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Nr. 4

ALF WOLLEBÆK:
THE SPITSBERGEN REINDEER
(RANGIFER TARANDUS SPETSBERGENSIS)

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THE SPITSBERGEN REINDEER

(RANGIFER TARANDUS SPETSBERGENSIS)

(ANDERSÉN 1862)

BY

ALF WOLLEBÆK

WITH 16 FIGURES IN TEXT, 6 PLATES AND 1 MAP



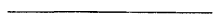
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Craniological Investigations.

Introduction, with Explanation of Measurements.

The reindeer, *Rangifer tarandus* Lin., is distinguished by its great range of variation in respect of appearance, and by its great power of adaptability under varying conditions of life. It varies in size, colour, shape of antlers, etc. And not only are its outer characters very variable, but also the size and shape of, for instance, the different parts of the cranium. Thus *R. tarandus* is considerably more variable than *Alces alces*, *C. elaphus*, and other species belonging to the *Cervidae*.

The marked variations in the reindeer have resulted in Linné's old species of 1758, *Rangifer tarandus*, having been divided by several subsequent authors into numerous sub-species. The American Caribou in particular, has been grouped into a considerable number of sub-species, or even into several species. As a rule, the different "races" and "species" are established principally on the basis of external characters, such as colour, shape of the antlers, and size, and in most cases on the basis of very scanty material. As the reindeer is one of those animals which easily varies, it will just for this reason be of very doubtful value to try, on the basis of scanty material, to determine which characters are really fixed and of such value as to justify the establishment of specific races and species, as opposed to such characters as are due to sex and age or are even merely individual variations.

With the exception of the Spitsbergen reindeer, which already in 1862 was given specific rank by ANDERSÉN [2], the reindeer of Europe were considered as one race, until E. LÖNNBERG [5] in 1909 divided them into *Rangifer tarandus typicus* and *Rangifer tarandus fennicus*.

In his treatise of 1862 ANDERSÉN not only emphasizes special characters in the cranium of the Spitsbergen reindeer but also certain characters in other parts of the skeleton, which should strengthen the correctness of the opinion that the Spitsbergen reindeer is a distinct race. Unfortunately, ANDERSÉN's treatise includes practically no actual measurements, and only a few ratios. Further, the author does not mention how large a number of specimens of Spitsbergen, Lapland, and Greenland reindeer he has had at his disposal for purposes of comparison, nor does he state the sex of the specimens examined

As regards the differences between certain cranial or other parts of the skeleton of the compared specimens, he merely states that the respective parts are larger or smaller, narrower or broader, shorter or longer, and so on, in the one than in the other.

On comparing some skulls of male reindeer from Spitsbergen with several tame reindeer skulls from Lapland, LILLJEBORG [12] (1874) came to the conclusion that some of the differences, asserted by ANDERSÉN, between Lapland and Spitsbergen reindeer were not constant. After all, the cranium of the Spitsbergen reindeer did not differ so much from that of the continental reindeer as should be the case according to ANDERSÉN's statement. According to LILLJEBORG's investigations there did not exist any other remarkable differences in the osteological construction of the head than the somewhat smaller size and the peculiar shape of the points of the nasal bones. The other differences pointed out by ANDERSÉN between the Spitsbergen, Greenland, and Lapland reindeer, apart from the cranium, have not been subjected to any further investigation by LILLJEBORG. But, in spite of the fact that LILLJEBORG does not find the racial differences mentioned by ANDERSÉN in the construction of the cranium of the Spitsbergen and that of the Lapland reindeer to be so constant as might have been expected according to ANDERSÉN, yet he maintains that the Spitsbergen reindeer is distinctly characterised as a separate race.

For further enlightenment on this question I have examined a number of reindeer skulls collected in Spitsbergen by Norwegian explorers (especially by Captain ISACHSEN and A. HOEL), and I have compared them with the rich material of reindeer skulls from other localities stored at the Oslo Zoological Museum. In all, I have examined over 200 reindeer skulls. This comparative investigation has proved that several of the differences stated by ANDERSÉN between the Spitsbergen and the Continental reindeer do not exist, but, on the other hand, I find other characteristics, not previously pointed out, whereby the reindeer skulls from Spitsbergen conspicuously differ from all the others in my material. Before giving a further account of the peculiar features found in Spitsbergen reindeer skulls, I will make some remarks on the measurements taken and the material at my disposal.

I have personally made all the measurements, and each skull has been measured in exactly the same manner. Besides the measurements of the distances which LÖNNBERG has made use of in his comparative studies of reindeer races, I have also taken measurements of some other distances used by other investigators in the study of racial marks. As, however, one and the same distance may be measured and indicated differently by different investigators, I find it

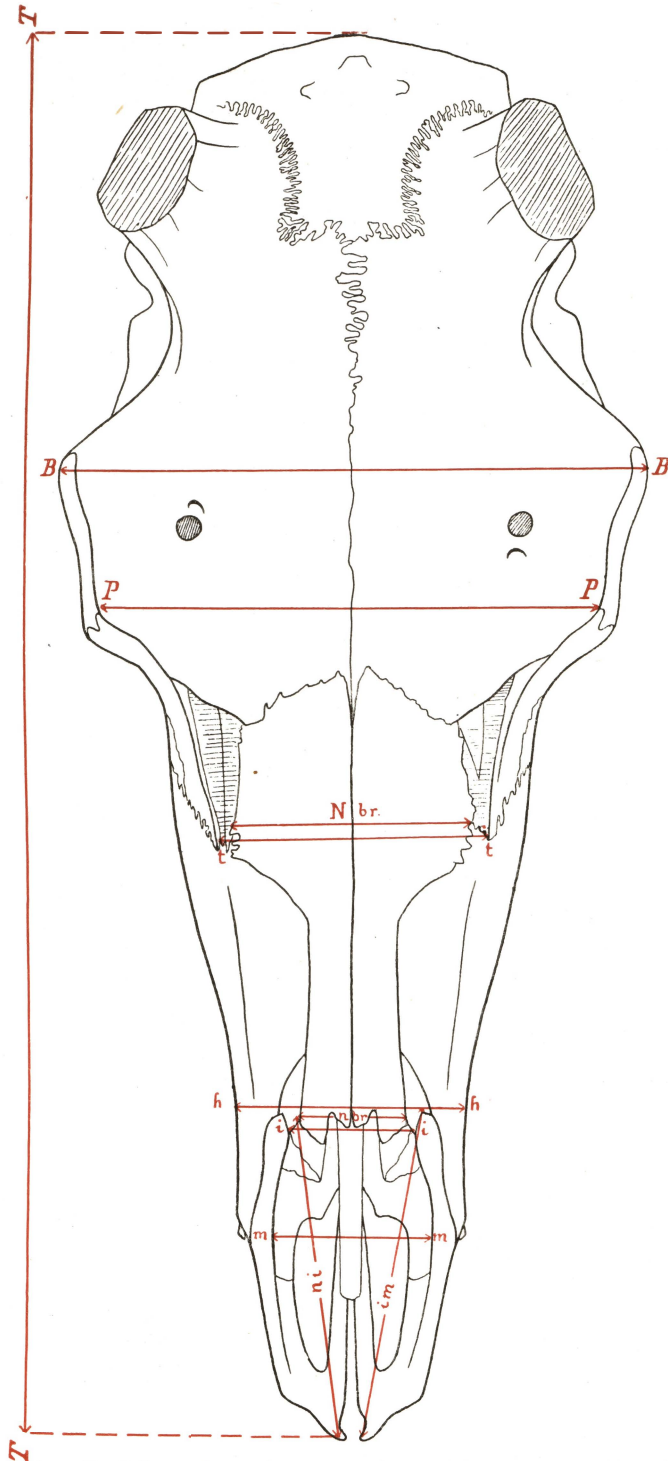


Fig. 1. Reindeer Skull from above (Diagrammatic), with Measurement Lines (V. pp. 6—11).

necessary to define the nomenclature and to indicate in detail the points between which the measurements have been taken.

All the measurements in the tables give the shortest distance — the straight line — between two points.

1. *Maximal Length of Cranium*

(Fig. 1, T—T)

measured from the anterior point of *praemaxilla* to the posterior point of *crista occipitalis*. Even in calves a few days old this distance will be longer than the *condylo-basal* length.

2. *Condylo-Basal Length,*

(Fig. 2, C)

the distance from the anterior point of *praemaxilla* to the posterior edge of the *condyli occipitales* (cf. O. THOMAS, [28], 1905).

3. *Basal Length,*

(Fig. 2, Bs.)

the distance from the anterior point of *praemaxilla* to the lowest anterior edge of *foramen occipitale* (cf. O. THOMAS).

For this distance LÖNNBERG (1906 & 1909) uses the designation *Basicranial Length*. In his work on red deer in Norway COLLETT [6], on the contrary, designates by basi-cranial length the distance from the posterior edge of the *condyli occipitalis* to the point of *praemaxilla* (above designated as the condylo-basal length). Neither COLLETT (1909) nor LÖNNBERG (1906) indicates in his treatise on red deer what he understands by basi-cranial length. What LÖNNBERG means by his basi-cranial length is to be seen from his work "Om Renarne etc." (1909), in which he says that the basi-cranial length is the distance from the anterior edge of the *foramen occipitale* to the point of the *praemaxilla*. What COLLETT has meant by the basi-cranial length appears from direct measurements of the red deer skulls in the Oslo Zoological Museum, used by COLLETT. The basi-cranial lengths stated by COLLETT and LÖNNBERG in their treatises on red deer are thus not directly comparable.

4. *Palatal Length,*

(Fig. 2, P).

distance from the point of *praemaxilla* to the posterior edge of *ossa palatina* at the end of the suture. (cf. O. THOMAS, 1905).

5. *Maximal Breadth of Cranium*

(Fig. B—B)

measured between the outer edges of the orbits.

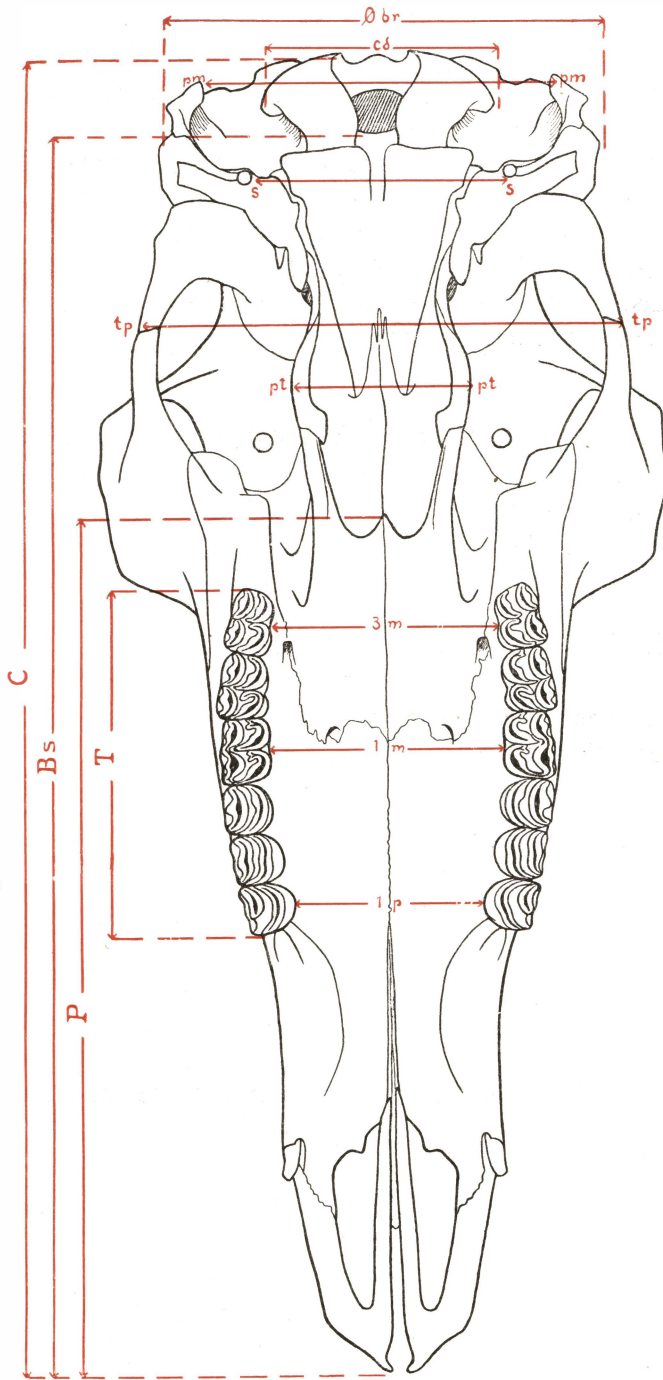


Fig. 2. Reindeer Skull from below (Diagrammatic), with Measurement Lines (V. pp. 6—11).

6. *Breadth of Forehead.*

(Fig. 1, P—P).

The measurements are taken between the outer ends of the suture between frontal and lachrymal.

Between these points, however, the *frontalia* have not their maximal breadth. In order to obtain an expression for the breadth of the forehead, I have, however, chosen to measure the distance between the above mentioned fixed points, which are always distinctly marked, instead of the distance between the unfixed points between the middle of the orbits as used by some authors.

7. *Breadth of Cranium at the External Auditory Meatus,*

(Fig. 2, Öbr.)

measured between the points of the protruding lateral parts of *pars squamosa* straight out from the auditory meatus.

8. *Breadth of Cranium behind the Canines,*

(Fig. 1, h—h)

is measured between the outer sides of *maxillae* directly below the posterior upper points of *praemaxillae*.

9. *The Breadth of Condylis occipitalis.*

(Fig. 2, cd).

The distance between the outer edges at the base of *condylis occipitales*.

10. *Distance between Jugalia*

(Fig. 2, tp—tp).

measured between the outer edges of the *jugals* at the posterior points of *ossa zygomatica*.

11. *Distance between the Processus paramastoidei.*

(Fig. 2, pm—pm.)

12. *Distance between Processus styloides tympani*

(Proc. styloidei, Fig. 2, s—s).

These short *processus*, to which *ossa hyoidea* are connected, are sometimes lying deeply concealed between *bulla ossea* and *processus paramastoidei*.

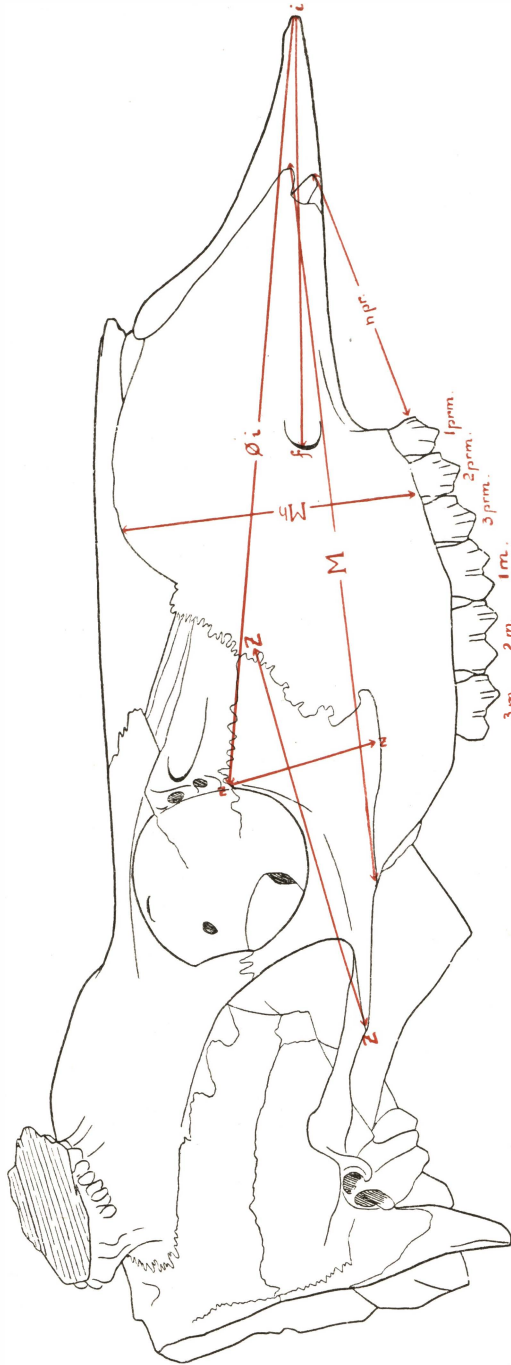


Fig. 3. Reindeer Skull, side view (Diagrammatic), with Measurement Lines (V. pp. 6—11).

13. *Distance between Processus pterygoidei*

(Fig. 2, pt-pt)

measured between the outer sides of *processus pterygoidei* (maximal distance).

14. *Distance from the Anterior Edge of Orbita to the Point of Praemaxilla*

(Fig. 3, i)

measured from the superior edge of *os zygomaticum* in the anterior edge of the orbit to the anterior point of *praemaxilla*.

15. *Distance from Foramen infraorbitale to the Point of Praemaxilla*

(Fig. 3, fi.)

Foramen infraorbitale may now lie just above the anterior edge, now over the middle, and sometimes so far back as above the posterior edge of first premolar.

16. *Maxilla.*

The length of this bone is measured from the anterior point in front of the canines to the posterior point at the inferior edge of *os zygomaticum* (fig. 3, M).

The breadth is measured perpendicularly on the longitudinal axis. The maximal breadth (height) of *maxilla* is as a rule over or immediately in front of the second premolar (Fig. 3, Mh).

17. *Os zygomaticum.*

The length is measured from the point of the posterior processus to the anterior edge of the bone at the suture against *maxilla* (almost at the end of the suture against *lachrymale* (Fig. 3, Z-Z).

The breadth is measured perpendicularly on the longitudinal axis from the superior point of *os zygomaticum* in the anterior edge of the orbit (Fig. 3, z-z).

18. *Distance between the Superior Edges of Lacrymalia*

(Fig. 1, t-t)

is measured between the anterior upper edges of *lacrymalia* at the suture against *maxilla*.

19. *Praemaxillae and the External Nasal Opening.*

The distance between the posterior upper points are measured between the insides of the jaw branches at the anterior point of the *os supra maxillare accessorium* (Fig. 1, i-i).

For the distance at the middle of the nasal opening, see Fig. 1, m—m.

The length of *Praemaxilla* Fig. 1, im.

The distance from the anterior edge of *nasalia* to the anterior point of *praemaxilla* see Fig. 1, ni).

20. *Nasalia*.

The posterior breadth is measured at the end of the suture between *nasalia* and *maxillae* (Fig. 1 N. br.). The smallest breadth of *nasalia* usually lies in the anterior third-part of *nasalia* at the posterior edge of *os supra maxillare accessorium*, more rarely farther back. Occasionally the breadth is smallest at the anterior edge of *nasalia* (Fig. 1, N. br.).

21. *Breadth of Os palatinum*,

is measured between the first pair of premolars (Fig. 2, 1 p), the first pair of molars (Fig. 2, 1 m), and the third pair of molars (Fig. 2, 3 m).

22. *Distance between Canines and Praemolares*,

see Fig. 3, hpr.

23. *Length of the Cheek-Teeth Row*,

see Fig. 2, T.

24. *Single Teeth*.

Measurements are always *maximal breadth* and *length*.

Remarks on the Material Examined.

Of the 21 Spitsbergen reindeer skulls examined, the following 7 were brought home by Captain ISACHSEN from his expeditions to the northern parts of Spitsbergen in 1909—10:

Z. M. No.	6615	♂.	Total length of cranium	300	mm.
—	-	6614	-	—	— 295 -
—	-	6619	-	—	— 272 -
—	-	6613	♀.	—	— 285 -
—	-	6616	-	—	— 267 -
—	-	6618	-	—	— 250 -
—	-	6617	-	—	— 248 -

Males. In the specimens with a total length of cranium of 300 and 295 mm. the milk-teeth are shed, the new premolars fully developed, somewhat worn in the case of the former, not worn in the case of the latter; this applies also to the molars.

The third male with a length of cranium 272 mm. is still a calf. The third molar has not broken through over the jaw-edge, the milk-teeth have not been shed. The antlers consist in this specimen of only a single straight branch, 40 cm. long, without snags, and of a brow-tine, also without snags, 11 cm. long.

Females. Only the specimen with a total length of cranium of 285 mm. has finished the shedding of teeth. The cranium belongs to an old animal with premolars as well as molars much worn.

Specimen No. 6616 (Total length of cranium 267 mm.) is in the teeth-shedding stage. In the right *maxilla* the milk-teeth are absent. Of the new premolars (permanent) the first has just broken through, the second entirely and the third half broken through. In the left *maxilla* the first premolar (milk-tooth) is not yet shed; the new premolar is to be seen above; the bone at the front of the tooth has partly been broken through. The second and third premolars (permanent) have almost entirely broken through; the third molar, on the contrary, only about half broken through in both *maxillae* (first and second molars completely developed). In the left *mandibula*, all the milk-teeth are shed, the new premolars are not completely full-grown. In the right *mandibula*, the third premolar (milk-tooth) is still left; it has a very worn crown and very small short roots left. Below this and considerably above the jaw-edge the distal part of the new premolar is to be seen. The first and second premolars are somewhat more developed than in the left *mandibula*.

The two remaining calves (of 250 and 248 mm.'s total length of cranium) both still have all the milk-teeth left. The second molar is not yet quite grown in either of them. In the jaw-bone above the third molar only an inconsiderable opening is to be seen.

The following 4 skulls were brought home from Spitsbergen in 1898; they have been lent to me by the Trondhjem Zoological Museum.

Thj. Mus. No. 11 ♀ .	Total length of cranium	285 mm.
— - 12 calf	—	200 -
— - 13 -	—	190 -
— - 14 -	—	178 -

The largest specimen belongs to an old animal (♀) in which the premolars as well as the molars are considerably worn. In the three others (calves) none of the molars are yet visible above the jaw-edge.

From the Tromsø Museum I have obtained the following 10 craniums from Spitsbergen:

Tr. Mus. No. 2 ♂.	Total lengths of cranium	335 mm.	} full grown
— - 4 -	— — —	321 -	
— - 3 -	— — —	305 -	
— - 1 ♀.	— — —	285 -	
— - 10 -	— — —	273 -	
— - 7 -	— — —	272 -	
— - 9 -	— — —	266 -	
— - 8 calf	— — —	220 -	
— - 5 -	— — —	217 -	
— - 6 -	— — —	207 -	

In the three males the teeth are rather much worn, most in the specimen with a total length of cranium of 321 mm. The specimen with tot. cr. length of 335 mm. has large strong teeth, the molars especially being extraordinarily broad.

