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THE EAST GREENLAND ESKIMO DENTITION

NUMERICAL VARIATIONS AND ANATOMY

A CONTRIBUTION TO COMPARATIVE ETHNIC ODONTOGRAPHY

BY

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WITH 27 FIGURES IN THE TEXT
AND 30 PLATES

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PREFACE

During the Spring and Summer of 1933 the present writer was engaged in dental practice at the cryolite mining town of Ivigtut, South-West Greenland. It then became clear that a wide field was open in Greenland for promising studies of native dental conditions and that such studies would probably be of no small interest as far as several main problems of modern dental science were concerned.

So during the next twelve years the writer devoted considerable effort to dental investigations of the former and present-day native population of the Danish Arctic Colony. His studies of the Greenland dentition took him another three times to the Arctic (between 1935 and 1939) and also led him into work in the Anthropological Laboratory of the Copenhagen University Department of Anatomy.

The principal purpose of the Greenland dental investigations was that of contributing to the knowledge of dental disease. Eventually, however, it became clear that the Eskimo dentition, besides displaying an interesting pathology, exhibited several features which seemed to show marked racial characteristics. Accumulating evidence to this effect was the exciting factor of the present study, the principal aim of which has been that of scrutinizing the Eskimo dentition for such characteristic features. The attempts to analyse the Eskimo dentition which have been made by the writer in the present study aim at the racial affinities of the Eskimo, and are in fact attempts at approaching the highly interesting and important question of their origin and antiquity from an angle heretofore completely ignored by students of Eskimo anthropology.

However, the scope of the present study is felt to be wider in so far as it has been successful in demonstrating the significance of the dentition as a bearer of racial characteristics in modern man. It has borne out that studies in this field may under favourable conditions yield valuable information of a modern human group. Hence future anthropological studies of races will not be complete without expert dental scrutiny.

Finally it has become obvious that studies of the influence of racial mixture, such as may be made on comparison of East and West Greenlanders will probably be able to yield information of far-reaching importance from the point of view of human genetics. Hints to that effect have been obtained from the present work supporting the views expressed by Dr. KAJ BIRKET-SMITH, the Danish authority on the Eskimo, in the concluding remarks of his report on physical anthropology of the Central Eskimo 1940.

In order to facilitate the work of future students of dental numerical variations and dental anatomy of human races, the writer in the present book has compiled a number of comparative data from anthropological and dental literature.

CHAPTER I

INTRODUCTION

A. THE ESKIMOS

The Eskimos live in the northernmost territories of the Western Hemisphere in an area situated roughly between 25° long. W. and 175° long. W. and between 55° lat. N. and 78° lat. N.

In proportion to the vast expanse of territory inhabited by the Eskimos (Fig. 1) their number is exceedingly small, *viz.* only about 44,000 in all. In 1939 in Alaska there were 15,576 Eskimos, and in 1944, the numbers living in Canada and Greenland were 7,700 and 20,574 respectively.

According to BIRKET-SMITH (27) and TH. MATHIASSEN (201) the Eskimo tribes can be divided into three groups, *viz.* (1) The Western Eskimos living in Alaska, the Mackenzie territory and Eastern Siberia (Chukchee Peninsula), (2) The Central Eskimos living along the extensive shores of Arctic Canada and the north and northwest coasts of Labrador, and (3) The Greenlanders.

In the northern regions the Western Eskimos are hunters and live by whaling and seal hunting. In the south, fishing is the principal occupation. During recent years reindeer breeding has been introduced on a large scale in Alaska. The influence of white civilization has deprived the natives of some of their characteristic cultural features and considerable mixture with Indians (BOAS (32)) and Whites has taken place in many of these regions. The majority of the Western Eskimos live in Alaska and are subjects of the U. S. A.

The Central Eskimos (principal tribes: Labrador Eskimos, Baffin Island Eskimos, Iglulik Eskimos, Caribou Eskimos, Netsilik Eskimos, and Copper Eskimos) lead a more migratory existence than the Western Eskimos. While the majority like other Eskimos provide their food, clothing etc. from the sea (kayak and ice hunting), and only seasonally go caribou hunting, most of the Caribou Eskimos of the Barren Grounds west of Hudson Bay entirely depend on caribou hunting and salmon fishing.

The spiritual and material culture of the Central Eskimo tribes has been studied by KNUD RASMUSSEN, KAJ BIRKET-SMITH and THERKEL

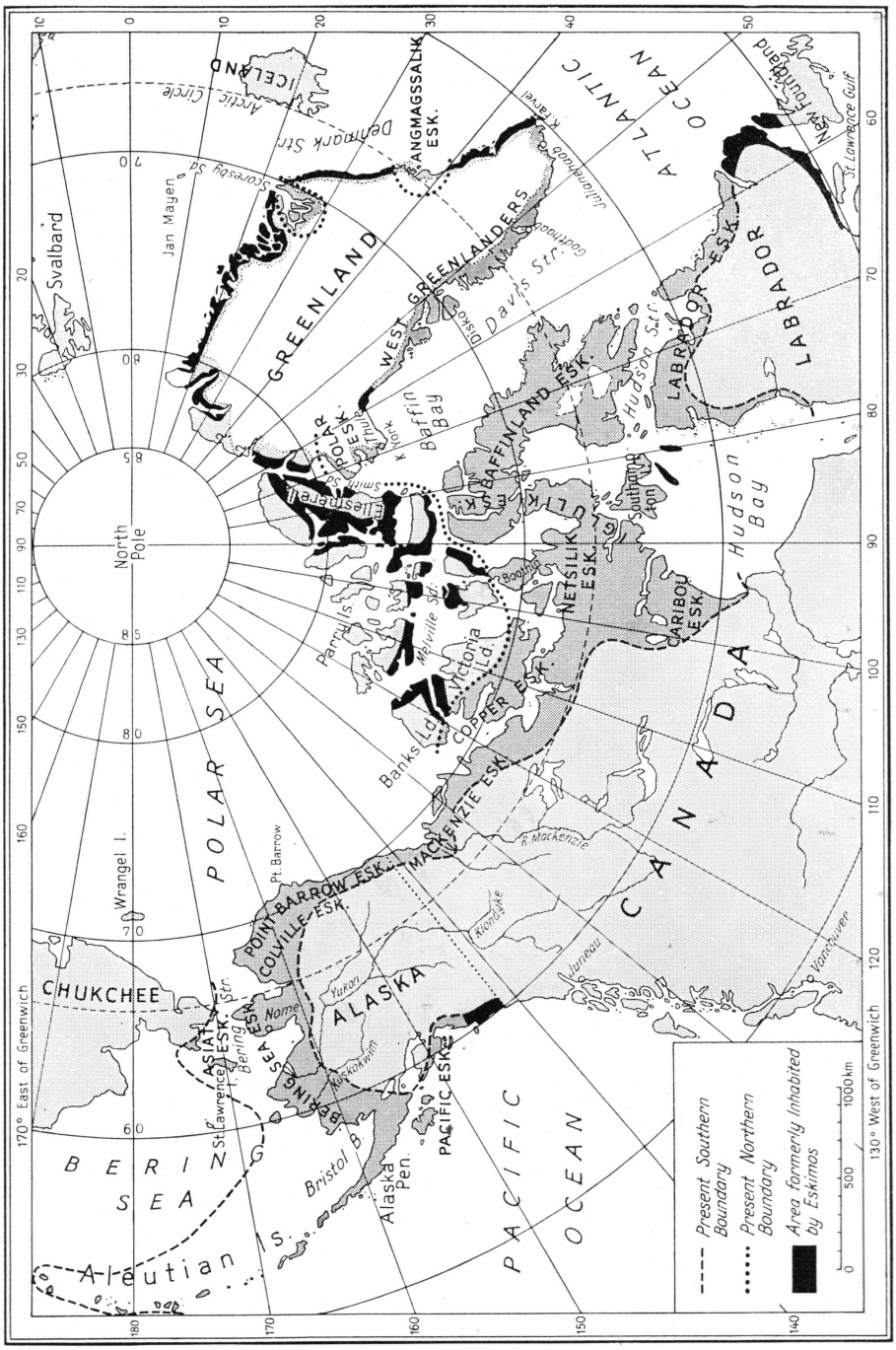


Fig. 1. Distribution of the Eskimos. (BIRKET-SMITH (27)).

MATHIASSEN (Fifth Thule Expedition 1921—24), that of the Copper Eskimos by DIAMOND JENNESS.

The Greenlanders may be subdivided into three groups: —

(1) The Polar Eskimos (310 individuals in 1944) of the Kap York District in the extreme north of West Greenland. The centre of this district is the trading station of Thule (founded by KNUD RASMUSSEN in 1910);

(2) The West Greenlanders (18,959 individuals in 1944) living along the west coast of Greenland between the northern boundary of the Upernavik District in the north, and Kap Farvel in the south; and

(3) The East Greenlanders (1,315 individuals in 1944) in the regions around Angmagssalik, (1,074 individuals in 1944) and around Scoresby Sund.

Three principal factors definitely show that all these extremely scattered native tribes form a unity. They are: their physical anthropology, their language, and their culture.

From the biological point of view it has been established by anthropological investigations, that the Eskimos exhibit characteristic anatomical features showing them to be a special and well-defined racial type. This type will be dealt with subsequently. According to FABRICIUS-HANSEN (83) a. o. a common trend is also found in such physiological conditions as the distribution of blood-groups.

The Eskimo dialects, which have been studied *e. g.* by RINK (270) and THALBITZER (316) form a special primitive family of languages different from all others.

As far as culture is concerned the resemblance is also striking. This applies to all aspects: spiritual, social, and material. The latter has been developed by two principal factors, *viz.* the eternal struggle against the cold, and the effort required to wrench from the desolate environment sufficient food to maintain life and family. With the exception of some of the Caribou Eskimos, the existence of all Eskimos is intimately connected with the sea. The whales, seals, bears and birds which are killed by the hunters provide the supply of food and clothing, the blubber for the heating and lighting of the huts, the skins for kayaks, umiaks and tents, the bones and lines for hunting weapons, fishing implements and sledges and much more. The type of hunting technique is determined by the climate. In the high-arctic zone, hunting of sea mammals is mainly done from the ice, whereas in the subarctic regions (South Alaska, Labrador and Greenland) seal hunting takes place from kayaks. Accordingly the material culture displays an arctic as well as a subarctic phase.

To-day the rapid development of transport has taken white man and his civilization—for good and evil—into the Eskimo countries. The writer is not going to enlarge upon the drawbacks and advantages, if any, of this state of affairs, but it must be mentioned, that many diseases have followed in the track of the white man, not the least being the principal dental disease, caries.

The degree of American and European influence is not the same all over the Eskimo territories. The areas which have been least exposed are the Kuskokwim territory in Alaska, the northernmost Canadian regions on the Baffin Bay and Smith Sound, the Kap York district in West Greenland, and East Greenland.

The physical anthropology of the Eskimo has been studied by many workers by means of skeletal material and on living individuals. It is outside the scope of the present work to go into great detail in this

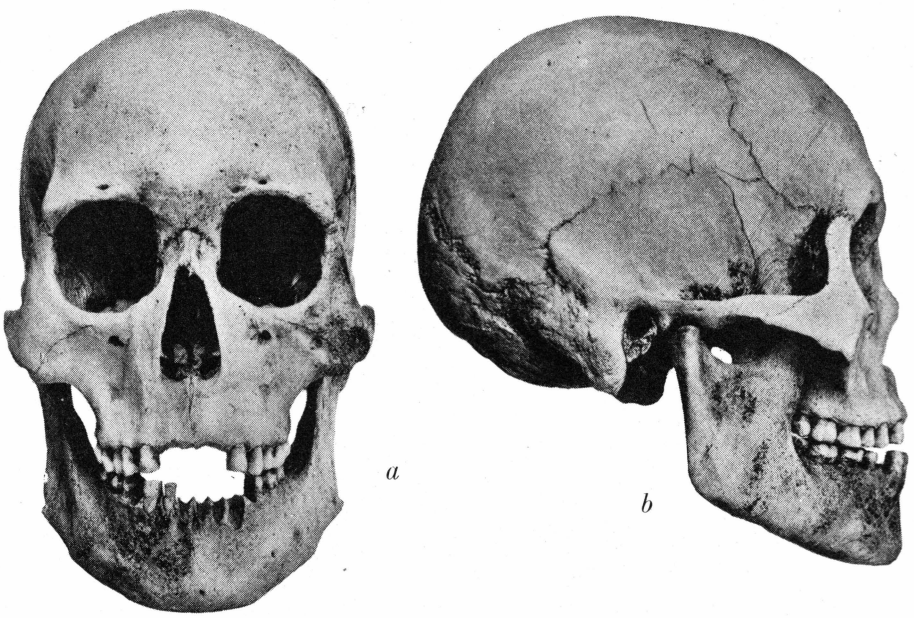


Fig. 2. East Greenland Eskimo skull ($^1/_3$ nat.). a, Frontal aspect. b, Lateral aspect. (FÜRST and HANSEN (95, p. 105 and Tab. XXXII)).

field or to present minute references on the subject, so the following is a synopsis of the principal anatomical features, particularly craniological, which characterize the Eskimo: —[1])

Contrary to what is generally supposed, the Eskimo is not markedly

[1]) Principally according to SØREN HANSEN (116, 117, 118), FÜRST and HANSEN (95), HRDLICKA (136, 146), and BIRKET-SMITH (28, p. 43 and 29, p. 58).

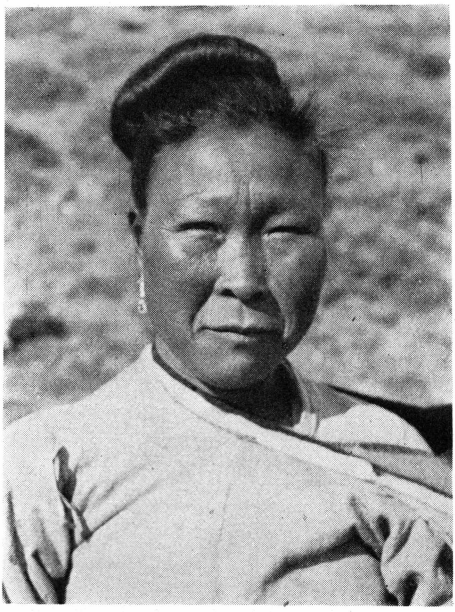


Fig. 3. Angmagssalik Eskimo.

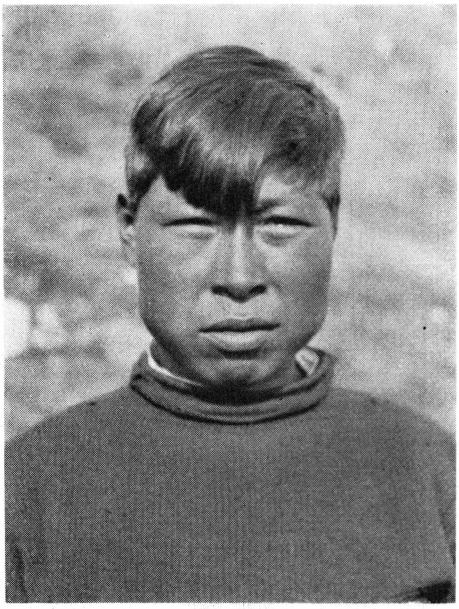


Fig. 4. Angmagssalik Eskimo.

small in stature. The average height of men is between 160 and 165 cm and that of women about 152 cm. The Eskimos are, on an average, powerfully built and plump, without being fat. Their chests are very broad and powerful. Their legs and arms are rather short.

The skull (Fig. 2) exhibits characteristic features, several of which were already described in 1722 by WINSLOW (341): The cranial capacity is large and the skull very heavy. The cranium is relatively long, narrow, and high, with a crest-like sharpening upwards, and a bulge (*tuber occipitale*) posteriorly. Seen from above the vault is long, narrow, ovoid or elliptical in form. The Greenland Eskimo skull is markedly dolichocephalic, often (25 per cent) hyperdolichocephalic (FÜRST and HANSEN (95, p. 230)). The western Eskimos have comparatively shorter and broader heads (HRDLICKA (146, p. 298), SHAPIRO (296, p. 381)). The distance between the upper temporal lines is exceptionally small, indicating extraordinarily powerful temporal muscles to have been present. The vault in most cases carries a pronounced median crest lending a keel-shaped configuration to the upper part of the skull (scapho-cephaly).

The Greenland Eskimo skull is mesoprosopic with a tendency towards leptoprosopy. According to SHAPIRO (296) in the western regions the face is broader. The frontal aspect of the Eskimo cranium is largely of a pentagonal outline, being very broad across the zygomatic bones and the posterior region of the mandible. The zygomatic



Fig. 5. Angmagssalik Eskimo children.

arches are heavy and very strongly bent outwards, their main orientation being frontal, rather than sagittal.



Fig. 6. Bimaxillary subnasal prognathism in Greenland Eskimo skull ($^1/_3$ nat.). (FÜRST and HANSEN (95, Tab. XXI)).

The lower part of the face generally does not project very much compared with the upper part (Fig. 2 b, p. 10). In some cases, however, a pronounced bimaxillary (subnasal) prognathism is observed (Fig. 6).

The orbits are large, high, and tend to be square. The glabella and superciliary arches are usually faintly developed. The bony nose is markedly leptorrhine.

The palate is rather long in most Greenland Eskimos (FÜRST and HANSEN (95, p. 232)) but tends to be broader (brachyuranic) in the western Eskimos (HRDLICKA (146, p. 276), FISCHER-MØLLER (87, p. 46)). A palatal torus is quite often present.

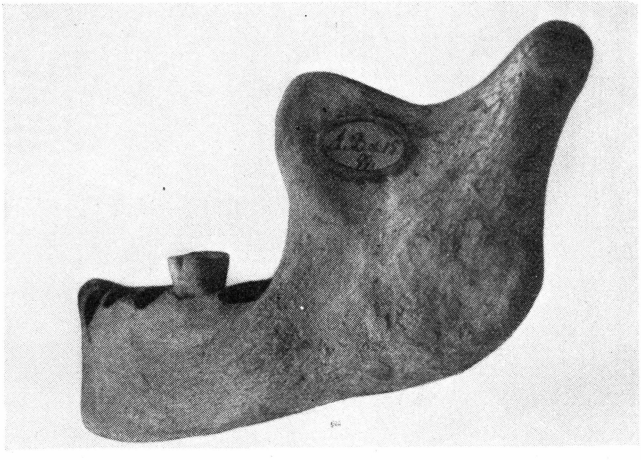


Fig. 7. Greenland Eskimo mandible ($^3/_4$ nat.).

The glenoid fossa is extremely shallow (RITCHIE (271), KNOWLES (172)).

The mandible (Fig. 7) is very heavy and characterized by a high and stout body. The mental portion is high (symphyseal height considerable, cf. HRDLICKA (146, p. 300)) and the chin projecting. The bigonial diameter is strikingly large. The lower parts of the rami are so to say bent laterally, in the regions of the very conspicuous masseter muscles. The bicondylar width is also impressive. The ascending rami are very broad and are low at the same time. The *incisurae mandibulae* are shallow or, at most, of medium depth. The condylar process is low and the condyle markedly worn at mature age. The coronoid process is generally high and is large in the sagittal direction. The body-ramus angle is moderate. Some metrical data on the mandible in different Eskimo groups were compiled by the present writer in an earlier publication (249, p. 180).

In a very high percentage of cases mandibular hyperostoses (mandibular tori) are present. Such bony overgrowths, of which Figs. 8 a and 8 b show examples, are situated on the inner aspect of the body and alveolar process above the mylohyoid line. Usually they reach their

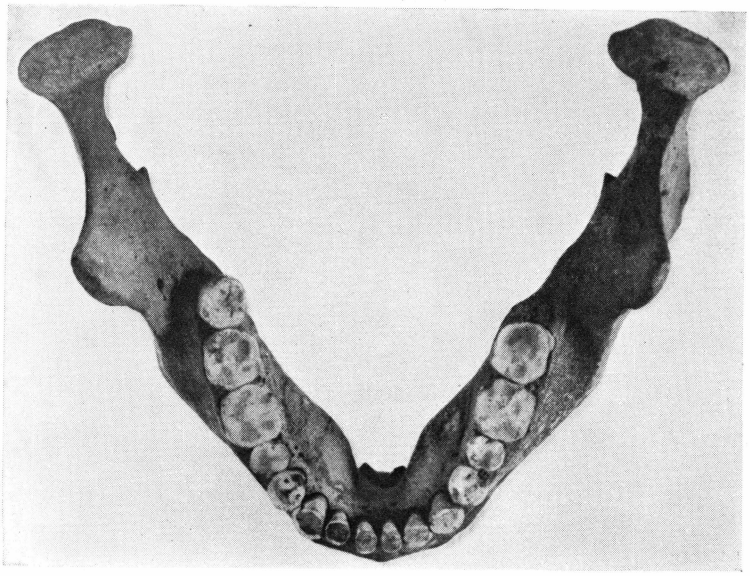


Fig. 8 a.

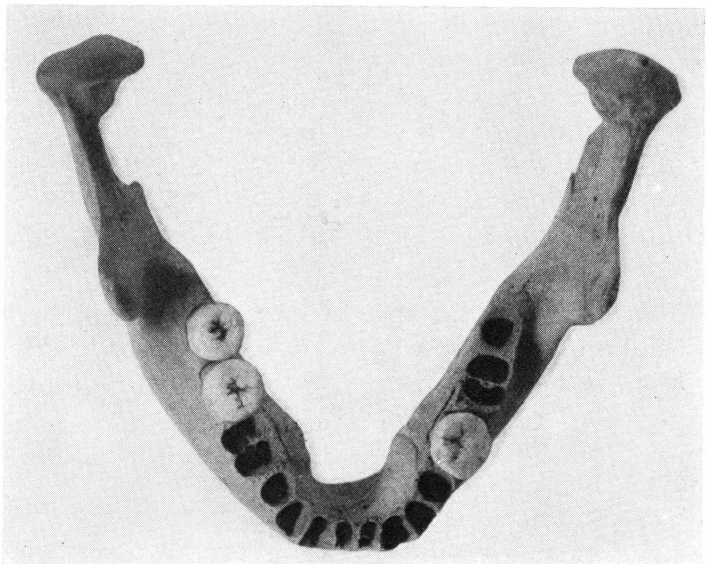


Fig. 8 b.

Fig. 8. Hyperostoses (*tori mandibulares*) in Eskimo mandibles ($^3/_4$ nat.). a, Smooth type. b, Irregular type.

culmination in the premolar regions. They may be smooth like that shown in Fig. 8 a or may be represented by from one to five, or even more, rounded or flattened bony "buttons" or tumour-like elevations (Fig. 8 b). In development the "tori" range from slight to very marked bulges. These interesting structures have been thoroughly dealt with by HRDLICKA (148) who studied the incidence and character of such hyperostoses in more than 5,000 mandibles of different racial origin and gave a complete survey of older literature on the subject.

The origin and antiquity of the Eskimo may be said to be the ultimate object of all efforts of students of their anthropology and culture. The cultural approach to this problem has been much more intensive than the anthropological.

STEENSBY (303) and BIRKET-SMITH (27, 29)[1]) consider that the Eskimo culture came from the interior of Canada and subsequently spread along the arctic coasts.

This view, however, is neither shared by MATHIASSEN (200, 202) nor by HELGE LARSEN and RAINEY (182) who on the strength of archaeological evidence believe that the Eskimo culture came to America from Asia across the Bering Strait.

RINK (269, 270), an early authority on Eskimo migrations, was of the opinion that the Eskimo culture is of American origin, having its sources in Alaska.

HRDLICKA (146, p. 330) reported the views of a number of workers and surveyed the anthropological evidence made available by himself and others. He arrived at the conclusion that the opinion first advanced by CRANZ (59, p. 30) is likely to be correct, *viz.* that the Eskimo originally came from Asia across the Bering Strait. HRDLICKA (l. c.) says that the conception of Asiatic origin of the Eskimo has not yet passed the status of strong probability, but he presents the following concluding statement, "The facts point to an original identity of the source from which were derived the Indian, more particularly his latest branches, and the Eskimo, and to the identification of this source with the palaeo-Asiatic yellow-brown people of lower northern Asia".

In a review of the present status of the problem of Eskimo origin BIRKET-SMITH (29, p. 104) points out the physical resemblance of the Eskimo with the extinct Lagoa Santa race in South America. This well-known authority on the Eskimo says that nothing as yet warrants final conclusions with regard to the origin of the Eskimos or their affinity with Indians and Asiatic Mongols. On the other hand he seems to be

[1]) See also KAJ BIRKET-SMITH: The Caribou Eskimos I—II. Rep. Fifth Thule Expedition, vol. 5, Copenhagen 1929, and *idem*: Amer. Anthropologist n. s. vol. 32, 608—624, 1930.

in favour of the idea that the Eskimo—and not only the Eskimo culture—came from the interior of the American Continent.

On the strength of anthropological investigations, SHAPIRO (296) concludes that the present Eskimos of Smith Sound, Coronation Gulf, and Seward Peninsula are derived from an Indian stock which migrated northward to the coast and then moved northeastward and westward. However, this migration seems to be recent, and superimposed upon an earlier distribution of Eskimos.

As will be seen, rather conflicting views are held by prominent students of the Eskimo as to the origin of their culture. Generally speaking the archaeologists support the theory of Asiatic origin, whereas some ethnographers believe in American origin.

