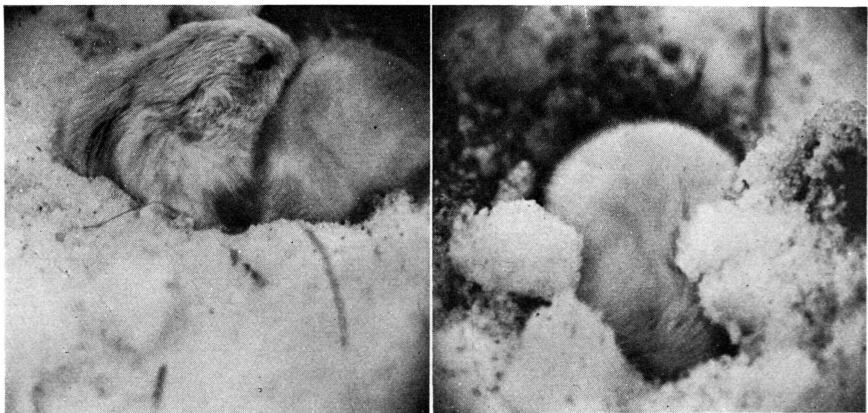


Fig. 17. Collared Lemming in winter pelage, in snow. Phot. 27.2. and 5.3.1937.

in rabbits, is of the opinion that "die Beschleunigung oder Verzögerung des Haarwechsels dürfte zu einem grossen Teil durch die Art der Haltung bedingt sein Die Art der Ernährung scheint den Mauserbeginn nicht zu beeinflussen" . . . but massage and increased metabolism in the skin "die beim natürlichen Haarwechsel durch erhöhte Sekretion der Schilddrüse bewirkt werden". SCHWANITZ explains that by feeding the animals with Thyroidine "konnte eine Lockerung des Haarkleides



Fig. 18. Collared Lemming in winter pelage. Phot. 5.3.1937.

herbeigeführt werden, wie sie auch der natürlichen Mauser vorausgeht. Eine Haarneubildung trat jedoch bei den Versuchen nicht ein." A removal of the Thyroidine causes a delay in the change of coat.

It may, however, be said of the Collared Lemmings here discussed that whereas the change of coat, as already mentioned, was progressing about November 1st, a single one retained its summer pelage throughout the greater part of the month of November. All in all, the change of coat progressed slowly. When three of the animals escaped at the end of January, they were still far from having developed their winter coat, whereas in others the change was practically completed at that time (fig. 16). Not until the end of Februar had they all acquired their full winter pelage (figs. 17 and 18), and this shows that the change of coat was greatly retarded in captivity. In North Greenland the winter pelage is developed at the end of September and the beginning of October.

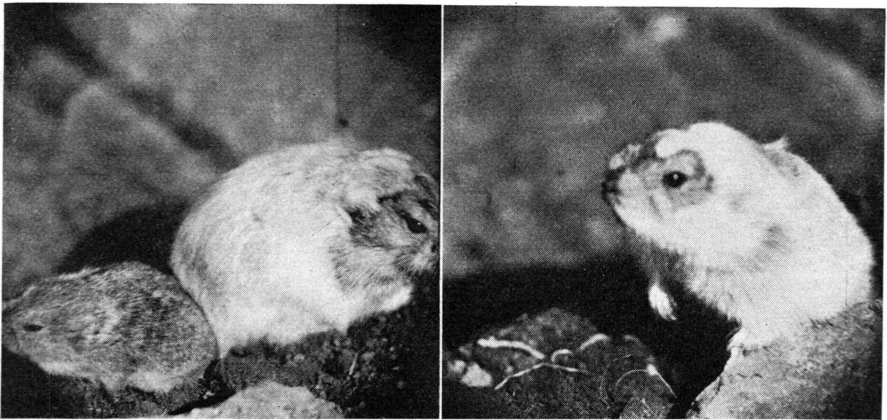


Fig. 19. Spring moulting. In spring the moult is very pronounced; the coloured summer coat first appears upon the head and gradually extends downwards and backwards. The old male together with a young from 1st litter, born about April 13th. Phot. 2.5.1937.