The same specimen has the most developed antlers, the brow-tine, with 7 snags, shovel-formed.

The largest female cranium has teeth not much worn; all (including the posterior molars) are fully developed.

The specimens with a total length of cranium of 273 and 272 mm. on the other hand, have both, much worn teeth. In the smallest full-grown female (cr. tot. 266 mm.) the teeth are yet only slightly worn.

In the calf craniums the point of the 1st molar is only just visible above the jaw-edge (the tip projects at most only one millimetre). All three specimens have milk-teeth.

For comparison with these 21 skulls from Spitsbergen I have had an opportunity to examine about 200 skulls of wild and tame reindeer, full-grown males and females as well as calves, from the Continent, besides 22 Greenland specimens. In all of them the measurements were made from the same parts of the cranium as in the Spitsbergen skulls.

Cranial Length.

The small skulls of the Spitsbergen reindeer has been emphasized as one of the characters on which the establishment of the Spitsbergen reindeer as a specific race is based. NITSCHÉ [22] (1893) has not however, from the material he has examined, been able to point out any noticeable difference in size between the skulls of reindeer from Spitsbergen and from the Continent. NITSCHÉ has, on the whole, compared only 5 skulls, all of young not full-grown animals. He considers it however a fact, as other authors (especially ANDERSÉN) have previously held, that the Spitsbergen reindeer has a decidedly

smaller length of cranium than wild as well as tame Russian and Norwegian reindeer. The measurements made by me further strengthen this. The smallest of all the skulls of full-grown males examined belong to Spitsbergen specimens, the largest belong to specimens from the forest tracts in Sunjel. The largest and probably the oldest males in my material from Spitsbergen, with rather badly worn teeth, have a smaller length of cranium (up to 335 mm.) than a 3½ year old male from Sunjel (length of cranium 340 mm.) in which the shedding of teeth was recently completed (the youngest and smallest of the 17 full-grown males examined from this district). The smallest full-grown male from Spitsbergen has a length of cranium of only 295 mm. (basal length 274 mm.), the largest Sunjel male of 408 mm. Between these limits lie all the rest of the cranial lengths of full-grown males examined from various localities. Apart from the Spitsbergen specimens, the limits of the cranial lengths of specimens from all the other localities intermerge. Specimens of the same age from one locality may sometimes have larger and sometimes smaller cranial lengths than specimens of corresponding ages from another locality, irrespective of whether one compares reindeer from wood tracts with reindeer from mountain tracts, although amongst these latter there are many lower measurements than amongst specimens from wood tracts.

Palatal Length.

In spite of the great difference between the absolute measurements in the material of the different ages, the ratio giving the relation between the total cranial length and the palatal length shows a remarkably slight variation. Between the material from different localities there is no pronounced difference in the ratio. Even in the small Spitsbergen skulls the ratio falls between nearly the same limits as in the largest skulls from the Continent, and irrespective of these latter belonging to reindeer from wood tracts or mountain tracts, the ratio is practically the same, viz. from 58 per cent. to 62 per cent. and only in exceptional cases slightly higher or lower.

Total Cranial Breadth, Breadth of Forehead, Length and Breadth of Nasal Section.

The ratio, giving the relation between length and breadth of the cranium, varies individually rather considerably, which is essentially due to the more or less protruding orbits. Between the outer edges of the orbit the cranium has its maximal breadth.

In the cranial breadth in proportion to the length we have, according to ANDERSÉN, a racial mark whereby the Spitsbergen reindeer can be distinguished from the Greenland and Lapland animals. ANDERSÉN says that the Spitsbergen reindeer has a broader and somewhat more bullet-shaped head in proportion to its length than is found in the reindeer from Lapland and Greenland, and he further asserts that this character not only applies to full-grown animals, but also to calves. In a Lapland calf cranium, which was nearly 10 cm. longer than his longest specimen from Spitsbergen, he has found smaller breadth and circumference than in the largest Spitsbergen cranium mentioned.

Amongst the skulls measured by me there is some, though inconsiderable, difference between the cranial breadth and length in Spitsbergen and Greenland reindeer. In males (full-grown) of the former, the ratio varies between 46.2 and 49.5, in the latter between 41.4 and 45.3; in females between 48.1—51.3 and 42.3—47.9 respectively.

Also the corresponding ratio in the skulls from the Continent is often slightly lower than in the Spitsbergen skulls. Very rarely the breadth constitutes half of the length in the Continental skulls.

By comparing the ratios from the different localities on the Continent, the variation limits are found to be fairly homogeneous. From none of the localities is the material distinguished by any characteristically large or small cranial breadth in proportion to length. Protruding orbits cannot be seen to characterise the skulls from any special locality. The reindeer of the wood tracts vary in this respect just as much as those of the mountain tracts.

Comparing the breadth of the skulls behind the canines, (one of the measurements which define breadth of snoutsection) the ratios prove to vary between somewhat narrower limits in the Spitsbergen skulls than in the skulls from the other localities. The individual variations are very considerable. The measurements, however, which illustrate the length of the snout, the distance from the front of the orbits to the foremost point of *praemaxilla* and the distance from the *foramen infraorbitale* to the foremost point of *praemaxilla*, are found in the Spitsbergen skulls to be no different from the same measurements in the skulls from the other localities, if we compare the distances named with the total length of the skull. The ratios for these distances vary between relatively narrow limits in all fullgrown specimens from the different localities. The distance from the front edge of the orbit to the foremost point of *praemaxilla* is only in a few cases under 57 per cent. and over 61 per cent. of the total length of the skull, the main part between 58 per cent. and 60 per cent. The distance from the

foramen infraorbitale to the foremost point of *praemaxilla* in proportion to the total length of the cranium varies in about the same ratio as the foregoing lengthproportion. In a couple of cases the ratio is some tenths lower than 31 per cent, not in any case higher than 35 per cent., and in the main between 33 per cent. and 35 per cent.

Condylus occipitalis.

As regards the distance between the outer edges of *condyli occipitales*, which LÖNNBERG considers as greater for woodland reindeer than for mountain reindeer, I have in my material found considerable variation in reindeer from Spitsbergen as well as from the Continent. In animals of the same age, sometimes specimens from wood districts, sometimes from the mountains show the greatest distance between the outer edge of *condyli occipitales*, and I have often found that even smaller mountain reindeer have larger breadths between *condyli occipitales* than reindeer of the same age from wood tracts. And as far as the Spitsbergen reindeer is concerned, one of the smaller full-grown female skulls is seen to be supplied with *condyli occipitales* which in breadth (57 mm.) almost corresponds to one of the largest males (58 mm.).

Breadth of Cranium at the External Auditory Meatus.

The breadth varies individually rather considerably both in males and females; the males, however, have as a rule an absolutely and relatively broader occiput than the females. The skulls of the Greenland and the Spitsbergen reindeer show no evident divergence in this respect from the skulls from other localities.

Nasal Aperture.

In the more than 200 skulls examined, the breadth at the middle of the external nasal aperture, both in the males and females, young and old animals, is nearly always greater than the breadth between posterior points of *praemaxilla*. In very rare cases these breadth measures are of equal size, and only in a single case — in one of the skulls from Spitsbergen — have I found the breadth of the external nasal aperture largest in the upper part of the aperture just below

nasalia or at the upper edge of *praemaxillae*. Such a form of external nasal aperture was found by LÖNNBERG in the "Skogsren-race" ("Woodland Reindeer Race") established by him (1909), but besides the above-mentioned case from Spitsbergen I have seen only one example of such a form, namely in a wild male from the Karelen (Finland), whilst in 5 other wild males from the same forest districts the nasal aperture was broadest in the middle.

ANDERSÉN points out that in the Spitsbergen reindeer the posterior nasal aperture is especially narrow; not even the smallest Lapland or Greenland skulls, says this author, have so small an aperture as the largest Spitsbergen skull. LILLJEBORG'S and later on NITSCHÉ'S investigations confirm ANDERSÉN'S statements. LILLJEBORG compares the breadth over the *ossa pterygoidea* with the distance between the posterior protuberances of the basal part of the occipital bone, and finds that the two distances are about equal in the Spitsbergen reindeer, whereas in the Lapland reindeer the former breadth is the greater. Amongst my materials there are, however, numerous exceptions to this rule. NITSCHÉ, on the other hand, compares the breadth of the posterior nasal aperture with the distance between the jugals, and finds that the latter distance in two Spitsbergen reindeer (♂♂) is 3.31—3.44 times as long as the breadth between the posterior points of *ossa pterygoidea*; in 2 Norwegian and 1 Russian tame reindeer, on the other hand, 2.86, 3.00 and 2.97 times as long. The absolute sizes in NITSCHÉ'S Spitsbergen reindeer for the distance between pterygoids of the points are 36 and 34 mm.; for the distance between the jugals, 119 and 117 mm. respectively.

In the largest full-grown male specimens in my Spitsbergen material the posterior nasal aperture is defective, in the other 4 males the conditions are as follows: Largest distance between the outer sides of *ossa pterygoidea*: 39, 33, 36, 36; distance between the outer sides of the jugals: 133, 120, 117, 115. From this it is found that the distance between the jugals are respectively 3.4, 3.6, 3.3 and 3.2 times as long as the distance over the pterygoid points. These figures agree very well with those of NITSCHÉ. In all the other specimens, the Greenland, Scandinavian and Finland, the breadth over the posterior nasal aperture is greater compared with the distance between the jugals. If the distance between the jugals is indicated with a and the breadth over the *ossa pterygoidea* with b , then $\frac{a}{b}$ will be in full-grown males from:

Greenland	Sunjel	Inari	Utsjoki	South Varanger	Petschenga	North Varanger	Repvåg-Magerøy	Karasjok	Karesuando	Southern Norway (wild reindeer)
2.9	2.8	-	2.8	-	2.7	3.1	2.8	-	3.1	2.9
2.8	2.7	-	3.0	2.9	2.4	2.9	3.1	-	2.8	3.0
3.0	2.8	2.6	2.9	3.0	3.1	2.9	2.7	-	3.0	2.6
2.9	2.7	2.8	2.5	2.8	2.8	3.0	3.1	-	2.9	2.9
3.1	2.6	2.8	-	3.0	2.5	3.2	3.0	2.9	2.7	2.6
	2.7	2.8	2.7	2.7		3.2	2.6	2.9	-	
	2.6	2.8	2.9	3.2		2.9	3.1	-	2.7	
	2.9		3.0	2.7		2.9	2.8	3.0	3.0	
	2.6		-	3.2		2.8	2.8		2.9	
	2.7		2.8	2.7		2.9	3.0			
	2.5		2.8	2.9		2.8	3.1			
	2.9		2.9				3.0			
	2.8		2.7				2.9			
	3.0		2.4				2.8			
	2.8						2.9			
	-						2.9			
	2.6									

From the above table it appears that $\frac{a}{b}$ does not in any of the specimens measured give so high a figure as the highest in the Spitsbergen reindeer.

Only in a few cases are they as high as the lowest in the Spitsbergen reindeer. Further, it will be seen that between specimens from the various localities shown in the table there is not any striking difference in the conditions mentioned.

Besides the difference in breadth, the shape of the posterior nasal aperture is also somewhat different in the Spitsbergen reindeer from the others. A profile view of the cranium (Pl. I) shows that the pterygoid points do not slope downwards so much in the Spitsbergen reindeer as in the Greenland reindeer as well as in wild reindeer from Southern Norway, tame reindeer from Finmark, Sweden, and Finland. In all these the "slope" is very similar, irrespective of whether they are "woodland" or "mountain" reindeer. Also in a large, full-grown specimen (male) from King William Land, Arctic America, both breadth and shape of the posterior nasal aperture are entirely in accord with the Greenland and European specimens.

The *vomer*, which in the genus *Rangifer*, as opposed to the genus *Cervus*, is united even with the posterior part of *crista canalis* of *palatinae*, extends, in full-grown reindeer from the Continent, as far back as the *ossa pterygoidea*. In the calveskulls the *vomer* is united with the *crista canalis* entirely or almost entirely back to the posterior part of the latter. In skulls, both of calves and full-grown specimens from the Continent, the *vomer* stretches forward and practically right

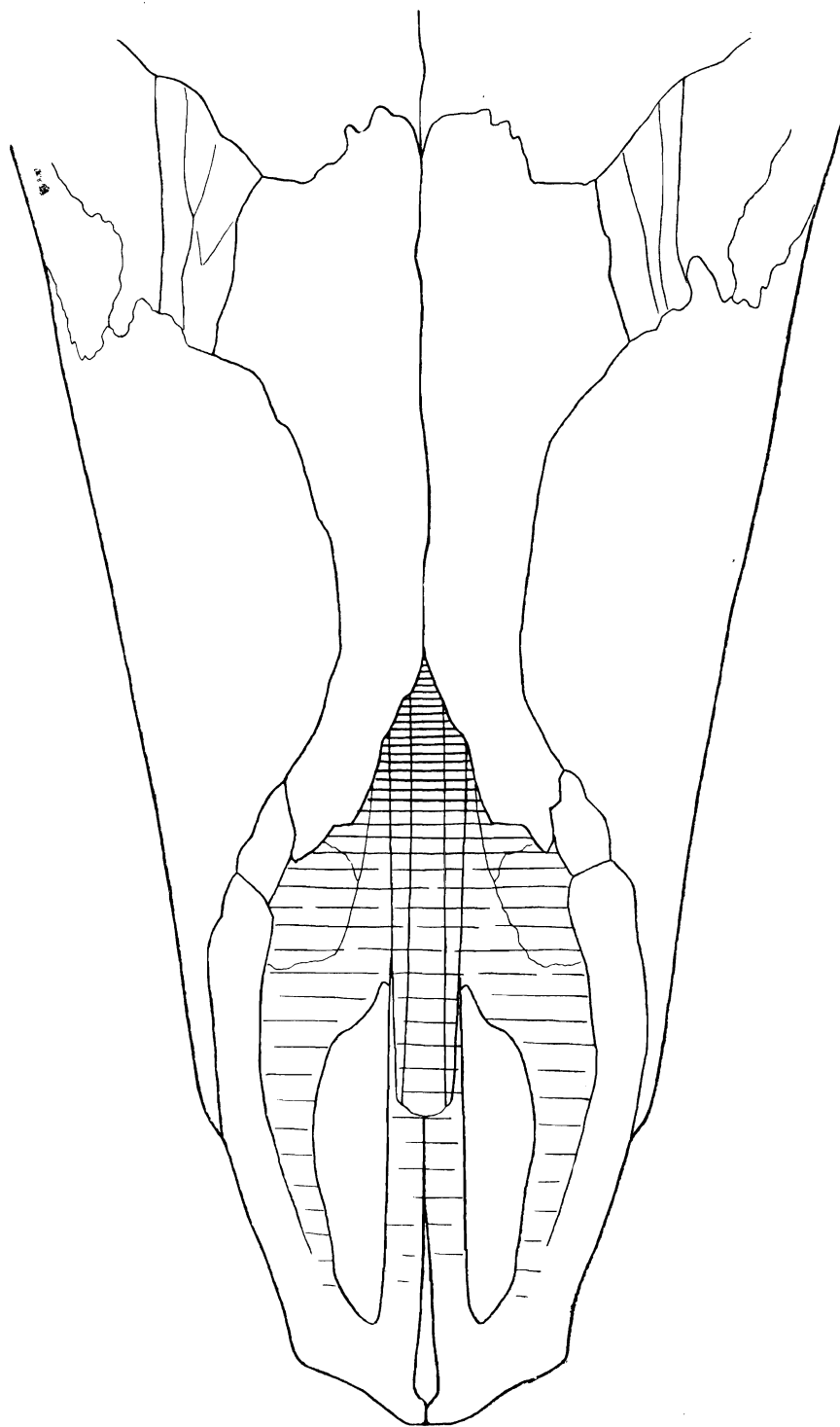


Fig. 4. *Nasalia* &c. of Spitsbergen Reindeer from above, ♂.

up to the basal part of *os sphenoidum posterius*, so that *os sphenoidum anterius*, in the ventral view, is practically altogether hidden by the posterior and upper point of the *vomer*.

In Spitsbergen skulls, on the contrary, the *vomer* seldom extends either so far back or so far up with the posterior points. In all calf skulls from Spitsbergen the posterior part of *os sphenoidum* is therefore for the greater part visible, and this is the case even in full-grown ones, indeed even in old specimens, as the ossification of the posterior part of the *vomer* is only seldom so far advanced as in the Continental reindeer. (Greenland reindeer and the above-mentioned cranium from King William Land correspond in this respect to the material from the European continent)¹.

Distance between Cheek-Teeth Rows.

In all reindeer skulls the distance between the first pair of premolars is smaller than between the first pair of molars. In other words, the first half of the teeth rows is in all cases divergent backwards. The difference between the two distances varies for males from the Sunjel forest districts between 7 and 16, from Inari 5—13, from Utsjoki 5—14, from Karesuando 9—15, from North Varanger 7—15, from South Varanger 6—16, from Petschenga 7—14, from Karasjok 6—15, from Magerøy 9—15, from Greenland 7—16, for the Spitsbergen

¹ It may be of interest in this connection to be reminded of the phylogenetic and systematic importance of *vomer* in *cervidae*. ADOLF RÖRIG writes in his work: "Das Wachstum des Schädels von *Capreolus vulgaris*, *Cervus elaphus* und *Dama vulgaris*" (Bibliotheca Medica, Abt. A. Anatomie, herausgegeben von Professor Dr. Wilh. Roux, Stuttgart 1904) p. 3: "Der Bau des Pflugscharbeines, Vomer, hat hervorragende Bedeutung und sowohl phylogenetische wie systematische Wichtigkeit für die Glieder der Cervidenfamilie erlangt. Bei einer gewissen Gruppe dieser Familie ist die senkrechte Platte des Vomer weiter nach rückwärts ausgedehnt und weiter nach unten verlängert als bei anderen, so dass sie eine knöcherne Scheidewand bildet, die das Rhinarium in zwei völlig voneinander getrennte Abteilungen scheidet. Ein solches Verhalten ist bei sämtlichen endogenen amerikanischen Cervidenarten (incl. des Renttieres, *Rangifer tarandus*) festgestellt worden. Ähnlichen Bau des Rhinariums zeigen auch die Schädel aller geologisch älteren Cervidenformen. Die amerikanischen Cerviden haben daher in dieser Hinsicht einen altertümlichen Charakter bewahrt. Bei allen in der alten Welt (Europa und Asien) heimischen Cervidenformen (einschliesslich des in der Postpliocänzeit oder vielleicht auch schon früher nach Amerika ausgewanderten Wapiti (*Cervus canadensis*)) ist der hintere Raum des Rhinariums durch die senkrechte Platte des Vomer nicht in zwei Abteilungen geschieden. Und einen gleichen anatomischen Bau zeigen unter vorweltlichen Cerviden *Cervalces americanus* und *Cervus megaros*. Diese hier erwähnte Verschiedenheit des Baues der senkrechten Platte des Pflugscharbeines hat zu der Trennung in ticho- und holothine Cervidengruppe die Veranlassung gegeben".

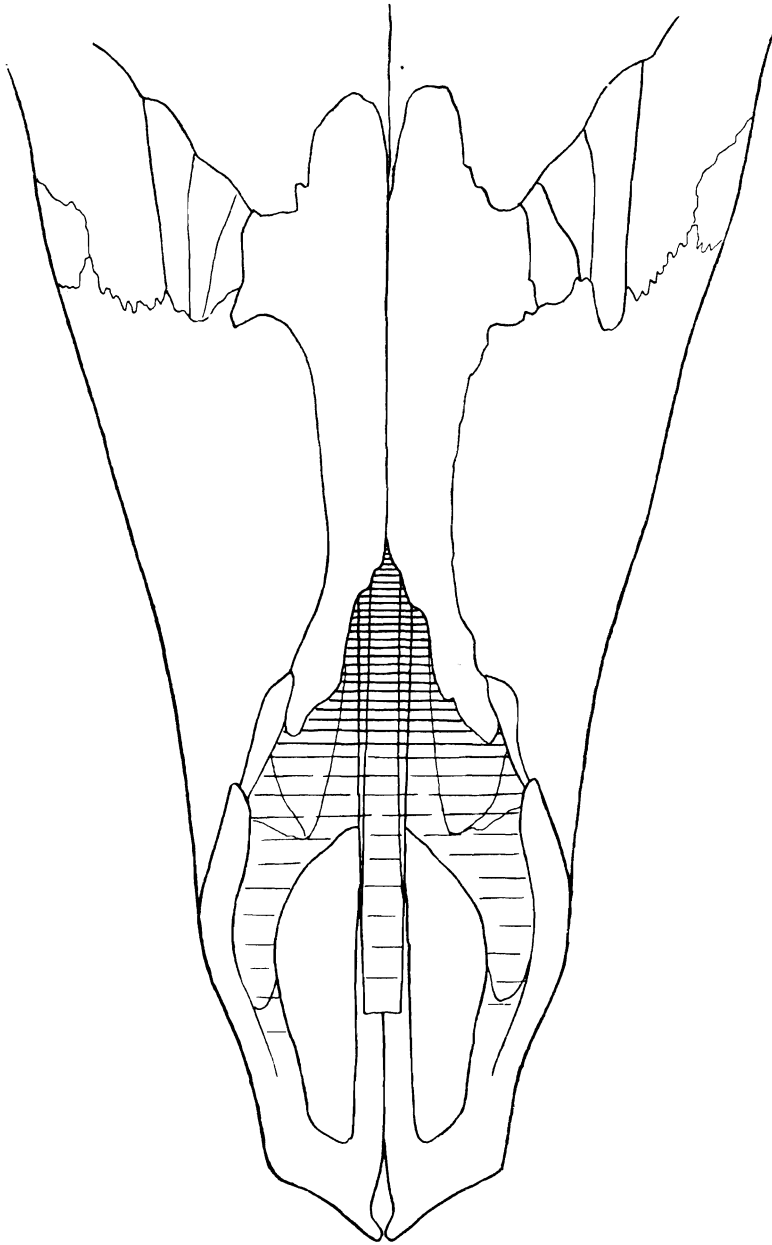


Fig. 5. *Nasalia* &c. of Spitsbergen Reindeer from above, ♂.

reindeer on the contrary between 12—20 mm. In the Spitsbergen reindeer there is thus, to judge from my material, an indication of a stronger divergency in a backward direction of the teeth-rows in their front half. For specimens from Greenland and the Continent, on the contrary, the distance changes between the first pair of premolars and the first pair of molars within fairly similar variation limits.