Cultural affinities, however, are not necessarily identical with the racial affinity of the peoples who are the bearers of the cultures in question, and it is felt that HRDLICKA (146, p. 330) especially, did not pay due consideration to this fact when surveying the views of previous students on Eskimo origin and antiquity.

As a matter of fact, hardly any convincing evidence has so far been presented as to either American or Asiatic ancestry of the Eskimos from a somatological point of view, nor has the nature of their racial relationship with the Indians been definitely established. On the other hand there is no doubt or controversy as to the common Mongoloid ancestry—however ancient this may be—of the Eskimo and Indian.

B. GREENLAND AND THE GREENLANDERS

Greenland, the largest island in the world, is situated N. E. of the American Continent (Fig. 1, p. 8) and extends from 59°46′ to 83°37′ lat. N. From North to South it extends 1,690 miles, and from East to West about 625 miles. The total area is more than 780,000 square miles. The interior of Greenland is covered by an immense ice-cap, "the Inland Ice". Only one seventh of the total area is free from ice, a fringe of varying width along the coasts. This mountainous coastal region is intersected by long fiords up to 125 miles in length.

The climate is a typical polar climate, so that the vegetation and, in consequence, the land fauna is very sparse. On the other hand animal life in the sea is abundant, and is the basis of the existence of the natives.

In an administrative respect Greenland is a Danish colony. According to statutory provisions Greenland is a closed country to which, with the exception of the uninhabited parts of the east coast, sailing is not permitted without the consent of the Danish government. Nor is any person allowed to enter Greenland without special permission from the

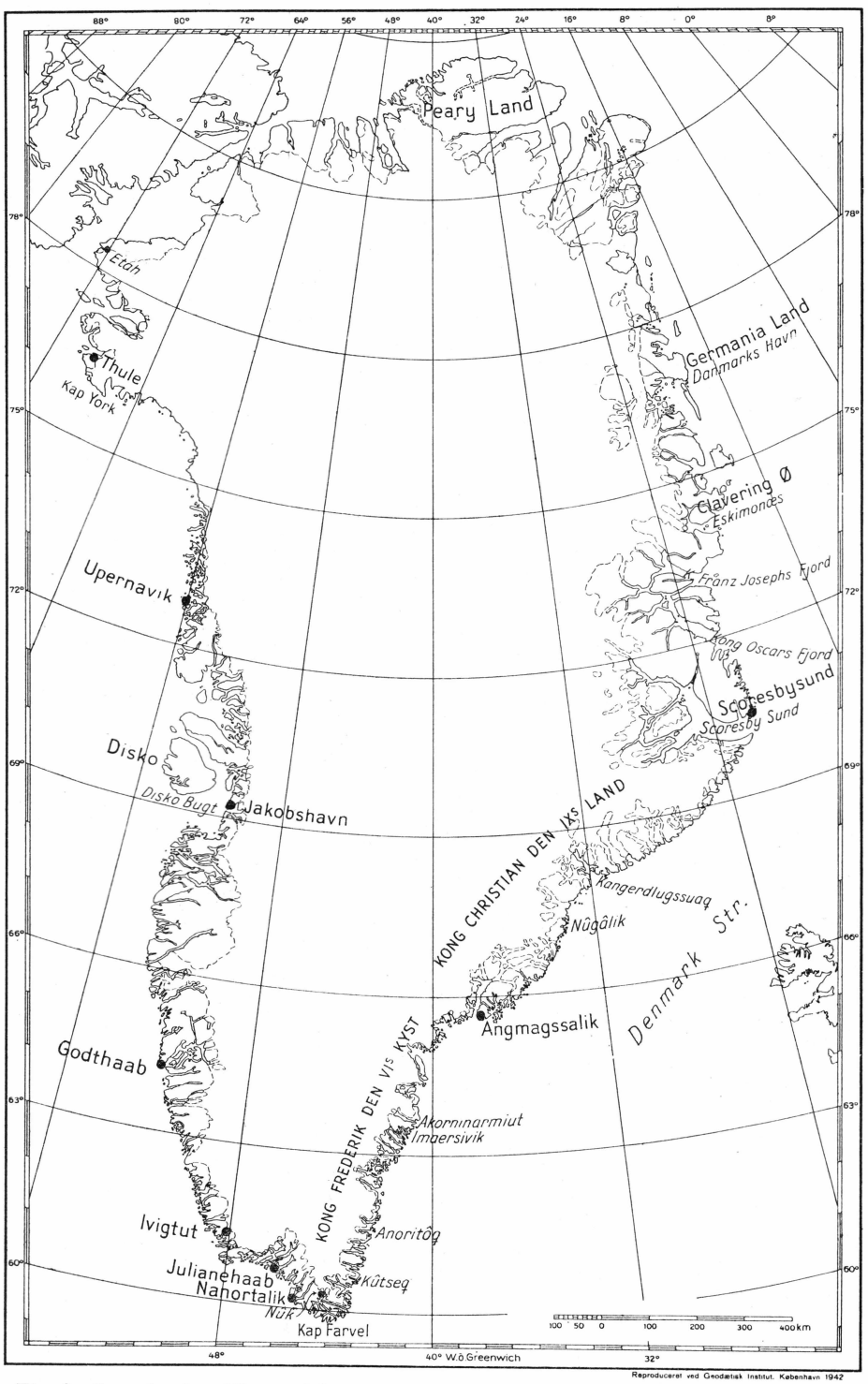


Fig. 9. Greenland, with special reference to the east coast (MIKKELSEN and SVEISTRUP (217)).

Danish colonial administration. Such permission is generally granted for scientific and artistic purposes only.

All trade in Greenland is a Danish state monopoly. The State also provides a variety of facilities such as educational, religious, medical and dental services, administration of justice, postal service etc. without cost to the native population. The trade monopoly is run with careful consideration for the interests of the natives, all necessary articles being supplied at very low prices. In return, the prices which are paid for the products of the Greenlanders, are below those of the world market. The state trade in Greenland may be termed "the Danish State's administrative and tutelary trade in Greenland" (OLDENDOW (230)).

The present-day Greenlanders are mostly of mixed blood, considerable white admixture having taken place for more than two centuries in West Greenland, where the majority of the natives live. There are, however, certain areas in West Greenland, such as the Thule district in the far north and the Kap Farvel area in the extreme south, where white admixture is slight. In East Greenland the native population has not received any white admixture during historic times.

The original Eskimo population of Greenland came to the country across Smith Sound from the American continent via the north-eastern isles of Canada (BIRKET-SMITH (28, p. 39)). The last immigration to the Thule district is known to have taken place between 1862 and 1866.

When Greenland was first invaded by Eskimos is not known for certain, but the general opinion is that they have been there for about a thousand years.

In the 12th century the Norsemen who emigrated from Iceland and settled in the South-West Greenland fiord areas met with the "skraelings" (*i. e.* weaklings) as they called the Eskimos. From archaeological investigations (NØRLUND a. o.) it is known that some intercourse has existed between the two peoples. During the 14th century the Norsemen declined, but it was not until towards the year 1500 that they succumbed to the Eskimos.

Whether the Eskimos of South Greenland received an admixture of European blood during the mediaeval Norse period remains an open question, but the possibility cannot entirely be rejected.

Towards the year 1700 the first European whalers came to the coasts of Greenland. They came particularly from the Netherlands. These whalers had considerable dealings with the natives, especially so in the areas adjacent to Disko Bugt and to the south of this (BOBÉ (33) and BIRKET-SMITH (29)). According to BIRKET-SMITH (l. c.) more than

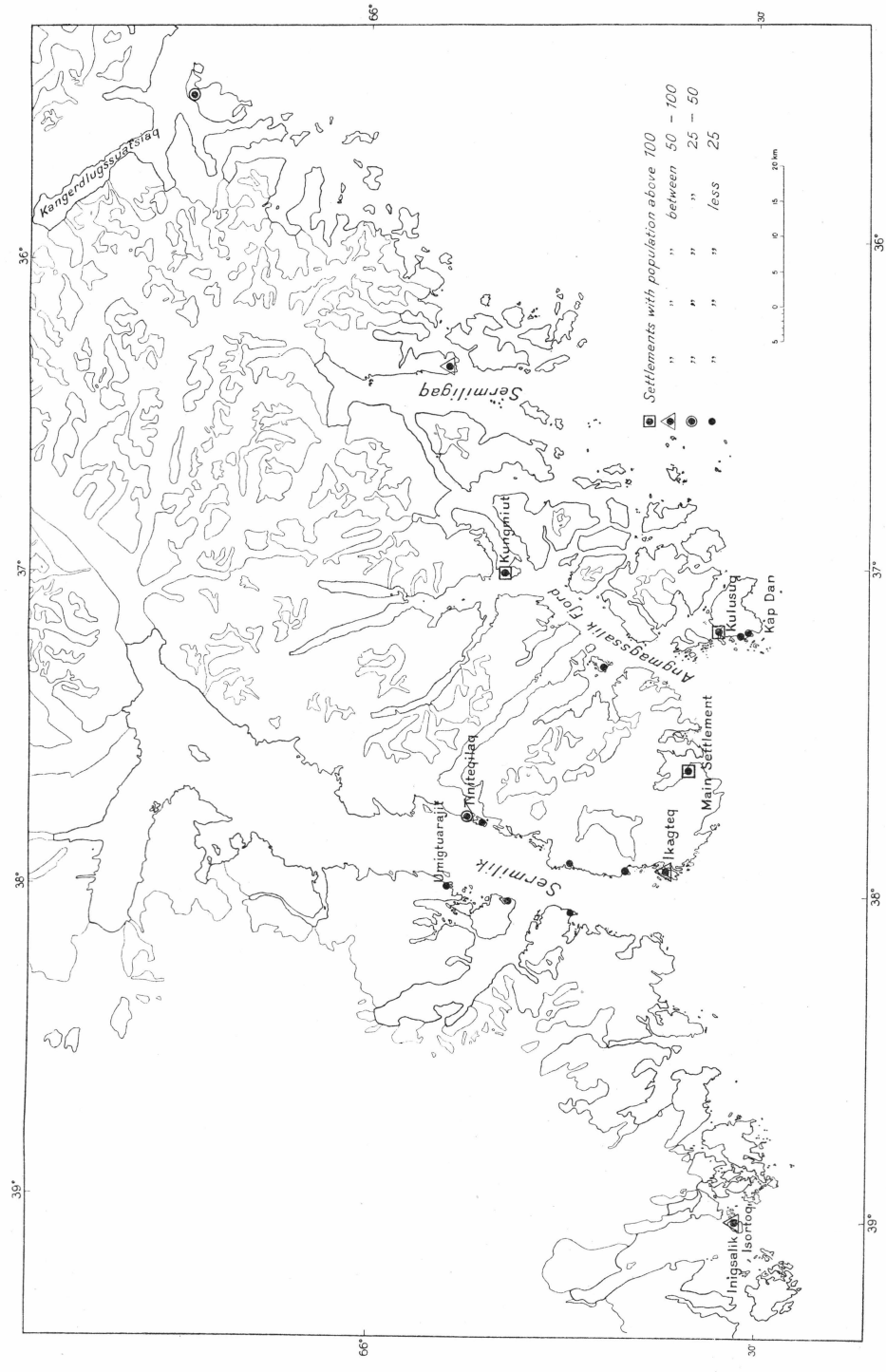


Fig. 10. The Angmagssalik territory. Inhabited localities 1937. (Mikkelsen and Sveistrup (217)).

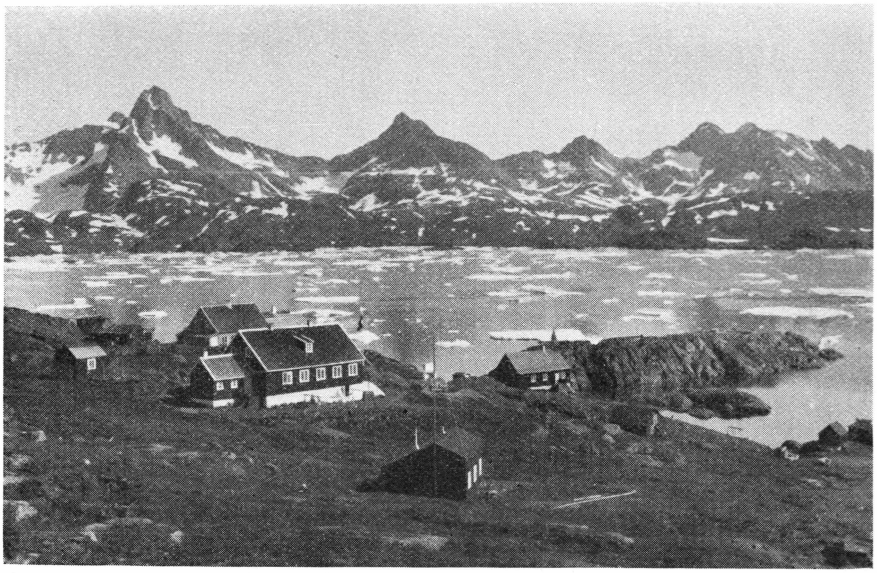


Fig. 11. Angmagssalik. The trading station 1937.

a hundred ships were equipped during one single year for whaling in Greenland waters. From this period dates the first definite European element in the West Greenland population.

The Danish colonization of West Greenland begins with the arrival of HANS EGEDE in 1721. In the 18th century most of the present colonies in West Greenland were founded. During the first century of the colonization (and also in more recent times, though to a decreasing extent) a number of Danes settled along the coast. Many of them married native women.

Thus, gradually, the original West Greenland Eskimo population has become mixed with Whites to a considerable degree (*e. g.* whalers, sailors, settlers, men from expeditions), but as mentioned above there are still a few regions on the west coast where the Eskimo element is predominant.

While the Danish colonization of West Greenland dates from more than two centuries back, conditions are different in East Greenland. Here Danish colonization is no more than half a century old, and the Eskimo population has not received white admixture during that period, apart from a few cases well-known to the local authorities.

The East Greenland Eskimos have migrated from West Greenland. On the basis of archaeological studies in the Angmagssalik area (203) and elsewhere in East Greenland (204, 206) as well as in West Greenland, MATHIASSEN felt justified in concluding that the first immigration to the east coast occurred in the 14th century (203, p. 60).

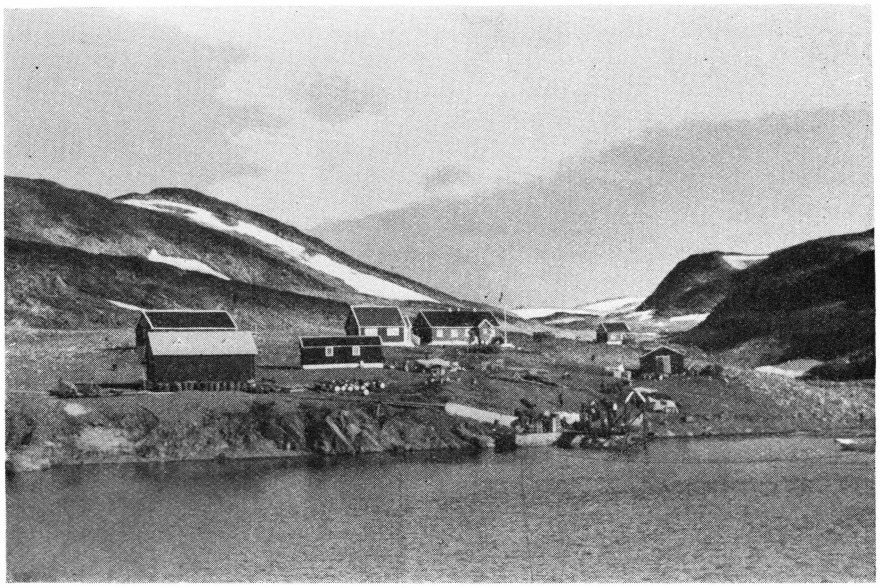


Fig. 12. Scoresbysund. The trading station 1937.

This immigration, according to MATHIASSEN, took place via the southern route, *i. e.* round the Kap Farvel area up along Kong Frederik den VI's Kyst to Angmagssalik. A second immigration from West Greenland to East Greenland via the southern route, according to the same author, is supposed to have taken place about the middle of the 17th century. The Eskimos coming from the South are supposed to have migrated at least as far north as Danmarks Havn (HELGE LARSEN (180)). To the north of Scoresby Sund, at least as far as beyond Germania Land, remnants of Eskimo dwellings and graves show that this area has also been inhabited by them in former times. Only once, living Eskimos were seen in North-East Greenland by Europeans, *viz.* in 1823, when the English whaler CLAVERING visited the island (74° lat. N.) named after him. The interesting report of his meeting with twelve Eskimos is quoted *in extenso* by MIKKELSEN and SVEISTRUP (217, p. 17).

Migration of Eskimos to East Greenland from West Greenland via the northern route and down the east coast has been proved by HELGE LARSEN (180), who found that they reached at least as far down the coast as just south of Scoresby Sund.

During the 19th century all Eskimos living along Kong Frederik den VI's Kyst moved to the southern part of West Greenland, and so this part of East Greenland, (like the coasts north of Scoresby Sund and Kong Christian den IX's Land), became altogether depopulated. Quite recently, however, some Angmagssalik Eskimos have been living along Kong Frederik den VI's Kyst where seal hunting is still very good.

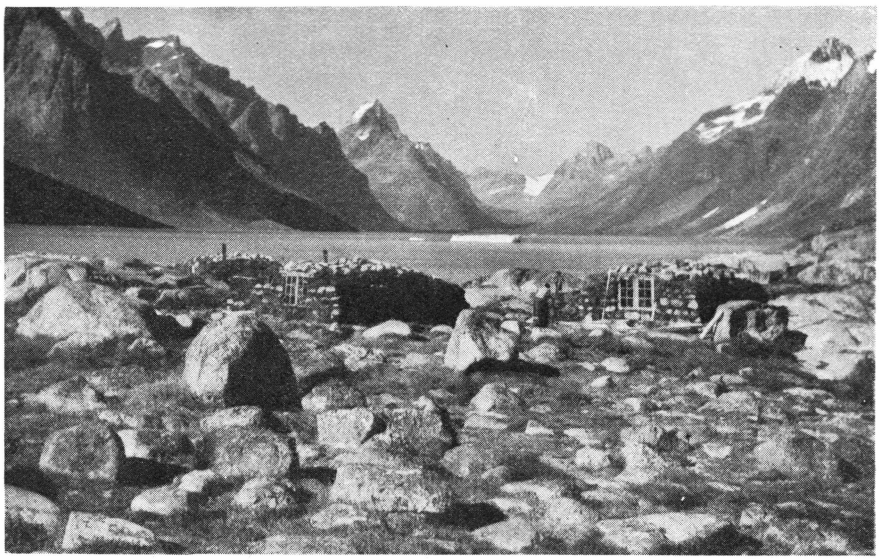


Fig. 13. The native village Nûk, South-West Greenland (near Kap Farvel) 1935.

At intervals some families from the Angmagssalik territory have wintered as far north as Kangerdlugssuaq (68° lat. N.).

Apart from these attempts to re-establish themselves in outlying regions, the East Greenlanders nowadays live exclusively in the territories around Angmagssalik and Scoresbysund (Figs. 9, p. 17 and 10, p. 19).

The Angmagssalik Eskimos were unknown until 1884 when the Royal Danish Naval Officer GUSTAV HOLM (131) discovered the tribe which was rapidly on the decline, and only numbered 245 individuals at that time. He spent a winter among them and returned to East Greenland in 1894 to found a trading station at Angmagssalik on behalf of the Danish government. This trading station (Fig. 11) has been run by the State ever since, and no doubt has saved the tribe from extinction. In 1930 the population had increased to 832 natives, despite the fact that 85 Eskimos were transferred to the newly-founded Scoresbysund settlement (Fig. 12) in 1925. In 1937, which was the year of the dental investigations undertaken by the present writer, the native population amounted to 1,042 individuals in the Angmagssalik and Scoresbysund territories together. Some of these, however, had been transferred from West Greenland. (The latter as well as children below one year of age were not included in the dental study).

The distribution according to age, of the native population in the Angmagssalik territory at the time of their discovery, is compared with their distribution in 1930 in Fig. 14. As will be demonstrated later, the

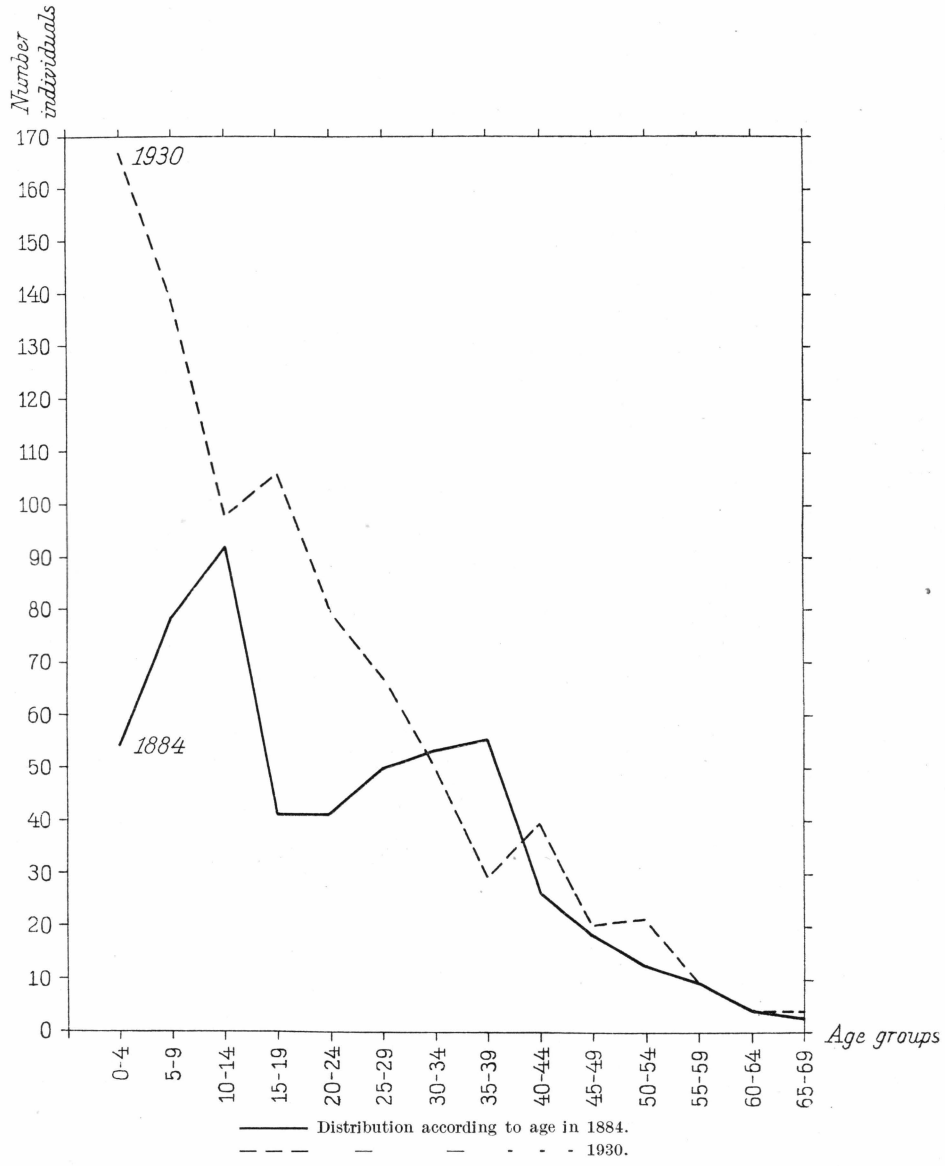


Fig. 14. Distribution of East Greenlanders, according to age. 1884 and 1930. (MIKKELSEN and SVEISTRUP (217)).

dental studies included 95 per cent of the total unmixed East Greenland population above one year of age. Consequently the distribution by age shown for 1930 in Fig. 14 is very much the same as that of the material examined by the writer (cf. Table 3, p. 29).

When in this work the term "unmixed" Eskimos is used of the East Greenlanders, this is done with the reservation that it applies to white admixture during the period after 1884. Early white admixture

in West Greenland before the Eskimos moved to East Greenland, is not entirely out of question, but at any rate must have been extremely slight[1]).

Some of the East Greenland skulls examined by the writer were collected by GUSTAV HOLM and GARDE and some by later expeditions to East Greenland by RYDER, AMDRUP, and the "Danmark" Expedition. The reports of these expeditions have been referred to in Table 1, p. 27, which also indicates the regions they explored.

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[1]) As far as East Greenland is concerned, SELTZER (294, p. 366) is definitely mistaken when maintaining, "In Greenland today both the east and west coasts are racially so mixed that very few pure Eskimos are to be found."

CHAPTER II

THE AUTHOR'S STUDIES OF GREENLAND NATIVE DENTITIONS

During the past ten years the present writer has published a number of reports on dental investigations of the native population of Greenland (125, 161, 239—253). The studies dealt with in these reports are as follows: —

1. Studies in West Greenland.

From February to October 1935 clinical dental investigations were made in the Julianehaab District, South-West Greenland. 1,634 natives (*i. e.* about 50 per cent of the population then living in that area) were examined. This material may be subdivided into a southern and a northern group almost equal in size. The southern group includes natives living at Nanortalik, and between the latter settlement and Kap Farvel (Fig. 9, p. 17). The majority of natives in this territory are descendants from immigrated East Greenland Eskimos, and white admixture is very slight. The northern group lives at the main trading of Julianehaab and in neighbouring outposts and villages where white admixture is abundant.