A couple of months later, about May 1st, the spring moulting begins in full force. On May 10th the female has already developed the summer

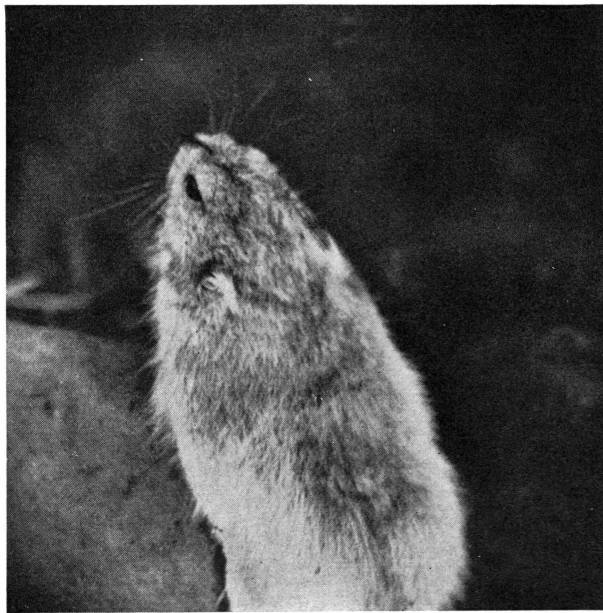


Fig. 20. Same animal as on fig. 19. The spring moult is more advanced. On the ears the long white winter hairs are still to be seen. Phot. 15.5.1937.

coat, whereas the male has as yet only shed the winter hairs on the head and the front part of the back; on the ears the long white winter



Fig. 21. Two animals from February 13th 1938. The change of coat is so retarded that the animals only acquire a complete winter pelage along the flanks, whereas the back still retains the summer colour.

hairs are still visible, and not until the 22nd was the male in full summer pelage. Whereas the change of coat in the autumn begins along the flanks and then extends to the back, the process is now reversed. In the spring the coloured summer coat first appears upon the head and shoulders and gradually extends downwards and backwards (figs. 19 and 20).

In the autumn of 1937 and the winter of 1937—38 the same process is repeated, only in a still more pronounced degree. The change of coat is so retarded that the animals only acquire a complete winter pelage along the flanks, whereas the back still retains the summer colour. Fig. 21 shows two animals from February 13th, 1938. The rusty-red summer hairs along the flanks are supplanted by the long, white winter hairs, but on the back there are comparatively few white hairs among the coloured summer hairs, the total impression being that the animal is practically in summer coat. Fig. 22 shows an animal, which was skinned 16.3.1938. This animal is more or less in its summer coat, though somewhat lighter-coloured. On the feet and the hindmost part of the belly it is winter-grey. On the back the light-coloured middle band of the hairs is particularly pronounced, almost pure white.

As late as medio April conditions were not essentially changed for most of the animals, whereas a few were more or less winter-white. This appears from a description of the animals, as they looked on April 12th. The old female from 1936 has long reddish-brown and black hairs along the back, having here particularly retained the summer pelage. The flanks were whitish downwards towards the belly, but upwards towards the back there were several rusty-red hairs. No double claw, but the pads comparatively marked. Also a male from 1937 had

more or less retained its summer coat. The throat and the anterior part of the flanks were still rusty-red, though intermixed with white hairs; the posterior part of the flanks was lighter-coloured; the ear region reddish. On the back there were likewise a number of white hairs intermixed with the summer hairs. No double claw. Another male was of more or less the same appearance, but on the back it had 3 whitish-grey