Nasalia.

Amongst the osteological characteristics in the reindeer cranium, which in a prominent degree have been the object of attention in the study of different reindeer races, the form and size of *nasalia* may be specially mentioned. In the first place, says LÖNNBERG, in his characteristics of woodland and mountain reindeer, it is evident that the shape and appearance of the nasal bones are quite unlike in both forms, and previous authors like ANDERSÉN, LILLJEBORG, NITSCHÉ, CAMERANO, and others, assert in a special degree the differences in the shape of *nasalia*, in distinguishing Spitsbergen from Lapland and other reindeer, and the differences have been considered so strongly marked, so constant, that they have been given value as racial marks. My material of wild and tame reindeer both from Scandinavian mountain districts and from Finland forest tracts, shows all transitions between flat nasal bones, which according to LÖNNBERG are characteristic of mountain reindeer, and highly arched, nasal bones which is said to be characteristic of woodland reindeer.

My material from Spitsbergen, on the contrary, shows considerably more conformity with the characteristics of the form and size of the nasal bones as employed by previous investigators.

ANDERSÉN maintains that the Spitsbergen reindeer, compared with those of Lapland and Greenland, have the narrowest nasal bones. The largest and broadest nasal bone, according to this author, is possessed by the Lapland animal; even the Greenland reindeer has a smaller nasal bone than the Lapland type. As to the length of the nasal bones, ANDERSÉN states that in the Spitsbergen reindeer it can hardly be contained three times in the length of the head, whilst in the Lapland reindeer the length of *nasalia* is contained almost four times in the length of the head. *Nasalia* are thus said to be relatively longest in the Spitsbergen reindeer.

My material show that in the Spitsbergen reindeer there is generally a greater difference between the breadth of the nasal bones at their narrowest and their breadth in front, than in both the Greenland and other reindeer. Thus, in the Spitsbergen reindeer the foremost half of the nasal bones is not, as a rule, so equal in breadth as in Lap-

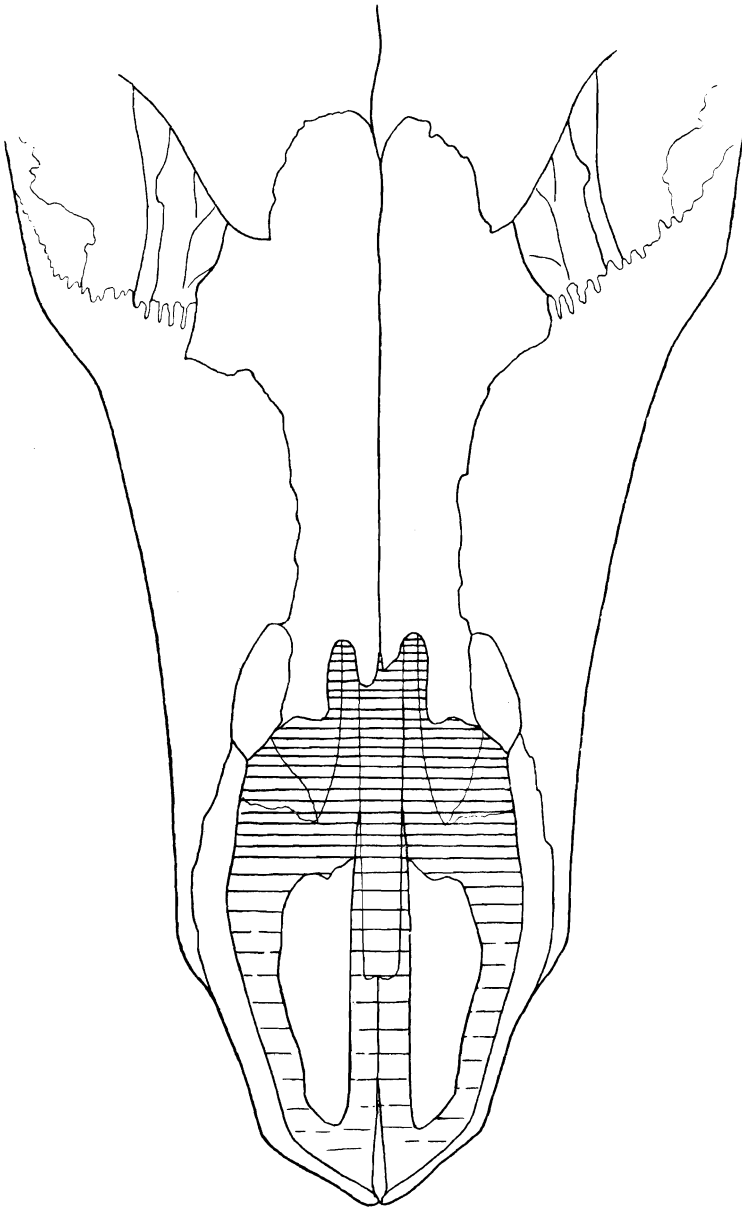


Fig. 6. *Nasalia* &c. of Spitsbergen Reindeer from above, ♀.

land, Greenland, and other reindeer; the breadth in front is relatively greater in the Spitsbergen reindeer. From Fig. 6, a full-grown female from Spitsbergen, it will however be seen that the front half of the nasal bones may be almost entirely equal in breadth right to the tip. In general, however, the breadth right in front of the nasal bones in the Spitsbergen reindeer even absolutely is not very much smaller than that of the rest of the reindeer in my material, in spite of the skulls being a good deal smaller. The breadth of the posterior part of the nasal bones, on the other hand, is smaller, and not in any of the full-grown specimens in my material from Spitsbergen is the breadth of the nasal bones in front less than the half of their greatest breadth behind; most often the breadth in front is over 60 per cent. of the breadth behind (in 3 out of 11 cases it is less than 60 per cent.).

When NITSCHÉ states in the case of the Lapland tame reindeer that the nasal bones have their narrowest part "am Vorderende der Nasenbeine", it would be a mistake to understand this otherwise than that the narrowest part of the nasal bones is, as a rule, further forward in the Lapland than in the Spitsbergen reindeer. Most often indeed the nasal bones are somewhat widened in the front part also in the Lapland and other reindeer.

Confirmation of ANDERSÉN's opinion as to the length of the nasal bones being contained scarcely three times in the cranium length or Spitsbergen reindeer, whilst it is contained nearly four times in the Lapland animal, I have not, however, been able to find in my material. The length of the nasal bones varies in the Spitsbergen reindeer as well as in the Greenland and Lapland types between $\frac{1}{3}$ and $\frac{1}{4}$ of the total length of the skull.

The difference in breadth and shape is, however, rather striking. Besides the mentioned greater breadth of the nasal bones in front, their anterior end is incised otherwise than in Greenland, Lapland, and the other skulls in my material. LILLJEBORG has already pointed out the characteristic shape of the anterior part of the nasal bones in the Spitsbergen reindeer. LILLJEBORG says that the nasal bone from the inner side outwards is cut obliquely, so that the front edges of both nasal bones form an acute inward angle, whilst in the Lapland reindeer the front ends are cut almost square and with a deep sinuosity. This difference is pointed out by LILLJEBORG to be the most essential one between Spitsbergen and Lapland reindeer, and, although the characteristic quoted from LILLJEBORG as to the shape of the nasal bones is not always an altogether apt one, yet it is correct in the main, and this is confirmed not only by the material examined by me, but also by other authors, e. g., NITSCHÉ and especially CAMERANO [4] (1901), who have had considerably more material than LILLJEBORG. Not only specimens of tame

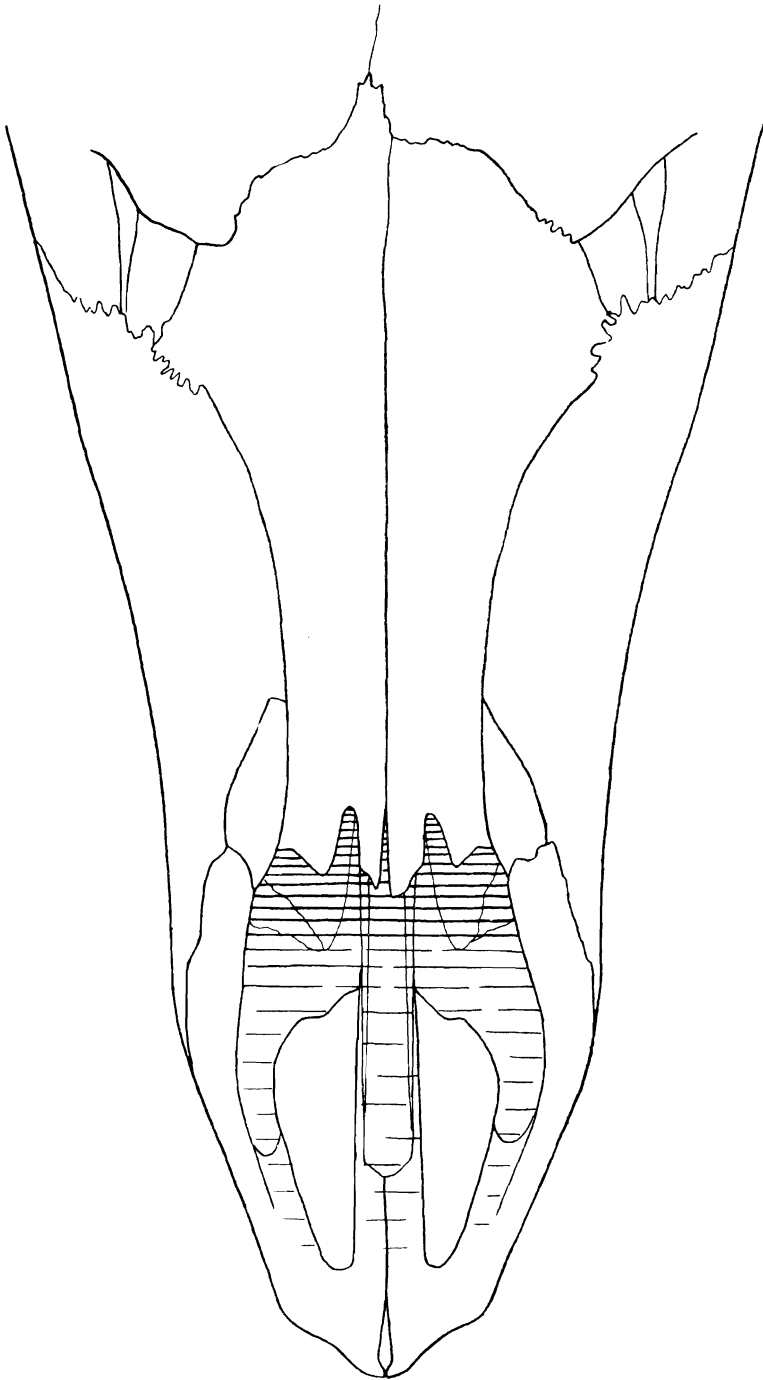


Fig. 7. *Nasalia* &c. of Reindeer from Karesuando from above, ♂, 3¹/₂ years old.

reindeer from Finmark, Karesuando, and Russia, but also wild reindeer from South Norway, Greenland, Novaya Zemlya (wild?), and Arctic America are most often strikingly divergent from Spitsbergen reindeer in the shape of the nasal bones. All have, as distinct from the Spitsbergen reindeer, the nasal bone often cut square or most often cut aslant (generally somewhat incised) from the outer side forward (practically never backwards), with a deep sinuosity, so as to form an often relatively long forward-pointed tip on the inward side of each nasal bone. These tips on each side of the middle-line very frequently project farther forward than the side-parts of the nasal bones bordering on the *os supramaxillare accessorium*. In the Spitsbergen reindeer the tips are either entirely absent or relatively slightly prominent. No other specimen of the Spitsbergen skulls has such long tips as the one from which Fig. 6 is taken. The difference between the shape of the nasal bones in Spitsbergen reindeer and the others will, on the whole, appear better from the appended figures than from a description. Fig. 4 shows a strongly notched nasal bone of an old male from Spitsbergen which is the nearest approach to LILLJEBORG's description. Projecting points on each side of the mid-line are completely wanting.

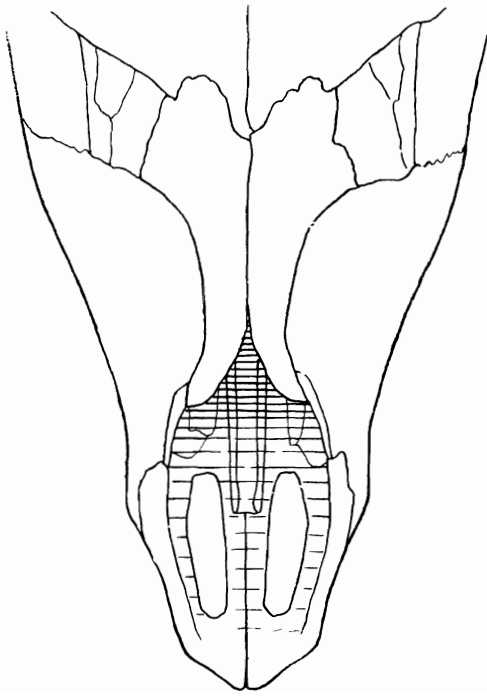
Fig. 5 gives a sketch of another common form. With this figure NITSCHÉ's sketches pp. 122, 123 show the closest agreement.

Fig. 6 represents the nasal bone in my Spitsbergen material whose shape bears the greatest likeness to the Finmarken and other reindeer.

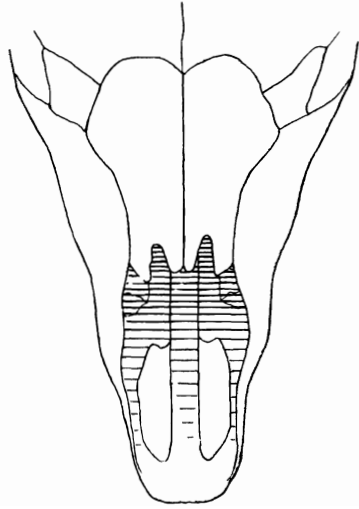
For comparison Fig. 7 of a 3½ years old uncastrated male from Karesuando is included, also photographs of Norwegian and Greenland skulls (Pl. II—III), and Pl. IV—V of skulls of a Spitsbergen and a Lapland reindeer.

The difference in shape has proved constant, not only amongst all the full-grown specimens — females as well as males — but also in calves, and even in the smallest calves only a few days old this difference is already strongly expressed. Sketches are given of nasal bones in 2 of the smallest calf skulls in my material from Spitsbergen, of which the one (Fig. 8) lacks every trace of pointedness on each side of the mid-line in front, the other (Fig. 9) is supplied with quite short points. The other calf skulls in the Spitsbergen material are sometimes like the latter, sometimes most like the former. For comparison I give figures of a calf skull from King William Land, (Fig. 10) from Namdal (Fig. 11) and Finmark (South Varanger, Fig. 12). The difference is clearly seen from the figures, and further explanations are unnecessary.

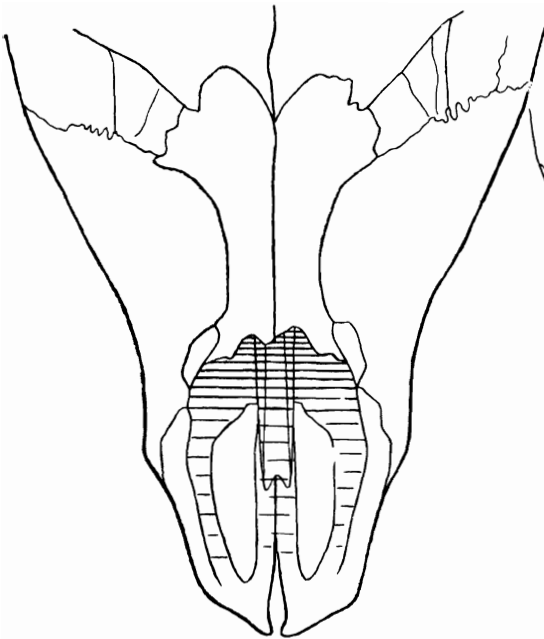
LILLJEBORG holds (p. 839) that *frontalia* often shoot a little forward between the nasal bones in the Spitsbergen reindeer. This condition is neither characteristic nor constant in this reindeer. It varies



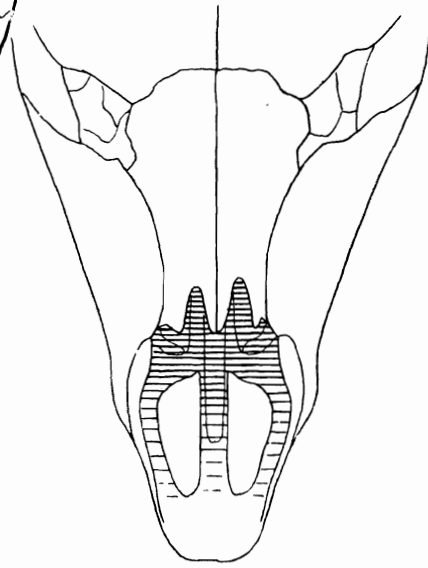
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10



9



11

Fig. 8—11. *Nasalia* &c. of Reindeer from above.
Fig. 8--9. Calf from Spitsbergen. Fig. 10. Calf from King William Land.
Fig. 11. Calf from Namdal (Norway).

just as much in Spitsbergen reindeer as in the other types of which I have had material for examination, a condition to which also NITSCHE has already called attention.

Os supramaxillare accessorium.

The form of this small bone, which on each side borders the front part of the nasal bones, is stated by NITSCHE (1893) to be different in the Spitsbergen and the Lapland reindeer.

NITSCHE [22], p. 123, says: "Ferner ist das Os supramaxillare accessorium bei den Spitzbergenrennen viel schmaler und mehr spindelförmig als bei den Lapplandsrennen, bei denen es ungefähr ein Deltoid, d. h. ein langgezogenes Viereck mit zwei rückwärts gewendeten langen und zwei vorwärts gewendeten kurzen Seiten bildet. Auch grenzt das Zwischenkieferbein bei den Spitzbergenrennen nur mit einer ganz kleinen Stelle an das Vorderende des Os supramaxillare accessorium, während bei den zahmen Rennen diese Berührung sich auf die ganze äussere kurze Seite des Vierecks erstreckt".

The great majority of the specimens of Spitsbergen reindeer in my material correspond in all essentials with NITSCHE's drawings and his above description of the bones mentioned. However, they are as a rule not quite so narrow and fusiform as NITSCHE depicts them, and in some older male skulls the departure from the form described by NITSCHE is very considerable; instead of fusiform it is short and almost square, about as long as broad (see Fig. 4). In the Greenland specimens and in reindeer from the Continent the *os supramaxillare accessorium* is very variable in size and shape. In several cases the branches of *praemaxillare* project right up to the nasal bones, and nothing or very little of the *os sup. accessorium* is then visible¹, in other cases the *os sup. acc.* is slender, fusiform as is general in the Spitsbergen reindeer, in other cases large, broad, and of an approximately square shape. The Russian woodland reindeer, Finmarken mountain reindeer, Greenland and South Norway reindeer, all vary so considerably as to the shape of the *os sup. acc.*, that it is not possible to claim any special shape as prevalent in the one more than in the other. This can only to a certain degree be done as far as the Spitsbergen reindeer is concerned, in which *os sup. acc.* usually has a slender fusiform shape.

¹ The condition is then as in the genus *Cervus*, for which is stated as being characteristic that *praemaxillaria* reach up to the nasal bones, in contrast to the *Rangifer* genus, in which *praemaxillare* is said to reach only up to the *os supramaxillare accessorium*, not to the nasal bones (cf. LILLJEBORG [12], pp. 787 and 830–831).

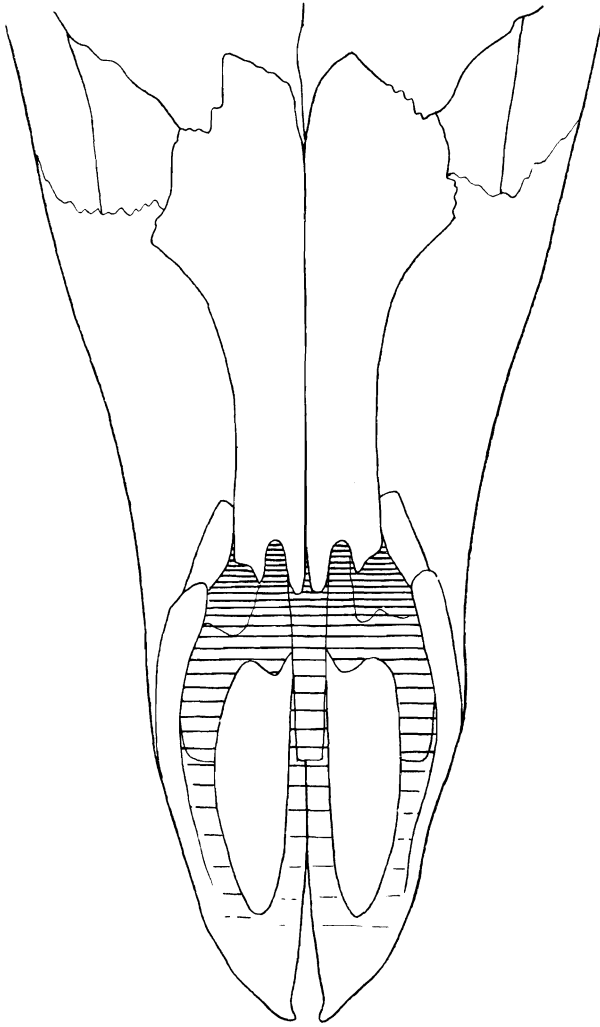


Fig. 12. *Nasalia* &c. of Calf from Finmark, Norway, from above.

Ossa parietalia.