In preliminary reports published 1938 (240, 241), further information has been given of the 1935 work in West Greenland.

No X-ray examinations were made during 1935. The writer, however, had the opportunity to make such examinations in 1939 when working in the same area with a number of co-workers (Thyssen, Bodil Østergaard, Fischer Jørgensen). 702 natives mostly from the northern part of the Julianehaab District were re-examined. This time the studies included clinical studies, biochemical work, X-ray examinations (1,250 roentgenograms), and impression-taking (245 dentitions).

In a special report published 1940 (248) an account is given of the 1939 work in West Greenland.

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2. Studies of Eskimo Skulls.

In the Copenhagen University Department of Anatomy (late director: Professor H. M. HOU-JENSEN, M. D.) during 1936 the writer examined the teeth and jaws of 525 Greenland Eskimo skulls. These skulls were collected from all over Greenland by a number of Danish arctic expeditions. The majority of skulls examined by the writer, however, were of West Greenland origin.

The East Greenland part of this collection was X-rayed in 1941 and re-examined in 1946.

3. Studies in East Greenland.

During the summer of 1937 the east coast of Greenland had its first visit by dental surgeons, *viz.* "The Second Danish Dental Expedition to Greenland". Assisted by Mr. E. HINSCH and Mrs. INGER PEDERSEN the writer examined 860 natives of unmixed Eskimo race, (*i. e.* 95 per cent of the entire Eskimo population of East Greenland), in the territories of Angmagssalik (65°40′ lat. N.) and Scoresbysund (70°31′ lat. N.). By courtesy of SIEMENS (Copenhagen), an X-ray machine was at the disposal of the expedition. In Angmagssalik current was supplied by the Government radio station. In Scoresbysund the time available was too short for X-ray equipment to be set up. At both places impressions were taken of the dentitions of 142 Eskimos in all.

Further information of the East Greenland work has been given in preliminary reports published 1938 (240, 241).

As the purpose of the present study is confined to presenting certain data on the dentitions of the East Greenland Eskimos, the material dealt with in this work has almost exclusively been drawn from the aforementioned studies (2) and (3). However, the West Greenland material, which is useful for comparison when the question is the influence of white admixture, has also been considered to some extent.

CHAPTER III

THE EAST GREENLAND MATERIAL

East Greenland Skulls.

Among 525 Greenland Eskimo skulls examined in 1936 by the writer, 60 can be said with certainty to originate from the east coast,

TABLE 1.

Origin of the 52 East Greenland Eskimo skulls examined.

Expedition	Area	Reports of expeditions	Anthropological studies of collection	Number of specimens examined by the writer	Museum numbers examined by the writer[1])
G. HOLM and V. GARDE 1883—1885	Coast of Kong Frederik den VI's Land and Angmagssalik	G. HOLM *et al.* (131)	SØRENHANSEN (116), FÜRST and HANSEN (95, pp. 107—108)	14	162, 163, 165, 166, 170—179
C. RYDER 1891—1892	Scoresby Sund	C. RYDER (277, 278, 279)	SØRENHANSEN (118), FÜRST and HANSEN (95, pp. 107—108)	2	222, 233
G. AMDRUP 1898—1900 (K. POULSEN 1898—99)	Coast of Kong Christian den IX's Land and Angmagssalik	G. AMDRUP *et al.* (14, 15), K. POULSEN (258)	SØRENHANSEN (119), FÜRST and HANSEN (95, pp. 108—112 and p. 114)	32	138, 267, 268, 270—289, 291—299
"Danmark"-Expedition 1906—1908	Germania Land, North-East Greenland	ACHTON FRIIS (93), C. B. THOSTRUP (319)[2])	FÜRST and HANSEN (95, p. 114)	4	376, 377, 380, 383

[1]) By FÜRST and HANSEN (95, pp. 105—114) indicated as K. A. ABα 15 and the following numbers.

[2]) See also AMDRUP, Meddelelser om Grønland, vol. 41, 1913.

but only 52 of these East Greenland skulls are in such a state of preservation that they are suitable for studies of dental numerical variations and dental anatomy.

Table 1 (p. 27) shows their origin and museum numbers. These skulls were included in the Greenland skull material of which FÜRST and HANSEN (95) made anthropological studies.

TABLE 2.

Distribution according to sex and age of 52 East Greenland skulls and calvaria examined for dental conditions.

Age (MARTIN)	Male		Female		Both sexes	
	crania	calvaria	crania	calvaria	crania	calvaria
inf. II	..	..	1[1])	..	1	..
juven.	4	..	2	..	6	..
adult.	9	4	9	4	18	8
matur.	8	3	1	1	9	4
senil.	1	2	3	..	4	2
Total...	22	9	16	5	38	14

[1]) Arbitrarily included as a female.

All 52 skulls can be said with certainty to date from the time prior to Danish colonization, and thus have belonged to Eskimos without white admixture. At all events such admixture can, practically speaking, have taken place only during the mediaeval Norse colonization of South-West Greenland. Whether and to what extent a mixture of the races occurred at that time has, as previously stated, as yet not been established.

Table 2 shows the distribution of the skull material according to sex and age[1]). The determination of sex and age was made by FÜRST and HANSEN (95, pp. 105—114), the grouping by age has, however, been altered by the writer according to MARTIN's method of classification (199, p. 580).

The material tabulated in Table 2, was thoroughly examined by inspection, and a complete X-ray examination of jaws and teeth was undertaken in each case.

Where it was the question of third molars, the two youngest groups were omitted, whereby the material was reduced to 45 skulls or calvaria.

As indicated above not all the 60 sexed East Greenland skulls in the Museum have been found suitable for study. Eight skulls or calvaria

[1]) In almost any collection, the males outnumber the females. Probably the greater fragility of the female skull, makes fewer of them worth preserving as specimens (cf. BIERLEY and PARSON (26, p. 115)).

of adults have been left out[1]), some of these 8 skulls showing *ante mortem* loss of teeth to such an extent that they could neither be used for the study of dental numerical variations, nor for that of dental morphology. Others had been exposed to such a considerable *post mortem* damage, including extensive *post mortem* loss of teeth, that they were completely unsuitable for studies of any dental conditions. This does not mean, however, that the material has undergone a selection likely to jeopardize the results of the studies. In the case of the numerical variations, extensive *ante mortem* loss of teeth is a disturbing factor which must necessarily be eliminated as completely as possible. In the case of the studies of dental anatomy, the sorting out of 8 skulls, only means that the entire skulls of the oldest persons are omitted, instead of the individual teeth of the same skulls having to be left out, on account of unfitness for reasons explained in the chapter on dental anatomy.

In connection with the studies of dental numerical variations, additional East Greenland Eskimo skull material has been examined for congenital absence of third molars. This material had neither been sexed nor been the object of anthropological studies.

Modern East Greenland Eskimos.

During the months of August and September 1937 the writer examined 860 unmixed East Greenland Eskimos in the Angmagssalik

TABLE 3.

Distribution according to sex, age and residence of 860 East Greenland Eskimos examined 1937.

Territory	Male						Female					
	1—5 years	6—13 years	14—21 years	22—35 years	36 years ∧||	Total examined	1—5 years	6—13 years	14—21 years	22—35 years	36 years ∧||	Total examined
Angmagssalik												
villages	55	93	53	62	39	302	60	87	69	70	49	335
trading station	9	14	9	10	4	46	10	13	8	14	9	54
Scoresbysund.....	12	21	8	11	9	61	12	18	12	14	6	62
East Greenland.....	76	128	70	83	52	409	82	118	89	98	64	451

and Scoresbysund districts, *i. e.* 95 per cent of the native population ≧ one year of age. 702 of these Eskimos were ≧ 7 years. The distribution of this material according to sex, age, and residence is seen from Table 3.

[1]) *viz.* museum numbers AB*a* 15; 220, 224, 229, 232, 236, 239, 269, and 290.

All these Eskimos were subjected to routine clinical dental examination whereby, *inter alia*, such findings were registered which have bearing upon the present work. In addition, casts of jaws and teeth were made in 142 cases, and X-ray examination was made in 134 cases (complete dental X-ray examination in 130 cases).

Further information on the material will be given in the following chapters dealing with the methods and results of the studies in East Greenland.

It should be noted, that both the deciduous and the permanent dentitions have been studied as far as the numerical variations are concerned, but it was found impossible to carry out a systematic study of the anatomy of the deciduous teeth, on account of insufficient numbers of skulls of young children, as well as of casts and roentgenograms of deciduous dentitions.

CHAPTER IV

DENTAL NUMERICAL VARIATIONS

The numerical variations in the human dentition, besides being of clinical interest, offer possibilities of interpretation as to the phylogeny of the dentition, and thereby give rise to speculations on the evolutionary status of man.

The purpose of the following presentation of the pattern of dental numerical variations in the East Greenland Eskimo, is that of supplying facts on this interesting ethnic group, for use in the pending discussion of the evolution of the dentition, and its bearing on man's phylogeny. Such discussions tend to go astray when not based on established facts obtained through systematic studies of as many modern and extinct human and sub-human groups as possible. In this as well as in many other dental fields, much—as ARTHUR KEITH (167) puts it—still remains to be done to complete even a preliminary survey of mankind.

Furthermore, studies of the numerical variations of the Eskimo dentition might contribute to throwing light on their origin and racial status, which are important problems of American anthropology and ethnography.

A. DEFINITIONS

Hyperodontia indicates increase in number of dental elements. The supernumerary teeth may have erupted or they may have failed to erupt. Some authors (*e. g.* PECKERT (238), LACAISSE (178), and BUSCH (46)) subdivide this group of dental numerical variations into 1) supplementary and 2) supernumerary teeth, considering the former (1) to be true reproductions or duplicates of normal individual teeth, the latter (2) to be real additional specimens. Such classification, however, seems to be of little practical value since a fair number of cases cannot with any certainty be classified according to these subdivisions. The writer, therefore, will confine himself to recording supernumerary teeth without further distinction than that made in the tables and illustrations showing various prototypes of supernumerary teeth.

As is the case in most publications dealing with an increase of the number of teeth, the occurrence of supernumerary cusps and roots as well as enamel nodules, (all three of them common in the Eskimo), is not considered in this chapter. Likewise a case of dentigerous cyst found in a modern Angmagssalik Eskimo, and reported elsewhere (249) was omitted.

Hypodontia means reduction in the number of teeth. One can also speak of "congenitally missing teeth", which is the usual term in English dental literature. MATHIS (208) distinguishes between *hypodontia vera* and *hypodontia spuria* (*per retentionem*, *per extractionem*). *Anodontia*, *agenesia dentium* and *aplasia dentium* (*totalis*, *partialis*) are used synonymously to indicate failure of teeth to develop.

There were no cases of supernumerary deciduous teeth in the material examined, neither was any congenital absence observed in the East Greenland Eskimo deciduous dentition. All information in the following chapters has reference to permanent teeth only.

B. INCREASE IN NUMBER OF PERMANENT TEETH

a. Previous Studies of Eskimos and Indians.

In the Eskimo, supernumerary teeth have previously been observed by SUNDEWALL (310), LEIGH (185), PEDERSEN and HINSCH (246), and by BIRKET-SMITH (29): —

SUNDEWALL (310, p. 231) found in a West Greenland skull, "on the right side the crypt of a fourth dens molar. verus with two roots, and on the left side some depressions which must have been the seat of a tooth germ crippled in development."

LEIGH (185, p. 887), studying a series of 325 modern Eskimo skulls (the majority from the American continent, a few from Greenland) noticed seven cases of supernumerary teeth, *viz.* "one lying near the anterior border of the left naris, three between the upper central and lateral incisors, one buccally between the upper right first and second premolars, one on the palate opposite the left second premolar."

PEDERSEN and HINSCH (246) in 461 West Greenland skulls (most of them probably of unmixed Eskimos) found the following five cases: — two skulls, each with one impacted small peg-shaped incisor in the premaxilla (246, p. 97, Table 1, cases 2 and 3), one skull having an inverted conical tooth in the floor of the left naris (l. c., case 4), and two skulls (l. c., cases 5 and 6) having small maxillary fourth molars (distomolars).

BIRKET-SMITH (29, p. 67), among Central Eskimos examined during the Fifth Thule Expedition, found one young Iglulik male who had

"a small supernumerary tooth between the two first incisors of the upper jaw."

RITCHIE (271), who studied teeth and jaws of about 50 skulls originating from Arctic Canada (Canad. Arc. Exp. 1913—18), does not mention any case of supernumerary teeth.

HRDLICKA (136, p. 211) did not observe supernumerary teeth in 37 Eskimo skulls from the American Continent and Smith Sound.

Cases of supernumerary teeth have been reported in modern West Greenlanders (mixed race) by KAMMA BUDTZ-JØRGENSEN, by MELDORF and by PEDERSEN and HINSCH: —

KAMMA BUDTZ-JØRGENSEN (45, p. 351) observed one supernumerary peg-shaped dental element situated between the maxillary incisors in each of three cases, out of a total of 1,208 West Greenlanders (including children) examined in 1923—24.

One case was observed by the colonial medical officer MELDORF (213) who presented a thorough description of the eruption on the palate of a small conical tooth in a West Greenland child living at Julianehaab about 1900.

Through clinical examination of 1,436 more or less mixed-blood natives in West Greenland ($\geqq$ 7 years), the writer found 17 erupted supernumerary permanent teeth in 12 natives (PEDERSEN and HINSCH (246, Table 3, p. 101)). They were 10 upper incisors, 2 upper paramolars, 3 upper distomolars, and 2 lower premolars. In one case 2 maxillary distomolars coincided with two supernumerary mandibular premolars so that the native in question, (a hunter from Nanortalik), had 36 teeth erupted.

In the Indian, who is related to the Eskimo, supernumerary teeth were observed by HRDLICKA and by LEIGH: —

HRDLICKA (138, p. 49), among 57 skulls of Delaware (Lenape) Indians found one with a supernumerary lower molar tooth.

In skulls of North American Indians supernumerary teeth were observed by LEIGH (184, p. 192—194) as follows: —

In 66 Algonquin,	none.
In 92 Sioux,	one diminutive upper left fourth molar.
In 129 Arikara,	two between the upper central incisors (2 cases), one between the upper lateral and cuspid[1]), one between the upper second and third molars[1]).
In 113 Zuni,	one between the upper central incisors (2 cases).

On the occurrence of supernumerary teeth in 900 skulls from Pre-Spanish Peru, LEIGH (188, p. 278) relates, "In three skulls supernumerary

[1]) Not stated whether right or left.

teeth occur between the superior central incisors, causing crowding. No. 3198 has a supernumerary incisiform element between the upper central incisors ... One supernumerary occurred distal to the first maxillary premolar."

b. The Author's Investigations.

1. Methods.

East Greenland Skulls. The inspection and complete X-ray examination must be assumed to have disclosed all supernumerary teeth—including those which might have failed to erupt—in the 52 skulls and calvaria under study (Table 2, p. 28).

Modern East Greenland Eskimos. During the clinical dental examination of 860 natives in the Angmagssalik and Scoresbysund territories, attention was given to supernumerary teeth and several cases were found representing the total occurrence of erupted supernumeraries in the population studied.

It was, however, impossible to carry out complete dental X-ray examination of the total number of clinically examined Eskimos in the Angmagssalik region, and at Scoresbysund X-ray studies were found totally impracticable. Consequently, the examination for totally embedded supernumerary teeth is not complete. However, the incidence of non-erupted supernumeraries in the 130 completely X-rayed Angmagssalik Eskimos conveys an impression, though not perfect, of the incidence of such teeth in the population.

2. Results.

East Greenland Skulls. The only case (out of 52) having a supernumerary tooth erupted is the following: —

No. 171. Adult male. Kûtseq. South-East Greenland.

There is an empty socket, once the seat of a supernumerary erupted incisor, between the upper right canine and the upper right lateral incisor. The tooth was lost *post mortem*. The upper right central incisor was lost during life.

The X-ray examination did not disclose any totally embedded supernumerary teeth in the 52 East Greenland skulls.

Modern East Greenland Eskimos. On examination of 702 Eskimos ($\geq$ 7 years) in the territories of Angmagssalik and Scoresbysund, 8 supernumerary erupted teeth were observed in 7 persons. Five of these erupted supernumerary teeth were maxillary incisors or incisiform elements, one was a mandibular bicuspid, and two were maxillary paramolars.

TABLE 4.

Supernumerary teeth found in 702 modern East Greenland Eskimos aged ≥ 7 years.

Case No.	Sex	Age	Supernumerary teeth	Eruption	Notes	Illustrations
19	♀	28	One peg-shaped tooth of considerable size, between upper central incisors	Erupted	..	..
74	♂	32	One small conical tooth, palatally to upper central incisors	Erupted	..	..
168	♂	16	Two small atypical teeth replacing left upper lateral incisor	Erupted	Nanosomia	Plate 1, Fig. 28
245	♀	18	One small conical tooth, palatally to left upper central incisor	Erupted	..	Plate 1, Fig. 29
364	♂	43	One supernumerary tooth (recently lost), between upper central incisors	Erupted	Severe malposition of anteriors	Plate 1, Fig. 30
232	♂	27	Blunt tooth of minor size, lingually to left lower premolars	Erupted	..	Plate 1, Fig. 31
331	♂	36	Two upper paramolars	Erupted	Two lower incisors missing	Plate 1, Figs. 32 a and 32 b
149	♂	42	Two vestigial teeth of blunt conical shape (odontoids) above and palatally to apices of upper central incisors	Embedded	..	Plate 28, Fig. 165
418	♀	31	One small conical tooth (odontoid) (similar to case no. 245) above and palatally to upper left central incisor	Embedded	..	..
139	♂	44	*Ut supra*	Embedded	..	Plate 2, Fig. 33

X-ray examination of 130 Angmagssalik Eskimos revealed four small non-erupted supernumerary dental elements in the premaxillae of three individuals.

All ten cases having hyperodontia are given in Table 4, which shows the location of the supernumerary teeth and presents particulars as to sex and age of the natives involved.

3. Discussion.

Attempts at close comparison of the incidence of supernumerary teeth in different human races have little prospect of being conclusive, inasmuch as none of the reports available on coloured races concern studies in which the total occurrence is recorded, (X-ray examination not undertaken).

As already stated the present study is not perfect in this respect either.

Furthermore, the comparison of different racial groups, as far as incidence of supernumerary teeth is concerned, is rendered uncertain by the fact that the range of age of the material examined, (mostly skull material), has not always been stated in the reports. This creates hesitation as to calculation of percentage incidence. In some cases even indication of the number of persons examined is missing.

However, such imperfections do not entitle one to ignore previous research in this field. The writer therefore has compiled a number of data from the literature (Table 5, p. 37), but suggests that these be studied with the reservations just mentioned. Only in the case of STAFNE's studies, the information contained in Table 5, p. 37, can be said to be absolutely sufficient in a quantitative respect. STAFNE (302) studied the incidence of supernumerary teeth in 48,550 patients from the Mayo Clinic (Rochester, Minn.) for whom complete dental X-ray examination was made. 441 (0.9 per cent) of these patients had one or more supernumerary teeth. STAFNE says, however, (302, p. 653) that, "since supernumerary teeth are probably more numerous than found in these cases[1]), it may be assumed that their incidence is at least one for every 100 persons."

If we compare the data of STAFNE with the incidence of supernumerary teeth found in Eskimos by LEIGH, (minimum incidence, no X-ray examination), and by the present writer, (X-rayed East Greenland cases), using a statistical analysis, we find that it is not possible to prove definite differences. It must, however, be pointed out that the East Greenland Eskimo material is so small that a slight difference will have no chance to prove valid.

Special attention has been paid to fourth molars (especially to the distomolars of BOLK (35)) from an evolutionary point of view. It has very often been claimed that fourth molars are more frequently present in coloured races than in white man. FERRIS (85), among others, holds the view that fourth molars occur more frequently in "primitive peoples" and considers this to be a reversion to lower forms.

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[1]) Failure of supernumeraries to show on the roentgenograms, early extractions etc.

TABLE 5.
Racial survey of supernumerary teeth.

Racial group	Author	Number of cases examined	Cases with supernumerary teeth	
			erupted	erupted and non-erupted
East Greenland Eskimo skulls ..	Present study	52[1])	1 (1.9 %)	1 (1.9 %)
Modern East Greenland Eskimos	—	702[1])	7 (1.0 %)	..
Modern Angmagssalik Eskimos (X-rayed)	—	130[1])	..	3 (2.3 %)
Modern West Greenland natives (mixed race)	PEDERSEN & HINSCH (246)	1,456[1])	12 (0.8 %)	..
Modern Eskimo skulls, mainly American	LEIGH (185)	325	7 (2.2 %)	
North American Indian skulls ..	LEIGH (184)	400	7 (1.8 %)	
South American aboriginal skulls (pre-Spanish Peru).....	LEIGH (188)	900	5 (0.6 %)	
Chinese (living and skulls).....	OSHIMA (233)	1,200	31 (2.6 %)	
Japanese (living)	SAITO *et al.* (280, 281)	2,600	10 (0.4 %)	
South African Bantu (living and skulls)	SHAW (299)	489	13 (2.7 %)	
South African Negroes (living)..	PROELL (259)	961	4 (0.4 %)	
Bushmen (skulls)	DRENNAN (70)	50	1 (2.0 %)	
Australian aborigines (living and skulls)	CAMPBELL (49)	942	17 (1.8 %)	
White North Americans	STAFNE (302)	48,550	441 (0.9 %)	
Children of Berne, Switzerland..	DOLDER (67)	10,000[2])	32 (0.3 %)	
Children of Philadelphia, U.S.A..	WERTHER & ROTHENBERG (335)	1,000[3])	16 (1.6 %)	

[1]) ≥ 7 years. [2]) 6—15 years. [3]) 3—15 years.

MARTIN (199, p. 989) says of fourth molars that so far they are found to occur more frequently in Australian aborigines, New Caledonians, Tasmanians and Negroes than in other racial groups. MARTIN, however, does not give any evidence to substantiate this statement. R. SCHWARZ (287) recorded seven fourth molars (including three paramolars) in 267 New Caledonian skulls and observed two paramolars in 400 skulls from the New Hebrides. FONTAN (91, p. 676) saw two instances among 21 skulls of New Caledonians and one further case (92, p. 594) in a living subject. Among several hundreds of skulls from South Pacific Islands FABIAN (82), however, failed to find more than one single case. PROELL (259, pp. 82—83), examining 961 South African Negroes found one bilateral case of upper distomolars coinciding with supernumerary upper anteriors. MIDDLETON SHAW (299) failed to find any super-

numerary molars in 141 Bantu skulls, whereas he recorded three lower fourth molars on examination of 248 living Bantu. In recent publications by T. D. CAMPBELL (50, 51) dealing with comprehensive studies of a considerable number of modern Australian aborigines, no fourth molars are mentioned. In his book on Australian skulls, however, T. D. CAMPBELL (49) reported six out of 600 skulls to have fourth molars. Further Australian cases have been published by TURNER (329) and WILSON (339). In his review of literature up to 1905 M. DE TERRA (313, p. 219) lists a number of cases in coloured races among them Indians, Negroes, Australians, Tasmanians and New Caledonians.

RÖSE (273) in 12,250 young adult males from Central and Northern Europe observed one case only. STAFNE (302), on the other hand, found fourth molars to be more common in North American Whites than generally anticipated, *viz.* 58 paramolars and 141 distomolars out of a total number of 800 supernumerary teeth observed in 48,550 patients in the Mayo Clinic. In dental literature a great number of fourth molar cases have been reported from white population groups, *e. g.* by M. DE TERRA (313), BONNEY (41), FIELD (86), FLEDMANN (88), HENNINGSON (123), KAUFMANN (162), MEYER (214), MORRISON (220), PALAZZI (235), and R. SCHWARZ (288).

As far as the Eskimo is concerned the incidence of fourth molars does not seem to exceed that found by STAFNE in Whites, neither in proportion to the number of cases examined, nor to the total number of supernumerary teeth. Admittedly the evidence available does not permit of definite conclusions, but taking everything into account it seems very doubtful whether the incidence of fourth molars is at all higher in coloured races than in Whites. At least the present writer has failed to find evidence in literature justifying definite conclusions to that effect.

C. DECREASE IN NUMBER OF PERMANENT TEETH WITH EXCEPTION OF THIRD MOLARS

a. Previous Studies of Eskimos and Indians.

Congenital absence of permanent teeth other than third molars has been reported in the Eskimo and Indian by the following authors: —

SØREN HANSEN (116, 119), who examined 15 adult skulls of South-East Greenland Eskimos in 1886, reported two cases of missing incisors, *viz.* both upper lateral incisors in one case and one lower incisor in a second case.

HRDLICKA (136, p. 211) mentioned absence of one of the upper bicuspids in one out of 37 American and Smith Sound Eskimo skulls.

In another of these skulls two lower incisors were congenitally missing (l. c., p. 265).