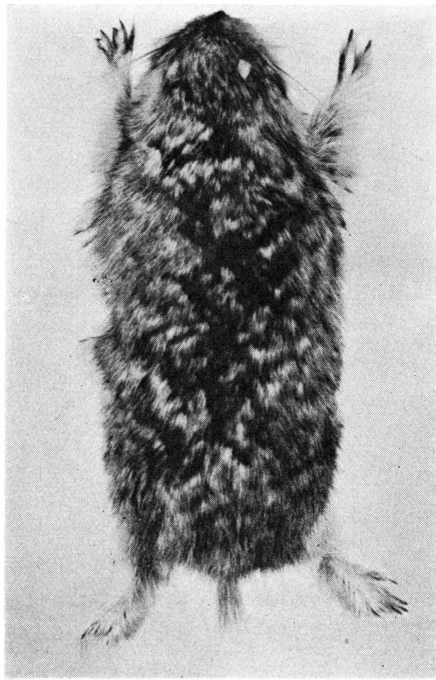


Fig. 22. Collared Lemming, skinned 16.3.1938. Almost in summer coat.

spots, the hindmost of which was fully 1 cm in diameter. A female had entirely white-grey flanks, but the back was more or less summer coloured etc. One animal had very nearly acquired the winter pelage, but was greyish on the nape and more particularly on the posterior part of the back. This animal had a double claw.

As formerly mentioned some of the animals, which were not winter-white and had no actual double claw, had brought forth young with a pronounced double claw and a very light coat, being very nearly in winter pelage.

Fig. 23 shows a female, adult, skinned 4.11.1938 (born in the summer of 1937). This skin is more or less the summer pelage, the flanks and the belly still having a rusty-red tinge, though lighter-coloured than otherwise in animals in summer pelage. The throat and the fore limbs winter-grey. On the back there are two large great spots, the

largest, the front one, which is rather of the shape of a triangle with the point turning forwards is about 3 cm long and of the same width at the base. The hairs are here much longer than upon the remaining part of the back. The lighter colour is, as far as the belly is concerned, partly due to an intermixture of many white hairs, partly to the fact that the remaining coloured hairs are very faintly pigmentated. It would be a

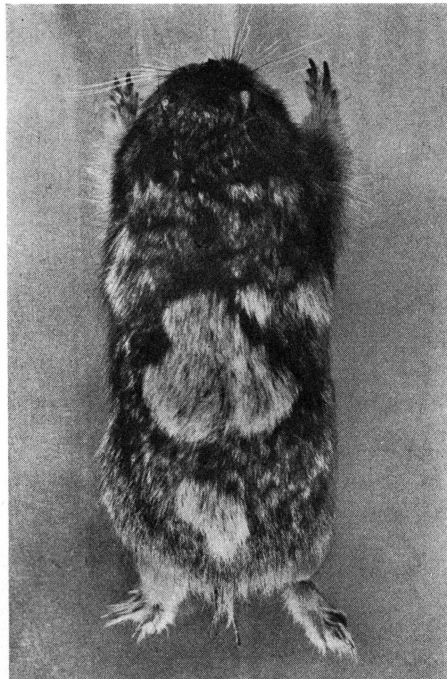


Fig. 23. Collared Lemming. Skin from 4.11.1938. Two large grey spots on the back.

likely supposition that there are still a number of coloured hairs left in the grey spots on the back. This is, however, not the case. On the other hand, many of the grey winter hairs have black tips and below those a faintly yellow band, but this is also found in the winter skins of animals living in liberty in Northeast-Greenland.

Neither in the following severe winters did the animals develop their full winter pelage, not even during the very severe winters of 1939—40, 1940—41 and 1941—42; cf. figs. 24—27, which show some animals photographed on April 5th, 1940. The temperature during these years was as low as $\div 25-30^{\circ}$ C.; during the last winter 27° of frost were measured in the house, where the cages of the lemmings stood.