As to the shape of that part of *ossa parietalia* which shoots forward between the antlers, NITSCHE calls attention to a striking difference between Spitsbergen and Lapland reindeer. On page 125 he says:

“Ein ganz auffälliger Unterschied zwischen den Spitzbergenrennen und den Vergleichschädeln besteht aber in der Gestalt des Scheitelbeines, und auf diesen ist weder von ANDERSÉN noch von LILLJEBORG hingewiesen worden. Wie man leicht aus dem Vergleiche von Fig. 5 mit Fig. 3 ersieht, ist nämlich der Zwickel des Scheitelbeines, der sich von hinten her zwischen die beiden Stirnbeine resp. die Stirnzapfen vorschiebt, viel schmaler bei den Spitzbergenrennen als bei den Vergleichschädeln, und während bei den Vergleichschädeln das Vorderende des Scheitelbeines fast quer abgeschnitten ist, bildet es bei den Spitzbergenrennen eine vorspringende Spitze in der Mitte. Doch nähert sich der russische Schädel etwas mehr den Verhältnissen der Spitzbergenrennen, als die beiden Laplandsschädel”.

NITSCHE himself comes very near to a right explanation of what significance the striking difference ought to be given, but he has lacked a sufficient number of skulls with reliable records as to sex, so that he does not venture to express himself definitely on this point. On page 125 he says:

“Einen durchgreifenden Wert kann ich aber diesem Merkmale darum nicht beimessen, da diese Bildung mit der Stärke des Geweihes zusammenhängen scheint. Denn wengleich ein direkter Vergleich der Geweihe aller Vergleichsschädel nicht möglich ist, da sie, wie gesagt, von Schädel C und D abgesägt sind, so zeigen doch die Dimensionen der stehen gebliebenen Rosenstöcke, dass die Schädel C und D weit schwächere Geweihe trugen, als Schädel E, der sich auch wirklich mehr den Spitzbergenschädeln nähert. Es ist ferner zu bemerken, dass zwei ganz starke männliche Rennschädel unserer Sammlung — — —, sich den Verhältnissen der Spitzbergenschädel in betreff der Scheitelbeinbildung bei weitem mehr nähern, als denen der übrigen älteren weiblichen Rennschädel unserer Sammlung”.

Of the two specimens, the one a Lapland, the other a Spitsbergen type, of which NITSCHE gives sketches, and for which, as above quoted, he points out the striking difference in the shape of the parietal bone, he supposes that the Lapland specimen is that of a female, the Spitsbergen one, however, of a male. And just herein lies the explanation of the difference in the shape of the parietal bone, not in the fact that in the one case we have a Lapland reindeer in the other a Spitsbergen one. We have to deal with a pronounced sex-character, and we may readily say also an age-character, since the character becomes more and more pronounced

the older the animals get. If the parietal bones in full-grown males and females of all the specimens in my material be compared, it will at once be seen that the shape of that part of the parietal bone which shoots forth between the antlers, is obviously different in the two sexes, irrespective of the origin of the skulls. The difference is closely connected with the difference in the size of the antlers in the two sexes. In small calves, in which the horn-cores have not yet grown out, there is only a weak protuberance of the parietal bone, Fig. 13 a (Fig. 13 b is of a somewhat older calf). The thickness of the pedicles increases with the age, and in old males grows very much thicker than in females. The skull part between the pedicles is thus differently shaped — in the old males it is pressed harder together between the cabbages (fig. 14 a, b). Often it increases again in breadth towards the boundary of the frontal bone. The anterior edge of this part is in older animals as a rule almost cut square, in other full-grown, but not old, animals it is often an angular projection (Fig. 13 c).

Females (Fig. 14 c, d) on the contrary maintain in a far greater degree the evenly rounded shape, which — broader or narrower according to age — the lingulated projection of the parietal bone has in younger animals. In some males with more than normally slender antlers the projection closely corresponds to that in females.

Cheek-Teeth in Maxillae.

One of the characters which have been specially emphasized in the establishment of certain reindeer races, is the length of the cheek-teeth rows. LÖNNBERG [16], p. 12, mentions the unequal size of the different cheek-teeth in woodland reindeer and mountain reindeer as a particularly interesting and important character, and urges as a specially important dissimilarity between the Finland reindeer and the Scandinavian mountain reindeer, that the former, quite contrary to what might be expected, has considerably shorter cheek-teeth rows than the latter.

If we first consider the Spitsbergen reindeer, there is no doubt that it has a length of cheek-teeth row relatively greater than the other reindeer in my material. The ratios, which indicate the length of the cheek-teeth row in proportion to the total length of the cranium, vary in full-grown males between 27.1 and 31.5 and in females between 29.8 and 32. For males the ratios in most cases are somewhat lower than 30, for females somewhat higher. It seems on the whole to be a general rule for all females, not only for the Spitsbergen females, that they have a relatively longer teeth row in proportion to the length of the cranium than males, that is, the absolute length of the teeth row

in females and in males is not particularly different, and, as the males have generally longer skulls, the ratios which express the length of the teeth rows in proportion to the length of the skulls, will accordingly be lower as far as males are concerned. If we now compare the corresponding ratios of the rest of the material with those of the Spitsbergen reindeer, the latter are found to be almost as often under as over 25 in the case of males, and never in any instance to reach as high as 30; in the case of females the ratio is only in quite a few instances over 30.

Comparing the actual figures for the length of teeth rows in the Spitsbergen reindeer and reindeer from other localities, it will at once be evident that the ratios for the Spitsbergen reindeer must be considerably higher. In the Spitsbergen reindeer the actual length of the teeth rows is almost of the same length as in the other reindeer, or often even greater, in spite of the fact that the skulls are shorter. Comparing, for example, males from Karesuando with full-grown males from Spitsbergen, the latter show a decidedly higher figure for the length of the rows. In 9 Karesuando males the length of the teeth rows varies between 81 and 87 mm. (average 83,89 mm.), in 5 Spitsbergen males, on the contrary, between 85 and 93 mm. (average 90 mm), that is, almost nearly the same as CAMERANO has found to be the average for a score of specimens from Spitsbergen. Of Karesuando males 4 were larger than the largest from Spitsbergen; the wearing away of the teeth in the Spitsbergen reindeer was, on the whole, just as great as in the former, but not in any of them so advanced that the length was thereby perceptibly diminished (one of the specimens with the longest row, 93 mm., had the teeth almost worn away). When, however, the wear of the individual teeth has reached the *collum* the reduction of the whole length of the row will be distinctly noticeable; LÖNNBERG also calls attention to this. He says in a note [16], p. 176, that smaller measurements may however sometimes be obtained from stunted specimens or from such as are so old that the teeth are worn down to the *collum*, in which case the measure of the total row must be shorter. A tooth not too worn has a considerably smaller diameter both above and below than in the middle. In older animals in which the upper and middle part of the crown of the teeth are worn off, the diameter of the remaining part will, as a result, be smaller than in a young animal, and the whole length of the molar series will thus also be shorter. Before the wear of the teeth has reached the *collum* or, on the whole, below the middle part of the crown, the reduction of the whole length of the row is inconsiderable; some reduction, however, takes place, caused chiefly by the fact that the single teeth in one and the same row are ground against each other.



Fig. 13. *Ossa parietalia* of Reindeer of different ages.
a. Calf from King William Land (North America). *b.* Calf from Spitsbergen.
c. Male from Spitsbergen. *d.* Male from Spitsbergen.

In specimens with newly full-grown molars we shall find that the single teeth in a row touch each other with a smaller surface than in older specimens. As, however, the reduction of the whole length of the row caused in the last-mentioned manner is inconsiderable, and the individual variations in the length of the row are very great, and the degree of wear amongst animals of equal size and age is often rather variable, no noticeable mistake will be made in comparing, as LØNNBERG has done, the different specimens without really knowing the exact age of all specimens compared, so long as we know that they are full-grown and, moreover, are so old that the teeth are worn down below the middle part or nearly down to the *collum*.

**Distance between the Jugals, Processus styliformes tympani,
and Processus paramastoidei.**

In establishing the Spitsbergen reindeer as a separate race. ANDERSÉN [2] calls special attention to the distance between the tips of the *processus styliformes tympani* in proportion to the breadth between the jugals. In ANDERSÉN'S treatise there is unfortunately no actual measurement given and only a few ratios. As to the differences between certain cranial or other skeleton parts, it is most often simply stated that they are larger, smaller, longer, shorter, etc. in the one race than in the other. One of the few proportions which have been described in figures is, however, the distance mentioned between the tips of the *proc. styl. tympani* compared with the breadth between the jugals. In the Spitsbergen reindeer, according to ANDERSÉN, the distance between the tips named is smaller than in the Lapland reindeer, the breadth between the jugals, on the contrary, is greater. ANDERSÉN gives the proportion in the Spitsbergen reindeer, between the distance between the *proc. styliformes tympani* and the breadth between the jugals as $1\frac{1}{2}:1$; in the Lapland reindeer, on the other hand, $\frac{2}{3}:1$.

From the measurements I have taken of skulls from Spitsbergen (cf. Tab. VII) it appears that the above-mentioned proportion both in males, females, and calves is very near $\frac{1}{2}:1$. In the males the proportion varies from 0.43:1 to 0.50:1, in females from 0.45:1 to 0.49:1, in calves the proportion is, as may reasonably be expected, somewhat more variable, (from 0.45:1 to 0.53:1).

In Greenland specimens the proportion is not perceptibly different; it varies in full-grown males from 0.41:1 to 0.47:1, in females from 0.41:1 to 0.51:1. In a male calf with a length of skull of 161 mm. the proportion is 0.62:1.

For both Spitsbergen and Greenland reindeer the proportion is thus very nearly in accordance with ANDERSÉN'S statement. On the other hand, I cannot find in the Lapland reindeer the proportion

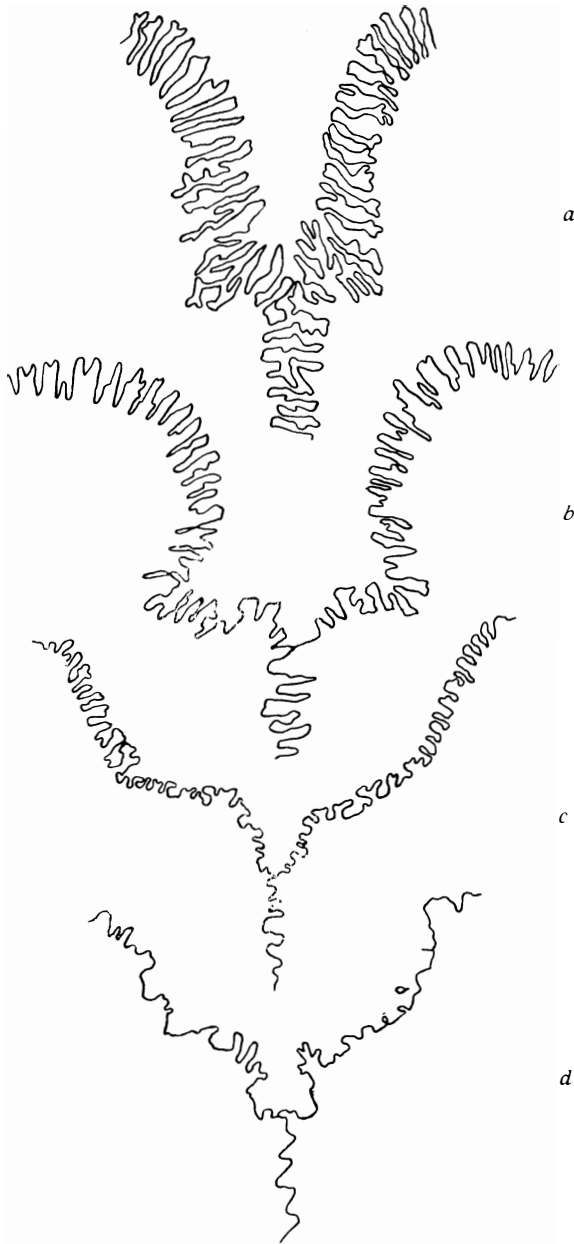


Fig. 14. *Ossa parietalia* of Reindeer of different sexes and ages.
a. Male (15½ years old) from Sunjel. b. Male (5½ years old) from Sunjel.
c. Female (5½ years old) from Sunjel. d. Female from Spitsbergen.

as ANDERSÉN gives it, $\frac{2}{3} : 1$; there is also in the latter a proportion which very nearly corresponds with that in the Spitsbergen and Greenland animals, namely about $\frac{1}{2} : 1$; mostly, however, just as in these, the dividend is somewhat less than $\frac{1}{2}$.

For the reindeer from the different localities the proportion varies between the following limits:

	Males	Females
Sunjel	0.39—0.50 : 1	0.40—0.51 : 1
Inari	0.44—0.52 : 1	0.47—0.53 : 1
Utsjoki	0.41—0.55 : 1	0.46—0.50 : 1
South Varanger	0.44—0.49 : 1	0.40—0.52 : 1
Petschenga	0.46—0.49 : 1	0.48 : 1 (2 spec.)
Karasjok	0.45—0.53 : 1	0.48—0.53 : 1
North Varanger	0.46—0.53 : 1	0.44—0.54 : 1
Repvåg-Magerøy	0.43—0.53 : 1	0.40—0.53 : 1
Karesuando	0.43—0.53 : 1	0.49—0.54 : 1

The downward pointed, short processus in the reindeer cranium, for the most part concealed between the base of *processus paramastoideus* and *bulla ossea*, which, seen from below, has an almost circular terminal face of a few millimetres diameter (cf. Fig. 2), I have understood as being homologous with *processus styloideus* or *styliformis* in *Homo*. NITSCHÉ, however, regards the forward pointed tip of *os tympanicum* as *processus styloideus* or *styliformis* (cf. Fig. 2). The distance between the tips of the forward pointed part of *os tympanicum* is found by NITSCHÉ to be so considerably different from that given by ANDERSÉN, that he considers it most probable that ANDERSÉN with *processus styliformis* has meant *processus paramastoideus*, that is to say, the large, strong, conspicuous process right behind the *os tympanicum*. In 2 Norwegian reindeer from Komagfjord and 1 Russian NITSCHÉ finds that the proportion between the distance between the paramastoid points and the breadth between the jugals is as 0.55, 0.60 and 0.57 : 1 respectively; in 2 Spitsbergen animals, on the other hand, 0.50 : 1. "Es ist also bei den Spitzbergrenen" says NITSCHÉ p. 120, "allerdings das Verhältnis verschieden von dem bei den Lapplandsrenen, aber durchaus nicht so sehr, wie ANDERSÉN angiebt".

In my material of Spitsbergen reindeer, I find that the above mentioned proportion is as a rule consistent with the proportion between the distance between the *processus styliformis* and the breadth between the jugals, namely, approximately $\frac{1}{2} : 1$. In males it varies from 0.45 : 1 to 0.50 : 1; in females from 0.44 : 1 to 0.48 : 1; in calves from 0.46 : 1 to 0.54 : 1.

The proportion thus agrees as nearly as possible with that given by ANDERSÉN and NITSCHÉ.

In male Greenland reindeer the proportion proves somewhat different. In a single case the proportion is 0.41 : 1, for the rest it varies from 0.50 : 1 to 0.61 : 1; in most cases the distance between the paramastoid points is somewhat more than half of the breadth between the jugals; in the Spitsbergen reindeer the same distance was mostly somewhat smaller and never greater than half of the breadth named.

In the Russian and Finland, Norwegian and Swedish reindeer, the proportion is as follows:

	Males	Females
Sunjel	(0.44) ¹ 0.58—0.64 : 1	0.51—0.60 : 1
Inari	0.61 : 1 ²	
Utsjoki	0.55—0.68 : 1	Defective
South Varanger	0.54—0.60 : 1	0.53—0.57 : 1; 2 spec.
Petschenga	0.57—0.63 : 1	Defective
Karasjok	0.53—0.60 : 1	(only 2 spec., the others defective).
		0.55—0.56 : 1
North Varanger	(0.45) ³ 0.50—0.60 : 1	0.49—0.58 : 1
Repvåg-Magerøy	0.54—0.60 : 1	0.50—0.56 : 1
Karesuando	0.50—0.63 : 1	0.49—0.56 : 1

To judge from these ratios the Spitsbergen reindeer has undoubtedly a characteristically small distance between the paramastoid points in proportion to the breadth between the jugals; however, as NITSCHÉ says, it is not so widely different from the Lapland reindeer, as ANDERSÉN has claimed. It is only in some few exceptional cases, in 2 Utsjoki males, that the distance between the paramastoid points is quite $\frac{2}{3}$ of the breadth between the jugals, it is quite often nearer half than two-thirds of this breadth. I consider it beyond doubt that ANDERSÉN with the *processus styloformis* has meant *processus paramastoideus*. For whether one measures the distance between the forward pointed tips of *os tympanicum*, which NITSCHÉ regards as *processus styloideus*, or between the processes, which I have looked upon as the styloid processes, the difference between the values found by ANDERSÉN, and those found by NITSCHÉ as well as by myself, will be considerably larger than if one measures the distance between the paramastoid processes.

¹ In a single case.

² In one specimen; in the others the paramastoid points were defective.

³ In a single specimen.

Maxillae.

The *maxilla*, according to ANDERSÉN, is higher (broader) in proportion to the length in the Spitsbergen reindeer and in the Lapland type than in the Greenland reindeer. ANDERSÉN has not stated any actual proportion between height and length.

From Tab. XII it will be seen that the height of *maxilla* in the Spitsbergen reindeer measured by me is from 38.8 per cent. to 41.9 per cent. of the length in males, and from 37.9 per cent. to 43.3 per cent. in females (in calves from 37.9 per cent. to 46.2 per cent.). Of the total cranial length in males *maxilla* represents from 52.5 per cent. to 54.2 per cent., in females from 52.6 per cent. to 55.1 per cent. In calves *maxilla* is usually shorter, the smaller the skulls are; as the teeth are developed to full number and size, the length of *maxilla* increases in proportion to the length of the skull. In the Greenland reindeer it is found that the breadth of *maxilla* in the full-grown males varies between 41.0 per cent. and 47.8 per cent., in females between 40.4 per cent. and 46.2 per cent. In proportion to the total length of the skull the length of *maxilla* in males varies between 43.3 per cent. and 53.3 per cent., in females between 49.8 per cent. and 52.5 per cent.

The breadth of *maxilla* in proportion to its length thus seems, according to the measurements taken by me, not to be greater, as stated by ANDERSÉN, but smaller in the Spitsbergen than in the Greenland reindeer. On the contrary, in the considerably smaller Spitsbergen skulls the length of *maxilla* forms on the whole a greater, although inconsiderably greater, percentage of the length of the skull than in the Greenland reindeer.

The variation limits for the breadth of *maxilla* in proportion to length in the full-grown Lapland reindeer examined are:

In males from Sunjel	per cent.	per cent.
— — Inari	38.2—46.5,	in females 37.1—42.3
— — Utsjoki	39.1—44.1,	— 40.5—43.6
— — South Varanger	38.5—45.5,	— 41.2—41.7
— — Petschenga		2 specimens.
— — Karasjok	39.0—44.6,	— 38.3—43.1
— — North Varanger	41.3—44.2,	— 41.4—42.7
— — Magerøy-Repvåg	41.1—44.7,	— 38.4—42.2
— — Karesuando	39.9—44.4,	(34.7) ¹ 37.3—44.8
	37.9—45.3,	— 38.1—47.0
	37.2—43.5,	— 37.6—42.8
		3 specimens.

¹ In one of 17 specimens.

The length of *maxilla* in proportion to length of skull varies between the following limits:

	per cent.		per cent.
In males from Sunjel	48.1—53.4,	in females	50.0—53.9
— — Inari	50.6—53.6,	—	51.7—53.1
— — Utsjoki	49.8—53.4,	—	50.6—52.2
			2 specimens.
— — South Varanger	50.1—53.9,	—	50.4—52.3
— — Petschenga	48.1—51.7,	—	52.1—52.3
			2 specimens.
— — Karasjok	49.4—53.2,	—	50.9—53.9
— — North Varanger	49.9—52.1,	—	50.7—54.2
— — Magerøy-Repvåg	51.2—53.9,	—	50.2—54.6
— — Karesuando	50.1—54.6,	—	49.5—51.8
			3 specimens.

The breadth of *maxilla* in proportion to its length varies in my material of Lapland reindeer between wider limits than in the Spitsbergen and in the Greenland reindeer. The latter can not by any means be said to have a narrower *maxilla* than the Lapland type; rather the reverse. So high a percentage for the height of *maxilla* in proportion to length as 47.5 and 47.8, as the material of the Greenland reindeer shows, does not occur amongst the Lapland deer. The length of *maxilla* in proportion to length of skull seems to be somewhat greater in the Spitsbergen reindeer also compared with the Lapland form. If we now compare the length and breadth proportions of *maxilla* in the Lapland reindeer from the different localities, the variations prove to be quite homogeneous. Reindeer from the forest tracts have neither broader nor longer *maxilla* than those from mountain districts.

Os zygomaticum.

In the Spitsbergen reindeer, according to ANDERSÉN, the length of *os zygomaticum* is shorter than three times its height. In the Greenland reindeer, on the contrary, the length is stated to be quite three times the height.

In my material of full-grown males from Spitsbergen (Tab. XIII), the height of the cheek-bone varies between 33 per cent. and 43.3 per cent. of the length of the same bone; the length is thus from quite 3 times to 2.3 times the height. In females the percentage proportion between the height and length varies from 38.9 per cent. to 44.4 per cent. (2.6 to 2.3 times the height). It is only in one case, a male, that the length is fully 3 times the height; in all the other cases, males and females, the cheek-bone, as ANDERSÉN states, is shorter, mostly a

little shorter than $2\frac{1}{2}$ times the height; in calves it is a little longer than $2\frac{1}{2}$ times, but never fully 3 times the height.

In the Greenland reindeer examined I can, however, not find any confirmation of ANDERSÉN'S statement to the effect that the cheek-bone is longer than in the Spitsbergen type. It is, on the contrary, in several cases shorter than in these, and the length is not in any case fully 3 times the height.

There seems to be no striking difference in the length of *os zygomaticum* in proportion to the length of cranium between the Spitsbergen and the Greenland reindeer; in some of the latter, it is true, the cheek-bone is a small percentage longer; on the whole, however, the percentage figures are of nearly equal value; the cheek-bone in both is sometimes a little more, sometimes a little less than $\frac{1}{3}$ of the length of cranium both in males and females (see Tab. XII a, b), (in males from Spitsbergen 31.2—33.9 per cent. in females 30.9—33.8 per cent.; in males from Greenland 30.1—35.6 per cent. in females 30.4—34.7 per cent.).

According to LILLJEBORG [12], p. 839, the cheek-bones are alike in Lapland and Spitsbergen reindeer, which will also be found confirmed by the numerous (on Tab. XII) measurements and ratios from my material.

Distance between Premolars and Canines.