The upper lateral incisors were congenitally missing in one of 50 Canadian Eskimo skulls examined by RITCHIE (271, p. 65). On examination of 325 Eskimo skulls (mostly American), LEIGH (185, p. 888) observed seven instances of non-erupted upper lateral incisors. STEWART (307, p. 51) observed two unilateral cases of congenitally missing upper lateral incisors among 60 skulls from Greenland and 76 from Labrador.

In the American Eskimo, CAMERON (47, p. 20) recorded one case having no mandibular right central or left lateral incisors developed (50 Canadian skulls examined).

PEDERSEN and HINSCH (246) examined 461 adult West Greenland skulls (most of them probably of unmixed Eskimos). They observed six cases of congenital absence of permanent teeth, *viz.* one without upper lateral incisors[1]), one without the right lower central incisor, one without one of the lower incisors, one without both lower central incisors, one without both second lower bicuspids, and one showing congenital absence of five teeth including three first molars. The latter case also exhibited partial cleft palate (PEDERSEN (250, p. 377)). Two American Eskimo skulls with suppression of lower incisors were observed by the writer in the Copenhagen University Department of Anatomy, *viz.* one ancient male Eskimo skull from Baffin Island (5th Thule Expedition) having no lower central incisors and one male Alaska Eskimo skull (Prince William Sound) in which the right lower lateral incisor was congenitally missing.

Congenital absence of teeth in American Indian skulls has been reported by DORSEY (68, 69) and by LEIGH (184, 188):—

DORSEY (68, 69), among 15 ancient Peruvian skulls (Inca) found two exhibiting "suppression of upper lateral incisors". LEIGH (188, p. 280), examining 900 skulls from Pre-Spanish Peru, observed that "the Peruvian maxillary lateral incisor, as in modern white races, not infrequently evidences decadency", but does not give any incidence of congenital absence. The same applies to the study by LEIGH of 400 skulls of North American Indians (184). In his report on this study, however, LEIGH mentions one case of suppression of the mandibular central incisors (Algonquin) and one of suppression of the mandibular lateral incisors (Arikara).

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[1]) Probably the case mentioned by DUCKWORTH and PAIN (75, p. 134).

b. The Author's Investigations.

1. Methods.

East Greenland Skulls. The only case of congenital absence found in this material was proved by X-ray examination not to be one of non-eruption. As has been pointed out by LEIGH (188, p. 281), students of skull collections often experience great difficulty in deciding whether congenital absence or *ante mortem* loss of teeth should be recorded. In case of the 52 East Greenland skulls, however, only 20 permanent teeth had been lost during life, bringing down this source of error to a minimum.

Modern East Greenland Eskimos. As X-ray examination could be made in Angmagssalik only, the material was reduced to 603 cases $\geqq$ 7 years of age. On the other hand practically all cases in this area suspected of having congenital absence of permanent teeth, other than third molars, were submitted to full X-ray examination. They are included in the series of 130 persons of whom complete dental roentgenograms were made. The X-ray examination revealed 7 cases of unerupted teeth exclusive of third molars (PEDERSEN (249, p. 122)). When no unerupted teeth were found, the decision had to be made whether the tooth in question had not developed or had been lost. This decision was not very difficult in East Greenland. The loss of teeth in the Angmagssalik area is quite negligible amounting to no more than 35 out of 2,729 permanent teeth erupted (1.3 per cent) in village natives aged $\geqq$ 36 years. Moreover, the natives involved will know of any removal of teeth, because this event is so rare among them. Consequently it has been possible to establish the incidence of congenital absence of teeth with a fair degree of certainty, and the figures arrived at can be relied on as good indications of the actual incidence.

2. Results.

East Greenland Skulls. Congenital absence of permanent teeth other than third molars was observed in one of the 52 cases examined, *viz.*

No. 162. Adult male. Anoritôq. South-East Greenland.

Both superior lateral incisors congenitally missing (Plate 2, Fig. 34). Lower left M_3 impacted (Plate 4, Fig. 42), upper right M_3 vestigial, upper left M_2 paramolar tubercle. Identical with the case mentioned by SØREN HANSEN (116, p. 24) and that described elsewhere by the present author (249, p. 116).

Modern East Greenland Eskimos. Out of a total of 603 Angmagssalik Eskimos aged $\geqq$ 7 years, 18 showed congenital absence of permanent teeth exclusive of third molars, *i. e.* 3 per cent. All cases are given in Table 6 (p. 41).

TABLE 6.

Congenitally missing permanent teeth (excl. third molars) in 603 modern Angmagssalik Eskimos aged ≥ 7 years.

Case No.	Sex	Age	Congenital absence of	Notes	Illustrations
513	♀	29	I_2 sup. dext. et sin.	..	Plate 2, Fig. 35
535	♀	23	I_2 sup. dext. et sin.	i_2 supp. (dext. et sin.) and c sup. sin. retained. C sup. sin. impacted	Plate 2, Fig. 36
65	♀	28	I_2 sup. dext.	..	..
75	♂	23	I_2 sup. dext.	..	..
350	♀	38	I_2 sup. dext.	..	..
679	♀	36	I_2 sup. dext.	..	..
757	♀	23	I_2 sup. dext.	..	..
338	♂	21	I_1 inf. dext. et sin.	..	Plate 3, Fig. 37
479	♂	10	I_1 inf. dext. et sin.	..	..
331	♂	36	I_2 inf. dext. et sin.	two upper paramolars (Table 4, p. 35)	Plate 2, Fig. 32 c
416	♀	15	I_1 inf. sin.	..	Plate 3, Fig. 38
524	♂	40	I_1 inf. dext.	..	Plate 3, Fig. 39
533	♂	22	I_1 inf. sin.	..	..
690	♀	21	P_2 sup. dext.; P_2 inf. dext.	m_2 sup. dext. and m_2 inf. dext. retained	..
646	♀	39	M_2 sup. dext.	..	..
459	♂	23	M_2 sup. dext. et sin.; M_2 inf. sin.	..	..
758	♂	14	M_2 inf. sin.	..	..
183	♀	27	M_1 sup. sin.	..	Plate 3, Fig. 40

3. Discussion.

The decrease in number of permanent teeth specified in Table 6 shows several interesting features.

It is rather peculiar, but probably incidental, that all unilateral cases of missing upper lateral incisors concern the right side. It is interesting, however, to see that a right-side predominance of this condition was found in Whites by BREKHUS *et al.* (42, p. 120) as demonstrated in Fig. 15 (p. 43).

As is the case in white population groups, previously studied by RÖSE (273) and HRDLICKA (140), female Angmagssalik Eskimos

seem to exhibit absence of upper lateral incisors more frequently than males.

There is a surprisingly high incidence of missing lower incisors especially as compared with that of upper lateral incisors. This also holds good of the West Greenland skull material previously examined by the writer and referred to on p. 26.

Further it is evident that absence of lower bicuspids is not found to any appreciable extent.

Finally, attention is called to the molar cases especially case No. 183 (Plate 3, Fig. 40) in which two upper molars are congenitally missing, M_2 sup. sin. being the only molar present on the left side. No molars had failed to erupt in this case (X-ray) and with certainty none were lost.

The abovementioned features, in particular the comparatively high incidence of absence of lower incisors—which seems to be about the same in Greenland Eskimo skulls and modern East Greenlanders—suggest that the pattern of congenital absence of teeth is different in Eskimos and Whites. Until now the question of differences between human races in this respect does not seem to have been discussed in dental or anthropological literature. It would seem useful therefore to throw some light on this question by means of the information available on the pattern of congenital absence of teeth in different racial groups: —

According to DOLDER (67), congenitally absent I_1 inff. averaged 2.2 per cent of all teeth missing in 10,000 Swiss children. Missing I_2 inff. averaged 1.1 per cent, I_2 supp. 12.3 per cent, and P_2 inff. 47.3 per cent. On examination of 11,487 patients in the Dental Clinic of the University of Minnesota BREKHUS, OLIVER and MONTELIUS (42) found 184 persons with congenital absence of teeth. "The nationalities of the patients were mixed. Most of them belonged to the Caucasian race." The pattern of absence appears from Fig. 15 (p. 43) showing the upper lateral incisor to take a predominant position in this respect. The sequence found by BREKHUS and co-workers is different from that given by DOLDER, in so far as BREKHUS *et al.* found I_2 supp. to be more frequently missing than P_2 inff. In general agreement with the findings by BREKHUS *et al.* is the report by WERTHER and ROTHENBERG (335) who in Philadelphia examined 1,000 children aged 3—15 years. WERTHER and ROTHENBERG report the following sequence, I_2 sup. (38.5 % of affected cases), P_2 inf. (14.5 %), P_2 sup. (14.5 %), I_2 inf. (6.5 %), C sup. (6.5 %), P_1 sup., C inf., I_1 inf., M_2 sup., M_2 inf. (each 3 %), P_1 inf., M_1 sup., M_1 inf. (each 1.5 %). QUINTERO (260) also states that P_2 inf. comes next to I_2 sup. as far as incidence of congenital absence is concerned.

Proceeding to Japanese studies we find different results. OHASHI and TONIHARA (229) record higher incidence of missing I_1 inff. (5.8 per cent of affected cases) than of I_2 supp. (4.5 %). HAMANO (115),

studying congenital absence of teeth in modern Japanese (using X-ray) found the general sequence to be the following, P_2, I_2, C, I_1, P_1, M_2. HAMANO, however, does not specify his findings so as to make them directly comparable with those of OHASHI and TONIHARA.

By many authors special attention has been paid to congenital absence of upper lateral incisors. HRDLICKA (140) reports the incidence

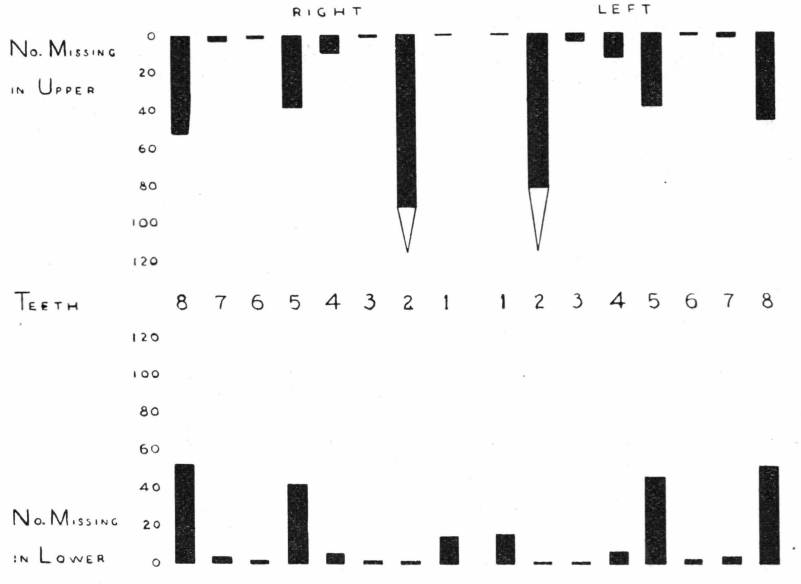


Fig. 15. Pattern of congenital absence of permanent teeth in 184 Minnesota dental patients (644 missing teeth). For the maxillary lateral incisors, the solid portion represents the number of missing teeth, the peaked portion the added number of peg-shaped teeth. (BREKHUS *et al.* (42)).

given in Table 7 (p. 44) for Whites, American Negroes, Hawaiians, Chinese and Japanese. The findings of HRDLICKA suggest a comparatively low incidence in the East Asiatic Mongols. RÖSE (273), widely quoted in dental and anthropological literature, says that in 12,250 young Scandinavian and Central European males, I_2 supp. were missing or vestigial in 2.4 per cent of cases (Scandinavians 5.9 %, Central Europeans 2.3—3.6 %). RÖSE found no I_2 supp. missing in Chinese and Japanese skulls. Among Melanesian skulls he found 0.6 per cent lacking one or two I_2 supp., among Indian skulls 0.8 per cent, among Malayan skulls 1.9 per cent, and among Australian skulls 6.0 per cent. In all, RÖSE found complete absence of upper lateral incisors in 1.1 per cent of 2,811 skulls from coloured races. D. K. CAMPBELL (48) observed congenital absence of upper lateral incisors in 35 cases out of a total of 2,000 examined in his office in New York (1.8 per cent of cases).

TABLE 7.
Congenital absence of upper lateral incisors, according to HRDLICKA (140).

Males						Females					
Living subjects		Both laterals	Right lateral	Left lateral	Total	Living subjects		Both laterals	Right lateral	Left lateral	Total
Whites (500)	No.	3	2	2	7	Whites (500)	No.	6	5	4	15
	%	*0.6*	*0.4*	*0.4*	*1.4*		%	*1.2*	*1.0*	*0.8*	*3.0*
American Negro (307)	No.	2	2	1	5	American Negro (500)	No.	3	4	2	9
	%	*0.6*	*0.6*	*0.3*	*1.6*		%	*0.6*	*0.8*	*0.4*	*1.8*
Hawaiian (21)	No.	..	..	..	..	Hawaiian (38)	No.	1	..	..	1
	%	..	..	..	..		%	*2.6*	..	..	*2.6*
Chinese (547)	No.	..	..	1	1	Chinese (104)	No.	..	..	..	..
	%	..	..	*0.2*	*0.2*		%	..	..	..	..
Japanese (172)	No.	..	1	1	2						
	%	..	*0.6*	*0.6*	*1.2*						

HJELMMAN (128, p. 106) examined 250 male Finnish skulls (white race), and found 1.6 per cent of them to lack upper lateral incisors. As far as coloured races are concerned the abovementioned findings by RÖSE neither agree with those of MIDDLETON SHAW (299, p. 43) from South African Bantu, nor with those of T. D. CAMPBELL (49, p. 22) from Australian aborigines. Both failed to observe any elimination of upper lateral incisors during their comprehensive studies of living natives and skulls. In fact MIDDLETON SHAW did not observe any absence whatever of incisors, canines and premolars.

As to records of congenital absence of upper lateral incisors in the Eskimo and Indian, the reader is referred to p. 39 where mention is made of the findings by RITCHIE (271), STEWART (307), LEIGH (184, 188) and DORSEY (68, 69).

Concerning congenital absence of lower incisors in Whites a number of case reports have been published especially in American dental literature (COOPER (58), STELZER (305), DAHLBERG (60) a. o.). M. DE TERRA (313) and R. SCHWARZ (288) also mention some cases. According to the extensive studies by DOLDER (67) and WERTHER and ROTHENBERG (335) the incidence of missing lower incisors in Whites, however, is far inferior to that of upper lateral incisors. This is also in perfect agreement with the experience of dental practitioners dealing with white population groups. In Mongolian peoples, however, absence of lower incisors seems to be more frequently met with. TRATMAN (325), working in Singapore, published one case of lower central incisor absence in a

Chinese girl aged 13 and (in 1938) kindly sent the writer particulars of another case (male Chinese) showing congenital absence of both lower central incisors. At the same time he stated that such cases are not at all rare among the Mongols in Malaya. In 1940 TRATMAN (327) published the results of a survey of missing lower incisors in Chinese patients. He found absence of lower incisors to be not uncommonly met with in that population group. These observations by TRATMAN in connection with records of lower incisor absence in Japanese (OHASHI and TONIHARA), kindly brought to the knowledge of the writer by Professor SHIBATA (Tokyo) suggest that this condition is not so rare in Mongolian stock as in Whites. OHASHI and TONIHARA (229) reported that of all teeth congenitally missing in modern Japanese of Formosa 3.6 per cent were I_2 inff., 5.8 per cent were I_1 inff. and only 4.5 per cent were I_2 supp.

When comparing the incidence and pattern of congenital absence of teeth (excl. of M_3) in Greenland Eskimos with those observed in other racial groups on record, we arrive at the following conclusions:

(1) The incidence of hypodontia seems to be about the same in Greenland Eskimos (skulls: 1.9 per cent of cases, modern Angmagssalik Eskimos: 3.0 per cent) as in Whites (DOLDER: 3.4 per cent, WERTHER and ROTHENBERG: 2.3 per cent).

(2) The incidence of congenital absence of I_2 supp. seems to be somewhat lower in Greenland Eskimos (skulls: one out of 52, modern Angmagssalik Eskimos: 1.2 per cent) than in Whites (RÖSE: 2.4 per cent of males, HRDLICKA: 1.4 per cent of males, 3.0 per cent of females). There are indications of the same female preponderance in the Eskimo as found in Whites by RÖSE, HRDLICKA and BREKHUS *et al.* and in Hawaiians by HRDLICKA. In East Greenland Eskimos all unilateral cases of congenital absence of I_2 supp. were found to concern the right side.

(3) The incidence of congenitally missing lower incisors in the Greenland Eskimo is high (1.0 per cent of cases both in skulls and living). As compared with the incidence of non-development of maxillary lateral incisors, the incidence of mandibular incisor absence is definitely very high.

(4) Remarkably few cases of congenital absence of mandibular second premolars have been found.

(5) The incidence of congenitally missing molars seems greater than that in Whites.

(6) The general pattern of congenital absence of permanent teeth does not seem to be identical in Mongols and Whites. That of the Eskimos seems to come closer to the Mongolian than to the White pattern. This is especially true of the distribution of missing incisors.

RÖSE (273) says that there is a definite relation between absence of upper lateral incisors and the cranial Breadth-Length index. He claims that dolichocephalic individuals and races have more frequently such dental agenesia than brachycephalic individuals. Now, the head of the Greenland Eskimo is markedly dolichocephalic, in many cases (25 per cent) even hyperdolichocephalic (FÜRST and HANSEN (95)) and accordingly would be expected to exhibit a very high percentage of missing upper lateral incisors. As has been demonstrated by the present writer this is far from being the case in the East Greenland Eskimo. Thus there is evidence that presence or absence of upper lateral incisors is not necessarily associated with the shape of the skull (as indicated by its Breadth-Length index) in the way claimed by RÖSE. This author also says (273, p. 250), "Je grösser die Anzahl der Weisheitzähne, um so seltener ist die Rückbildung der seitlichen Schneidezähne des Oberkiefers." The findings of the present writer rather suggest the opposite ratio (few upper laterals missing, numerous third molars absent).

D. DECREASE IN NUMBER OF THIRD MOLARS

a. Previous Studies of Eskimos.

The very first description of a human skull of coloured race dates from 1722 and was given by the Danish anatomist J. B. WINSLOW (341) living in Paris at that time. It is the question of "un Sauvage de l'Amérique Septentrionale" originating from North-West Greenland. The very accurate drawings of this typical Eskimo skull show only four postcanine teeth on the right side of the maxilla (Plate 4, Fig. 41). Provided the artist did not make a mistake—which is not very likely when the minute accuracy of all other structures is considered—the tooth absent in this adult skull was probably a congenitally missing right maxillary third molar.

In his catalogue of specimens contained in the Museum of the Royal College of Surgeons of England W. H. FLOWER (89) 1879 mentioned one Eskimo skull (out of 29 from Greenland and Hudson Bay) in which the left upper third molar was absent (no. 810, p. 138).

HRDLICKA (136), studying 37 American and Smith Sound Greenland skulls 1910 found two from Smith Sound (one was from Etah) the third molars of which were congenitally missing. In the Etah case absence of the third molars coincided with absence of two lower incisors (l. c. p. 265). In one out of three male Smith Sound Eskimo skulls brought to New York by PEARY, absence of both lower third molars was observed by HRDLICKA (136, p. 225).

Among 50 Canadian Eskimo skulls, CAMERON (47, pp. 8—38) noticed several cases of absence of third molars.

Congenital absence of mandibular third molars has been studied by GOLDSTEIN (99) in 759 American and Greenland Eskimo skulls. This study is considered in some detail in the following section of this chapter.

The first account of absence of M_3 in the East Greenland Eskimo was published by PANSCH (236, p. 150). "The Second German North Polar Expedition 1869—70" brought home from North-East Greenland eleven Eskimo skulls. PANSCH who examined these skulls from an anthropological point of view says, "Der letzte Backenzahn scheint häufiger auszubleiben. So fand sich bei Nr. 6 und 8 nur ein einziger verkümmerter vor; bei Nr. 1 fehlt er unten rechts."

In his essay on skeletal remains of East Greenland Eskimos, the Danish anthropologist SØREN HANSEN (116) 1886 called attention to the frequent absence of third molars in 14 skulls unearthed by HOLM and GARDE (131) in South-East Greenland. The present study includes the material examined and described by SØREN HANSEN (*e. g.* the interesting case No. 162 from Anoritôq (Table 43, p. 134; Plate 2, Fig. 34 and Plate 4, Fig. 42)). It also includes the skull material brought home by RYDER (277—279) from North-East Greenland. This material was likewise examined by SØREN HANSEN (118) who observed that third molars were not infrequently missing in these skulls.

b. The Author's Investigations.

1. Methods.

East Greenland Skulls. The inspection and complete X-ray examination of 45 adult cases revealed two cases of impacted third molars: —

No. 294. Adult female. Nûgalik.

The upper left M_3 (now lost) has been of minor size. Crypt visible in the alveolar process distal to the second molar.

No. 162. Adult male. Anoritôq.

The left lower M_3 is embedded deep in the mandible. Severe hypercementosis and pulp stones visible on the roentgenogram (Plate 4, Fig. 42). Upper lateral incisors congenitally missing (see also p. 40).

In all other adult cases showing non-eruption of third molars, it remained to be decided whether *ante mortem* loss or failure of the teeth to develop should be recorded. As no old-aged skulls with extensive *ante mortem* loss of teeth have been included in the present study, however, the error arising from mistakes in this respect is supposed to be very slight and without any significance. The magnificent health of the dentitions which have been studied, strongly speaks against isolated

loss of the posterior molars in a population, which even nowadays, experiences almost no loss of permanent teeth.

To the East Greenland skull material used throughout this study, have been added a number of other adult East Greenland skulls kept in the Copenhagen University Department of Anatomy[1]), as well as some skulls examined by the writer in 1937 at Imaersivik (Akorninarmiut), South-East Greenland (63°40′ lat. N.). This additional material augments the number of specimens examined for congenital absence of third molars, to 81 crania and 28 calvaria, making 109 individuals in all. The latter part of the material has not been systematically X-rayed. Consequently one has to reckon upon a few impacted wisdom teeth to be included in the number recorded as congenitally missing. The magnitude of this source of error can be estimated by means of the incidence of impactions in the 45 adult skulls which have been X-rayed, as well as the corresponding incidence in the 87 X-rayed present-day natives dealt with in the following section of this chapter. In the two latter groups of material, between 2 and 4 per cent of the natives had one M_3 impacted each. This magnitude of error will not affect the results to any appreciable extent.

Modern East Greenland Eskimos. Because no X-ray examinations could be made in Scoresbysund, this part of the study is confined to 257 Angmagssalik Eskimos $\geq$ 22 years of age (115 males and 142 females).

During the field work in East Greenland 1937 the natives were questioned as to previous removal of teeth so as to avoid mistaking lost teeth for non-erupted. This precaution rules out any appreciable influence by a source of error which under more civilized conditions (productive of caries) might seriously affect the results. Next in order of importance comes the verification of the diagnosis of congenital absence by means of X-ray examination. For practical reasons it was impossible to make this examination in all cases of non-erupted third molars. Out of the 94 adult Eskimos concerned, however, 87 had a full X-ray examination. Only three of the X-rayed cases (3.4 per cent) exhibited non-eruption (one wisdom tooth each). This finding tends to confirm the statements by GOLDSTEIN (99) and MEAD (212) who have claimed that the error brought about by omitting X-ray examination will not seriously affect studies of the incidence of congenitally missing third molars.

The three cases of non-eruption found on X-ray examination of 87 adult Angmagssalik Eskimos were the following: —

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[1]) Particulars of this material are given p. 66.

No. 323. Male aged 36. Tiniteqilaq.
The right lower third molar totally embedded. (Plate 5, Fig. 43).

No. 319. Male aged 48. Pupik.
The left lower third molar totally embedded (Plate 5, Fig. 44).

No. 433. Female aged 24. Kap Dan.
The left lower third molar totally embedded (Plate 5, Fig. 45); the right lower third molar partially erupted.

2. Results.

East Greenland Skulls. Table 8 gives the incidence of congenital absence of third molars in 109 upper jaws and 81 lower jaws of Pre-Danish East Greenland Eskimos. Table 8 conforms to the style of tabulation applied by GOLDSTEIN (99) in his report on congenital

TABLE 8.

Congenital absence of third molars in adult East Greenland Eskimo skulls.

Maxilla							Mandible						
Number of jaws examined	M_3 missing on both sides	M_3 missing on one side		Total jaws with M_3s missing	Per cent of jaws with M_3s missing	Per cent of M_3s missing to M_3s that should be present	Number of jaws examined	M_3 missing on both sides	M_3 missing on one side		Total jaws with M_3s missing	Per cent of jaws with M_3s missing	Per cent of M_3s missing to M_3s that should be present
		right	left						right	left			
109.....	5	3	4	12	*11.0*	*7.8*	81.....	15	2	6	23	*28.4*	*23.5*
Per cent of upper jaws (109).....	*4.6*	*2.8*	*3.7*	*11.0*			Per cent of lower jaws (81).....	*18.5*	*2.5*	*7.4*	*28.4*		

absence and impaction of third molars, in 759 modern Eskimo mandibles kept in the U. S. National Museum (Washington, D. C.). It is supposed that by following the same line as the above author, comparison of the various Eskimo groups can be more readily made.