The time is not ripe to discuss in detail, which factors are the determining ones as regards this change of coats; that the hormone of the thyroid gland is of importance has already been suggested, as

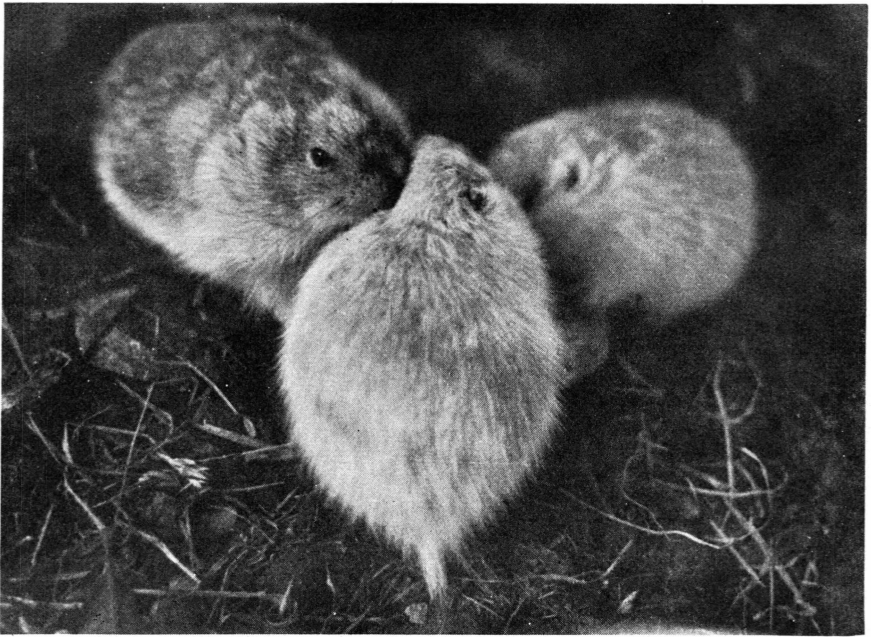


Fig. 24. 3 Collared Lemmings, phot. 5.4.1940. The one animal still almost in summer pelage along the back, the others more in winter pelage with a grey back.



Fig. 25. 2 Collared Lemmings, phot. 5.4.1940, cf. fig. 24.



Fig. 26. Collared Lemming from 5.4.1940.



Fig. 27. Collared Lemming from 5.4.1940.

was also discussed by SALOMONSEN (1939). That the temperature alone is not the decisive factor will appear from what has been said above. In the mild winter of 1936—37 the animals acquired their winter coat in January—February, but during the later severe winters they did not change into a pure winter coat; most of them more or less retained the summer pelage on their backs throughout the winter. This circumstance is further emphasized by the fact that some animals, which for a great part of the winter were kept in an indoor temperature of 18—20°C, followed the same course as the other animals, which lived in cages placed in an outhouse with comparatively small, but open windows i. e. where there was practically the same temperature as in the open air, though comparatively little light.—By the crossing of different races of *Peromyscus* and by keeping them in captivity during half a score of generations, SUMNER has been able to show that many of the fine distinctions, used to separate sub-species in mice and often correlated closely with climatic conditions, are genetically fixed and not the result of climatic conditions acting within the lifetime of the individual. In contradistinction the alterations in the change of coat of the Collared Lemmings here mentioned must undoubtedly be characterized as modifications, determined by the conditions under which they live, but it is worthy of note that the same conditions have not been able to prevent the nest-young from acquiring a more or less complete winter coat with a double claw. However, the acquisition of a white winter coat is a characteristic, which may fairly easily alter with the climate, as is known from several species of animals: Weasel, *Mustela nivalis*; Stoat, *Mustela erminea* and varying hare, *Lepus timidus*, and as it has been possible to follow it in detail in the case of the hare from the Faroes (DEGERBØL, 1940).

General Behaviour.

In conclusion only a few remarks elucidating the general behaviour of the animals. On the journey from East Greenland to Copenhagen the animals lived in three empty biscuit boxes which were screwed together and perforated, the animals having all the three boxes at their disposal. They had settled in a very practical manner, using one box as sleeping accomodation, where the nest was placed; the other compartments were used for eating purposes and a privy, respectively, which division of the dwelling is evidently characteristic of the animals and was kept up later on.