A relatively short distance between the premolars and the canine teeth is stated by ANDERSÉN to be a racial character in the Spitsbergen reindeer; the distance is, according to ANDERSÉN, longer in the Lapland and longest in the Greenland reindeer. On account of the comparatively longer rows of teeth in the Spitsbergen reindeer the distance from the first pair of premolars to the canine teeth seems at first glance to be, not only absolutely, but also relatively smaller in the Spitsbergen reindeer than in the larger Greenland and Lapland forms. If, however, the distance named is reckoned in proportion to the total cranial length there is no striking difference between the Spitsbergen reindeer and the others.

In my material of Spitsbergen males (Tab. X) the distance mentioned represents 15.7—17.6—18.3 per cent. and 18.7 per cent. of the total length of the cranium (the fifth full-grown male was defective), and in females from 16.8—18.9 per cent; in calves the variation practically falls between the same limits. For Greenland reindeer, which, according to ANDERSÉN, should have the longest distance, I have measurements from Oslo Museum specimens only. In the 4 males the distance varies between 16.2 per cent. and 17.4 per cent. of the total length of the cranium and for the female it is 17.4 per cent. These percentages thus do not confirm ANDERSÉN'S statement, and from

the percentage figures for the Lapland reindeer, it appears, indeed, that there are wider variations amongst this considerably more ample material, but, considered on the average, there is no marked difference in the percentages either between the Lapland and the Spitsbergen or the Greenland reindeer, or between the specimens of Lapland reindeer from different localities. The considerably smaller Spitsbergen skulls have, as was to be expected, an absolutely smaller distance than the rest.

[In none of the specimens I have had an opportunity to examine before the preparation of the cranium — some were from animals up to 17 and 18 years old — have the canine teeth pierced through the gum. The canine-teeth are not worn in any of the specimens. In the specimens, which NITSCHÉ has examined, the same has been the case, and therefore I venture to suppose that it is a general rule for reindeer, that the canine teeth, which are of equal size in both sexes (cf. red deer) constantly remain hidden under the gum].

Besides the closely examined skulls from Spitsbergen mentioned above, which all have a peculiar stamp whereby they can easily be distinguished from all the other reindeer skulls which I have had for comparison both from Greenland and from King William Land and from the European continent, I have had an opportunity to go over a score of skulls from Spitsbergen in the Helsingfors Zoological Museum. All these were also of the same distinctive type. The same thing may be said of ANDERSÉN'S, LILLJEBORG'S, NITSCHÉ'S and CAMERANO'S materials. New-born calves also from Spitsbergen have peculiarities by which they are plainly distinguished from new-born calves of reindeer from the Continent. The differences in the construction of the skull alone in the Spitsbergen reindeer, compared with the others, are so great, so far constant, that, in my opinion, it is quite reasonable that the Spitsbergen reindeer has been regarded as a peculiar race.

Limbs.

Besides the construction of the skull, ANDERSÉN compares the limbs of the Spitsbergen reindeer with those of the Lapland, Greenland and fossil Scanian reindeer. Unfortunately I have not had material of the limbs for the supplementation of ANDERSÉN'S investigations, according to which the Spitsbergen reindeer has a short and broad scapula, a slender humerus, a short tibia and a long metatarsus, whilst, on the contrary, the Lapland reindeer has a long and slender *scapula* and a short foreleg. For the Greenland reindeer ANDERSÉN states: foreleg long, pelvis long, tibia long, and metatarsus short. The difference in length between tibia and the large metatarsal bone in the Spitsbergen reindeer is, according to ANDERSÉN, not 1 dm., whilst,

on the other hand, in the Greenland reindeer the difference in length varies between 4.3 and 1.25 dm.; as to the fossil Scanian reindeer he states that, next to the Spitsbergen reindeer, it has the longest metatarsus.

LÖNNBERG, on the other hand, states (1909) that the Spitsbergen reindeer has short metacarpal and metatarsal bones. The metacarpal bone, according to LÖNNBERG, forms in the Spitsbergen reindeer only about 74.7 per cent. of humerus and the metatarsal bone 93.8 per cent. of the femur, which facts LÖNNBERG regards as a sign that the Spitsbergen

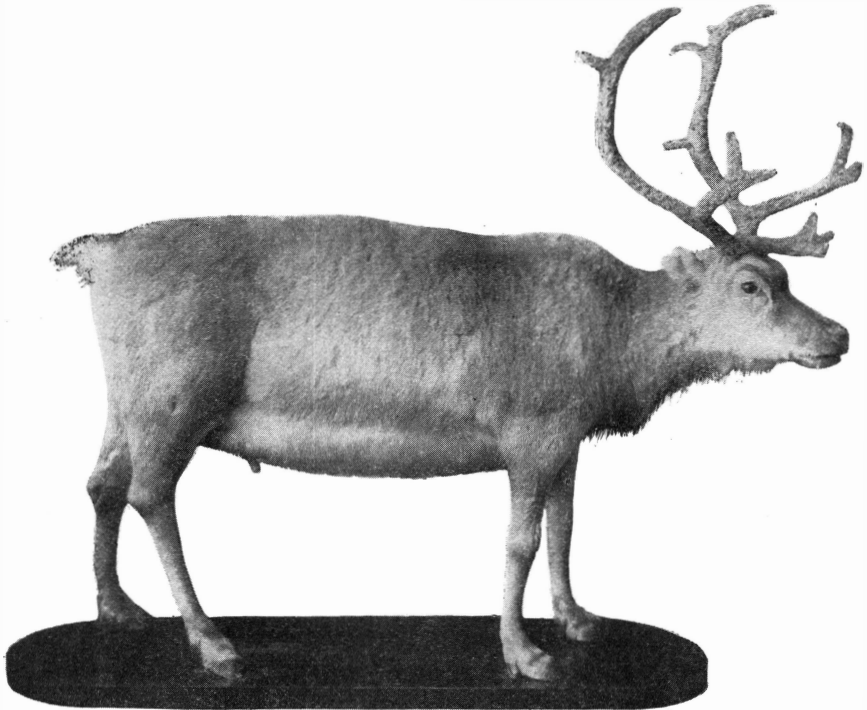


Fig. 15. Spitsbergen Reindeer, ♂, Sassen Bay, August 1911,
Zool. Museum, Oslo.

reindeer is of stunted form, "which in its degenerated condition still remains in certain respects at a juvenile stage". As to woodland reindeer and mountain reindeer LÖNNBERG holds that the metatarsal bones and metacarpal bones in the former are respectively shorter than in the latter, which LÖNNBERG has found by comparing, in a skeleton from a mountain reindeer and one from a woodland reindeer, the bones mentioned with the humerus and the femur, and likewise also by comparing the metacarpal bone with the radius and the metatarsal bone with the tibia. The reason why the woodland reindeer has a comparatively shorter metacarpal (and metatarsal) bone is due, thinks LÖNNBERG, to the differ-

rence in mode of life, as the woodland reindeer prefers bog and swamp land.

“But likewise the short metacarpal and metatarsal bones (“cannon” bones) form both an ontogenetic and a phyllogenetic primitive character,



Fig. 16. Norwegian wild Reindeer, ♂, Veodalen, Vågå, Dec. 1881, on the same scale as Fig. 15. Zool. Museum, Oslo.

and the longer ones indicates a specialisation. The greater length of the “cannon” bones in mountain reindeer is therefore probably associated with their more mobile mode of life together with their long wanderings”. [16] p. 181.

Here it must, however, be remarked, as will be more fully dealt with below, that the reindeer in Spitsbergen move from one tract to another according to the seasons, and undoubtedly are under the necessity of leading a mode of life more in conformity with that of wild reindeer in the Norwegian mountain tracts than with that of reindeer in Swedish and Finland forest tracts. The conformity between woodland

reindeer and those of Spitsbergen, with respect to the short metatarsal and metacarpal bones and the cause of this conformity, does not seem to be quite cleared up. Further, it appears beyond doubt that reindeer in Spitsbergen are partly recruited through immigration, and just by reindeer which make extremely long wanderings (see below).

External Characters.

Size.

The inferior size of the Spitsbergen reindeer has been emphasized by many authors, and undoubtedly its smallness has first called forth the idea that it formed a dwarfed race distinguishing it from the typical one. The shoulder height of a full-grown Spitsbergen male in the Oslo Zoological Museum, Fig. 15, shot at Sassen Bay in August 1911, measures 82 cm. and of a full-grown male in the Trondhjem Museum (according to the Director, Mr. O. NORDGAARD) 94 cm. For comparison it may be stated that a Norwegian wild reindeer male in the same museum, from Opdal (Sept. 1908), measures 116 cm., and 3 males in the Stavanger Museum, from Ryfylke (according to the late Conservator, Mr. HELLIESEN) measure 109½, 107, and 106 cm. (all measurements taken to the hair roots; length of the hair is about 2½ cm.).

Concerning the cause of this inferior size of the Spitsbergen reindeer LILLJEBORG [12], writes on pp. 838—839: "This is without doubt due partly to the insular, and partly to the hyperborean nature of this region. The reindeer is confined to a small area, and partly this circumstance and partly the hard climate with the long and dark winter — which during the greater part of the year threatens its very existence and during which, as A. J. MALMGREN [17], (1863), p. 147 supposes, it must to no small extent live on the fat accumulated during the summer — must prevent its development".

Fatness.

When the Spitsbergen reindeer is met with down at the coast early in spring it is quite fat, but later on in the spring when a hard crust of snow covers the mountains and the iceencrusted mountain sides are almost inaccessible, the Spitsbergen reindeer becomes so skinny that it is of no use as food. During the summer it recovers very quickly, so that before autumn it can put on a layer of fat several inches thick, which gives the animal quite an unshapely appearance. At the end of August and all September it is like a "fatted slaughter-ox" and its flesh is so impregnated with fat, that for many people it is almost uneatable. The layer of fat under the skin is said to be 3 to 4 inches thick (cf. Skipper HOLM's journal from winters spent in Spitsbergen, 1895—1896, Spitsbergen Gazette 1897).

DANIEL NØIS the Arctic traveller and hunter, who through ADOLF HOEL has kindly communicated to me several observations on Spitsbergen reindeer, writes in a letter of April 1923: "When the Spitsbergen reindeer, after a peaceful winter, is met with down at the coast it is generally very thin and can only in cases of necessity be used for human food. Only in some places and under favourable conditions can it keep itself in condition from one year to another. As a rule, it is worst from the beginning of May to the middle of June. In North Spitsbergen it may even be very thin until far into July. In an average year it may begin to get a nice white layer of fat in the last days of June, and in the latter half of July the full-grown animal is considered suitably fat, and the smaller animals in the middle of August. Later it becomes exceedingly fat and the layer of fat increases up to the early days of October, and on the hindmost part of the back large males may then have a layer measuring over 3 inches; but they lose much fat in the rutting time (October). Gravid females keep in better condition during winter than the other animals. In 1901 the reindeer were in good condition far into the winter, and on the 17th of May, on the mountain on the left side of Björndalen, I shot a female which had about one inch of fat left from the autumn layer. I shot a male in 1913 on the expedition for the relief of Schröder-Stranz on the east side of Wijde Bay; it was suitably fat for eating. It was a big animal which had begun to get new antlers on the 8th or 9th of May. In 1906 and 1912 the reindeer was of little use for food in May".

Regarding a couple of specimens (an oldish female and a calf), which were shot in Mossebaya in the middle of October, during the Swedish Polar Expedition 1872—1873, it is said (cf. KJELLMAN [10], p. 127) that one might be tempted to believe that these thick, coarse, colossal animals could scarcely belong to the reindeer species. They were reindeer in winter coat. The whole body was covered with a very dense, winter coat several inches thick. The head, almost unnoticeably separated from the neck, was short and thick with a broad muzzle, and eyes which could scarcely be seen. The body seemed unshapely. The legs were short and thick. This peculiar, unshapely appearance is due to the thick layer of fat under the hide, and also the long coat of hair.

Colour and moulting.

In winter the Spitsbergen reindeer is of a whitish colour, which causes it to be difficult to detect against the snow. Its summer coat (immediately after the moulting) is very like that of our Norwegian wild reindeer, but on the back and rump it has some white hair mixed. Of the summer coat, immediately after the moulting, LILLJEBORG [12],

p. 839, says that it seems to be somewhat darker than in Norwegian wild reindeer. On the back and rump it is then quite dark brown interspersed with white hair. "The Spitsbergen reindeer has lost its winter coat" writes NØIS (April 1923), "at the close of June or early in July; the fattest and oldest lose the winter coat first. They then get quite dark hair, but retain a white streak under the belly to the middle of the neck. Little by little, as the hairs grow, they become lighter and in winter the Spitsbergen reindeer turns quite white". Mr. M. A. INGEBRIGTSEN, the well-known Norwegian whaler, has likewise informed me that moulting takes place later in small animals than in large and fat ones. And in the valleys he thinks that the moulting generally took place earlier than near the coast.

Also, according to KOLTHOFF's [11] (1903) observations, the winter coat does not seem to be shed until after midsummer. The specimens which were shot during A. G. NATHORST's expedition to Spitsbergen and Kong Karls Land in 1898 had still, in the beginning of July, their white winter coat, but the hairs were so loose that they fell off in big tufts when one took hold of the animals. "On the Spitsbergen reindeer killed in June", says KOLTHOFF (p. 25), "there were traces of an easily falling, woolly winter coat growing out from the long winter hairs, which indicates a tendency to the formation of an auxiliary winter coat, analogous to that of the musk-ox".

This growth of a woolly winter coat in the Spitsbergen reindeer "which should be quite a curious feature in the case of a member of the deer family", has not yet been closely investigated in specimens from the winter-season, and unfortunately I have not yet been able to get information from the members of hunting expeditions who have shot reindeer in Spitsbergen in winter.

Antlers.

In the shape of the antlers there is, in the Spitsbergen as in other reindeer, much variation. I have not sufficient material to be able to state whether the Spitsbergen reindeer's antlers have any special peculiarity. The antlers had been sawn off in most of the skulls in my material. "The antlers are really as in most reindeer", writes NØIS (April 1923), "and the largest and oldest males cast their antlers at the close of February, possibly a little earlier. I have seen females with antlers right into April, as well as calves under a year old. The largest and oldest males begin to get new antlers in the middle of May, the younger later". On the 21st of May, 1901, NØIS shot at Coles Bay a large reindeer male which had new antlers about 8 inches long. The antlers were single and of "full thickness". The male was supposed to

be from 15 to 20 years old. The largest number of tines Nøis has seen on the antlers of Spitsbergen reindeer is 26.

The "rubbing" of the velvet does not occur until far into August. The most developed males have a start in this respect, not however so great as in the casting process.

Habits, Occurrence, &c.

Food.

In the "Spitsbergen Gazette" for 20th July 1897, C. C. writes in an article, "Spitsbergenrenen", that its food consists of grass and other phanerogame plants of all kinds; also fungi in summer. In winter it lives chiefly on reindeermoss (*Cladonia rangiferina*) which is found almost everywhere in Spitsbergen. Further he says that it also eats lemmings, which it pursues with avidity. Here it must be noted that the lemming is extremely rare in Spitsbergen!¹

Reindeer moss does grow in most parts of Spitsbergen, but in most places only sporadically and never in great quantities. The real *Cladonia rangiferina* is at any rate seen so rarely that it cannot be of any importance as food for reindeer in Spitsbergen. *Cladonia silvatica* is found there, but it does not occur in any abundance either. Of lichens on which the reindeer may be supposed to live, the *Cetraria* comes in the first rank. Most frequent are several kinds of Iceland lichens especially *Cetraria hiascens* and *Crispa*, besides *Cetraria nivalis* and *Cucculata*, and probably some of these lichens form the principal food of the reindeer in winter. Of fungi, fuzz-balls (*Lycoperdon*) are found now and then, and also some other small mushrooms. If eaten by the reindeer the mushrooms surely must be regarded as tit-bits rather than as nourishment.

"The food of the Spitsbergen reindeer" writes Nøis (April 1923), consists of different kinds of grasses, flowers and foliaceous plants, together with reindeer moss; but of reindeer moss there is not much. I have examined the stomach contents of some reindeer that had been

¹ The following extract from a letter to me from Professor Dr. BRÜHL, Institut f. Meeresk., Berlin, appears however to indicate that lemmings actually have been observed in Spitsbergen. Prof. BRÜHL says: "M. TH. VON HEUGLIN spricht auf Seite 8 des 3. Teiles seiner Reise im Nordpolarmeer 1870—1871 (Beiträge zur Fauna, Flora und Geologie von Spitsbergen und Novaja Semlja), Braunschweig 1874, vom Halsband-Lemming (*Myodes torquatus* PALL.). Er meint daß der Halsband-Lemming nach Spitzbergen nur zufällig auf dem Eise verschlagen sei, und erwähnt, daß Parry auf dem Eise nördlich Spitzbergen ein Skelett dieses Tieres gefunden habe. Wenige Zeilen darauf teilt er aber mit, daß er Lemmingbauten in der Adventbai gefunden habe und daß der Eislotse die Tiere früher wiederholt ausgegraben habe."

shot, and it appears that if the animal can get an acid grass that Arctic hunters call "Skjørbukgress" (*Cochlearia officinalis*) it prefers this". It must be noted that in Norway the "Skjørbukgress" is found at the coast; in Spitsbergen, however, it does not only occur along the shore but frequently to the very summit of the mountains. "In winter", says NØIS further, "the reindeer must often be content with various kinds of dry straw, the longest of which penetrate the crust of ice prevalent in so many places. Such layers of ice are formed late in the autumn after southerly storms with rain and sleet, which after a day or more freeze into a hard crust of ice. In winters when this ice crust is especially prevalent the Spitsbergen reindeer has a hard struggle to procure sufficient food, and it then wanders great distances and may come down to the coast at any time during the winter. The oldest reindeer which know the localities best, and have the greatest strength to kick the ice crust to pieces, fare best. In winter the hoofs are much sharper than in summer".

A. E. NORDENSKIÖLD [21], (1880) Vol. I p. 129 says that the Spitsbergen reindeer comes down in autumn to the coast in order to eat seaweed, but NØIS considers this to be improbable, as there is little accessible seaweed, on the beach, which in Spitsbergen is early covered with ice.

The Norwegian botanist, JOHANNES LID, who has visited Spitsbergen, has informed me that seaweeds (*Laminaria* etc.) are to be found stranded in quantities in several places along the sandy shores of Spitsbergen, on the west coast as well as in the fiords. This seaweed is certainly accessible food for the reindeer at all events early in the autumn.

Rutting season.

At the end of September Spitsbergen reindeer begin to congregate in herds, and the large males, which during the whole summer prefer solitude, begin to join the herds. In the early days of October, says NØIS, pairing is going on, and at that time every herd must have its leader, so that there often occur violent fights between the males. One can often meet a bull, that has been driven away, accompanied only by a single female in some remote place, and solitary wandering males, which have been driven off by their stronger rivals, can be enticed to within a short distance by setting up a reindeer horn over the ridge of a hill. The rutting season is over at the end of October (or early in November).

Occurrence, &c.

Up to a short time ago, the reindeer occurred over practically the whole of the ice-free parts of Spitsbergen, and it has undoubtedly been far more numerous in earlier times than now. First the Dutch and the English, and later on the Russians and Norwegians, hunted reindeer in

Spitsbergen. A. E. NORDENSKIÖLD [21], Vol. I, p. 128 says: "When Spitsbergen was first mapped, many places were named after the reindeer, which indicates that it then occurred in great numbers, and it is just in most of these places that the reindeer is no longer found at all". — To this must however be remarked, firstly, that the mapping of Spitsbergen took place little by little, so that one can scarcely use the words "when Spitsbergen was first mapped"; secondly, it cannot be said that a number of places have been named after the reindeer, as there are comparatively few names of places in Spitsbergen which point to the occurrence of reindeer there; and, in the third place, one may, as a rule, still find reindeer in the places which are named after them. Some valleys in Spitsbergen have been named by Norwegian hunters with names containing "Ren", for instance *Rendalen* ("Reindeer Valley"), viz. Rendalen on the Kapp Thordsen peninsula, Rendalen on the east side of Green Harbour and Rendalen on the north side of Van Mijen Bay.

Besides these, there are other localities named after the reindeer, e. g. Rensdyrpynten on the south side of Bellsund and Rensdyrlandet on the north coast of Spitsbergen. But the reindeer is still found in most of these places. In Rendalen in Green Harbour it is not found at present, but it occurred there, at any rate, up to 6 or 8 years ago, long after A. E. NORDENSKIÖLD's expeditions.

In "Reise i Öst- og Vest-Finmarken samt til Beeren-Eiland og Spitsbergen i Aarene 1827 og 1828" [9], p. 156, B. M. KEILHAU says that he found many antlers and bones of reindeer around the Russian settlement at the entrance to Wybe Jans Water (= Storfjorden). In the year 1743 a Russian vessel with 14 men went to Spitsbergen, but instead of going to the west side, where the Dutch and other nationalities at that time went whaling every year, they sailed to East Spitsbergen, which the Russians call Maloy (Little) Brovn to distinguish it from Bolschoy (Great) Brovn, as Spitsbergen proper is called. Four men of the crew escaped from the ship, which was probably wrecked, and until the 4th of August 1749, they remained on an island on the east coast of Spitsbergen (KEILHAU thinks it has been on Halvmåneøya, on the south side of Edge Øy), and lived chiefly on bear and reindeer meat. The root of a pine-tree drifted in from the sea was used as a bow, for which the string was made of bear sinews. With this bow 250 reindeer in all were shot and a great number of white and blue foxes. Nine bears were killed.

The late JOHAN HAGERUP, sealing captain and hunter of Tromsö, who as early as 1867 made his first voyage to Spitsbergen, writes in a letter of April 1923 to Mr. HOEL regarding the quantity of reindeer in Spitsbergen, that the conditions now are nothing like what they were at that time. In the sixties reindeer swarmed in Sassen Bay, Advent Bay, and Green Harbour, and it did not take long to kill a hundred

reindeer or so. In the seventies, cod-fishing began in those waters. For several years about 30 fishing vessels lay in Isfjorden and other places, and each of these vessels took yearly 25 to 50 reindeer. Later on tourists came, who shot a great many; they took the heads as hunting trophies, and left the carcasses.