Table 9 (p. 50) gives the incidence of congenital absence of third molars found by GOLDSTEIN (99) in Eskimo mandibles.

Comparing our findings (Table 8) with those of GOLDSTEIN (Table 9, p. 50) we find that the incidence of third-molar absence is definitely higher in the East Greenland lower jaw than in American Eskimo mandibles which form the vast majority (709) of his material.

TABLE 9.

Congenital absence of lower third molars in adult Eskimo skulls (mostly American), according to GOLDSTEIN (99).

Sex	M_3 missing on both sides	M_3 missing on one side		Total jaws with M_3s missing	Per cent of jaws with M_3s missing	Per cent of M_3s missing to M_3s that should be present
		right	left			
Males (363)	32	10	18	60	*16.53*	*12.67*
Females (380)	44	11	11	66	*17.37*	*14.47*
Totals...	76	21	29	..	..	..
Per cent of total adult mandibles (759)[1]	*10.0*	*2.8*	*3.8*	*16.6*	..	*13.31*

[1]) Including 16 unsexed.

GOLDSTEIN is of opinion that distinct differences exist between incidences of third-molar absence in the three main Eskimo groups of HRDLICKA (146, p. 274) as follows: —

Eskimo group according to HRDLICLA		Per cent of of mandibles missing M_3s	Per cent of M_3s missing
South-West and Mid-West	(477)	*14.9*	*12.3*
North-West	(232)	*19.0*	*15.5*
North and North-East	(40)	*22.5*	*18.8*

GOLDSTEIN (99, p. 383) says, "A consistent percentage increase of individuals lacking one or more lower third molars is noted from the southwest to the northwest to the north-northeast." As is demonstrated in Table 15 (p. 55) the Greenland groups examined by the present writer fit well into this general pattern.

Modern East Greenland Eskimos. Tables 10 (p. 51) and 11 (p. 51) deal with the congenital absence of third molars in 257 adult Eskimos living at Angmagssalik 1937. 36.6 per cent of the natives examined showed elimination of one or more third molars. 31.1 per cent of the mandibles and 20.6 per cent of the maxillae showed absence of one or two third molars. 26.7 per cent of lower third molars, and 15.2 per cent of upper third molars were congenitally missing. Thus the reduction in number of third molars—lower as well as upper—is numerically still

TABLE 10.

Congenital absence of third molars in modern adult Angmagssalik Eskimos. Numbers of persons affected.

Jaw	Sex	M_3 missing on both sides	M_3 missing on one side		Total jaws with M_3s missing	Per cent of jaws with M_3s missing
			right	left		
Maxilla	Males (115)	11	12	3	26	*22.6*
	Females (142)	14	5	8	27	*19.0*
	Totals...	25	17	11	53	..
	Per cent of total maxillae (257)	*9.7*	*6.6*	*4.3*	*20.6*	..
Mandible	Males (115)	30	9	0	39	*33.9*
	Females (142)	27	6	8	41	*28.9*
	Totals...	57	15	8	80	..
	Per cent of total mandibles (257)	*22.2*	*5.8*	*3.1*	*31.1*	..

greater than in the East Greenland skulls (compare Table 10 with Table 8 (p. 49)).

TABLE 11.

Congenital absence of third molars in modern adult Angmagssalik Eskimos. Numbers of teeth affected.

Jaw	Sex	M_3 dext.			M_3 sin.			M_3 dext.+ M_3 sin.		
		Number of M_3s that should normally be present	Number of congenitally missing M_3s	Percentage of congenitally missing M_3s	Number of M_3s that should normally be present	Number of congenitally missing M_3s	Percentage of congenitally missing M_3s	Number of M_3s that should normally be present	Number of congenitally missing M_3s	Percentage of congenitally missing M_3s
Maxilla	Males (115)	115	23	*20.0*	115	14	*12.2*	230	37	*16.1*
	Females (142)	142	19	*13.4*	142	22	*15.5*	284	41	*14.4*
	Totals...	257	42	*16.3*	257	36	*14.0*	514	78	*15.2*
Mandible	Males (115)	115	39	*33.9*	115	30	*26.1*	230	69	*30.0*
	Females (142)	142	33	*23.2*	142	35	*24.6*	284	68	*23.9*
	Totals...	257	72	*28.0*	257	65	*25.3*	514	137	*26.7*

TABLE 12.

Distribution of modern adult Angmagssalik Eskimos,

Sex	Individuals																			
	no M_3s		one M_3																	
	$\frac{M_3}{M_3}$	$\frac{M_3}{M_3}$	$\frac{M_3}{M_3}$	$\frac{M_3}{}$	$\frac{M_3}{}$	$\frac{M_3}{M_3}$	$\frac{M_3}{M_3}$	$\frac{}{M_3}$	$\frac{M_3}{M_3}$	$\frac{M_3}{M_3}$	$\frac{M_3}{}$	$\frac{}{M_3}$	$\frac{M_3}{}$	$\frac{M_3}{}$	$\frac{M_3}{}$	$\frac{}{M_3}$	$\frac{M_3}{}$	$\frac{M_3}{}$	$\frac{M_3}{}$	$\frac{}{M_3}$
Males (115)	69		..		6		3		2				14		..					
Per cent of adult male Eskimos.	*60*		*9.6*																	
Females (142)	94		6		6		1		3				9		1					
Per cent of adult female Eskimos	*66.2*		*11.3*																	
Total Eskimos (257)	163		6		12		4		5				23		1					
Per cent of total adult Eskimos.	*63.4*		*10.5*																	

Table 12 shows the distribution or pattern of non-development of third molars in the modern Angmagssalik Eskimos. As will be noticed, the most frequent occurrence is that of congenital absence of both mandibular third molars. The combinations $\frac{M_3|}{|M_3}$ and $\frac{|M_3}{M_3|}$ have not been observed in the East Greenland Eskimo. That such combinations, however, now and then may occur, appears from the studies by KNAP (171) who found one case of each among 64 Chinese living in Java.

Modern South-West Greenlanders. In order to pursue the question of congenital absence of third molars in East Greenlanders and, if possible, study the influence of white admixture in this respect, the writer presents additional data on the condition in question as observed in the adult native population living in the Nanortalik—Kap Farvel territory, Julianehaab District, South-West Greenland. Unlike the northern part of the Julianehaab District where white admixture is abundant, the greater part of the population of the southern district (Nanortalik—Kap Farvel) is unmixed (see for instance V. FABRICIUS-HANSEN (83)) and contains a considerable East Greenland element which has come from the southern part of the east coast (MIKKELSEN and SVEISTRUP (217, p. 24 ff.)).

Although no X-ray examination has been made of the West Greenlanders in question, the writer does not hesitate to present his results from that area because, as has been shown at an earlier stage, the error

according to pattern of congenitally missing third molars.

showing absence of									
two M_3s				three M_3s				four M_3s	one or more M_3s
M_3 M_3	M_3 M_3	M_3 M_3	M_3 M_3	M_3 M_3 M_3	M_3 M_3	M_3 M_3	M_3 M_3	M_3 M_3	
..	..	3	2	..	7	..	..	9	46
16.5				*6.1*				*7.8*	*40.0*
..	..	..	3	6	2	1	..	10	48
9.2				*6.3*				*7.0*	*33.8*
..	..	3	5	6	9	1	..	19	94
12.5				*6.2*				*7.4*	*36.6*

TABLE 13.

Congenital absence of third molars in almost unmixed modern South-West Greenlanders aged 25—50.
Numbers of persons affected.

Jaw	Sex	M_3 missing on both sides	M_3 missing on one side		Total jaws with M_3s missing	Per cent of jaws with M_3s missing	Per cent of M_3s missing to M_3s that should be present
			right	left			
Maxilla	Males (83)	7	5	0	12	*14.5*	*11.4*
	Females (127)	20	5	3	28	*22.0*	*18.9*
	Totals...	27	10	3	40	*19.0*	*16.0*
	Per cent of total upper jaws (210)	*12.9*	*4.8*	*1.4*	*19.0*	..	..
Mandible	Males (83)	13	5	1	19	*22.9*	*19.3*
	Females (127)	17	9	3	29	*22.8*	*18.1*
	Totals...	30	14	4	48	*22.9*	*18.6*
	Per cent of total lower jaws (210)	*14.3*	*6.7*	*1.9*	*22.9*	..	..

TABLE 14.

Tabulation of almost unmixed South-West Greenlanders aged 25—50, according to the number of their congenitally missing third molars.

Sex	Natives showing congenital absence of				Natives having developed all M_3s	Percentage of natives missing one or more M_3s
	one M_3	two M_3s	three M_3s	four M_3s		
Males (83)	7	10	4	3	59	*28.9*
Females (127)	9	12	7	10	89	*29.9*
Totals...	16	22	11	13	148	..
Per cent of total natives examined (210).....	*7.6*	*10.5*	*5.2*	*6.2*	*70.5*	*29.5*

caused by omitting X-ray examination is only slight from a statistical point of view. In order to eliminate cases of delayed eruption, only natives above 24 years of age were considered. To avoid mistakes in deciding whether congenitally missing or lost third molars should be recorded, natives aged more than 50 years were excluded.

Tables 13 (p. 53) and 14 contain particulars—corresponding to those given for the modern East Greenlanders proper in Tables 10 (p. 51) and 11 (p. 51)—on congenital absence of third molars. From Tables 13 (p. 53) and 14 it appears that the incidence of congenitally missing third molars is rather high in the southernmost West Greenland group, with considerable East Greenland Eskimo admixture.

It being outside the scope of the present report to consider in detail the West Greenland mixed-race material from the northern part of Julianehaab District, the writer, as far as this group is concerned, refers to the summarized information given at the bottom of Table 15 (p. 55). Here it is clearly seen that the incidence of third molar absence is remarkably low in mixed-bloods.

3. Discussion.

The principal results made available by the present survey are given in Table 15 (p. 55). This table presents evidence that some difference occurs between various Eskimo groups as far as congenital absence of third molars is concerned.

The very highest percental incidence was found in modern and ancient East Greenlanders. Next to the East Greenland groups comes the group from the extreme South of West Greenland (partly East

TABLE 15.

Survey of congenital absence of third molars in 1,616 Eskimo mandibles examined by GOLDSTEIN *and the present writer.*

Group and author	Number of mandibles examined	Per cent of mandibles missing one or two M_3s	Per cent of M_3s missing
		σ	
Modern Angmagssalik Eskimos (present study)	257	*31.1 ± 2.9*	*26.7*
East Greenland Eskimo skulls (present study)	81	*28.4 ± 5.0*	*23.5*
Modern South-West Greenlanders, almost unmixed (present study)	210	*22.9 ± 2.9*	*18.6*
Skulls of modern North and North-East Eskimos (GOLDSTEIN) (99)	40	*22.5 ± 6.7*	*18.8*
Skulls of modern North-West Eskimos (GOLDSTEIN) (99)	232	*19.0 ± 2.6*	*15.5*
Skulls of modern South-West and Midwest Eskimos (GOLDSTEIN) (99)	477	*14.9 ± 1.6*	*12.3*
Modern South-West Greenlanders, mixed race (PEDERSEN and HINSCH) (246, p. 120)	319	*14.7 ± 2.0*	*11.0*

Greenlanders or descendants of the latter). The same magnitude of third-molar absence was found by GOLDSTEIN (99) in North and North-East (including Greenland) Eskimo skulls[1]). Definitely lower incidence of congenitally missing third molars was recorded by the present writer in the northern Julianehaab District mixed-blood group of natives.

Generally speaking, we may accept the results here presented as being rather for, than against the view put forward by GOLDSTEIN (99) as to the decrease in third-molar absence from the south-west to the north—north-east. From a racial standpoint it is interesting that the very lowest incidence is found in the West Greenland group to which white admixture is ample.

The writer does not intend to make a complete survey of the abundant literature on congenital absence of third molars. References to a few principal data, however, can hardly be dispensed with if one shall be able to estimate the incidence of congenitally missing third molars in the Eskimo, in proportion to that of other racial and local groups.

From the Mongolian stock to which the Eskimo is supposed to be related[2]) an excellent study has been published by SAITO, UEHARA

[1]) Groups according to HRDLICKA (146, p. 274).

[2]) *e. g.* by HRDLICKA (145, p. 27 and p. 50).

and OZAKI (280, 281), who examined 4,347 young male Japanese, using X-ray. 34 per cent of third molars that should normally be present were congenitally missing. Lower incidence has been reported by HAMANO (115) who found that out of 1,300 Japanese, 239 (18.4 per cent) showed third-molar absence. HELLMAN (121) studying 19 Chinese skulls found 32 per cent to lack one or more third molars, while among 21 Mongoloid Buriats 17 per cent lacked third molars. KNAP (171) from Java, among 64 Chinese recorded 31.2 per cent lacking one or more third molars and 17.6 per cent of third molars to be missing. For 71 Javanese the corresponding percentages according to KNAP were 22.7 and 17.6 respectively, for 90 Europeans, 27.9 and 14.2. GOLDSTEIN (99) says that the Mongoloid peoples, taken as a whole, appear to be the most advanced with regard to congenitally missing mandibular third molars. HELLMAN (122) making comparative studies of 19 racial and local groups (849 skulls), including Mongoloids, found the highest incidence but one in 19 Chinese skulls.

LEIGH (184) says of the Algonquin Indians that "there were cases of suppression of both upper and lower third molars", but does not report the incidence. W. SMITH (301) among ten Sioux Indians found five in whom three M_3s were missing and one, (male aged 40), without third molars at all. MAUREL (209) observed that 48 out of 68 Caribis-Indians in Guyana showed absence of third molars.

KAJAVA (159) reported congenital absence of M_3 in Finnish Lapps to amount as much as upper + lower jaw 4.5 per cent, upper jaw 10.7 per cent, lower jaw 13.9 per cent (in all 29.1 per cent).

According to HELLMAN (122) the Tasmanians had an exceedingly low occurrence of third-molar absence. This also applied to West African Negroes examined by HELLMAN (l. c.).

In ancient Egyptians according to RUFFER (275) only 3.2 per cent out of a total number of 156 individuals showed congenital absence of wisdom teeth.

Proceeding to Whites we find that almost incredible figures were given long ago by TALBOT (311) who reported 42 per cent of male and 58 per cent (!) of female "Europeans" to lack third molars. GOBLIRSCH (97) studied 2,112 white Americans by means of X-ray examination and found 9.0 per cent of cases to exhibit third-molar absence. 5.2 per cent of third molars had not developed. BANKS (19) among 461 Colorado office cases found 19.7 per cent missing one or more third molars. HELLMAN (122) in 261 American male students found 21.7 per cent having decrease in number of M_3s. In female students the corresponding percentage was 30.8. EULER (77) making comparative studies of neolithic skulls from Silesia and modern Germans failed to record more than 1.3 per cent of 150 Breslau dental students showing congenital absence of

third molars. In 41 neolithic mandibles, however, EULER observed absence of third molars in 26.8 per cent of cases.

M. DE TERRA (313) found third molars to be congenitally missing in many racial groups. DE TERRA (p. 230) concludes, "dass Reduktion oder Fehlen der M_3 durchaus nicht speziell den Europäern eigen ist, dass dagegen die Erscheinung auch anderen Rassen zukommt. Was M_3 betrifft so fällt seine häufige Reduktion bei Arabern, Malayen, Birmanen etc. auf." HELLMAN (121, p. 173) says, "With the exception of the West African Negroes congenital absence of third molars appears in a rather high percent in all races examined." Likewise RÖSE (273) as early as in 1906 stated that the wisdom tooth frequently shows retrogression not only in Europeans but also in coloured races.

From the data and quotations given above it may readily be seen that the following statement by MARTIN (199, p. 989) cannot be corroborated, "M_3 hat die Tendenz zu verschwinden und zwar bei Kulturrassen (!) in viel höheren Grad als bei Naturvölkern."[1]) Neither is it possible to agree with BLUNTSCHLI (31) who maintains that congenital absence of I_2 sup. and M_3 very seldom occurs in "lower" races (if by lower races is meant coloured races). Likewise FALERO (84) is wrong in categorically saying that "the third molar is never (!) wanting in primitive races."

As a matter of fact there is abundant evidence of a widespread occurrence of third-molar absence among human races, and it seems likely that congenital absence of the third molar is at least as frequent —and probably more so—in the Eskimo and in Mongolians proper (*e. g.* Japanese) than in other racial and local groups studied so far.

The incidence of missing third molars in the East Greenland Eskimo far exceeds that of white man generally reported in literature, although it must be admitted that extreme variations occur in the percentages given on missing third molars in Whites. The possibility cannot be ruled out that the very high incidence of congenital absence of third molars in the modern Angmagssalik Eskimo is in part the result of centuries of isolation. (ADLOFF (10) advanced this view upon the neolithic material examined by EULER (77)). However, the bearing of this factor upon third-molar absence in the modern Angmagssalik group can hardly be very far-reaching, since high incidence was also found in East Greenland skulls dating from earlier centuries and collected all along the coast of East Greenland.

Judging from his findings in modern West Greenland natives of mixed race as compared with the other Eskimo groups dealt with in Table 15, the writer assumes that white admixture has interfered with

[1]) Almost the same words were used by HJELMMAN (128, p. 104).

congenital absence of third molars so as to bring about lower incidence. This may be a parallel to the fact demonstrated later on, that the incidence of CARABELLI's tubercle is far higher in West Greenlanders of mixed blood than in the East Greenland Eskimo.

Attempts to explain the causes of absence of third molars have been made by many authors, some of whom (FALERO (84) a. o.) maintain that the (supposed) higher incidence of this condition in white man is associated with civilization. These authors are of opinion that civilization (urbanization) reduces the function of the masticatory apparatus, and thus causes reduction of the size of the jaws, the consequence of which in its turn being lack of space for the third molars, thus preventing them from developing. DARWIN (62), MANTEGAZZA (198), TOMES and others proposed the causative factor to be, in the words of TOMES (322, p. 530), "a consequence of want of space during the formative period." There is, however, nothing to substantiate that the development of the third molar is dependent on the space available, and it is out of the question that civilization be responsible for the very high incidence of missing third molars in the East Greenland Eskimo. Neither does any lack of space generally occur in the powerful jaws of this group or in those of other native peoples in which absence of third molars is frequently met with. In most Greenland Eskimo jaws, indeed, abundant space is available for the accommodation of the third molar (Plate 5, Fig. 46, and PEDERSEN (249, p. 176 ff.)). According to HELLMAN (121) this is also true of the American Negro, the American Eskimo, the Buriat and the Australian Aboriginal, and yet they all show a high percentage of congenitally missing third molars. Thus it is safe to say that it has not at all been proved that congenital absence of third molars is caused by lack of space for their accommodation.

Turning against the conception that retrogression of the wisdom tooth in modern man is caused by decrease of masticatory function, ADLOFF (10), in his notes to the third molar study of EULER (77), calls attention to the fact that retrogression of the third molar already occurred in fossil hominids.[1]) ADLOFF also very clearly points out that decrease of function may be the cause of changes such as reduction of the total dental arch, but not of one single tooth only. According to ADLOFF the congenital absence of third molars is exclusively a question of phylogeny. Similar views have been expressed by WEIDENREICH (332).

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[1]) According to CARETTE-PILLOT (52) several third molars are missing in the Neanderthal jaws from Krapina. Third molar absence may even be found in the lower primates. According to HELLMAN (122) absence of third molars has been observed in Chimpanzee. SCHULTZ (286) gives the average incidence for the whole order of primates at 1.4 per cent of cases, and DE TERRA (313, p. 286) quotes several authors who have reported decrease in the number of wisdom teeth in anthropoid apes.

It is well known that there is an evolutionary trend of numerical reduction in the mammalian dentition. It is also well established that the reduction of the molar series takes place through reduction of its posterior element (cf. HALL (114, p. 118)). As has been substantiated in this chapter, definite differences seem to occur among modern human racial groups as far as congenital absence of third molars is concerned. However, it is extremely doubtful what significance, if any, can be attached to such differences from an evolutionary point of view. Provided high incidence of congenitally missing third molars be really indicative of advanced evolution of a modern human racial group, as is assumed by some students of anthropology[1]), evidence has been presented by GOLDSTEIN and the present writer that the Eskimo ranges among the most advanced peoples of the present time.

The results of the present study of dental numerical variations, seem to suggest racial affinity between the Eskimo and the peoples of Eastern Asia. It would seem proper therefore to consider numerical variations of the dentition in various Mongols and also in Indians[2]), when further attempts are being made at approaching the interesting questions of racial origin and relationship of various American peoples, including the Eskimo.

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[1]) T. KEMP (169), among others, holds this view.

[2]) DORSEY (68, p. 213) says 1887, "Variations in the number and arrangement of the teeth are very frequent, and it is surprising to see how often it is the case among aboriginal American crania."

CHAPTER V

ANATOMY OF THE PERMANENT DENTITION

A. PREVIOUS ACCOUNTS AND STUDIES

a. General Impressions of the Eskimo Dentition.

Many reports given by explorers, anthropologists and medical officers who have visited the Arctic, refer to the impression that the Eskimo dentition made upon them. General as these impressions usually are, they cannot, it is true, be considered of high scientific value, but when collated they are of unquestionable interest in connection with our subject.

The following quotations, which are not exhaustive but rather representative, contain references not only to the shape, size and colour of the teeth, but also to other dental conditions which were noticed and recorded by the observers in question.

The numerous statements in arctic literature referring only to attrition and abuse of the teeth, have not been considered in the following collection.

EAST GREENLAND.

GUSTAV HOLM (1888),

"The teeth are small, of uniform size and well set, the teeth of the upper jaw fitting exactly unto the teeth in the lower jaw; but they decay[1]) prematurely, and the teeth of old people are worn off right down to the gums." (131, p. 58).

KNUD POULSEN (1909),

"The teeth are on the whole strong, but much worn. Only once I saw a carious tooth. They are often rather misplaced, but holes in the series of teeth are so to speak never seen, not even in old people in whom they are nearly worn away. The eye-teeth are often chisel-formed." (258, p. 142).

KAP YORK.

JOHN ROSS (1819),

"His mouth was large, generally half open, and shewing that he had lost his

[1]) The English translation (1914) quoted here is wrong. The original Danish text (1888) has "ere afslidte" which means "become worn".

fore-teeth, the remainder of which were, however, white and regular ..." (274, p. 126), "both these, who were brothers, had white regular teeth" (p. 127).

H. P. Steensby (1910),
"The teeth are fine and strong and form regular rows almost always. It is well-known how they are greatly worn down ..." (303, p. 386).

West Greenland.

R. Virchow (1878)
examined in Berlin four adult Eskimos and two children from Jacobshavn. "Das Gebiss ist sehr entwickelt, namentlich sind die Unterkiefer weit ausgelegt ..." (344, p. 186).

American Continent.

P. F. Charlevoix (1721),
"Ils ont ... de petits Yeux effarés, des Dent larges et fort sales ..." (54, p. 178).

James Cook (1784),
"Their teeth were of a tolerable whiteness, broad, well set, and equal in size ..." (57, vol. 2, p. 300). "The teeth of both of them were black, and appeared as if they had been filed down level with the gums." (vol. 3, p. 31).

W. E. Parry (1824),
"Their teeth are short, thick, and close, generally regular, and in young persons almost always white. The elderly women were still well furnished in this way, though their teeth were usually a good deal worn down, probably by the habit of chewing the sealskins for making boots." (237, p. 493).

G. F. Lyon (1824),
"The teeth are strong, and deeply fixed in the gums. They are formed like rounded ivory pegs, and are as flat on the upper end as if filed down. Old people have them worn quite even with the gums, and it is but rarely that any are decayed." (195, p. 311).

F. W. Beechey (1832),
"... old age [in the women] is attended with a haggard and care-worn countenance, rendered more unbecoming by sore eyes and by teeth worn down to the gums by frequent mastication of hard substances" (23, p. 475).

B. Seemann (1853),
"The teeth of the Eskimos are regular, but from the nature of their food and from their practice of preparing hides by chewing, are worn down almost to the gums at an early age." (291, vol. 2, p. 51).

M'Clintock (1859),
"They [the women at C. Victoria, Boothia Felix] had fine eyes and teeth as well as small hands ..." (211, p. 234).

W. H. Dall (1870),
"A noticeable feature is their teeth. These are always sound and white, but are almost cylindrical, and in old people are worn down even with the gums, producing a singular appearance ..." (61, p. 140), "... a pleasant smile, displaying

two rows of very white teeth, conquered any objection I might have felt to his large mouth." (p. 17).

H. H. BANCROFT (1874),

"... the teeth [are] regular, but well worn ..." and quoting BROWNELL, "they have small, wild-looking eyes, large and very foul teeth ..." (18, p. 45).

J. SIMPSON (1875),

"The mouth is prominent and large, and the lips, especially the lower one, rather thick and protruding. The jawbones are strong, supporting remarkably firm and commonly regular teeth. In the youthful these are in general white, but toward middle age they have lost their enamel and become black or are worn down to the gums. The incisors of the lower jaw do not pass behind those of the upper, but meet edge to edge, so that by the time an individual arrives at maturity, the opposing surfaces of the eye and front teeth are perfectly flat, independently of the wear they are subjected to in every possible way to assist the hands .... While young the women are generally well formed and good looking having good eyes and teeth ... There was another at Point Barrow, whose wrinkled face, silvery hair, toothless gums ... indicated an age nothing short of 75." (300, p. 239).