Upon their arrival in Denmark I placed, as already mentioned, four of the animals in a large box, 2 m long and barely 1 m broad,

filled with earth and placed in a cold conservatory in my garden in Lyngby. Here the animals immediately dug themselves in, and soon the ground was undermined crosswise. This burrowing took place with great rapidity, the animals using their fore and hind limbs with equal ease. With the fore limbs they scratched and dug up the ground, and with the hind limbs the loosened material was flung far behind them. While working they moved their limbs with a phenomenal rapidity; the fore limbs so quickly that it was difficult to follow the individual movements, and when the animal had dug itself so deep down that it had reached the bottom of the box, the taps of the fore limbs against the bottom boards were heard in such rapid succession that it sounded almost as when passing a finger along the teeth of a comb.

The burrows were as a rule not broader than just to permit the animals to pass through them, and more particularly their outer openings were comparatively narrow, often so narrow that the animals when passing were drawn out lengthwise, almost like a sausage. Other holes, particularly under stones or boards where the animals loved to burrow, were very low, but broad, the animals being very flattened when pressing through them. In other words, the shape of the body was very changeable, as is frequently the case with animals with a loosely fitting coat, to which must in this case be added its extreme thickness. The animals were upon the whole very agile and pliable. When they were for instance lifted up by the skin, the fore limbs, as it were, gave way and stood out vertically right up into the air.

Upon the whole it did not cause any difficulty to keep these animals in captivity. Apart from the spring of 1938, when two of the three existing animals were males, and one of them was bitten dead, they got on very well among themselves.

The made a soft bed from the material at their disposal, as e. g. grass and leaves, but also paper, thread, small rags and whatever else they might find, they carried to the nest. The latter was often placed down in the ground, more frequently, however, at the surface, only halfway concealed. If they had sufficient material, the nest might be fairly large, about 30 cm in diameter. Particularly during the breeding season this nest was subject to much wear and tear, so that it was necessary always to provide sufficient material. The whole family inhabited the same nest, where they were lying clustered. They generally did not all leave the nest at the same time, but one animal remained, as it were to keep it warm. When my animals escaped in the spring of 1937, there was thus one individual left in the nest.

Neither did the food cause any difficulty. The animals were by preference fed with leaves and branches of willow, grasses, of which like our native field-mice they preferred the lower, light-coloured part,

dandelions etc. Besides they had a generous supply of oatmeal, carrots and apples. It was not necessary that the leaves and the grass should be fresh; even when it was half withered, they ate it with a very good appetite.

Like our native mice, they take up a special position when eating, on their hind legs and keeping the fore limbs free, so as to be able to use them as a pair of small hands to hold the food while eating. This particularly applies to the leaves. In a course of a minute or two a willow leaf is consumed. The animal holds the leaf horizontally with all four digits on the same side, that is, almost in the same manner as man playing a jew's harp holds his hands. Just as often, however, it holds the leaf vertically or obliquely with a paw on each side of the leaf. Also blades of grass are held between the fore limbs, and it is a very comical sight, when the grass is as thin as a thread; it then happens that the animal takes four blades at a time or holds it carelessly in one hand, while supporting the other on the ground. If the animal holds the blades with both hands, it may take up a position, which greatly resembles that of a mole consuming an earth-worm. While eating they raise the fore limbs a little from the underlayer, lifting them up and down with small jerks, while the blade is passing in between the hands. However, the Collared Lemming has its palms turned towards each other as if sitting with folded hands, while the mole pulls the earth-worm between the inner sides of the hands. It is quite interesting to find such a pronounced agreement in the eating position of two such widely different animals. More especially in the case of the mole, this particular position is of decisive importance for the swallowing of the live earth-worm (DEGERBØL 1927).