“Als vor Jahren eine bekannte Persönlichkeit von hohem Rang mit ihrem Gefolge die Westküste Spitzbergens besuchte,” writes H. CONWENTZ [5], (1911), “wurden bei der Kolbay 47 Renntiere erlegt, wovon die Gesellschaft nur 13, ja, nach einer anderen Version nicht ein einziges Stück verwertete. Ferner wurden auch alle Seevögel, die in Schußweite kamen, nutzlos hingemordet. In den Jahren 1891—1892 reiste eine andere hochgestellte Persönlichkeit in Begleitung von Damen und Herren nach Spitzbergen. Die kleine Gesellschaft schoz allein in drei Tagen in der Kolbay und Adventbay mehr als 60 Renntiere; einige wurden allerdings verwertet, aber die meisten hatte man nur getötet, um die Geweihe als Trophäen mitnehmen zu können”.

Norwegian hunters have shot reindeer both on Kong Karls Land and on the north coast of North-East Land, and on islands lying still farther away to the north (Castréns, Parrys, Martens and Phipps Øyer), the reindeer, according to A. E. NORDENSKIÖLD, [21], B. I, p. 126 has been fairly common.

Capt. HANS JOHANNESSEN, the well known Arctic explorer of Tromsø, who for many years hunted in Spitsbergen, has informed me that Edge Øy was the best hunting ground for reindeer in Spitsbergen. However, as in other places in Spitsbergen, the reindeer have decreased considerably in number since the ice-conditions from the beginning of the nineties allowed ships to call at the island group from the north side. Some hunters could, in former years, when reindeer were far more numerous in Spitsbergen than now, return with up to 150 animals. Now, on the contrary, they must hunt the reindeer specially if they are to succeed in shooting fifty or so in the course of the summer (noted in 1900 after personal conversation with Capt. HANS JOHANNESSEN). Other Arctic travellers have stated as the best hunting-grounds: the north side of Bellsund, round Isfjorden and Wijde Bay, on the coasts of Hinlopenstredet and at Heleysund. During NATHORST's expedition in 1898 reindeer, according to KOLTHOFF, [11], were found to be most numerous round Van Mijen Bay, and, in 1900, the same author met many in the valley at Coles Bay (Isfjorden). Further K. relates that the reindeer was specially numerous in the valley which stretches between Van Mijen Bay (Lowe Sound) and Coles Bay. From here the reindeer wandered during his visit at Coles Bay out to that bay daily and then came even to Advent Bay, where six animals were killed in June by a hunter.

On Kong Karls Land, on the other hand, no reindeer were to be seen during NATHORST's expedition in 1898. But there were here and

there reindeer antlers lying about, which showed that reindeer had occurred there before. "In the year 1872 an uncommonly large bull was shot on Kong Karls Island by N. JOHNSEN, a hunter, and in 1889 HEMMING ANDREASEN killed three reindeer on the Swedish foreland (see NATHORST, *Två Somrar i Norra Ishafvet* Vol. I, p. 251). Since that time no reindeer have probably appeared on Kong Karls Land. As this land seems much too small for a permanent stock of reindeer, it seems to me likely that the animals had wandered over the ice from Spitsbergen". (KOLTHOFF 1903). "That the Spitsbergen reindeer, which are killed yearly in great numbers by Arctic hunters, is not exterminated, seems a proof" says KOLTHOFF, "that it is found in greater numbers in the valleys which stretch into the country, where these hunters never go". Besides, it may be mentioned as an indirect reason, that the polar wolf does not occur in Spitsbergen. The immigration of the wolf to East Greenland, thinks NATHORST [19] (1899) p. 235, is the reason why the numerous reindeer stock that formerly existed there, has been so decimated that its early extinction may be expected. NORDENSKIÖLD thinks that the Spitsbergen reindeer stock, not being decimated in spite of severe molestation, is recruited from without. (More about this later).

Extensive hunting of the reindeer during recent years has driven it from the easily accessible west coast of Spitsbergen. On the other hand, it is still, according to HOEL (1916), abundant on the north coast (west of Wood Bay and eastward), on the east side of the main island, as well as in Barents Land and Edge Øy.

In spite of the fact that the reindeer has been driven from the easily approachable west coast of Spitsbergen, HOEL thought in 1916 that there was no danger of its being totally exterminated as has been asserted by some foreign naturalists. But after the increased mining operations in Spitsbergen during recent years, on account of wintering hunters equipped with sledges and dogs, the scarcity of meat, and the high meat prices during the war, the hunting of the reindeer has taken another form. In his proposal for a Royal decree concerning protection of hunting and fishing in Svalbard (viz. Spitsbergen and Bjørnøya) submitted to the Eastern Section of the Association for the Protection of Natural Objects in Norway, dated 15th March 1921, HOEL writes, amongst other things, the following¹:

"Until 50 or 60 years ago the reindeer was distributed over the whole of Spitsbergen. To the end of last century the Spitsbergen reindeer was hunted chiefly by sealers, who occasionally went ashore and also by hunting expeditions wintering there. At the close of the last century there also came some few tourists who often destroyed large flocks. But these people never reached far inland. Hunting took place

¹ This proposal exists only in manuscript. This reference is given with Mr. HOEL'S permission.

in summer, and the hunters had to carry the reindeer on their backs to the coast, which in itself limited their invasion inland.

Reindeer-hunting has lately, however, completely changed as the wintering Arctic hunters have added polar-sledges and dogs to their equipment, and by these means of transport they can cover almost unlimited distances and search out and kill reindeer in their most secluded places of refuge. Furthermore, on account of shortage of meat and the high prices ruling in Norway during the war, sealing vessels have in increasing numbers visited the coasts of Spitsbergen, where they have killed reindeer in hundreds, partly for their own requirements and partly for sale in Norway.

In addition, there is the growing exploitation of Spitsbergen's coal deposits and the resultant increase of population just in the best reindeer district, between Isfjorden and Bellsund. These mining settlements are in the main situated on the east and west side of Advent Bay (Norwegian companies) and the north side of Van Mijen Bay (Swedish and English companies). These companies keep also dogs and polar-sledges, with which they can make extensive hunting expeditions and load up on one sledge 8—10 reindeer. Some of these companies have spared the reindeer as much as possible, whilst other have hunted extensively. It has even happened that one of the companies relied for the whole of its fresh meat supply on reindeer hunting, and kept its own hunter for this purpose.

Statistics for the last few years show that the Spitsbergen reindeer is taxed too heavily. At the Tromsø Custom House the following numbers of Reindeer were registered during the years 1915—1925¹:

1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
159	499	535	993	268	293	61	115	55	68	90

But besides the reindeer which have been brought to ports in the north of Norway, a considerable number have been shot for local consumption, — one may reckon at least a couple of hundred a year up to 1920.

There is only a single year in all the time Norwegians have hunted on Spitsbergen, i. e. for over a hundred years, that so many reindeer have been shot as in 1918; this was in the year 1878, when 1491 animals were killed.

These numbers prove that the Spitsbergen reindeer has until lately been quite numerous; it has not been exterminated by Norwegian hunters at all, as was asserted at the beginning of this century for purposes of agitation, principally from Swedish quarters.

¹ Spitsbergen reindeer have not been registered at other ports in North Norway in these years.

But, on the other hand, it is clear that the reindeer stock in that region cannot bear such heavy inroads upon their numbers. Both from my own observations and from information from other sources, I have been able to convince myself that the reindeer has been heavily decimated everywhere in Spitsbergen during the last few years. If this is continued for 3 or 4 years more the reindeer will be entirely exterminated, in any case in the Isfjorden and Bellsund districts. Already now one must go a few miles inland in order to find reindeer there."

In the same proposal HOEL mentions the following places in Spitsbergen where the reindeer is found at present:

1. On the north and west coast of the Nordostland.
2. A part of the north coast of Spitsbergen: — Rensdyrlandet, Liefde Bay and Wood Bay districts, peninsula between Wood Bay and Wijde Bay, Wijde Bay's vicinity.
3. District between Isfjorden and Van Mijen Bay and the valleys running up from these fjords eastward to Storfjorden.
4. The islands Edge Øy and Barents Land.

DANIEL NØIS (April 1923) has given me the following particulars regarding the occurrence of the reindeer in Spitsbergen: —

"The fact that reindeer are now so few in number on the coasts of Spitsbergen compared with formerly, is not, as many think, due to their having withdrawn to more peaceful haunts, but they will certainly be gradually extirpated merely because far more are being shot than ever come into existence. Since Arctic vessels have been fitted with motors, the hunters can allow themselves better time, even in places where the ice-conditions are difficult, and the reindeer stock has been reduced in an alarming degree both on the north and east coast. In 1900 reindeer were occasionally to be seen everywhere on the peninsula between Isfjorden and Bellsund, but now there is scarcely an old animal left; an occasional animal may come from the inner part of Conways Dal in Van Mijen Bay, and may also still be seen in the most south-easterly Sassendal districts, where there is certainly access from the Kjellstrøm Dal and Agardh Bay in Storfjorden.

On the south side of Isfjorden, Green Harbour and Sassendalen included, no less than about 400 reindeer were shot in 1905 and 1906 by hunters wintering there and by coal-mining companies.

In the winter 1906 Mr. MUSCHAMP, head of the Spitzbergen Coal & Trading Co., Ltd., built a hunting-lodge in Adventdalen intended specially for reindeer hunting, and later there were built two more, of which one was built by the Arctic Coal Co., which in the first few years also took an active part in reindeer hunting.

The Spitsbergen reindeer does not generally roam far, and it therefore has difficulty in re-establishing itself in a place in which it has

once been exterminated. This is proved, for instance, by Daumannsøyra, Kings Bay, Kapp Mitra at Cross Bay with its great lowland, and likewise Prins Karls Forland with several other places, amongst them Kapp Boheman and Treurenberg with the long Verlegen Hoek.

Regarding hunting conditions before and now, I must mention that, whilst hunters previous to 1905 transported reindeer only on their backs, they are now fetched to the winter stations by dog teams, even if it means several days' journey.

HANS J. FURFJORD, who wintered the first time in 1898—1899 in Vesteraalske's Tourist Hotel, Advent Bay, has told me that in 1896, 1897, and 1898 many reindeer were shot by tourists in Advent Bay. FURFJORD himself shot while wintering there more than 100 reindeer. In 1900—1901 I wintered there myself for the first time, and we shot 80 reindeer, principally in Coles Bay. The same winter L. NISJA stayed in Sassen Bay, where they shot about 150. Of our 80 reindeer 13 were shot in Dickson Bay. At that time sealers sailed into Sassen Bay every year to hunt the reindeer. In 1905 to 1906 we shot 250 reindeer, 150 of which in Sassen Bay, 30 in Advent Bay, 20 in Green Harbour and at Russelven, and 50 in Coles Bay. During my third wintering from 1909—1910 there were no reindeer in Coles Bay, as Mr. MANGHAM and BERNTSEN of the Arctic Coal Co. had hunted there and shot what was left (so far as I remember 14 head). We shot in all, during that winter 80 reindeer, of which 35 were shot in Rendalen on the north side of Van Mijen Bay and 45 in Sassen Bay. In the winter of 1910—1911 there were likewise no reindeer in Coles Bay, nor up in Rendalen on the north side of Van Mijen Bay. In 1911—1912 we shot 180 reindeer, principally in the Sassen Bay valleys, with the exception of three, which were shot at Kapp Thordsen."

Of the places frequented by the Spitsbergen reindeer in the different seasons, NORDENSKIÖLD, [21], Vol. I, p. 129 says that in the summer it seeks the grassy plains in the ice-free valleys; in autumn, according to what hunters say, it goes down to the coast and in winter goes back to the lichen-covered mountain heights in the interior. This statement of NORDENSKIÖLD partly coincides with information I have myself obtained from hunters. Capt. HANS JOHANNESSEN told me that in summer the reindeer stay in the valleys miles away from the sea; in autumn, however, when the snow begins to cover the ground, it betakes itself, as a rule in herds, down towards the sea. The snowfall in Spitsbergen may begin some years even in August, in other years not before well into October. Both Capt. SIVERT BRÆKMØE and Capt. ANDREAS HOLM have while wintering in Spitsbergen shot reindeer in the neighbourhood of their winter-house down by the sea. S. BRÆKMØE, who wintered in Spitsbergen 1893—1894, shot a reindeer at Kapp Thordsen, 18th December 1893, and 2 in Sassen Bay 19th January 1894, and, at the same place,

2 on 16th March, also 4 in the middle of May. Capt. HOLM, who wintered in Spitsbergen 1895—1896 and hunted round Advent Bay, shot 15 reindeer between October 19th and November 12th. During the Swedish Polar Expedition 1872—1873 an old female was shot in Mossel Bay and an almost full-grown calf in the middle of October.

It has been noticed that the reindeer disappeared from the coast in the winter and did not come back till the spring. This has given rise to the idea amongst some hunters that it was dormant in winter! Others think that it makes long wanderings over the ice, for instance, to Novaya Zemlya and then comes back each year. (Cf. Reindeerwandering to and from New Siberia, see p. 62). It was, moreover, the general opinion amongst hunters, that the Spitsbergen reindeer had come from Novaya Zemlya, and NORDENSKIÖLD states that the fact that such destructive hunting as takes place year after year in Spitsbergen can occur without the stock being exterminated, has even given rise to the belief in immigration, — a recruiting from Novaya Zemlya. NORDENSKIÖLD has himself also the impression that the stock of Spitsbergen reindeer is recruited from outside, but he thinks it does not come from Novaya Zemlya but possibly from “some unknown land or other” north-east of Spitsbergen; for the Novaya Zemlya reindeer is, he remarks, different from the Spitsbergen. Of reindeer from Novaya Zemlya I have had the opportunity to examine only a single skull, which is kept in the Oslo Zoological Museum. This skull corresponds in all essentials to the Lapland reindeer skulls, and is thus considerably different from all the Spitsbergen skulls that I have examined. The Novaya Zemlya cranium is of an older date, but its locality is not exactly indicated. I am inclined to think that it is derived from a Samoyede animal, and on Samoyede reindeer LÖNNBERG 1909 remarks, that it is not improbable that, on closer examination, it will prove to correspond closely to or be identical with the Lapland mountain reindeer. How far reindeer are found in the northerly part of Novaya Zemlya, with the distinctive features of the Spitsbergen stock, is open to question.

LYDEKKER'S *R. tarandus pearsoni* classified in 1902 [13], p. 360, should certainly be left out of consideration for the present. The name refers only to a reindeer antler which LYDEKKER found in a Samoyede cottage on Novaya Zemlya and which he thought was distinguished by a regularity and a distinct shovel-form, both in brow and bez¹ tines, which reminded him of the woodland type. “That the antlers are quite unlike those of the Scandinavian reindeer (or at any rate those I have seen) is plain at the first glance. They are less unlike the Spitsbergen reindeer” says LYDEKKER. Without going into further details, LYDEKKER gave this reindeer (or more correctly this antler) the name *R. tarandus pearsoni*,

¹ Second tine.

which he considered typical of Novaya Zemlya (cf. LÖNNBERG [16] p. 17, note).

As previously stated, all the reindeer skulls from Spitsbergen I have had the opportunity to see, have distinctive features whereby they have been clearly distinguished from the reindeer from the Continent, and this seems to have been the case with the Spitsbergen reindeer skulls which other writers have examined. Nevertheless, there appears absolute proof that in Spitsbergen reindeer can be found that have wandered in from outside, but of material relating to the latter there exists only a single pair of antlers (without the skull). This pair of antlers is kept at the Oslo Zoological Museum, and is mentioned further (with illustrations) in an article by ADOLF HOEL in "La Géographie" [7]; it has belonged to a tame reindeer male, an unusually large specimen, which has probably wandered in from Novaya Zemlya. According to HOEL this reindeer was shot in July 1912 in a valley crossing Sassendalen, about 10 kilometres from Sassen Bay. To the tip of the left antler a piece of the metatarsus of an ice-gull (*Larus eburneus*) was attached with cotton thread, and, besides, the reindeer's ears were marked. So far as is known, tame reindeer have only on three occasions been introduced into Spitsbergen — in all cases to be used as draught animals — namely in 1827 by PARRY'S polar expedition (8 reindeer), in 1872 by A. E. NORDENSKIÖLD'S expedition (40 reindeer, which all escaped except one) (cf. KJELLMAN [10]) and in 1913 by Capt. A. STAXRUD (20 reindeer, which were shot after being used as draught animals during a great part of the expedition) [27]. The tame reindeer shot in 1912 is, after the way it is marked, in all probability a sacrificial animal that has escaped from Samoyedes in Novaya Zemlya or Waigatsch (cf. opinions of KARL DONNER, Ethnographer, and H. BACKLUND, Geologist, given by HOEL).

From Novaya Zemlya to Spitsbergen it is, as the crow flies, 770 kilometres. In spite of the fact that the reindeer, says HOEL, is a swift and enduring animal, this seems to be a long distance to cover in one stage without food. HOEL thinks it therefore most probable that reindeer from Novaya Zemlya's north point have crossed to Franz Josef Land and from there on to Spitsbergen, (Kong Karls Land). The distance from Novaya Zemlya to Franz Josef Land is 380 kilometres and from Franz Josef Land to Kong Karls Land 340 kilometres, and further from here to Edge Øy 90 kilometres. On Franz Josef Land the reindeer will (according to NANSEN), find food enough. Several reindeer antlers and bones have been found on Franz Josef Land (cf. WILLIAM BRUCE, [3], p. 81). HOEL finds, however, that the conditions of life in this island group are so hard that the reindeer will perish if it has not reached Spitsbergen before winter.

Marked reindeer are said to have been shot on several occasions in Spitsbergen by Norwegian Arctic skippers. Capt. H. P. JOHANNESSEN

writes of this in a letter to HOEL. "There can be no doubt that the reindeer in Spitsbergen have come from Novaya Zemlya. — — — The most certain proof of this is the fact that reindeer with different sorts of marks on the ears have been shot, and this exclusively on Edge Øy, where they first make land. In 1864 when I travelled with my father, several marked reindeer were shot, and in 1889, when I had the "Gjøa", I shot 100 reindeer on Edge Øy, of which 3 or 4 were marked. They must undoubtedly have been animals that had escaped from the Samoyedes. Nor is it improbable that the animals make their way over Franz Josef Land and Kong Karls Land and then finally land on Edge Øy, where the best grazing is found, and where there are also the largest number of animals. I remember that the Russians, whom I met in Novaya Zemlya in 1869, said that they had for several years observed 4 large reindeer on the north end of Novaya Zemlya, but at last they disappeared. In 1898 I saw several reindeer on the low land east of the north point of Novaya Zemlya." JOHANNESSEN agrees with HOEL in saying that reindeer migration takes place late in the winter. From 1864 to 1872, the ice in the Olga Strait, says JOHANNESSEN, was not broken.

"Reindeer have come to Spitsbergen all the way from Novaya Zemlya," writes GUNNAR HOLMSEN in "Spitsbergens Natur og Historie" [8], p. 74. „Skipper C. KULSTAD relates that in the summer of 1852 he had shot several marked reindeer in Spitsbergen. The animals bore distinct marks in the ears, some being clipped across, others marked in the form of an M, and with such clean cuts as only a pair of scissors or a sharp knife can produce. In "Tromsø Tidende" for 19th Sept. 1852 the following statement is made: As these animals in Spitsbergen naturally run quite wild, one cannot do otherwise than accept, on proofs found this year and several times before, the conclusion that the reindeer from the tame herds in Novaya Zemlya have made their way over the firm ice and taken the long journey without food—truly a wonderful migration."

"In Spitsbergen," says HOLMSEN, "the reindeer makes great wanderings. When Norwegians first came to Kong Karls Land, there were many reindeer spoor, but during Nathorst's expedition in 1898 not a single reindeer was found left. It is not conceivable that the polar bear could have destroyed the stock. They have more likely wandered over to the Continent. During NORDENSKIÖLD'S wintering in North Spitsbergen about 40 sledge reindeer, with which they were going to drive to the North Pole, ran away. One of these marked reindeer was shot on Edge Øy 11 years later."

After 11 years, however, it can scarcely be known with any certainty whether this has been one of NORDENSKIÖLD'S or not. From other regions too, says HOEL, we have examples of reindeer wandering great

distances over drift-ice. Thus VON TOLL [29], found, on his arrival at Bennet Island, a herd of 30 reindeer, on which he subsisted for a long time and clothed himself with their skins.

The shortest distance from Bennet Island to the New Siberian Islands, where reindeer live in summer and wander over to the Continent in autumn, is 125 kilometres.

VILKITSKI mentions nothing about reindeer on the island (SHOKALSKY, [25]). When HOEL, at the close of his article in "La Geographie", says that after the observations stated one must take it for granted that at present tame reindeer roam from Novaya Zemlya to Spitsbergen, we must quite agree with him in this; but there seems to be some doubt as to whether the wandering takes place direct, or with Franz Josef Land and Kong Karls Land as intermediate stations; but it is most probable that in its wandring the reindeer follows the "land-connection" as much as possible out of regard to the food supply.

A journey of 7 to 8 hundred kilometres — from Novaya Zemlya to Spitsbergen — is in itself not prohibitive for reindeer; both in North America and in Asia the reindeer roams over as great a distance. MIDDENDORFF [18] (1875) states that the reindeer from Taimyr Land wander over 100 geographical miles southward in autumn, and back again northward in the spring, and from North America we hear of still longer roamings. It may be of interest to mention in this connection, that the reindeer, also on the islands in the Arctic Sea, north of the American continent, undertakes journeys to and from the mainland, in autumn and spring respectively, and the same should certainly be the case with reindeer on the New Siberian Islands (cf. VON TOLL [29]). But the Spitsbergen reindeer may be said to be considerably more isolated. The fact that the skulls examined have distinctive characters points to this — and of absolutely certain immigrant reindeer to Spitsbergen (apart from those brought over by man) there is only one instance to date. The comparatively numerous statements regarding marked reindeer must, however, be taken into account. It must be presumed that from time to time there has been a recruiting from outside, most probably of Samoyede reindeer via Novaya Zemlya. The likeness of the Samoyede reindeer to the Lapland type, and the lack of the peculiarities which mark the Spitsbergen animal, do not exclude such a supposition. After its immigration into Spitsbergen the reindeer have perhaps in a short time got the distinctive features they possess on this isolated island group, lying as it does on the outer limits of the habitat of this species, where snow and ice to a great extent confine the sphere in which this animal, on the whole, can support life, where the climate is severe, the summer short, the winter long and dark. At all events, no very great length of time elapses before such peculiar features as the layer of fat under the hide can readily be recognised as the

result of the change of habitat. Some of the marked draught reindeer from Norway which NORDENSKIÖLD brought with him to Spitsbergen during his expedition in 1872, escaped as soon as they were put ashore. In the summer of 1875 some of them were shot by hunters. The draught animals grazed along with the wild reindeer and were, like these, very fat. As regards the change of colour and coat several observations have been made in reindeer transferred from Norway to Finland, — for instance, from Varangernes to Enare. When moved from mountain to forest, the reindeer acquires a somewhat darker colour, and the contrary has been observed when reindeer are transferred from forest to mountain, i. e. the coat becomes lighter. This change is said to take place as early as the second year after such change of habitat. In the offspring of females that have moved from forest to mountain, or the reverse, the change comes earlier.