J. MURDOCH (1888),

"The mouth is large and the lips full, especially the lower one. The teeth are naturally large, and in youth are white and generally regular, but by middle age they are generally worn down to flat-crowned stumps, as is usual among the Eskimos." (223, p. 35).

J. MURDOCH (1890),

"When they [the Point Barrow Eskimos] are young they have white and regular teeth, but these are worn down to stumps before middle life is reached." (222, p. 233).

E. W. NELSON (1900),

"The Eskimo of the Diomede Island in Bering Strait, as well as those of East Cape and Mechigme and Plover Bay on the Siberian coast, and of St. Lawrence Island are tall ... and characterized by the unusual heaviness of the lower part of the face due to very massive lower jaws carrying strong teeth ..." (226, p. 27).

SH. JACKSON (1905),

"They [the Eskimos of Alaska] have ... good teeth" (150, p. 258).

A. P. LOW (1906),

The teeth of four Hudson Bay Eskimos are described as follows, (1) "two-thirds teeth remaining and perfect." (2) "teeth perfect, though large." (3) "teeth discoloured and large, though sound." (4) "teeth regular." (192, pp. 343—45).

D. JENNESS (1923),

"The teeth [of the Copper Eskimo] are usually regular and pearly white. The incisors of the old women are often worn down almost to the gums, the results of constant chewing on seal-skins and other hard objects. Toothache seems rare; the remedy is to jerk out the tooth with a thread of sinew. Several old men were found to have lost their teeth in this way, and one child was seen extracting a milk tooth" (152, pt. B, p. 44).

A. HRDLICKA (1926),

"The teeth and dental arches [of the Kuskokwim Eskimo] in general are rather large and regular. The teeth and gums in these people are still in general in a much

better condition than they are in the whites, but the process of wearing off the crown is earlier universal, and much more marked than in the whites ..." (146, p. 100).

K. Birket-Smith (1940),

"The teeth [of the Central Eskimo] are almost always sound and strong, but display marked signs of wear. A young Iglulik Eskimo had two carious incisors, and it is scarcely accidental that caries occurred in this tribe, which more than the others has abandoned the original diet. Another man, a Qaernermio, lacked several teeth, but I know nothing of the reason. Edge to edge bite is extremely common; no fewer than 61 individuals, which is much more than half, had this peculiarity. Three individuals, all of the Netsilik group, had a projecting lower jaw. The only other anomaly observed was in the case of a young Iglulik Eskimo who had a small supernumerary tooth between the two first incisors of the upper jaw." (29, p. 67).

Eskimos Generally.

J. Richardson (1861),

"The teeth of the young people [are] white and regular, but the sand that, through want of cleanliness, mixes with their food wears the teeth down at an early age almost to the level of the gums, so that the incisors often have broad crowns like the molars." (268, pp. 303—04).

b. Previous Studies of Eskimo Dental Anatomy.

The following is a survey of the anatomical studies which have so far been made of the teeth of the Eskimo. Superficial remarks made by non-experts on the form, size etc. of Eskimo teeth have been considered only in case of the East Greenland Eskimo.

East Greenland.

A. Pansch (1874), who studied the skeletal material collected by "Die zweite deutsche Nordpolarfahrt 1869/70", paid some attention to the teeth and made a few observations on them (236, p. 150).

Søren Hansen (1886), while making anthropological investigations of the skull material brought home from South-East Greenland and the Angmagssalik area by Holm and Garde (131) noticed various peculiarities in the form of the teeth. Søren Hansen (116, 119), however, did not proceed to systematic or detailed studies of these dentitions, nor did he do so when (in 1895) he studied the skull material from Scoresbysund (S. Hansen (118)) brought home by Ryder (277, 278, 279).

Gustav Holm (1888) commented on the proportionate size of the anterior teeth as quoted p. 60.

Knud Poulsen (1909), who wintered at Angmagssalik with the Amdrup Expedition, mentioned *en passant*, as quoted p. 60, the shape

of the maxillary canine crowns. He did not, however, make systematic dental studies.

H. HOESSLY (1916), who was a medical officer on the QUERVAIN Expedition in 1912/13, made thorough anthropological studies of 36 skulls and calvaria collected on the islands of "Amaut and Sivinganeq" (situated at the mouth of the Sermilik near Angmagssalik). HOESSLY (130) mentioned various characteristics of the teeth and measured the length and breadth of the lower molar crowns. HOESSLY's material included two juvenile mandibles to which special attention was paid.

H. KRANZ (1934) examined a small number of skulls from Kap Hope near the trading station of Scoresbysund. They were collected by WEGENER's expeditions in 1929 and 1930/31. PETERS (255) supplied information as to the graves from which they were collected. KRANZ (174) examined one cranium, one calvarium and three mandibles. He made various observations of interest from a dental point of view (174, p. 116).

WEST GREENLAND.

K. GORJANOVIC—KRAMBERGER in Agram (1909) received from Professor F. C. C. HANSEN, Copenhagen, eight West Greenland Eskimo mandibles which he compared with the lower jaws of *Homo primigenius* from Krapina (Croatia). The root conditions, the pulp cavities, and the proportionate size of the Eskimo molars interested this famous anthropologist, and are mentioned several times in his publication (105).

KAMMA BUDTZ-JØRGENSEN (1922 and 1925), in 1913/14 and 1924/25 examined the dental condition of 500 and 1,208 natives (mixed-bloods), in a great number of settlements on the west coast of Greenland. Detailed studies of dental anatomy were not made, but various anomalies were recorded (44, p. 19 and 45, p. 351).

GREENLAND GENERALLY.

M. DE TERRA (1905) in his comprehensive dental investigations of skulls from all parts of the world included two from Greenland, and described anatomical details partly on the basis of them, partly on the basis of earlier literature (313, p. 84 and p. 140).

C. M. FÜRST and F. C. C. HANSEN (1915) in their monumental work on Greenland skulls—mainly skulls from West Greenland—made one or two brief comments on dental anatomy (95, p. 177).

P. O. PEDERSEN and H. THYSSEN (1942) made comparative studies of the course of the gingival enamel margin on molar teeth of Eskimos and a number of other racial and local groups of *Homo*, as well as some *Anthropomorphae*. The material studied by these authors included

ancient and modern Eskimos from many localities in East and West Greenland (252).

American Continent.

A. Hrdlicka (1910) says, among other things, that the upper incisors in Eskimos and Indians are "shovel-shaped", (136, p. 261 and p. 266). Hrdlicka (l. c.) also measured a small number of Eskimo teeth. In 1920 he published a paper (139) in which shovel-shaped incisors were described, and their racial distribution was determined by means of studies of Eskimo skulls, *inter alia.*

S. G. Ritchie (1923) has carefully examined and measured the teeth of about fifty Central Eskimo skulls collected by D. Jenness, The Canadian Arctic Expedition 1913—18. Ritchie's work (271) is the first report of detailed studies of Eskimo dental anatomy and pathology, and was until the present day, the only publication containing results of metrical observations of a comprehensive number of Eskimo teeth.

A. Hrdlicka (1923) measured the principal dimensions of M_1 and M_2 in the mandibles of a series of human racial and local groups, (including the Eskimo), as well as in the mandibles of anthropoids, in order to compare them with the Piltdown molars (142). In a later work of the same year (143), Hrdlicka supplied data on variations of the dimensions of the lower molar teeth of Eskimos and other groups.

R. W. Leigh (1925), a scrupulous student of dental anatomy and pathology in skulls of various racial groups, in his important work "Dental Pathology of the Eskimo" (185), mentioned several dental morphological features, and made several original observations regarding Eskimo dental anatomy.

M. Hellman (1928) devoted considerable interest to the occlusal pattern of the lower molar crowns as a racial characteristic. In order to elucidate this point he examined the mandibles of quite a number of racial groups including 30 lower jaws of Eskimos (121).

M. S. Goldstein (1931) published a comprehensive study of the cusps of the mandibular molar teeth of the Eskimo with comparative data on other racial groups (98).

T. D. Stewart (1939) studied dental conditions, in particular attrition and *ante mortem* loss of teeth, in Eskimo skulls from Labrador, and mentioned, *inter alia*, reduction of size of third molars in these Eskimos (307).

Eskimos Generally.

E. Lambert (1877) presented data on the number of molar cusps in twelve Eskimo skulls (179).

P. ADLOFF (1910) made interesting comments on the shape of the roots in Eskimos (5, p. 156) as did

WINGATE TODD (1915) who called attention, among other things, to the tendency towards fusion of roots which is prevalent in the Eskimo (320, p. 258).

B. THE AUTHOR'S INVESTIGATIONS OF EAST GREENLAND ESKIMOS

a. Material.

EAST GREENLAND SKULLS.

The skull material examined for morphological conditions of the teeth is tabulated according to sex and age in Table 2 (p. 28). This skull material is identical with that examined for dental numerical variations.

In making a morphological study of teeth, especially a metrical study, it is essential to know the sex of the skulls in question. Several authors such as BESSELS (25), SØREN HANSEN (116, 119), HRDLICKA (136), FÜRST and HANSEN (95), GRANT (107), KRANZ (174), and STEWART (307) have emphasized that the determination of the sex of Eskimo skulls involves very great difficulty. FÜRST and HANSEN (95, p. 56) who decided the sex of the skulls dealt with in the present work, say that, "There are many instances in which it is very difficult, not to say impossible, to assign a skull with certainty to one or the other sex. This uncertainty is not least due to the strong development of the masticatory apparatus which is present in the crania of the Greenlandish women."

Obviously it would have been more advantageous if the number of East Greenland skulls studied for dental anatomical conditions, could have possibly been greater, especially as the number of one-rooted teeth is so limited (Table 16, p. 69). However, the remaining East Greenland skull material of the Museum has not yet been examined by the anthropologists, and taking into consideration the difficulties encountered in this respect, even by experienced experts, the writer has not ventured the determination of the sex of these Eskimo skulls. Hence the valuable and archaeologically well dated material, brought home by THERKEL MATHIASSEN (203, 204), HELGE LARSEN (180, 181) a. o. from Southern and Northern East Greenland respectively, could not be included in the present study of East Greenland Eskimo dental anatomy.

The value of the present material is limited by the comparatively small number of skulls available for examination. This reservation is

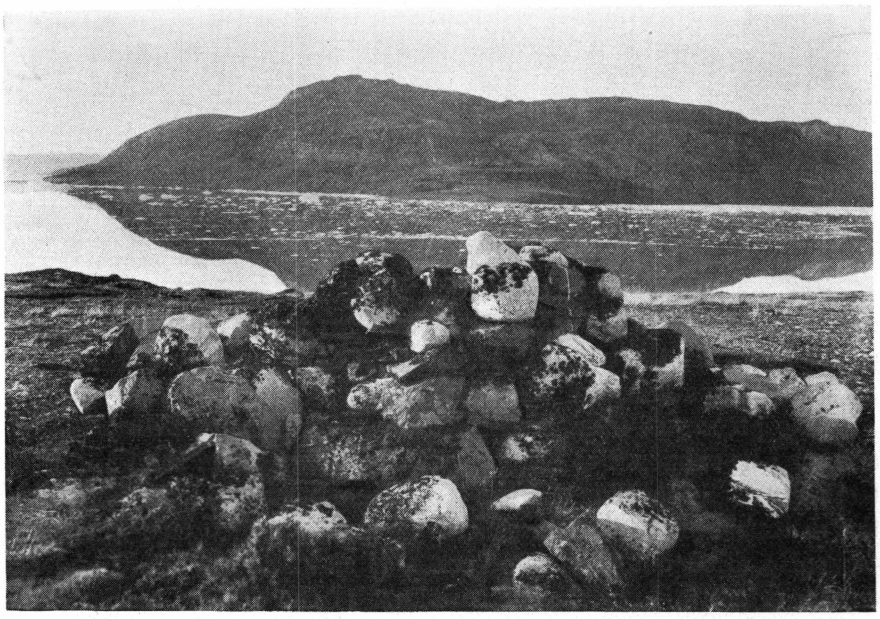


Fig. 16. Greenland Eskimo grave (THERKEL MATHIASSEN phot.).

not minimized by the fact that it is the most comprehensive Eskimo material thoroughly studied so far. Further, however, it is limited by two other factors, *viz.*

(1) Disintegration and *post mortem* loss of teeth, (*i. e.*, artificial damage), and
(2) Post-eruptive changes in the crowns and roots of the teeth occurring during life.

(1). *Disintegration and post mortem loss of teeth.*

The Eskimo graves are more or less primitive stone chambers (Fig. 16) in which the corpse is laid down on the rock with its superstratum of sparse vegetation. The chamber is then closed with stones of different sizes. Such graves have been described in detail by STEENSTRUP (304), HANTZSCH (120) a. o.

The corpse, and subsequently the skeleton, is exposed to the destructive influence of climate and animals, and in many instances suffers considerable damage in the course of time. In addition, falling stones often result in crushing of the bones.

HANTZSCH (120) has pointed out that the bones often disintegrate, especially when they lie in a layer of moss, whereas they are preserved fairly well if lying on the bare rock. As far as the teeth are concerned they are prone to fall out of their sockets, especially if they are one-

rooted teeth. They become covered by the moss, and a great deal of care and patience is required to retrieve them, so that generally they are never recovered, at any rate when the skulls are collected by explorers who are not archaeologists.

Bones and teeth which are permanently exposed to the acid reaction of the moss layer gradually turn brown and become more or less demineralized.

Plate 6, Fig. 47 shows the jaws of a Greenland Eskimo skull, the left side of which has been exposed to disintegration, while the right side is undamaged. This case also illustrates that such dental changes as are found on the left side of the jaws are caused by disintegration and are not pathological conditions.

The process of demineralization affects all the hard dental tissues and may be supposed to bring about slight changes in the form of the teeth, especially shrinking. While the enamel in general looks unaffected, the dentine becomes demineralized to such a degree that when subsequently dried out in the museums, it shrinks perceptibly and also cracks. (Plate 6, Fig. 48). The shrinkage of the dentine results in the enamel tending to come off in flakes (cf. PEDERSEN (254, p. 42)).

When not too pronounced, the *post mortem* changes here described are no serious obstacle to successful studies of gross dental anatomy, but they will interfere with any study of microscopic structure, hardness etc. *Post mortem* changes in Eskimo teeth are largely similar to those found in European skeletal material. In the latter they are quite often the cause of such loss of tooth substance (especially of the cervico-facial cementum) that was mistaken for carious lesions by early students of skull collections (cf. WERNER (334)).

In numerous Eskimo skulls, however, the state of preservation of the teeth is excellent. These are probably the cases where the graves were situated on the bare rock. Among the East Greenland skulls, only few with advanced disintegration of the teeth were found, and these have not been included in the present study. On the whole, the teeth of the present material must be said to be in a fine state of preservation, as were the American Eskimo dentitions examined by LEIGH (185).

A more serious drawback to the study of the East Greenland dentition than disintegration, is the considerable *post mortem* loss of teeth. As will be shown later on, the Eskimo teeth generally have short roots, particularly when reaching mature age. Their roots are usually straight and only slightly divergent. These conditions together with the Eskimo customs of burial, result in the frequent tendency for the teeth, —especially the anterior teeth—, to fall out of the skulls in the graves (Plate 7, Fig. 49).

TABLE 16.

Numbers of permanent teeth present, and lost post mortem, in 52 Eskimo skulls from East Greenland.

Tooth	Maxilla				Mandible			
	♂		♀		♂		♀	
	teeth examined	sockets examined	teeth examined	sockets examined	teeth examined	sockets examined	teeth examined	sockets examined
M_3	33	28	12	24	26	13	8	12
M_2	50	16	24	18	35	12	16	16
M_1	57	9	34	8	38	10	21	11
P_2	25	38	10	32	18	29	11	21
P_1	22	44	10	32	11	37	7	25
C	22	44	10	32	19	28	7	25
I_2	7	55	4	37	9	37	6	26
I_1	6	58	2	39	9	36	5	26
Total...	222	292	106	222	165	202	81	162

An additional number of teeth were lost during collection[1]) and transport[2]) as well as in the anthropological museums, where formerly the teeth were often regarded as rather useless structures and consequently were handled with deplorable carelessness.

As a cumulative result of these unfavourable circumstances, the East Greenland (as well as the West Greenland) skulls, now exhibit a very considerable *post mortem* loss of teeth. The extent of this loss is demonstrated in Table 16.

573 teeth and 878 empty sockets were examined in the 52 skulls. This means that the permanent teeth lost *post mortem* amounted to 60.5 per cent of the 1,451 permanent teeth which were present at death. Table 16 shows that the upper first molars are the teeth which are most frequently left in the jaws (divergence of the roots), and that the majority of the anterior (one-rooted) teeth have fallen out. The upper central incisors fall out so easily that very few remain *in situ*.

It should be noted that the numbers of individual teeth or sockets tabulated in Table 16 are the maximum numbers of each tooth or socket available for examination of a specific morphological character. In most cases the number examined is inferior to that given in Table 16, and in few cases are they identical. This is due to the fact that sometimes one, sometimes another demand had to be made on the teeth with regard to their state of preservation, their degree of attrition etc.

The considerable *post mortem* loss of teeth which may be said to

[1]) Cf. PANSCH (236, p. 150).

[2]) Cf. FÜRST and HANSEN (95, p. 177).

be increased by a number of totally missing mandibles[1]), is not specific to the Eskimo skulls examined by the present writer. It seems to be of the same magnitude in Eskimo crania studied by BIERLEY and PARSON (26, pp. 104—07), HRDLICKA (136, p. 182), RITCHIE (271, p. 59), and STEWART (307, p. 50). HRDLICKA (l. c.) says of Eskimo skulls from Southampton Island, "it should be noted that the majority of the teeth are now missing (lost *post portem*)[2]), and STEWART (l. c.) says of skulls from Labrador, "Lower jaws were missing for many of the old stone grave skulls."

(2) *Post-eruptive changes of the teeth during life.*

While dental caries does not occur in the East Greenland Eskimo skull material, a number of other conditions contribute toward rendering morphological studies of the teeth difficult: —

The study of the occlusal pattern of the postcanine teeth is impossible in numerous cases, on account of the excessive attrition. In an additional number of cases (young Eskimo) the occlusal pattern can be recognized although not quite clearly. This has been pointed out already by M. DE TERRA (313, p. 139) and by FÜRST and HANSEN (95, p. 177). As a result of the pronounced attrition—occlusal (Plate 7, Figs. 50 and 51) as well as interproximal (Plate 7, Fig. 52)—many teeth are also unsuitable for metrical studies of the crown dimensions.

Dental fractures interfere to some extent. This does not only apply to extensive fractures, but also to multiple small traumatic lesions of the enamel and dentine caused by abuse of the teeth (Plate 8, Figs. 53 and 54) or—less frequently—arising *post mortem*.

Mutilation of the teeth, common in certain native peoples, is unknown among the Eskimos (cf. HRDLICKA (146, p. 83)[3]).

As far as the crowns are concerned it should be mentioned that hypoplasia is entirely insignificant, constituting no hindrance to anatomical studies. Salivary calculus and other external deposits are not (any longer?) to be found on the teeth of the East Greenland Eskimo skulls.

The study of root anatomy is rendered very difficult by frequent resorptive and productive changes to be dealt with later on. Furthermore a number of teeth cannot be removed from their sockets. The

[1]) Principal reason: lack of care in collecting the specimens.

[2]) HRDLICKA (139, p. 449) in order to be able to examine 700 incisor teeth of various races had to "handle 8,000 crania, such is the bad state of conservation and preservation of the front teeth in skeletal material from burials."

[3]) KOGANEI (173, p. 128) in a paper on dental mutilation says, "Für die Eskimos wird berichtet, dass bei ihnen die Frontzähne oft bis auf die Wurzeln verkürzt sind. Diese wie amputiert aussehende Verkürzung der Zahnkronen wird aber von den meisten Forschern als nicht absichtlich abgeschliffen erklärt ..."

latter drawback is in part made up for by the abundant opportunity of studying empty sockets. X-ray examination is not in all cases successful in providing information on root conditions of the teeth *in situ*. For instance it is very difficult, sometimes even impossible, to disclose the slender supernumerary lingual roots on the lower molars, because they tend to be superimposed upon the distal main roots. Moreover, the jaw is very heavy in this region and often carries a pronounced mandibular torus which interferes considerably with the radiographic interpretation of root conditions.

Modern East Greenland Eskimos.

In the districts of Angmagssalik and Scoresbysund the writer in 1937 examined 860 Eskimos ($\geq$ one year) of unmixed race. Their grouping, according to sex and age, appears in Table 3 (p. 29).

The routine clinical dental examination included all morphological conditions of any interest, such as supernumerary cusps, occlusal wrinkles, large caecal foramina, proportionate size of molars, aberrant tooth forms, vestigial teeth, shovel-shape of the incisors, occurrence of Carabelli's cusp etc. Scrutiny of the cusp pattern of every single molar was, however, not undertaken in the field.

In addition to the 860 case reports, 142 casts of East Greenland Eskimo dentitions have been at the writer's disposal. The latter have been subject to additional studies and observations. Though these casts are very accurate, the writer considers that the impression technique was not so perfect that measurements of their teeth can be used generally as a scientific basis for comparative study. In case of the upper incisors, however, certain measurements were made on casts of young Eskimo dentitions.

Finally 130 X-ray series (of 10 roentgenograms each), as well as a few roentgenograms of another 4 persons, were available. 50 X-ray series were taken of males, 80 of females. All roentgenograms have been systematically scrutinized for morphological and pathological conditions which have any bearing upon the subject.

b. Methods.

The study of dental anatomy in the 52 East Greenland Eskimo skulls includes: —

(1) Measurement of maximum length and maximum breadth of the crowns[1]).

[1]) Here and everywhere else in this work "length" of a crown means the mesio-distal diameter, "breadth" of a crown the facio-lingual diameter (cf. Hrdlicka (142, p. 195)) and Weidenreich (332, p. 4).

(2) The occlusal pattern.
(3) Occurrence of tubercles on the facial and lingual surfaces of the molar crowns (*tuberculum Càrabelli*, *tubercula paramolaria et distomolaria*).
(4) Occurrence of pits (*foramina caeca*) and grooves on lower molars.
(5) The configuration of the molar enamel margin.
(6) Number and shape of the roots. Measurements of root height[1]).
(7) Occurrence of enamel nodules.
(8) The pulp cavity.

By means of records, casts and roentgenograms the same descriptive details have been studied in the modern East Greenlanders as in the East Greenland skull material.

Apart from conditions registered in the field, all morphological details have been studied in perfect light in the anthropological or dental laboratory and all necessary facilities have been available. Special registration forms were used. On the latter all descriptive characters were classified by means of symbols in order to make subsequent working out of data more accurate.

In addition to the inspection of the dentitions of the skulls, a complete X-ray examination was made of all jaws.

(1) *Descriptive Characters.*

The number of cusps and the cusp pattern have been studied on all postcanine teeth which were sufficiently well preserved for this purpose, *i. e.* those that were but slightly worn and otherwise undamaged. H. VIRCHOW (342) states, that only those teeth which are completely intact present a sound basis for morphological analyses. WEIDENREICH (332) says that they must be free, not only from strong attrition—which goes without saying—but even from faint wear. This no doubt is true of the painstaking analyses of minute details in the occlusal pattern, such as have been made by WEIDENREICH and others, of rare fossil specimens of major importance from an evolutionary point of view. To a somewhat less rigid degree, it is true of determination of the principal cusp pattern in a series of skulls, when one disregards the minute details (cf. HELLMAN 121, Fig. 5, p. 163). To a still lesser extent it is valid when it is merely the question of the number of principal cusps. In this case moderate attrition of the occlusal surface is not very disturbing. Teeth, the attrition of which exceeds grade 1 (BROCA (43, p. 149)), are however, never suitable for any morphological studies of occlusal surfaces. The present writer eliminated from his studies of

[1]) "Height" of a root (crown, tooth) here and everywhere else in this work means the vertical dimension (often called the length).

occlusal morphology all teeth which did not satisfy the conditions outlined above, *i. e.* a greater number of teeth have been excluded on account of attrition, when it was the question of analysis of occlusal structures, such as cusplets and the cusp-and-groove pattern, than when the main cusps were counted.

The counting of cusps is no easy undertaking. This fact has been stressed by several authors, among them GOLDSTEIN (98) who pleads for more unity and better definitions. The present writer can fully sub-

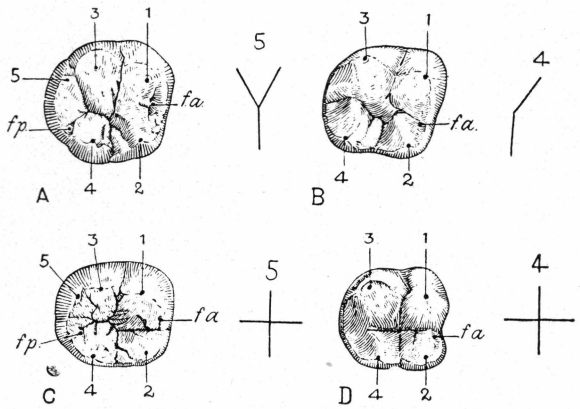


Fig. 17. Four stages of development of lower molar teeth, illustrating the different changes from the *Dryopithecus* to the most advanced pattern. A, *Dryopithecus* pattern indicated by Y 5, meaning primitive system of grooves and cusp formula; B, Modified *Dryopithecus* pattern indicated by Y 4, meaning cusp formula reduced to four, and groove system primitive, with the loss of the posterior limb of the Y; C, Primitive cusp formula retained but groove system changed to cruciform, the sign being + 5; D, Cusp formula and groove system changed, sign + 4. (HELLMAN (121)).

scribe to that. The principal difficulty is encountered in distinguishing with certainty main cusps and cusplets or—as HELLMAN (121) puts it—"to know which cusps are homologous and which are only analogous". On the other hand this source of error may be supposed to have only a minor bearing upon the results, since the principal features are very clearly recognized in the Eskimo teeth.