The Collared Lemming, however, does not use its hands so much or so deftly as the mice. If f. i. they are fed with oatmeal, which the mice would immediately take up in their hands, the Collared Lemmings eat it without using their hands, that is, directly from the ground by means of the lips, which are extremely mobile.

As after some time it proved rather difficult to procure the quantity of willow-branches, which the animals required, I tried at an early period to offer them all sorts of other branches, but without success; the animals would neither eat the leaves nor gnaw the bark. When one day I discussed the problem of their nourishment with the botanist HAGERUP, he told me that he had found the stomach of *Eutamias glareolus* entirely filled with masticated male catkins of *Corylus*, and I determined to give my animals some of these. It is true that earlier in the autumn I had offered them branches with catkins of *Corylus*, which, however, they had refused to eat; but there was a possibility that later in the winter and in the early spring, when the catkins were more developed, they would regard

them in a different manner. And this really proved to be the case. The animals now greatly appreciated these catkins. In the months of February, March and April they were regularly fed with them. They quickly bit off a catkin at its base, held it with the point upwards between their hands and took some rapid bites, which were thoroughly masticated, and in a minute or two even large catkins were consumed. Many were, however, dragged below ground. Thus, in the course of one night three animals carried away a hundred catkins, and a more detailed investigation showed that considerable supplies were generally accumulated here. We often managed to see how this transport was made. It did not require much time; the animal took 4—5—6 catkins into its mouth and thus, with the catkins bristling like a funny moustache, it carried them away. Also the male catkins of willows were greatly appreciated.

But the Collared Lemming now not only ate the catkins of *Corylus* with great relish, in fact preferring them to *Salix*, but they also ate the bark of *Corylus*, and upon the whole as the winter advanced, they were more inclined to gnaw bark than at any other time of the year. This undoubtedly has some connection with the accumulation of sugar and oil, which at that time is found in the branches.

Water the animals never drank. During the early days of their captivity there was always a bowl with water in the cages, but like other mice they immediately used these bowls as W.C.'s. As the animals never drank, the water was entirely removed after some weeks, and after the autumn of 1936 they were given nothing whatever to drink.

Like many other voles the Collared Lemming is not a pronounced nocturnal animal, but moves about a good deal in the daytime, and even a glaring sunshine does not seem to trouble it. Nevertheless it is undoubtedly most active and lively in the evening. At any rate a couple of times a day it comes forth to eat, often at fairly regular hours.

One often hears the animals purr like a cat, the jaws simultaneously moving with great rapidity, as if they were munching.

Summary.

- 1) In the autumn of 1936 we received 7 live specimens of Collared Lemmings (*Dicrostonyx groenlandicus*) from Northeast-Greenland.
- 2) The only pair of these, which were alive in the spring of 1937, brought forth in the course of the summer five litters of young with an interval of about a month. Also in the following years the stock breded (cf. p. 10).
- 3) The first litter was born very early in the year, already in March. In spite of the fact that the parents were only winter-white along

the flanks and lacked the double claw (see p. 17) these first litters of nest-young had a partly developed winter pelage and the appertaining "double claw". That this also takes place in nature appears from the fact that a young brought home skinned from Northeast-Greenland still had a "double claw" as late as June 1st.

- 4) The autumn change of coat is greatly retarded in animals in captivity. The animals brought home only acquired their winter pelage in January—February 1937. During the following years most of the animals retained their summer coats on their backs throughout the winter, in spite of the fact that the winters of 1939—40 and 1940—41 and 1941—42 were very severe, with temperatures as low as $\div 30^{\circ}\text{C.}$, and of several months duration. Only a few of the animals developed a winter pelage of a bluish-grey or whitish-grey colour.
 - 5) The longest life-time of the animals is two years.
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LITERATURE