Of the numerous species of reindeer which have been established especially by American scientists, the one (*R. pearyi*) from Ellesmere Land described by J. A. ALLEN [1], (1902) undoubtedly comes nearest in size and colour to the Spitsbergen reindeer. Unfortunately ALLEN has had only 4 more or less defective hides of full-grown animals, without skulls, and a complete hide of a young calf, taken on Ellesmere Land in June 1902. "In coloration," says ALLEN "they are strikingly different from any other known caribou, being pure white except for a large dark patch on the middle and posterior part of the back." "It is practically wholly white, at least in the winter coat, and has at most a shade of gray on the middle of the back and at times with a leaden gray band over the nose. By its smallness it is easily distinguished from all other American reindeer and likewise also by its unusually large spoon-formed lateral toes which by PEARY (as well as ALLEN) are said to be "as large as hare's ears." The antlers are erect in an unusual degree for a reindeer" (LÖNNBERG 1909, p. 3). ALLEN gives the length of the full-grown reindeer's hide as being from 1560 to 1660 mm. (for comparison the hide of a Greenland reindeer is given as 1820 mm.). Both in colour and size there thus seems to be agreement with the Spitsbergen reindeer. I have not had the opportunity of measuring the length of the hide of Spitsbergen reindeer, but hunters have told me "5 to 6 feet" as the usual length. The mounted full-grown male reindeer in the Oslo Zoological Museum, from Sassen Bay 1911, has a length from the root of the tail to the point of the nose of only 145 cm. The lateral toes are, however, not of any striking size (compared with Norwegian reindeer), and in length not nearly so large as "hare's ears." ALLEN compares the Ellesmere reindeer with the Greenland type. He says: "*R. pearyi* is evidently a very distinct insular form, very different from *R. grœnlandicus* in coloration and doubtless in other features. Unfortunately only flat skins are available for examination. Specimens of *R. grœnlandicus* in corresponding

pelage are dark slaty brown above, this color fading gradually on the sides to the white of the neutral surface, the Greenland caribou being very much darker in its winter pelage than the Newfoundland caribou, which heretofore has been the whitest known form of the group." "I have seen many winter coats of the Greenland caribou," says PEARY, in a letter to ALLEN, "and they are pronouncedly darker than the Ellesmere specimens." In the same letter PEARY mentions the various localities where "remains and traces of reindeer have been noted by previous explorers: Alexandra Haven, Ellesmere Land; Rawlings Bay, Grinnell Land; and in the Fort Conger region, Grinnell Land; and an antler was picked up by a member of my party in the summer of 1901 at Erik Harbor, some twelve miles south of Cape Sabine. The published reports of SVERDRUP'S expedition state that he found reindeer in abundance on the west side of Ellesmere Land." Unfortunately no specimens of reindeer were brought home by Sverdrup's expedition. LÖNNBERG (1909) considers it probable that the same reindeer form occurs also in other extreme Arctic American islands. During JOHN ROSS' second voyage a little reindeer was seen on Melville Island, which in size has been compared to the Spitsbergen reindeer, and which had only half the size of the Barren Ground caribou in Boothia.

Besides this reindeer from the islands of Arctic America, also the reindeer on the New Siberian Islands is said to be small of size. According to LÖNNBERG [16] the Russian missionary, ARGENTOFF, says in the Russian Geographical Society's "Sapiske" 1861 that the fishermen in the Ustjansk districts distinguish between two forms of Arctic wild reindeer, the one is called "tundra reindeer", the other "sea reindeer." The tundrareindeer spend the summer on the tundras and on the Arctic sea coast and the winter in the forest belt; the sea reindeer, on the contrary, spend the summer somewhere on the other side of the sea (New Siberian islands), from where they come in autumn to the Asiatic mainland and pass the winter on the Indigirka-Jansk tundra. This mode of life is the reason for the division into tundra and sea reindeer. ARGENTOFF says that the most important thing he learnt from the native fishermen about these two forms of reindeer was that the sea reindeer was smaller than the tundra type and came annually in great numbers to the tundra.

"On the whole stretch between Bjørnekap (the most southerly point of Kersel Island (Kotelnoi) right to Little Ljachov Island we found spoor, like a road, of the reindeer herds that had wandered southward in autumn" says VON TOLL in the report of the "Sarjas" polar expedition, 1900—1902.

"This interesting account of the smallness of the "sea" reindeer, says LÖNNBERG, should be compared "with the fact that the Spitsbergen reindeer, like the reindeer recently described from Ellesmere and

Grant's Land, is considerably smaller than other kinds. It is obvious that the analogous extreme Arctic conditions on the New Siberian Islands produce just such a dwarfed form of animal as the two extremely Arctic islands mentioned, but the New Siberian form may through its wanderings to and fro maintain a connection with its original habitat on the Continent."

LÖNNBERG, who classifies the reindeer races established by various scientists into three distinct groups, according to occurrence as well as biological and morphological characteristics, reckons the *extreme-Arctic Island reindeer*, as one group, the Arctic resp. sub-Arctic tundra and mountain reindeer as another and the boreal woodland reindeer as the third, and in LÖNNBERG'S opinion it is from the barren ground group (the Arctic resp. sub-Arctic tundra and mountain reindeer) that the reindeer which occurs in the extreme north on the inaccessible islands of the Arctic, cut off from the continent by broad arms of sea, has its origin.

It may be admitted, says the same author, [16], p. 21, that the characteristics pointed out are not in themselves of such great importance as to justify the establishment of separate races. But on the other hand, it may be considered fully justifiable to regard these different forms as geographical sub-species, especially if the exterior variations should prove to be connected with differences in osteological respect, if material had existed for judging this matter. Moreover the important difference in regard to occurrence and mode of life must be added, which naturally stands in direct connection with the dissimilarity in the structure of the body.

It is, as LÖNNBERG points out, the outer characters, such as colour, size, shape of antlers, etc. which in quite an overwhelming degree form the basis of the races and species of reindeer as classified in different countries, especially in America, whilst, on the contrary, investigations as to how far the outer dissimilarities and different mode of life are also connected with dissimilarities, for instance, in osteological respects, have as yet been carried out to but a small extent on account of lack of material.

We must also take into account the well-known fact that many animals and plants possess great powers of adaptability, and that a change of habitat not infrequently calls forth certain dissimilarities in the appearance of the organisms concerned; that, for example, certain animals and plants increase in size and acquire a somewhat different colour in certain localities than in others will be known to all. Neither such morphological differences, however, nor the various modes of life, entitle the naturalist to divide the species in question into sub-divisions or geographical races, unless the differences have reached a certain degree, show a certain constancy, and are what may be

termed fixed. In the judging of these conditions the personal estimate may of course play a very great part, and has always done so. If, however, in representatives of a "race" there is proof of the occurrence of all or a majority of such morphological characteristics as are said to be the characteristics of another race, then it will be clear that these cannot be given rank as racial marks. Their occurrence could then only be considered as a sign of a considerable tendency to variation as regards construction, and their different modes of life, in the same way, could be regarded merely as the sign of great power of adaptability to different outer conditions of life.

As regards Spitsbergen reindeer, it may in my opinion, be said that its distinctive features have reached a certain degree of development, show a certain constancy, and are, what may be termed fixed. But, how far the analogous extreme Arctic conditions have produced a likeness between the Spitsbergen reindeer and the other far Arctic animals from Ellesmere and Grant's Land and the New Siberian Islands, not only in size (and to a certain extent in colour) but also in general, for example, in the construction of the skull, or how far the *R. tarandus forma Spitsbergensis* in its distribution is confined to Spitsbergen, is an open question.

Since this paper was written Norway has assumed sovereignty over Svalbard (Spitsbergen and Bear Island), thus establishing law and right in these islands. This took place on August 14th, 1925, and the first administrative step taken by the Norwegian Government was to prohibit the killing of reindeer for a period of ten years¹, in conformity with the above-mentioned proposal submitted by HOEL². And this step was taken none too soon, as is evidenced by the following statement made by HOEL, from which it appears that the reindeer had almost entirely disappeared from West-Spitsbergen.

"In the summer of 1925 the region between Isfjorden, Van mijen Bay, Kjellström Valley, and Agardh Bay was crossed in every direction by four topographical and two geological parties of the Norwegian Government expedition. In Conway Valley they did not see a single reindeer, in the upper end of De Geer Valley they saw seven, in the upper end of Advent Valley and Brent Pass fourteen, and at the head of Lundström Valley two. These have always been regarded as the best reindeer grounds.

¹ Kongelig resolusjon av 7. august 1925. — Norsk Lovtidende, Nr. 37, p. 527. Oslo 1925.

² This proposal has now been printed in *Norge, Tidsskrift om vårt land*, Oslo 1926, Årg. 2, No. 12, p. 74—91, and in *Naturfredning i Norge. Årsberetning 1926*, p. 8—24 [Oslo 1926].

The scarcity of reindeer in West-Spitsbergen will also be understood from the fact that only fifty-five were shot by hunters during the winter of 1924—1925, viz. twenty-four in Sassen Valley, seven on Kapp Thordsen peninsula, nine in the Liefde Bay and Wood Bay tracts, nine on the west side of Wijde Bay, and five on the east side of the same fjord, while one was shot by some coal-mining people between the heads of Advent Valley and Conway Valley. In the summer of 1925 three were shot at the upper end of De Geer Valley, in Brent Pass, and in Advent Valley about three kilometres below that pass. And seeing that there were approximately forty hunters in the various reindeer districts of West-Spitsbergen during the past winter, it is obvious that reindeer must be very scarce in this island. The main stock is to be found on Edge Øy, Barents Land, and Nordost-Landet; but even in those parts their numbers are limited. Practically all the reindeer mentioned in the table, p. 54, in the last 3—4 years, were shot in these parts of Spitsbergen”.

This statement by HOEL shows how fortunate it was that Norwegian rule in Svalbard should be inaugurated by the issuance of an order in council for the protection of reindeer. The number of reindeer still left in the remote parts of these islands is believed to be sufficient for the renewal of the stock by immigration throughout the archipelago during this period of protection, which lapses at the end of 1934.

Tables of Measurements of Spitsbergen Reindeer.

Museum.	Number.	Sex.	I				II		III		
			Maximal Length of Cranium, mm.	Condylbasal Length mm.	Basal Length mm.	Palatal Length mm.	Ratio of Maximal Length of Cranium to Palatal Length, per cent.	Maximal Breadth of Cranium, mm.	Ratio of Maximal Breadth to Maximal Length, per cent.	Breadth of Forehead, mm.	Ratio of Breadth of Forehead to Maximal Length of Cranium, per cent.
Full-grown Specimens											
T. M.	2		335	def.	def.	205	61.2	157	46.9	117	34.9
"	4		321	311	293	193	60.1	159	49.5	116	36.1
"	3		305	295	277	177	58.0	141	46.2	100	32.8
Z. M.	6615		300	297	278	184	61.3	139	46.3	103	34.3
"	6614		295	294	274	175	59.3	141	47.8	103	34.9
T. M.	1		285	282	264	170	59.6	139	48.8	100	35.1
Thj. M.	11		285	280	262	173	60.7	140	49.1	104	36.5
Z. M.	6613		285	279	262	169	59.3	137	48.1	99	34.7
T. M.	10		273	266	251	164	60.1	140	51.3	102	37.4
"	7		272	270	251	166	61.0	139	51.1	99	36.4
"	9		266	262	247	166	62.4	136	51.1	95	35.4
Calves											
Z. M.	6619		272	264	249	161	59.2	135	49.6	95	34.9
"	6616		267	260	245	def.	—	def.	—	95	35.6
"	6618		250	246	231	146	58.4	125	50.0	84	33.6
"	6617		248	241	226	147	59.3	122	49.2	86	34.7
T. M.	8		220	213	196	126	57.3	116	52.7	83	37.7
"	5		217	213	194	125	57.6	110	50.7	77	35.5
"	6		207	201	186	120	58.0	110	53.1	75	36.2
Thj. M.	12		200	193	176	114	57.0	104	52.0	74	37.0
"	13		190	183	168	106	55.8	99	52.1	69	36.3
"	14		178	171	157	98	55.1	95	53.4	69	38.8

Museum.	Number.	Sex.	IV				V	VI	
			Maximal Length of Cranium, mm.	Breadth of Cranium at the External Auditory Meatus, mm.	Breadth of Cranium behind the Canines, mm.	Ratio of Breadth at the External Auditory Meatus to Maximal Length, per cent.	Ratio of Breadth behind the Canines to Breadth at the External Auditory Meatus, per cent.	Distance between the outer Edges of Condyl occipitales, mm.	Distance between the superior Edges of Lachrymalia.
Full-grown Specimens									
T. M.	2		335	119	67	35.5	56.3	def.	69
"	4		321	113	66	35.2	58.4	58	61
"	3		305	102	56	33.4	54.9	53	56
Z. M.	6615		300	99	54	33.0	54.5	51	58
"	6614		295	95	53	32.2	55.8	54	60
T. M.	1		285	89	59	30.2	66.3	52	59
Thj. M.	11		285	89	55	31.2	61.8	52	58
Z. M.	6613		285	89	51	34.7	57.3	53	57
T. M.	10		273	84	56	30.8	66.7	57	57
"	7		272	84	53	30.9	63.1	52	def.
"	9		266	81	49	30.5	60.5	49	48
Calves									
Z. M.	6619		272	87	46	32.0	52.9	52	57
"	6616		267	81	48	30.3	59.3	49	def.
"	6618		250	72	44	28.8	61.1	50	54
"	6617		248	76	44	30.6	57.9	48	48
T. M.	8		220	72	39	32.7	54.2	47	41
"	5		217	67	37	30.9	55.2	45	50
"	6		207	68	37	32.9	54.4	48	49
Thj. M.	12		200	71	36	35.5	50.7	43	45
"	13		190	68	34	35.8	50.0	44	45
"	14		178	58	34	32.6	58.6	42	44

T. M. = Tromsø Museum. Z. M. = Oslo Zoological Museum. Thj. M. = Trondhjem Zoological Museum.

Museum.	Number.	Sex.	VII							VIII			
			Maximal Length of Cranium, mm.	Distance between Jugalia, mm.	Distance between Processus paramastoid., mm.	Distance between Proc. styl. tympan., mm.	Distance between Proc. pterygoid., mm.	Distance between Proc. paramast. and Jugals in the following ratio:	Distance between Proc. styl. tympan. and Jugals in the following ratio:	Distance from the anterior Edge of Orbita to the Point of Praemaxilla, mm.	Distance from Foramen infraorbitale to the Point of Praemaxilla, mm.	Ratio to the maximal cranial Length: (per cent.)	Distance from Foramen infraorbitale to the Point of Praemaxilla in Ratio to the maximal cranial Length: (per cent.)
Full-grown Specimens													
T. M.	2	♂	325	132	def.	def.	def.	—	—	195	113	58.2	33.7
"	4	♂	321	133	65	59	39	0.49:1	0.44:1	192	109	59.8	34.4
"	3	♂	305	120	59	52	33	0.49:1	0.43:1	178	100	58.4	32.8
Z. M.	6615	♂	300	117	53	52	36	0.45:1	0.44:1	178	101	59.3	33.7
"	6614	♂	295	115	58	57	36	0.50:1	0.50:1	170	96	57.6	32.5
T. M.	1	♀	285	113	50	54	—	0.44:1	0.49:1	167	93	58.6	32.6
Thj. M.	11	♀	285	109	49	52	—	0.45:1	0.48:1	166	96	58.2	33.7
Z. M.	6613	♀	285	115	53	52	—	0.46:1	0.45:1	169	95	59.3	33.3
T. M.	10	♀	273	111	53	51	—	0.48:1	0.46:1	158	90	57.9	33.0
"	7	♀	272	111	53	51	—	0.48:1	0.46:1	162	90	59.6	33.1
"	9	♀	266	111	50	50	—	0.45:1	0.45:1	156	88	58.6	33.1
Calves													
Z. M.	6619	♂	272	110	51	50	—	0.46:1	0.45:1	160	87	58.8	32.0
"	6616	♂	272	def.	def.	def.	—	—	—	155	88	58.1	33.0
"	6618	♀	250	105	48	49	—	0.46:1	0.47:1	142	82	56.8	32.8
"	6617	♀	248	102	50	47	—	0.49:1	0.46:1	144	82	58.1	33.1
T. M.	8	♀	220	96	48	49	—	0.50:1	0.51:1	113	70	51.4	31.8
"	5	♀	217	95	47	47	—	0.49:1	0.49:1	119	69	54.8	31.8
"	6	♀	207	97	50	48	—	0.52:1	0.49:1	111	65	53.6	31.4
Thj. M.	12	♀	200	91	45	48	—	0.49:1	0.53:1	108	63	54.0	31.5
"	13	♀	190	84	45	def.	—	0.54:1	—	102	62	53.7	32.6
"	14	♀	178	87	45	def.	—	0.52:1	—	91	55	51.1	30.9

Museum.	Number.	Sex.	IX					X		XI					
			Maximal Length of Cranium, mm.	Distance from upper posterior Point of Praemaxilla to anterior Point of the same, mm.	Distance between upper Point of Praemaxillae, m. m.	Distance between Praemaxillae at Middle of Nasal Opening, mm.	Distance from anterior Edge of Nasalia to anterior Point of Praemaxilla, mm.	Distance between 1st Pair of Praemolars and Canines, mm.	Distance between 1st Pair of Praemolars and Canines bears the following Ratio to maximal cranial Length	Maximal Length of Nasalia, mm.	Posterior Breadth of both nasal Bones, mm.	Breadth of both nasal Bones of narrowest Point, mm.	Anterior Breadth of both nasal Bones, mm.	Length of Nasalia bears the following Ratio to maximal cranial Length, per cent.	Anterior Breadth of both nasal Bones bears following Ratio to posterior Breadth, per cent.
Full-grown Specimens															
T. M.	2	♂	335	89	41	49	88	59	17.6	100	53	25	34	29.9	64.2
"	4	♂	321	87	36	46	86	60	18.7	99	53	23	34	30.8	64.2
"	3	♂	305	78	35	def.	81	48	15.7	90	46	20	23	29.5	50.0
Z. M.	6615	♂	300	75	35	39	78	55	18.3	84	47	21	27	28.0	57.4
"	6614	♂	295	71	37	41	76	def.	—	83	40	16	27	28.1	67.5
T. M.	1	♀	285	67	31	40	71	48	16.8	85	45	19	27	29.8	60.0
Thj. M.	11	♀	285	71	37	40	76	54	18.9	81	41	19	28	28.4	68.3
Z. M.	6613	♀	285	71	33	38	74	50	17.5	84	39	17	27	29.5	69.2
T. M.	10	♀	273	69	35	38	71	47	17.2	75	41	19	28	27.5	68.3
"	7	♀	272	71	33	32	72	48	17.6	80	45	22	25	29.4	55.6
"	9	♀	266	68	31	37	66	46	17.3	84	43	19	28	31.6	65.1
Calves															
Z. M.	6619	♂	272	61	30	32	71	48	17.6	74	43	18	24	27.2	
"	6616	♂	267	68	32	36	68	def.	—	80	46	20	28	30.0	
"	6618	♀	250	55	32	33	66	48	18.4	59	32	17	24	23.6	
"	6617	♀	248	62	30	32	65	def.	—	68	38	16	22	27.4	
T. M.	8	♀	220	53	23	26	60	39	17.6	53	30	12	15	24.1	
"	5	♀	217	52	22	26	53	40	18.4	57	54	14	18.5	26.3	
"	6	♀	207	49	22	26	50	37	17.1	57	33	11	17	27.5	
Thj. M.	12	♀	200	45	22	24	50	36	18.0	49	32	13	17	24.5	
"	13	♀	190	40	23	24	47	33	17.4	42	28	11	16	22.1	
"	14	♀	178	39	22	23	43	29	16.3	37	31	13	19	20.8	

Museum.	Number.	Sex.	XII				XIII				
			Maximal Length of Cranium, mm.	Height of Maxilla mm.	Length of Maxilla mm.	Height of Maxilla bears the following Ratio to the Length, per cent.	Length of Maxilla bears the following Ratio to maximal cranial Length per cent.	Height of Os zygomaticum, mm.	Length of Os zygomaticum, mm.	Height of Os zygom. bears following Ratio to the Length, per cent.	Length of Os zygom. bears following Ratio to maximal cranial Length, per cent.
Full-grown Specimens											
T. M.	2	♂	335	73	178	41.0	53.1	45	107	42.1	31.9
"	4	♂	321	72	174	41.4	54.2	43	100	43.0	31.2
"	3	♂	305	67	160	41.9	52.5	42	97	43.3	31.8
Z. M.	6615	♂	300	65	160	40.6	53.3	36	98	36.7	32.7
"	6614	♂	295	62	160	38.8	54.2	33	100	33.0	33.9
T. M.	1	+O+O+	285	66	156	42.3	54.7	39	93	41.9	32.6
Thj. M.	11	+O+O+	285	65	150	43.3	52.6	38	88	43.2	30.9
Z. M.	6613	+O+O+	285	66	157	42.0	55.1	39	95	41.1	33.3
T. M.	10	+O+O+	273	63	146	43.2	53.5	36	88	40.9	32.2
"	7	+O+O+	272	57	150	38.0	55.1	40	90	44.4	33.1
"	9	+O+O+	266	55	145	37.9	54.1	35	90	38.9	33.8
Calves											
Z. M.	6619	♂	272	63	146	43.2	53.7	35	90	38.9	33.1
"	6616	+O+O+	267	55	145	37.9	54.3	34	def.	—	—
"	6618	+O+O+	250	57	132	43.2	52.8	33	82	40.2	32.8
"	6617	+O+O+	248	55	133	41.4	53.6	34	87	38.4	35.1
T. M.	8		220	49	113	43.4	51.4	28	75	37.3	35.0
"	5		217	43	105	41.0	48.4	28	70	40.0	32.3
"	6		207	45	106	42.5	51.2	27	69	39.1	33.3
Thj. M.	12		200	45	99	45.3	49.5	25	65	38.5	32.5
"	13		190	42	91	46.2	47.9	22	60	36.7	31.6
"	14		178	36	85	42.4	47.8	21	58	36.2	32.6