The writer's studies of the lower molar cusp pattern rest upon the views put forward by GREGORY (108) and GREGORY and HELLMAN (109, 110) in their studies of the evolution of the human dentition and the dentition of *Dryopithecus*. Employing these ideas in an essay on racial characters in human dentition, with special reference to the distribution of the *Dryopithecus* pattern and its modifications in the lower molars of man, HELLMAN (121, p. 164) has demonstrated that it is possible to classify the lower molar pattern according to four well-defined main stages (Fig. 17).

Stage 1 is that representing the original *Dryopithecus* pattern.

Stage 2 is that in which the primitive[1]) cusp formula is reduced from 5 to 4, but the groove system still retains the Y form with the loss of the posterior limb, *i. e.* the basal contact of cusps 2 and 3 is retained.

Stage 3 is that in which the primitive cusp formula is retained, but the groove system is changed from the Y to the +. The basal contact of cusp 2 and 3 has been lost.

Stage 4 is that in which both the cusp formula and the groove system is changed, thus producing the most advanced[2]) lower molar pattern which consists of four cusps and a cruciform groove system.

The examination of the configuration of the gingival enamel boundary, ("the enamel line" of KLEINSCHMIDT (170)), on the molars was made according to principles laid down by PEDERSEN and THYSSEN (252, p. 454) in their comparative study of Eskimo molars and molars from various other racial and local groups of *Homo* and some *Anthropomorphae*. Examining 10,380 molar surfaces, they observed that the curves of the enamel margin may be referred to one of the following principal types,

Type 1 is that in which the enamel margin is a curve, more or less convex in the direction of the occlusal surface. No enamel extension.

Type 2 is that in which the enamel margin is concave in the direction of the occlusal surface. No enamel extension.

Type 3 is that in which the enamel margin is straight. No enamel extension.

Type 4 is that in which the enamel streams in the direction of the bifurcation, forming a small triangle which divides the enamel margin into mesial and distal halves which are more or less curved. The height of the enamel extension[3]) does not exceed about $1^1/_2$ millimeters.

Type 5 is that in which the enamel extension is more pronounced than in the previous type, but does not extend between the roots.

Type 6 is that in which the enamel extension continues in between the roots.

Examples of the above types are given in Plate 18, Figs. 96—107. Figs. 100 and 107 are Angmagssalik Eskimo molars.

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[1]) *i. e.* coming closer to conditions found in common ancestors of hominids and anthropoids.

[2]) The term "advanced" is used in the sense of being furthest removed from the primitive condition. It is not meant to imply that the change is either beneficial or detrimental.

[3]) This term was first used by LEIGH (186, 187).

Careful tests have proved that the East Greenland skulls do not differ from the total Greenland skull material (2,340 molars), examined 1942 by PEDERSEN and THYSSEN, as far as the distribution of the aforementioned types is concerned. For this reason data are given in the following sections of this chapter for the total material, instead of the much smaller material from East Greenland.

To indicate the type of fusion of the roots in the upper molars, the writer used the system devised by VISSER (347, p. 5) in his excellent study of fusion of roots in the vast collections belonging to the Amsterdam University Institute of Anatomy (BOLK's collections). According to VISSER the following types are met with,

I. Three separated roots.
II. Fusion of the lingual and mesio-facial roots.
III. Fusion of the lingual and disto-facial roots.
IV. Fusion of both facial roots.
V. Fusion of all three roots.
VI. Increase in number of roots. (Fusion of supernumerary root with one of the main roots is frequent).

VISSER divides types IV and V into three subtypes each. This discrimination, however, is not made by the present writer.

No basis for comparison was available at the time of examination as far as the fusion of lower molar roots was concerned. Classification was made as follows,

A. Two separated roots.

B. Fusion of facial aspect of roots, with or without longitudinal groove.

C. Fusion of lingual aspect of roots, with or without longitudinal groove.

D. Total fusion with or without grooves facially and lingually.

E. Three separated roots. Fusion of supernumerary root may occur more or less completely with main root(s).

In recent publications VISSER (348, 349) gives methods for proper classification of fusion of roots in upper and lower premolars as well as in lower molars. Those concerning lower molars, however, were received too late to be considered in this study.

When dealing with fusion of roots in the Eskimo the writer occasionally found it difficult to decide which "fusions" were primary and which were mere congregations caused by hyperproduction of secondary cementum. In cases of mature age this source of error doubtless is of some importance and may to a certain extent have affected the results.

(2) *Measurements.*

Technique. The lack of well established standards and definitions has been felt in several respects throughout the present study. This applies not least to measurements of teeth. Although many studies have been made in this field for more than half a century, discrepancies still prevail as to the technique which should be employed. Many professional quarters do not have great confidence in metrical studies of teeth. In his introduction to a paper on the dimensions of the teeth of early man and certain fossil European apes, HRDLICKA (144, p. 109) summed up the situation in a rather discouraging way, saying, "Measurements of teeth are, as is well known, in themselves extraordinarily difficult, in addition to which there is no definite agreement as yet as to the exact points from or the precise manner in which to measure. As a result hardly any two separate measurements of the same teeth, even by the same observer, give absolutely the same values, and occasionally the differences are so marked that the student loses confidence in the records." Later on, however, HRDLICKA seems to have gained more confidence in measurements of teeth which he used to a very considerable extent himself.

Methods of measurement of teeth are dealt with by *e. g.* REMANE (265), R. MARTIN (199, p. 670), HRDLICKA (144, p. 110), and GREGORY and HELLMAN (110, p. 55), all of them prominent authorities in the fields of comparative anatomy and physical anthropology. The present writer has taken his measurements of Eskimo teeth in accordance with the directions given by MARTIN (199, p. 670, no. 81), because similar ideas as those followed by this pioneer of standardization seem to be more universally accepted by students of dental anatomy[1]) than those advanced by HRDLICKA (142, p. 199 and 144, p. 110).

The crown measurements indicated by MARTIN (l. c.) are 1) *breadth* ("Dicke") which is the facio-lingual diameter, 2) *length* ("Breite") which is the mesio-distal diameter and 3) maximum *height* ("Länge").

As far as the *breadth* is concerned MARTIN and HRDLICKA agree. HRDLICKA says of this measurement taken by him on lower molars (142, p. 199), "That of the breadth is, I believe, identical with most."

The *length* has been measured by MARTIN (l. c.), WEIDENREICH (332, p. 5) and many others as the maximum length. HRDLICKA, however, took this measurement along the middle of the crown (144, p. 110), because he—correctly—supposed this to be more accurate when the teeth are still in their sockets in close contact with the neighbouring teeth. For reasons of comparison the present writer has nevertheless measured the maximum length even in the—rather few—cases in which

[1]) See for instance the excellent studies by SHAW (299) of the Bantu and by NELSON (225) of Pecos Pueblo Indians.

all the teeth were in the jaws during the examination. Another source of error is that of interproximal wear. No doubt this type of wear renders the measurement of crown length more or less inaccurate in quite a number of cases. This cannot possibly be avoided. In the present study no specimens with pronounced interproximal attrition, however, have been measured as to length of crown.

The *height* of the crowns has not been measured at all, because occlusal attrition is a definite obstacle to accurate measurement of that dimension. Generally speaking moreover, the height of the crown is an ill-defined measurement because it has to be taken from the gingival enamel border which is curved in various fashions. Also the configuration of the enamel margin is different in the Eskimo and most Whites as will be shown later on.

The height of the root(s) is not well-defined either. This measurement has been taken by the writer in the same way as by WEIDENREICH (332, p. 5), *viz.* from the lowest boundary of the enamel on the facial side opposite the highest facial root to the tip of the same root. The writer does not consider this measurement taken on Eskimo teeth of mature age, to be of much value from a normal anatomical point of view since very conspicuous secondary changes of the root dimensions were found to have already started during adolescent years.

Aberrant tooth forms specified in Tables 43 (p. 134), 44 (p. 135), and 56 (p. 196) were excluded from the metrical study because they were supposed to affect the results too much.

All measurements were taken in millimeters. For the measurements of crowns and roots a small sliding compass provided with vernier was used. With this, results were obtained that did not differ more than, at most, 0.2 millimeters on repeated measurement by the same person[1]). On taking the measurements of the crowns the legs of the compass —which were sharply pointed—were held in the direction of the long axis of the tooth[2]). The length and breadth measurements were taken at right angles to one another.

In the skull material very few canines and incisors were available for measurement, but a series of upper incisor lengths (mesio-distal diameters) were taken on casts of the dentitions of 45 Angmagssalik Eskimos, aged 7—20, in order to convey some idea of the length (*i. e.* mesio-distal diameter) of upper incisors as well as of the proportion in "size" of central and lateral upper incisors. The latter measurements were maximum values (contact to contact). No breadth measurements

[1]) SHAW says that it is impossible to obtain greater accuracy than to 0.5 of a millimeter (299, p. 11). NELSON, however, maintains (225, p. 264) that a metrical accurary to 0.1 mm is easily obtainable.

[2]) Cf. GREGORY and HELLMAN (110, p. 55).

were taken of the incisors on the casts, because the shovel-shape of the incisors tends to render such measurements of little comparative value.

The metrical data. The measurements have to be weighed in various ways to make them apt for interpretation. The absolute dimensions must be converted into indices, modules etc. in order to make them tell the proper story of shape and size of the teeth concerned.

Anthropologists frequently use the dental index, devised by FLOWER (90), to determine the size of the teeth in proportion to that of the skull. The dental index is an expression of the ratio or proportion, between the length of the teeth measured "from the most anterior point on the first upper premolar to the most posterior point on the third molar"[1]) and the length of the skull from the basion to the nasion,

$$\text{Dental index (FLOWER)} = \frac{\text{dental length} \times 100}{\text{basion — nasion length}}.$$

M. DE TERRA (313, p. 200) has some sound criticism of FLOWER's dental index. His points are that the dental arch is not a straight line and that anomalies of tooth position, caries etc. will seriously affect the results. T. D. CAMPBELL ((49) quoted by DRENNAN (70, p. 75)), DRENNAN (70, p. 74) and MIDDLETON SHAW (299, p. 38), all able odontologists, calculate the average dental index for their materials of Australians, Bushmen and Bantu respectively. Their conclusions, however, are extremely cautious. The present writer like DE TERRA is not at all convinced of the value of the dental index. To the objections already mentioned, he might add that the shortening of the postcanine series resulting from the cumulated amount of interproximal wear on premolars and molars, is another factor tending to jeopardize the results. Moreover, in the opinion of the present writer, it is of doubtful value to calculate the ratio between skull length and "dental" (*i. e.* molar + premolar) length, thus running the risk of missing or camouflaging what is really characteristic of tooth and/or skull length. These are the reasons why no dental indices were calculated in the present study.

The crown index is calculated according to the principles well known in craniology and laid down by the famous Swedish anatomist ANDERS ADOLF RETZIUS (1796—1860), a pioneer in the field of physical anthropology. The crown index, *i. e.*

$$\text{Breadth-Length index of the crown}^{2}) = \frac{\text{breadth of crown} \times 100}{\text{length of crown}}$$

[1]) Cf. MARTIN (199, p. 670, no. 80 (2)).

[2]) Some confusion is caused by the indiscriminate use of B.—L. and L.—B. index. Even HRDLICKA has B.—L. Index in the text and L.—B. Index in the tables (143, p. 426).

tells the story of the ratio between the facio-lingual and mesio-distal diameters of the crown of a tooth, or the shape of the crown.

The crown module or mean diameter, *i. e.*

$$\frac{\text{length of crown} + \text{breadth of crown}}{2}$$

has been introduced by M. DE TERRA (313, p. 204) and adopted by HRDLICKA (143, p. 424). Still later, this type of crown module has been employed by SHAW (299), NELSON (225) and others. The crown module is an expression of the mass (size) of the crown although a rather imperfect one. In craniology all three dimensions of the skull are used as a basis for calculation of the skull module (R. MARTIN (199, p. 655)). This of course is more sound, but that principle cannot be adopted in the case of teeth which are markedly worn.

WEIDENREICH (332, p. 123) in his work on the *Sinanthropus* dentition gives another formula for the robustness of the crown, *viz.* the length multiplied by the breadth. WEIDENREICH did not seem to be aware that this expression of the "robustness" or mass had already been used long ago by KAJAVA (159, p. 14) in his dental study of skulls of Finnish Lapps.

In the present study, crown indices, crown modules and crown "robustness values" have been calculated to two decimal places wherever reliable measurements of the dimensions involved could be secured. From this individual material, average lengths and breadths as well as mean indices, mean modules and mean "robustness values" have been worked out for each type of tooth. In the following section of this chapter these values are tabulated tooth by tooth beginning with the molars, which are better represented than the anterior teeth, and ending with the canines. The few measurements taken of incisors are mentioned in the text, or tabulated in a different way. Except those given in Table 54 (p. 182) all metrical data concern teeth of the skulls. The descriptions, however, also consider observations made in the field as well as on the casts and on the X-ray series of living subjects and skulls.

c. The East Greenland Eskimo Permanent Dentition.

1. Data on Dimensions.

As to the dimensions of the teeth the reader is referred to the following tables: —

Table 17 (p. 80—81) shows the dimensions of the individual types of teeth, distinction being made between sexes and sides. In this table,

TABLE 17.

Principal dimensions of molars, premolars, and

♂ Tooth	Length of crown				Breadth of crown			
	n	$M \pm m$[1])	σ[2])	range max. — min.	n	$M \pm m$	σ	range max. — min.
M_3 sup. dext.	12	*9.83 ± 0.27*	*0.93*	11.1 — 8.3	12	*11.58 ± 0.21*	*0.72*	13.0 — 10.5
M_3 sup. sin.	14	*9.51 ± 0.24*	*0.91*	10.9 — 8.0	14	*11.19 ± 0.20*	*0.77*	12.1 — 9.4
M_2 sup. dext.	19	*10.27 ± 0.12*	*0.51*	11.5 — 9.4	19	*11.59 ± 0.12*	*0.53*	12.4 — 10.2
M_2 sup. sin.	19	*10.19 ± 0.11*	*0.48*	11.1 — 8.7	19	*11.53 ± 0.15*	*0.66*	12.5 — 10.0
M_1 sup. dext.	13	*10.85 ± 0.13*	*0.46*	11.8 — 10.3	15	*11.79 ± 0.08*	*0.29*	12.2 — 11.3
M_1 sup. sin.	14	*10.84 ± 0.15*	*0.57*	11.9 — 9.8	15	*11.80 ± 0.09*	*0.34*	12.2 — 11.1
P_2 sup. dext.....	5	*6.88 ± 0.15*	*0.34*	7.4 — 6.5	7	*9.43 ± 0.26*	*0.68*	10.0 — 8.5
P_2 sup. sin.	6	*6.97 ± 0.16*	*0.38*	7.4 — 6.5	8	*9.64 ± 0.12*	*0.34*	10.0 — 9.1
P_1 sup. dext.	5	*7.70 ± 0.31*	*0.70*	8.6 — 6.9	7	*9.76 ± 0.20*	*0.53*	10.5 — 9.0
P_1 sup. sin.	5	*7.60 ± 0.12*	*0.27*	7.9 — 7.2	7	*9.53 ± 0.28*	*0.74*	10.1 — 8.1
C sup. dext.	5	*8.16 ± 0.08*	*0.18*	8.4 — 8.0	7	*8.63 ± 0.07*	*0.18*	9.0 — 8.5
C sup. sin.	4	*8.00* ..	..	8.4 — 7.7	6	*8.55 ± 0.08*	*0.18*	8.8 — 8.3
M_3 inf. dext.....	12	*11.32 ± 0.19*	*0.66*	12.2 — 10.4	12	*10.89 ± 0.23*	*0.80*	12.4 — 9.6
M_3 inf. sin.	10	*11.55 ± 0.25*	*0.78*	12.8 — 10.1	10	*10.99 ± 0.22*	*0.68*	12.3 — 10.3
M_2 inf. dext.....	12	*11.42 ± 0.15*	*0.53*	12.4 — 10.3	12	*10.93 ± 0.25*	*0.88*	11.7 — 8.5
M_2 inf. sin.	10	*11.63 ± 0.19*	*0.58*	12.8 — 11.0	10	*11.11 ± 0.10*	*0.33*	11.5 — 10.5
M_1 inf. dext.....	10	*11.96 ± 0.14*	*0.44*	12.6 — 11.2	10	*11.63 ± 0.19*	*0.60*	12.5 — 10.9
M_1 inf. sin.	8	*12.09 ± 0.17*	*0.48*	12.6 — 11.2	9	*11.63 ± 0.16*	*0.50*	12.5 — 11.0
P_2 inf. dext.....	6	*7.07 ± 0.17*	*0.42*	7.5 — 6.3	7	*8.50 ± 0.14*	*0.38*	9.0 — 8.0
P_2 inf. sin.	5	*7.22 ± 0.20*	*0.44*	7.8 — 6.7	7	*8.66 ± 0.13*	*0.34*	9.0 — 8.1
P_1 inf. dext.....	4	*7.18* ..	..	7.3 — 7.1	5	*8.00 ± 0.25*	*0.56*	8.7 — 7.3
P_1 inf. sin.	3	*7.10* ..	..	7.0 — 7.0	3	*7.73* ..	..	8.1 — 7.4
C inf. dext.....	2	*7.20* ..	..	7.2 — 7.2	6	*7.97 ± 0.15*	*0.37*	8.3 — 7.5
C inf. sin.	2	*7.35* ..	..	7.4 — 7.3	5	*7.72 ± 0.24*	*0.55*	8.4 — 7.0

[1]) Cf. MARTIN (199, p. 88). [2]) Cf. MARTIN (199, p. 84).

statistical analyses have been made of all mean values and the range of variation has been indicated. Due to the small numbers of teeth examined the standard deviations are extraordinarily high. If the number of teeth on the one side were added to that of the other side —as has been done *e. g.* by NELSON (225, p. 265)—the increase of *n* would certainly lower the standard deviation very considerably, but because close correlation must be assumed to exist between the dimensions of two M_3 supp., M_2 supp. etc. in the same person this would not bring out the true estimate of the error. The latter, however, is

canines in 52 East Greenland Eskimo skulls.

♀ Tooth	Length of crown				Breadth of crown			
	n	$M \pm m$	σ	range max. — min.	n	$M \pm m$	σ	range max. — min.
M_3 sup. dext. ...	4	*9.38* ..	..	10.0 — 9.1	4	*10.23* ..	..	11.5 — 8.3
M_3 sup. sin.	5	*9.52 ± 0.32*	*0.71*	10.7 — 9.0	5	*10.58 ± 0.36*	*0.81*	11.6 — 9.5
M_2 sup. dext. ...	8	*10.03 ± 0.24*	*0.67*	11.5 — 9.4	8	*11.45 ± 0.25*	*0.70*	12.3 — 10.0
M_2 sup. sin.	9	*10.12 ± 0.16*	*0.49*	10.8 — 9.2	9	*11.53 ± 0.22*	*0.68*	12.3 — 10.0
M_1 sup. dext. ...	18	*10.54 ± 0.14*	*0.58*	11.8 — 9.6	18	*11.48 ± 0.15*	*0.64*	12.5 — 10.0
M_1 sup. sin.	12	*10.52 ± 0.15*	*0.52*	11.1 — 9.6	12	*11.38 ± 0.20*	*0.70*	12.4 — 10.0
P_2 sup. dext. ...	3	*6.40* ..	..	7.2 — 5.6	3	*8.47* ..	..	9.5 — 7.7
P_2 sup. sin.	3	*6.73* ..	..	7.3 — 6.4	3	*8.30* ..	..	8.7 — 8.0
P_1 sup. dext. ...	2	*7.15* ..	..	7.7 — 6.6	2	*8.40* ..	..	8.8 — 8.0
P_1 sup. sin.	3	*7.33* ..	..	7.7 — 7.1	4	*8.00* ..	..	8.8 — 6.8
C sup. dext. ...	3	*7.73* ..	..	8.4 — 7.0	4	*7.98* ..	..	9.1 — 7.5
C sup. sin.	4	*7.48* ..	..	7.7 — 7.0	4	*8.10* ..	..	8.7 — 7.9
M_3 inf. dext.	3	*11.27* ..	..	12.0 — 10.1	3	*10.40* ..	..	10.8 — 9.9
M_3 inf. sin.	2	*10.90* ..	..	11.7 — 10.1	2	*10.05* ..	..	10.4 — 9.7
M_2 inf. dext.	6	*11.37 ± 0.23*	*0.56*	12.0 — 10.5	6	*10.78 ± 0.27*	*0.65*	11.5 — 9.6
M_2 inf. sin.	6	*11.20 ± 0.21*	*0.53*	11.8 — 10.5	7	*10.43 ± 0.19*	*0.51*	11.0 — 9.9
M_1 inf. dext.	5	*11.44 ± 0.23*	*0.51*	11.8 — 10.6	6	*10.85 ± 0.21*	*0.52*	11.5 — 10.1
M_1 inf. sin.	6	*11.50 ± 0.24*	*0.59*	12.1 — 10.6	8	*10.94 ± 0.15*	*0.43*	11.6 — 10.3
P_2 inf. dext.	5	*7.04 ± 0.11*	*0.25*	7.3 — 6.8	6	*7.75 ± 0.23*	*0.55*	8.4 — 6.9
P_2 inf. sin.	3	*6.90* ..	..	7.3 — 6.5	4	*7.58* ..	..	8.3 — 7.3
P_1 inf. dext.	2	*7.00* ..	..	7.2 — 6.8	3	*7.47* ..	..	7.7 — 7.1
P_1 inf. sin.	3	*7.07* ..	..	7.2 — 6.8	4	*7.38* ..	..	7.6 — 6.9
C inf. dext.	1	*6.90* ..	..	6.9	1	*7.10* ..	..	7.1
C inf. sin.	2	*6.95* ..	..	7.0 — 6.9	2	*7.15* ..	..	7.2 — 7.1

undoubtedly somewhat smaller for both teeth together, than when they are dealt with separately.

From Table 17 it is readily seen, that comparison of the Eskimo average values, with corresponding data on other racial groups, will lead to definite conclusions only when differences are extreme. Heretofore, few studies have included statistical constants with dental measurements and so far no study seems to have utilized any for the one side separately. This is another reason why the prospects of proper comparison are not very good.

Tables 18 (p. 83), 19 (p. 88), 20 (p. 92), 22 (p. 99), 25 (p. 105) and 28 (p. 112) as well as 47 (p. 156), 48 (p. 158), 49 (p. 161), 50 (p. 164), 52 (p. 173), and 53 (p. 176) present the dimensions of the individual tooth types, (both sides together), and include (in brackets) the numbers of teeth examined for each dimension. Distinction is made between sexes.

Tables 34 and 35 (pp. 120—21) contain, (for upper and lower teeth respectively), mean, minimum, and maximum dimensions of crowns, as well as the corresponding values of crown indices, crown modules and "robustness" figures.

Tables 36 and 37 (pp. 122—23) compare, (for upper and lower teeth respectively), mean dimensions, mean indices, and mean modules of East Greenland Eskimo teeth, (both sexes), with corresponding data given in literature on other racial and local groups. Average values for Canadian Eskimos examined by RITCHIE (271) have in part been calculated by the present writer from the individual measurements published by RITCHIE.

Table 58 (p. 198) is a similar compilation of average root height values as found in the East Greenland Eskimo and various other groups, (both sexes).

To avoid repetition few tabulated data are given in the text.

In Fig. 22 (p. 190) the lengths of the crowns are compared for East Greenland Eskimo skulls and Whites (according to BLACK). The corresponding comparison of breadths is made in Fig. 23 (p. 191).

Figs. 24 (p. 192) and 25 (p. 193) compare the crown dimensions in male and female East Greenland Eskimos.

In Fig. 26 (p. 198) a compilation is made of average root heights in East Greenland Eskimos, Whites, Australians and *Sinanthropus*.

Fig. 27 (p. 199) compares average root heights in male and female East Greenland Eskimo skulls.

2. Description of the Maxillary Molars.

UPPER THIRD MOLAR.

As is the case in Whites (MÜHLREITER—DE JONGE-COHEN (221, p. 105)) this tooth exhibits extreme variation in the Eskimo, both as to size and form.

Size of crown. The range of variation in the skull material is very considerable (Table 34, p. 120) and still more so in the living.