- ALLEN, G. M.: The American Collared Lemmings (*Dicrostonyx*). Bull. Mus. Comp. Zool. Vol. LXII, No. 12. Cambridge, Mass. U. S. A. 1919.
- ALLEN, G. M. and COPELAND, M.: Mammals from the MacMillan Expedition to Baffin Land. Journal of Mammalogy. Vol. 5. 1929.
- ALLEN, J. A.: Report on the Mammals collected in Northeastern Siberia by the Jesup North Pacific Expedition, with Itinerary and Field Notes by N. G. Buxton. Bull. Amer. Mus. Nat. Hist. Vol. XIX. New York 1903.
- ANTHONY, H. E.: Field Book of North American Mammals. New York 1928.
- BRAESTRUP, F. W.: A Study of the Arctic Fox in Greenland. Meddelelser om Grønland. Bd. 131. Nr. 4. København 1941.
- CHITTY, D. and ELTON, C.: Canadian Arctic Wild Life Enquiry. Journ. Animal Ecology. Vols. 6, 7 and 8. Cambridge 1937—1939.
- DEGERBØL, M.: Do Moles (*Talpa europae* L.) store up Worms? Vidensk. Medd. Dansk naturh. Foren. Bd. 84. København 1927.
- Mammals. Part I. Systematic Notes. Report of the Fifth Thule Expedition 1921—1924 to Arctic North America. Vol. II. No. 4. Copenhagen 1935.
- Mammalia. Zoology of the Faroes. Copenhagen 1940.
- DEGERBØL et al.: Danmarks Pattedyr. København 1935.
- FLEROV, C.: Zur Biologie der Säugetiere des nördlichen Urals und Westsibiriens. Bull. Acad. Sci. 1933. No. 3.
- FREUCHEN, P.: Mammals. Part II. Field Notes and Biological Observations. Report of the Fifth Thule Expedition 1921—1924 to Arctic North America. Vol. II. No. 5. Copenhagen 1935.
- HAGERUP, O.: The Morphology and Biology of the *Corylus*-Fruit. Det kgl. danske Videnskabernes Selskab. Biologiske Medd. Bd. XVII. Nr. 6. København 1942.
- HINTON, M. A. C.: Monograph of the Voles & Lemmings (*Microtinae*) living and extinct. London 1926.
- KOLTHOFF, G.: Bidrag til kännedom om norra Polartracternas däggdjur och fåglar. Kgl. Sv. Vet.-Akad. Handl. Bd. 36. No. 9. Stockholm 1903.
- MEINERTZ, THYDSEN: The Skin Musculature of the Greenland Lemming *Dicrostonyx groenlandicus* (Traill). Meddelelser om Grønland. Bd. 131. Nr. 3. København 1941.
- MIDDENDORFF, A. TH. V.: Reise in den äussersten Norden und Osten Sibiriens 1843—44 Bd. 2. Theil 2. St. Petersburg 1851.
- PREBLE, A. E.: A Biological Investigation of the Hudson Bay Region. North American Fauna. No. 22. Washington 1902.
- PEDERSEN, A.: Fortgesetzte Beiträge zur Kenntnis der Säugetier- und Vogelfauna der Ostküste Grønlands. Meddelelser om Grønland. Bd. 77. København 1930.

- PEDERSEN, A.: Polardyr. København 1934.
— Säugetiere und Vögel. Dansk Nordøstgrønlands Ekspedition 1938—39. Meddelelser om Grønland. Bd. 128. Nr. 2. København 1942.
- SALOMONSEN, F.: Moults and Sequence of Plumages in the Rock Ptarmigan (*Lagopus mutus* (Montin)). Vidensk. Medd. Dansk naturh. Foren. Vol. 103. København 1939.
- SCHWANITZ, J.: Untersuchungen zur Morphologie und Physiologie des Haarwechsels beim Hauskaninchen. Zeitschr. f. Morph. und Ökologie der Tiere. Bd. 33. H. 4. 1938. Berlin.
- TULLBERG, P.: Ueber das System der Nagethiere, eine phylogenetische Studie. Uppsala 1899.
- WINGE, H.: Grønlands Pattedyr. Meddelelser om Grønland. XXI. København 1902.
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