Museum.	Number.	Sex.	XIV					XV			
			Maximal cranial Length, mm.	Breadth between 1st Pair of Premolars, mm.	Ratio of the same to maximal cranial Length, per cent.	Breadth between 1st Pair of Molars, mm.	Ratio of the same to maximal cranial Length, per cent.	Breadth between 3rd Pair of Molars, mm.	Ratio of the same to maximal cranial Length, per cent.	Length of Row of Teeth in Maxilla, mm.	Length of Row of Teeth in Ratio to maximal cranial Length, per cent.
Full-grown Specimens											
T. M.	2	♂	335	47	14.0	59	17.6	54	16.1	93	27.8
"	4	♂	321	32	14.6	59	18.4	55	17.1	87	27.1
"	3	♂	305	32	10.5	52	17.0	53	17.4	88	28.9
Z. M.	6615	♂	300	40	13.3	52	17.3	50	16.7	85	28.3
"	6614	♂	295	32	10.8	50	16.9	48	16.3	93	31.5
T. M.	1	+O+O+	285	40	14.0	55	19.3	50	17.5	90	31.6
Thj. M.	11	+O+O+	285	37	13.0	47	16.5	49	17.2	85	29.8
Z. M.	6613	+O+O+	285	37	13.0	52	18.2	48	16.8	90	31.6
T. M.	10	+O+O+	273	36	13.1	48	17.5	47	17.1	84	30.8
"	7	+O+O+	272	34	12.5	48	17.6	50	18.4	87	32.0
"	9	+O+O+	266	31	11.7	44	16.5	49	18.4	84	31.6
Calves											
Z. M.	6619	♂	272	41	15.1	48	17.6	—	—	—	—
"	6616	+O+O+	267	—	—	—	—	—	—	—	—
"	6618	+O+O+	250	36	14.4	42	16.8	—	—	—	—
"	6617	+O+O+	248	38	15.3	43	17.3	—	—	—	—
T. M.	8		220	36	16.4	—	—	—	—	—	—
"	5		217	33	15.2	—	—	—	—	—	—
"	6		207	35	16.9	—	—	—	—	—	—
Thj. M.	12		200	29	14.5	—	—	—	—	—	—
"	13		190	28	14.7	—	—	—	—	—	—
"	14		178	26	14.6	—	—	—	—	—	—

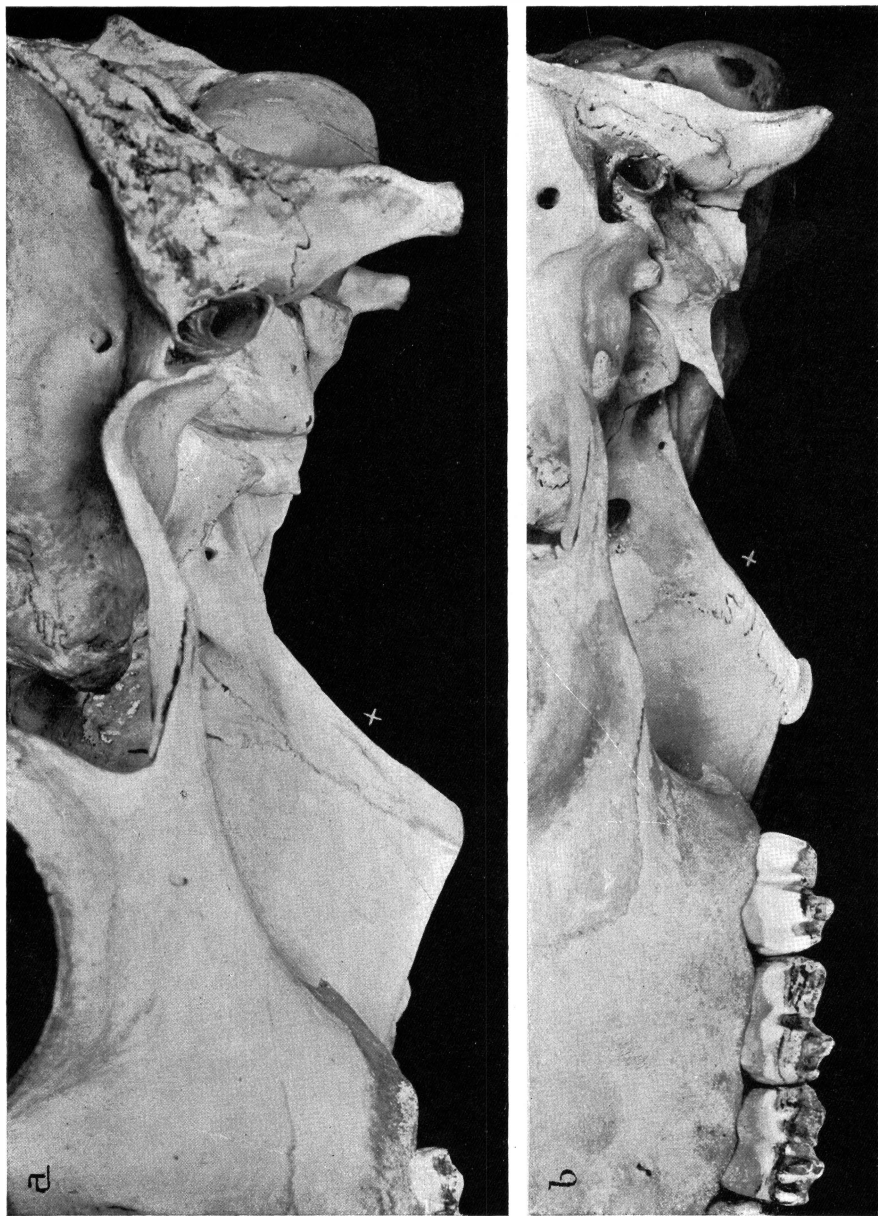
XVI															
Museum.	Number.	Sex.	Size of Premolars and Molars in Maxilla, mm.												
			Maximal cranial Length mm.	1st Premolar.		2nd Premolar.		3rd Premolar.		1st Molar.		2nd Molar.		3rd Molar.	
				l.	br.	l.	br.	l.	br.	l.	br.	l.	br.	l.	br.
Full-grown Specimens															
T. M.	2	♂	335	14	14	15	16	15	16	16	16	14	17	17	17
"	4	♂	321	13	15	15	16	14	16	15	16	17	17	17	17
"	3	♂	305	12	13	14	15	14	15	17	15	17.5	15	15	15
Z. M.	6615	♂	300	13	13	14	15	15	16	16	16	16	17	17	17
"	6614	♂	295	14	14	16	16	16	16	16	17	19	16	18	16
T. M.	1	+	285	12	13	14	15	14	15	16	15	18	15	17	15
Thj. M.	11	+	285	13	13	13	15	13	15	15	16	16	16	17	15
Z. M.	6613	+	285	13	13	15	16	15	16	17	16	19	17	18	17
T. M.	10	+	273	13	13	14	15	15	15	15	14	17	15	15	15
"	7	+	272	13	13	14	14	14	14.5	14	15	16	16	18	17
"	9	+	266	12	13	14	14	14	14	16	14	17	16	16	15
Calves															
Z. M.	6619	♂	272	12	9	14	12	16	14	17	15	18	17		
"	6616	+	267	—	—	—	—	—	—	—	—				
"	6618	+	250	13	9	14	10.5	16	14	17	17				
"	6617	+	248	12	8	15	11	16	13	17	15				
T. M.	8		220	11	8	15	11	17	13						
"	5		217	11	9	15	11	16	13						
"	6		207	11	7	15	10	16	13						
Thj. M.	12		200	13	8	16	11	16	14						
"	13		190	12	8.5	16	11	—	—						
"	14		178	12	9	16	11	17	14						

List of Papers referred to in the Text.

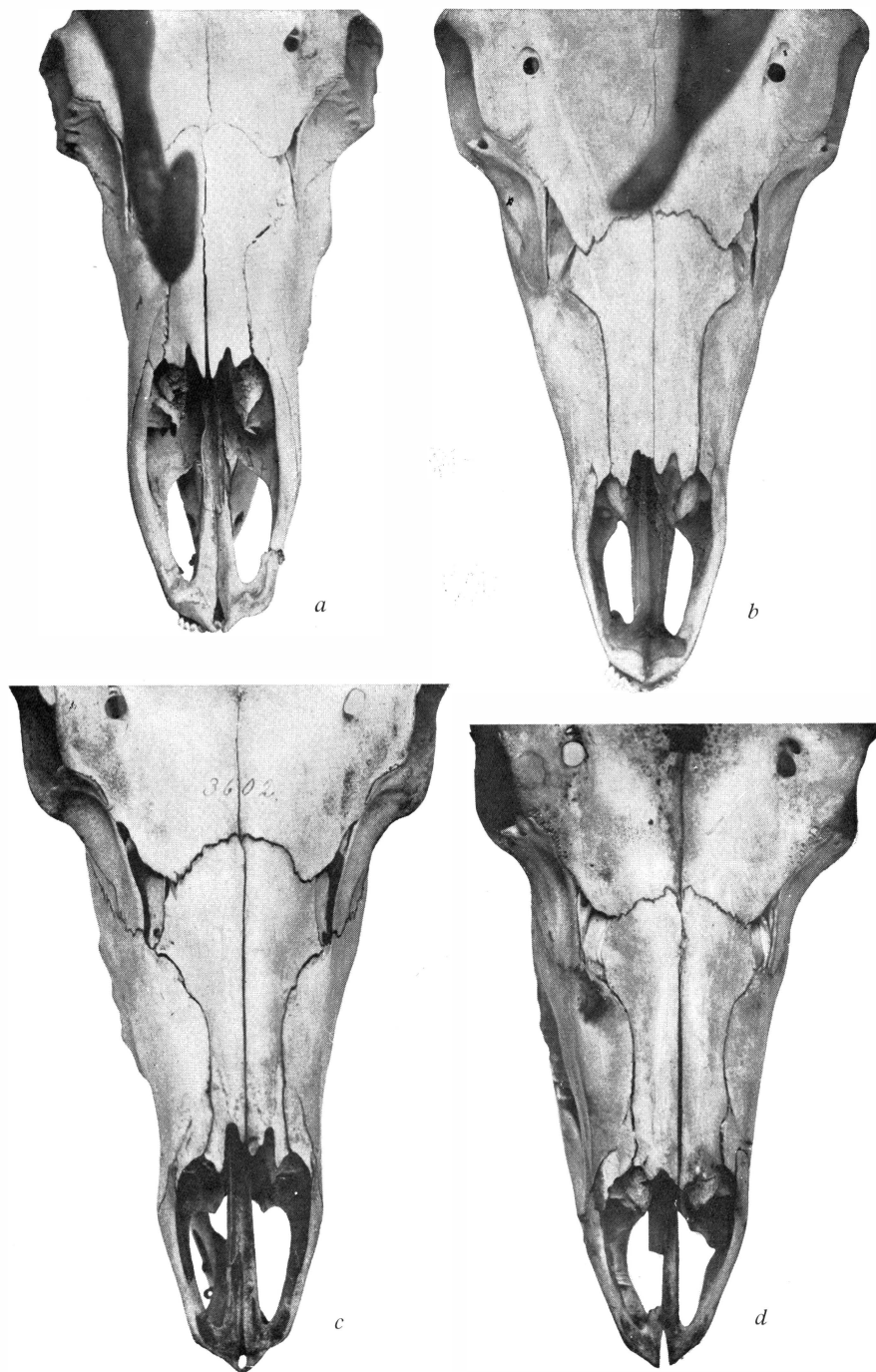
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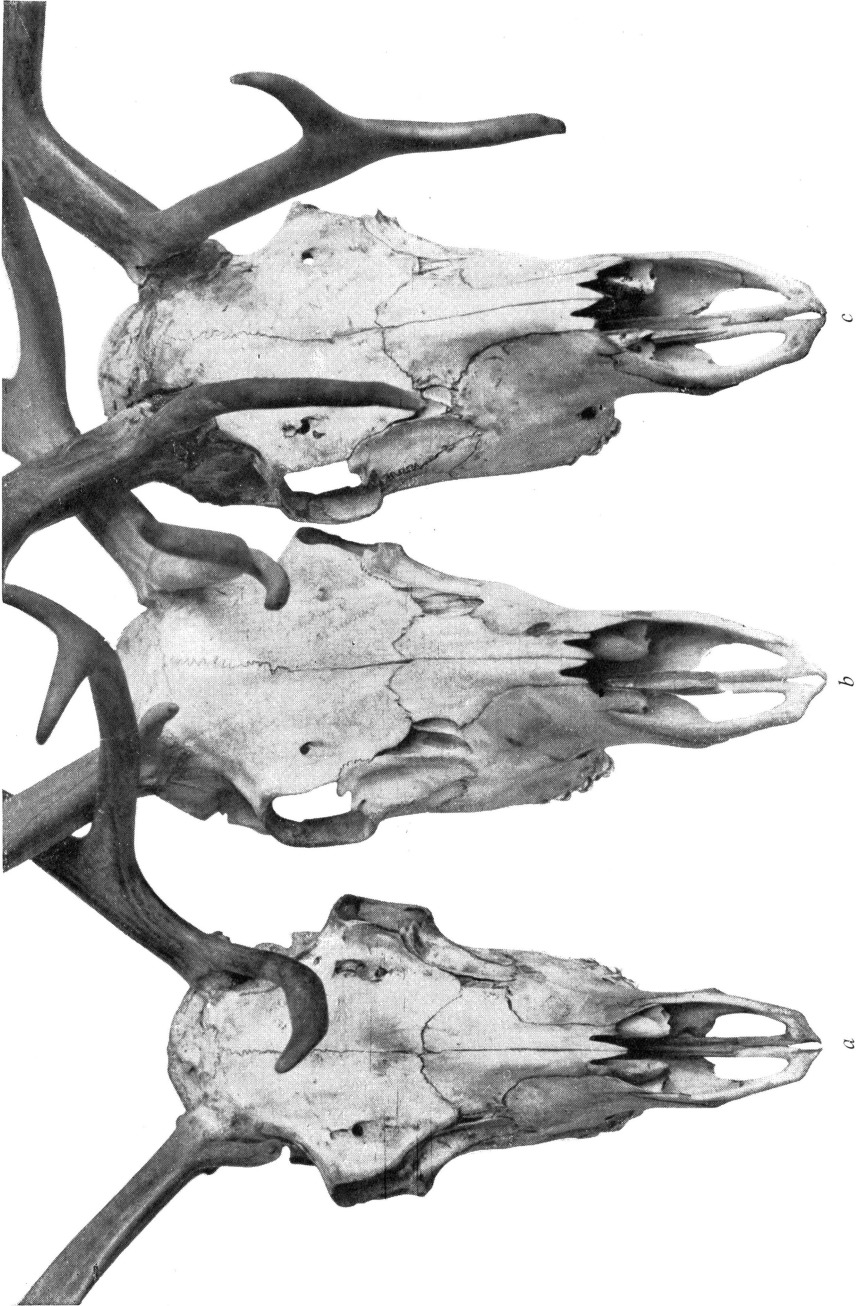
Printed, April 23rd, 1926.



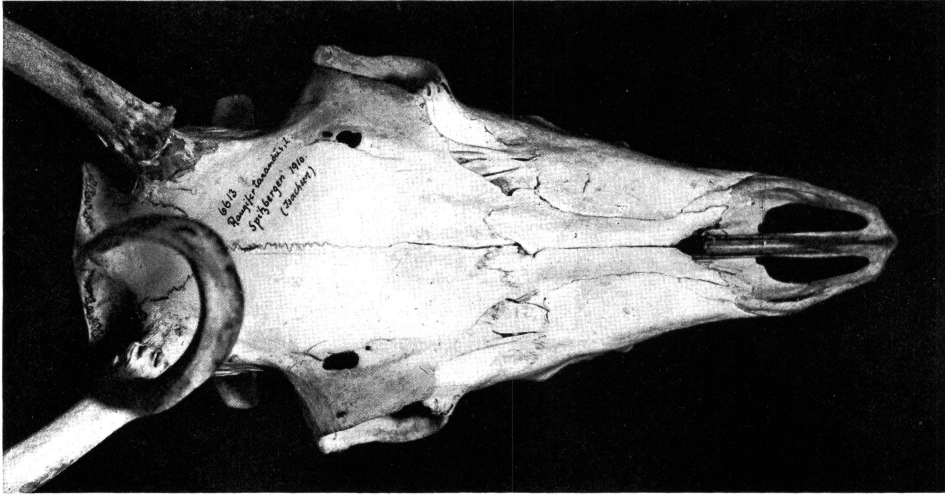
Lower Part of Cranium, side view.
× Ossa pterygoidea.
a. Norwegian wild Reindeer (Male) from Sandalsfeld, Hallingdal, September 1907.
b. Male Reindeer from Spitsbergen.



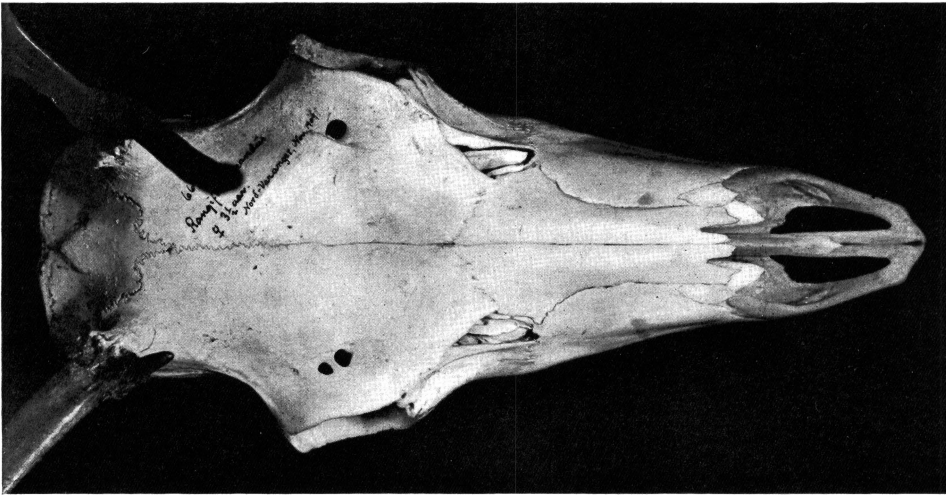
a—d. Norwegian Reindeer, Nasalia, &c., from above.



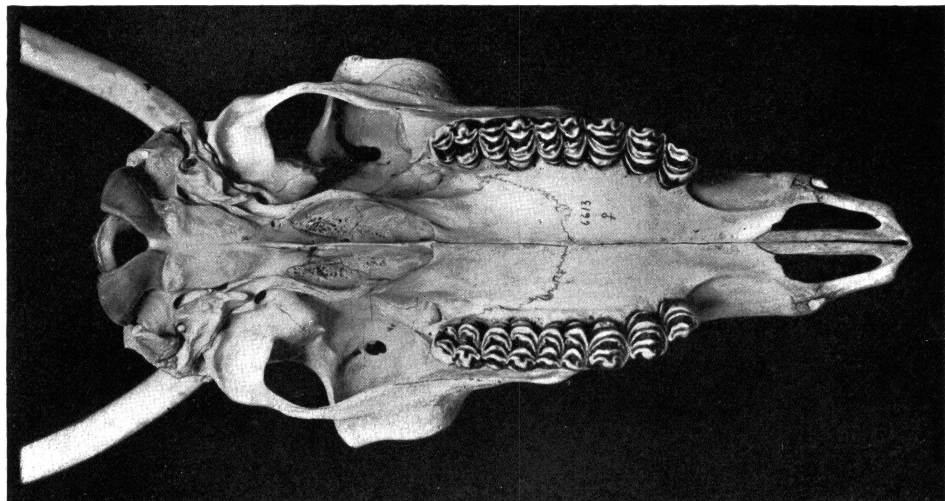
a—c. Skulls of Greenland Reindeer, from above.



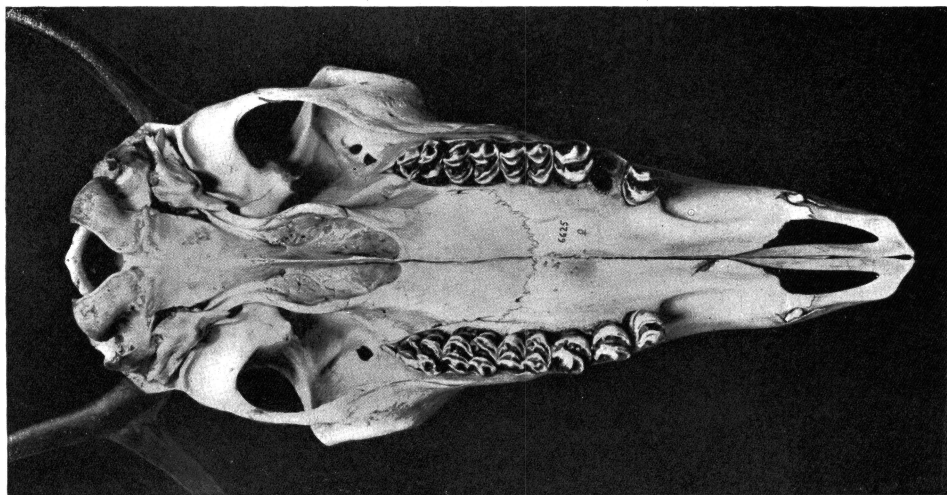
b
Skull of Female Spitsbergen Reindeer, from above.



a
Skull of Female Reindeer from Nord-Varanger,
Norway, from above.



b
Skull of Spitsbergen Reindeer (Female),
from below.



a
Skull of Female Reindeer from Nord-Varanger,
Norway, from below.



a

W. Solheim fot. 11/s 1925.



b

A. Koller fot. 29/s 1909.

Typical Reindeer Tracts in Spitsbergen.

a. Upper part of Conway Valley, near Watershed in the Direction of Lundström Valley. Looking up the Valley from a Mountain 876 m. high. *b.* Rensdyrlandet from Mt. Sköldkulla, 481 m. Looking ENE.