In modern East Greenlanders (257 adult Eskimos of both sexes) both M_3 supp. were found to be abnormally massive in one case, M_3 dext. in three cases, and M_3 sin. in five cases. One of the unilateral cases is demonstrated in Plate 8, Fig. 55. Microdont upper third molars were frequently met with and some were real vestigial types (Plate 8,

TABLE 18.
Dimensions of upper third molars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	9.6	11.4	*118.6*	*10.6*	*110.4*	12.1
	n.....	(26)	(26)	(26)	(26)	(26)	(16)
♀	M	9.5	10.4	*113.4*	*10.0*	*98.4*	11.1
	n.....	(9)	(9)	(9)	(9)	(9)	(3)
♂ + ♀	M	9.6	11.1	*117.2*	*10.4*	*107.3*	12.0
	n.....	(35)	(35)	(35)	(35)	(35)	(19)

Figs. 56 and 57)[1]. 14.8 per cent of modern adults had one or both upper third molars far below average size (Table 39, p. 127). In a minority of these cases the lower third molar was also very small (Table 39, p. 127). More often, however, the lower wisdom teeth were totally missing.

As will be demonstrated later on, vestigial M_3 supp.—which were more widespread than vestigial M_3 inf.— tend to occur more frequently in Eskimos with congenital absence of other third molars, than in Eskimos showing no such absence, indicating, perhaps, a common causative factor to be involved in extreme reduction of size and total absence of the third molar.

In many cases small size coincided with abnormal form, including the peg-shape (Plate 8, Fig. 57)[2].

The average length and breadth dimensions in the East Greenland skull material are almost equal to those given for *Sinanthropus* (females) by WEIDENREICH (332, p. 71), but well below the values reported by T. D. CAMPBELL (49) for Australian aboriginal skulls. They are of the same magnitude as found by SHAW (299, p. 19) in the Bantu and by NELSON (225, p. 268) in the Pecos Pueblo Indian. They are clearly superior to average dimensions published by BLACK (30, p. 16) and HJELMMAN (128, p. 23) for Whites as well as by DRENNAN (70, p. 67) for Bushmen. M. DE TERRA (313, p. 127) has most of his racial groups within the same range of size as shown in Table 34 (p. 120) for the Eskimo.

The average crown module was reported to be 10.0 in the Bantu (SHAW (299, p. 29), and 10.0 in the Pecos Pueblo Indian (NELSON (225, p. 276)), which is very much the same as in the Eskimo (Table 36, p. 122).

Thus the upper third molar crown in Eskimo skulls from East Greenland, is seen to be on an average rather stout. In the modern

[1]) HRDLICKA (136, p. 232) mentions small-sized upper M_3s in skulls from Smith Sound.

[2]) Cf. HJELMMAN (128, p. 45) and SHAW (299, p. 47).

East Greenlanders real vestigial specimens, on the other hand, seem to be more frequently met with than in Whites. However, no proper comparative data are available for Whites.

Form of crown. The higher the crown index, the greater the breadth of the crown in proportion to length. The average crown index of M_3 sup. was calculated at 117.2.

The racial variations of crown indices seem to be rather limited (Table 36, p. 122). The Eskimo appears to take an intermediate position, his upper third molars being neither very long nor very broad. The Australians and Bushmen tend to have relatively broad, the Pecos Pueblo Indians relatively long, M_3 supp.

One upper third molar was found to be of peculiar aberrant form —and abnormally massive—in a modern East Greenland Eskimo male aged 18 (case No. 543). This case is shown in Fig. 58 (Plate 9).

Cusps. The distribution of third molars according to numbers of cusps, is given in Table 40 (p. 129) for the skulls, and in Table 41 (p. 129) for casts of modern East Greenland dentitions.

In the skull material about one third of the number of M_3 supp. exhibit four cusps. In some cases, however, the disto-lingual cusp is so markedly reduced in size that some dental anatomists would perhaps consider it $^1/_2$ cusp when recording the number.

As is seen from Table 41 (p. 129) the incidence of four cusps is about 30 per cent in the dentitions of modern East Greenland Eskimo.

In Europeans, ZUCKERKANDL (350, p. 59) found the three-cusped type to amount to 71.4 per cent of upper third molars. DUCKWORTH (73) recorded 63 per cent, v. LENHOSSEK (189) 65.83 per cent, and HILLEBRAND (124) 60 per cent in Europeans. In the Bantu, SHAW (299, p. 30), found 80.3 per cent of M_3 supp. to have three cusps and stated that "rarely are four cusps exhibited" (l. c. p. 19). CAMPBELL (49), in Australians found 77 per cent with four cusps, 20.5 per cent with $3^1/_2$ cusps and 2.5 per cent with three cusps. DRENNAN (70, p. 72), in the Bushmen recorded 12 per cent with four, 38 per cent with $3^1/_2$ and 50 per cent with three cusps. NELSON (225, p. 279) reports 38.2 per cent with four cusps in Pecos Pueblo Indians. Further data for comparison are found in the reports by M. DE TERRA (313, pp. 134—35), HJELMMAN (128, pp. 34—53) and KAJAVA (159, p. 20).

The incidence of retention of four cusps therefore, seems to be largely the same in the Eskimo material taken as a whole, as in other races on record, including Whites. The great exception is the Australian, who has retained a definitely more primitive pattern.

About half the number of M_3 supp. examined in the skull material exhibit cusplets, most of them having one each (Table 42, p. 131). Cusplets tend to occur more frequently on the three-cusped type of third molar than on the four-cusped type, but in a single case even two cusplets were seen on a M_3 sup. with four main cusps.

Pronounced wrinkles on the occlusal surface, partly obscuring the cusp pattern, occur in 11 out of 45 M_3 supp. in the skulls (cf. Plate 9, Fig. 59), and are also rather common in the collection of casts from East Greenland.

One M_3 sup. (the right M_3 in modern East Greenlander No. 516) exhibits a peculiar enamel pearl-like "cusp" on the occlusal surface (Plate 10, Fig. 60). A similar pearl was found by LEIGH (185, p. 887) on an American Eskimo upper M_3.

No tubercles of CARABELLI were observed on the third upper molar, nor were any pits of CARABELLI met with on that tooth, neither in the skulls nor in the live subjects.

The facial cusp which is generally called the paramolar tubercle (BOLK (35, 36)) occurred on one M_3 sup. in the skull material (Table 43, p. 134). Seven modern East Greenlanders had this cusp or tubercle, four of them on one M_3 sup., three of them on both. Casts were made of three of these cases. Table 44 (p. 135) shows the location and size of paramolar tubercles on the casts of modern East Greenland dentitions. Figs. 58 (Plate 9) and 61 (Plate 10) are examples from this group.

In the skull material (Table 43, p. 134) there was a case with one supernumerary lingual cusp (No. 233), and another case (No. 284), with two lingual cusps on M_3 sup. dext. and one on M_3 sup. sin. (Plate 10, Fig. 62).

Enamel margin. The total Greenland Eskimo skull material examined by the writer and THYSSEN (252, p. 461) included 208 facial surfaces and 215 lingual surfaces of upper third molars. PEDERSEN and THYSSEN also examined modern Danish molars for comparison. The results were as follows: —

		Total percentage with enamel extension	Percentage with pronounced enamel extension
Eskimo skulls	208 facial surfaces ...	*87.0*	*24*
	215 lingual surfaces..	*9.3*	*3.3*
Danes.....	314 facial surfaces ...	*59.6*	*20.4*
	318 lingual surfaces..	*1.6*	*0.0*

Enamel extensions of the type described by LEIGH (184, 185, 186, 187) and others, are definitely more frequent on the Eskimo upper third molars than on modern Danish M_3 supp. The difference, however, is less pronounced than that recorded for upper anterior molars.

Roots. The number of roots was closely studied in the skull material only. The numbers are given in Table 45 (p. 141). Ten third molars are listed as being "one-rooted". The writer suspects that at least some

of these used to have incomplete fusion of three roots with more or less deep longitudinal grooves on the facial and proximal surfaces. The grooves, however, tend to disappear during mature age being gradually filled out by formation of cementum (hypercementosis). In the Eskimo such formation is abundant during adult age, especially so when the opposing third molar has not erupted (PEDERSEN (249, p. 123, Fig. 20 and pp. 126—28)). A survey of the X-ray series, however, confirms that real one-rooted specimens (one wide pulp cavity), are present in some Eskimo cases (Plate 10, Figs. 63 and 64).

The incidence and distribution of various types of root fusion as found in the skull material, appear from Table 51 (p. 167). As far as the upper molars are concerned, the types to which the teeth are referred were devised by VISSER (cf. p. 75). The totally fused type (V) is predominant, being found on 39.1 per cent of upper third molars examined, (including empty sockets). This percentage includes 10 specimens with "one root" (Table 45, p. 141) and 17 M_3 supp. in which three roots also were clearly seen to have "fused", (*i. e.* not to have divided), but less completely, grooves still being perceptible. Only 4.4 per cent of M_3 supp. have three roots (type I). Fusion of the lingual and mesio-facial roots (type II) is much more common than fusion of the lingual and disto-facial roots (type III). In fact type II is almost as frequently met with as is type V, *i. e.* fusion of all three roots.

SHAW (299, p. 19) says, "in the majority of cases, the roots [of Bantu M_3 supp.] are fused either entirely or in part." In the Pecos Pueblo Indians, according to NELSON (225, p. 285) three roots occurred in 17.6 per cent, complete fusion in 52.7 per cent. In 29.7 per cent of M_3 supp. the roots were partially fused.

FABIAN (81, p. 97) and VISSER (347, pp. 1—5), published comprehensive data from earlier literature and recorded their own findings in Germans and Dutchmen, respectively. VISSER examined 2,431 upper third molars. His figures are by far the most reliable hitherto published for Whites. He reports a much higher proportion of type I (28.2 per cent) than that found by the present writer in the Eskimo (4.4 per cent), and so does FABIAN (21.13 per cent). The full details of the results obtained by VISSER and FABIAN are as follows: —

	No fusion (I)	Lingual with mesio-facial (II)	Lingual with disto-facial (III)	Both facial (IV)	All three (V)
VISSER (347) ...	*28* per cent	*6*	*11*	*11.5*	*37*[1])
FABIAN (81)....	*21.13*	*9.76*	*15.04*	*6.5*	*47.56*

Fusion of the roots of M_3 supp. according to the available evidence can safely be said to be more common in the Eskimo of East Greenland than in Whites. Fusion of the lingual and mesio-facial roots is more frequent in the East Greenland Eskimo, than is fusion of the

[1]) To this should be added 6 per cent with supernumerary roots (type VI).

lingual and disto-facial roots. In the—much larger—groups of Whites, the opposite proportion was recorded.

Bent or crooked roots on upper third molars are practically absent in the skull material. On the X-ray series of living East Greenlanders nine upper third molars were seen to have roots of post-horn shape.

The root height is 12.0 mm on an average. As appears from Table 58 (p. 198) this is about the same as in other coloured races and in Whites (Black).

Enamel nodules. In each of four skulls one M_3 sup. exhibited an enamel pearl, either on the distal, or on the mesial aspect of the root. One additional skull had enamel nodules on both upper third molars. Fusion of three roots was found in all five cases with enamel nodules. In all, 28 upper third molars were examined. As there is nothing to indicate that molars with enamel nodules are lost, either more or less frequently than molars without enamel nodules, we may accept the incidence observed (nodules on 21.4 per cent of upper M_3) equal to the incidence of enamel drops on all upper third molars present at death. Enamel nodules being dealt with at some length in a separate section of this chapter, comparative data are not submitted here.

Pulp cavity. The "normal" configuration of the pulp cavity can be studied successfully in young persons only. In all human races and not least so in the Eskimo, the pulp cavity is gradually diminishing in size during life. In many Eskimos, pulp stones of very considerable size are already present at young adult age. (Cf. Plate 16, Figs. 87 and 88). In others, diffuse calcifications of the pulps are met with. For the above reasons it is impossible to make accurate observations of the normal shape and size of the pulp cavity along a statistical line. As is the case in the other molars of the Eskimo, however, the pulp chamber is clearly seen on the roentgenograms to be wide and deep during the early twenties. In a minority of cases one root canal—a very wide one—is found (Plate 10, Figs. 63 and 64). In most cases a deep pulp chamber branches out into three rather narrow root canals. More favourable conditions for observation of the pulp cavity are met with in the lower molars.

Upper Second Molar.

According to Mühlreiter—de Jonge-Cohen (221, p. 100), Zuckerkandl (350, p. 56), Krogh-Poulsen (175, p. 178) a. o., almost all M_2 supp. are referable to one of the following subtypes,

(1) Four cusps. Similarity with M_1. Rhomboid form.

(2) Three cusps. Distolingual cusp absent. Triangular form.

(3) Three cusps. Decrease of length, increase of breadth. Oblong ovoid form.

TABLE 19.
Dimensions of upper second molars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	10.2	11.6	*113.1*	*10.9*	*118.4*	12.1
	n	(38)	(38)	(38)	(38)	(38)	(18)
♀	M	10.1	11.5	*114.1*	*10.8*	*116.1*	12.5
	n	(17)	(17)	(17)	(17)	(17)	(13)
♂ + ♀	M	10.2	11.5	*113.4*	*10.9*	*117.7*	12.3
	n	(55)	(55)	(55)	(55)	(55)	(31)

Size of crown. The range of variation is not as wide as in the third molar. In fact specimens of aberrant size were not observed at all except in cases with supernumerary facial or lingual cusps. Such cases are not included in Tables 19 (p. 88), 34 (p. 120), and 36 (p. 122). A survey of Table 36 seems to bear out that the upper second molar is more massive in the East Greenland Eskimo than in Whites (BLACK, HJELMMAN). The size is largely the same as in the other coloured groups dealt with in Table 36. As is the case with the third molar, the Australian second molar, however, is clearly superior to that of the Eskimo.

Form of crown. No valid differences exist as to crown indices in the racial groups on record in Table 36 (p. 122), yet the Australian upper second molar tends to be broader in proportion to length than that of the other races.

Cusps. Out of 53 upper second molars in the skulls (Table 40, p. 129) 34 had four cusps (subtype 1; Plate 9, Fig. 58), 19 M_2 supp. had three cusps (subtype 2; Plate 3, Fig. 40). Typical specimens of subtype 3 were not observed. In the modern East Greenlanders 181 upper second molars were studied on casts (Table 41, p. 129). 65.7 per cent had four cusps, 34.3 per cent had three cusps. Subtype 3 did not occur at all.

In Europeans subtype 1 (four cusps) was found by ZUCKERKANDL (350, p. 59) to amount to 45.6 per cent of upper second molars, by FABIAN[1]) (81, p. 81) to 48.59 per cent. Subtype 2 (three cusps) was found by ZUCKERKANDL (350) in 54.4 per cent of M_2 supp., by v. LENHOSSEK (189) in 57.30, by HILLEBRAND (124) in 38 per cent, and by FABIAN (81, p. 81) in 30.31 per cent. CAMPBELL (49), in the Australian found 100 per cent with four cusps and so did DRENNAN (70, p. 72) in the Bushman. SHAW (299, p. 30), in the Bantu observed 48.7 per cent with four cusps and 51.3

[1]) FABIAN (81, p. 80) mentions four different types of M_2 sup.

per cent with three cusps. NELSON (225, p. 279) in Pecos Pueblo Indians found 66.5 per cent with four cusps and 33.5 per cent with three cusps.

From the aforementioned evidence it appears, that whereas the four-cusped type of upper second molar seems to be more common in the East Greenland Eskimo than in Europeans and some coloured races (*e. g.* the American Indians), the upper second molar in Australians and Bushmen have four cusps more frequently than in the Eskimo, *viz.* in all cases examined by CAMPBELL and DRENNAN. The findings by the present writer do not agree with the statement made by GREGORY (108, p. 495), that the Eskimo second upper molars are "relatively small, with only three cusps, the hypocone being lost."

Cusplets occur on 17 of 52 M_2 supp. in the skull material, most of them on the three-cusped type of molar (Table 42, p. 131).

Pronounced occlusal wrinkles were not observed on upper second molars in the skull material, but a few fairly pronounced cases were seen on the casts, among them one (No. 394), having wrinkles on the occlusal surfaces of all four second molars (Plate 11, Fig. 66).

CARABELLI's tubercle is not present on any of the 44 upper second molars examined in the skulls, nor has CARABELLI's pit been observed. Out of 162 M_2 supp. examined on the casts (maximum wear = degree 1), two have CARABELLI's cusp but none has the pit. The two teeth having the tubercle of CARABELLI were detected in the same case, *viz.* No. 290 female aged 15. These tubercles were only just visible.

Facial and lingual cusps are present in the skull material as appears from Table 43 (p. 134). In four persons, four upper second molars were involved, one (No. 162; Plate 2, Fig. 34) having both a facial and a lingual tubercle on the left M_2 sup. On the casts of modern East Greenland dentitions, two unilateral cases (Plate 12, Figs. 67 and 68) and one bilateral case (Plate 12, Fig. 69a and b) of paramolar tubercles were found (Table 44, p. 135), and four additional cases examined in the field each had facial cusps on one M_2 sup.

Enamel margin. In the total Greenland material and in modern Danes examined by PEDERSEN and THYSSEN (252, p. 460) the configuration of the gingival enamel boundary was recorded as follows,

		Total percentage with enamel extension	Percentage with pronounced enamel extension
Eskimo skulls	371 facial surfaces ...	*97.6*	*57.1*
	368 lingual surfaces ..	*6.8*	*1.1*
Danes	258 facial surfaces ...	*60.1*	*24.4*
	258 lingual surfaces ..	*3.1*	*0.0*

Hence enamel extensions are more frequent and also more pronounced in the Eskimo than in the modern Dane.

Roots. The number of roots observed in the skull material are given i Table 45 (p. 141). One root occurred on three upper second molars. The overwhelming majority, however, had three roots. Supernumerary roots (*radices paramolaricae*) were found in two instances. In the East Greenlander of the present day a survey of the roentgenograms revealed similar conditions. Here the number of one-rooted specimens was also small. The incidence, however, cannot be given by figures, because artificial distortions and superimpositions render the diagnosis uncertain in no small number of Eskimo cases (massive jaws).

The incidence and distribution of the various types of fusion of roots in the skull material appear from Table 51 (p. 167). No fusion (type I according to VISSER), was observed in 23.7 per cent, fusion of lingual with mesio-facial root (type II), in 48.7 per cent, fusion of lingual with disto-facial root (type III), in 2.6 per cent, of both facial roots (type IV), in 5.3 per cent and of all three roots (type V), in 17.1 per cent (including three with one root in Table 45).

Plate 12, Fig. 70 shows fusion of upper second molar roots in an Eskimo aged about 14, proving at the same time that the condition in question is not secondary coalescence of root branches.

VISSER (347, p. 4) studied 2,859 Dutch upper second molars and FABIAN (81, p. 96) examined 474 German M_2 supp. They calculated the following percentage distribution of types,

	No fusion (I)	Lingual with mesio-facial (II)	Lingual with disto-facial (III)	Both facial (IV)	All three (V)
VISSER (347) ...	*55* per cent	*15*	*1.3*	*14*	*15*[1])
FABIAN (81)....	*44.51*	*40.96*	*1.69*	*4.85*	*8.02*

There is no accordance of the results obtained by VISSER and FABIAN. The data published by VISSER, however, are the best on record for Europeans.

Fusion of the roots of the upper second molars is definitely more widespread in the East Greenland Eskimo than in the Europeans examined by VISSER and FABIAN. As is the case in Europeans, fusion of the lingual and mesio-facial roots is much more common than is fusion of the lingual and disto-facial roots[2]).

The M_2 sup.-roots of the East Greenland Eskimo show a marked tendency not to spread. The distance between the root tips is generally very small. In general, the roots are almost straight right to their apices. On the roentgenograms of modern East Greenlanders a slight distal drifting of the roots was seen in seven persons.

[1]) To this should be added 0.5 per cent with supernumerary roots (type VI).

[2]) See also MÜHLREITER—DE JONGE-COHEN (221, p. 105).

The average root height is 12.3 mm which is not materially different from the average values given for comparison in Table 58 (p. 198), although the roots tend to be somewhat higher in Whites.

Enamel nodules. Five skulls exhibited enamel nodules on the roots of upper second molars, *viz.*

No. 176	male	M_2 sup. sin.	one large	mesial
			one large	distal
No. 178	female	M_2 sup. dext.	one medium	mesial
No. 179	female	M_2 sup. sin.	one small	mesial
No. 268	female	M_2 sup. dext.	one small	mesial
No. 276	male	M_2 sup. sin.	one small	distal

The number of teeth examined was 44. Therefore the percentage of upper second molars exhibiting enamel drops was 11.4. All these were situated on the coronal half of the roots.

On the X-ray series of modern East Greenland Eskimos, two cases were observed, *viz.* No. 511 (female) having one nodule distally on both upper second molars, and No. 350 (female) having one distally on the right upper M_2. Probably more nodules are present in these Eskimos, but when not above average size they are very difficult to see on the roentgenograms.

Pulp cavity. The pulp cavity is more suitable for study in the second than in the third molar. It is of considerable size in adolescents and young adults. The pulp chamber is generally wide and deep. It divides into three almost straight root canals except in cases of complete fusion of the roots. In the few such cases, of which Plate 13, Figs. 71 and 72 are examples, there is only one wide root canal. In E. G. No. 288 M_2 sup. dext. has partly fused roots and three root canals, whereas M_2 sup. sin. (Plate 13, Fig. 72) has only one root with one wide root canal. There are also further typical examples of asymmetrical root and pulp conditions in upper second molars.

Upper First Molar.

Due to the more pronounced divergence of the roots this tooth is left in the jaws more often than is any other type of tooth in the Eskimo skulls (cf. Ritchie (271, p. 61)).

Size of crown. The range of variation is rather narrow indicating that the size of this tooth is fairly constant (Table 34 ,p. 120). M_1 supp. are small on both sides in two skulls (Nos. 268 and 295). No upper first molars are extraordinarily massive.

The material compiled for comparison in Table 36 (p. 123) once again shows the Australian molar to be the biggest. The crown of the

TABLE 20.

Dimensions of upper first molars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	10.9	11.8	*108.7*	*11.4*	*128.5*	12.9
	n.....	(27)	(30)	(27)	(27)	(27)	(7)
♀	M	10.5	11.4	*108.9*	*11.0*	*121.1*	12.4
	n.....	(30)	(30)	(30)	(30)	(30)	(6)
♂ + ♀	M	10.7	11.6	*108.8*	*11.2*	*124.6*	12.7
	n.....	(57)	(60)	(57)	(57)	(57)	(13)

Eskimo upper first molar seems to be of about the same size as that of the Pecos Pueblo Indian and also that of white Americans, whereas it is more massive than the corresponding crown in the Bushman. (As previously mentioned M_3 supp. and M_2 supp. are clearly more massive in the Eskimo than in American Whites).

Form of crown. The form is very constant (Table 34, p. 120). The average crown index of 108.8 comes close to that of Bantu, Bushman and Indian. Even the Australian index is only slightly higher (crown a little broader in proportion to length).

Cusps. All upper first molars examined in the skulls and on the casts have four cusps (Tables 40 and 41 (p. 129); cf. Plate 11, Fig. 65).

In white races four cusps are generally said to be a constant finding (*e. g.* by MÜHLREITER—DE JONGE-COHEN (221, p. 91)) although the disto-lingual cusp tends to be reduced in size. DRENNAN (70, p. 72) and CAMPBELL (49) record four cusps in 100 per cent of Bushmen and Australians respectively. In the Bantu, SHAW (299, p. 30) saw four cusps on 97.5 per cent of upper first molars. 2.5 per cent had three cusps + one cusplet. NELSON (225, p. 279) arrived at the percentages of 98.9 M_1 supp. with four cusps and 1.1 per cent with three cusps + one cusplet in Pecos Pueblo Indians.

The writer did not find any cusplets on the upper first molar (Table 42, p. 131), nor were any Eskimos found to have wrinkled occlusal surfaces on that tooth.

A very striking fact is that *no instance whatever of* CARABELLI'*s cusp was observed* on any of 25 (slightly worn) upper first molars in the skull material. Nor was any trace visible of this cusp on 49 casts of modern East Greenland dentitions. In either case very rigid precautions were taken to exclude all molars not perfectly suitable for the study. One single M_1 sup. dext. (in modern E. G. No. 298) had a

faint CARABELLI's pit. No such pit, however, was present on the left first molar of this case.

In a following section of this chapter closer attention will be paid to the absence of CARABELLI's cusps on Eskimo upper molars.

No supernumerary facial or lingual cusps were met with on the first upper molar in the skulls, but one unilateral case (facial cusp, *i. e.* paramolar tubercle) was seen in East Greenland. This is quite remarkable since the occurrence of such cusps on first molars has been denied by BOLK (36).

Enamel margin. PEDERSEN and THYSSEN (252, p. 459) found the configuration of the gingival enamel margin in Eskimo skulls and modern Danes to be the following, as far as first upper molars were concerned: —

		Total percentage with enamel extension	Percentage with pronounced enamel extension
Eskimo skulls	490 facial surfaces . . .	*90.4*	*36.7*
	509 lingual surfaces . .	*5.1*	*0.2*
Danes	168 facial surfaces . . .	*67.3*	*6.5*
	168 lingual surfaces . .	*5.4*	*0.0*

Thus enamel extensions were more frequent and much more pronounced on the Eskimo upper first molars than on the Danish M_1 supp.

Roots. All M_1 supp. in the skulls have three roots (Table 45, p. 141), and so have the upper first molars of modern East Greenlanders examined by means of X-rays.

Fusions were rare in the upper first molars which could be removed from the jaws of the skulls, and there is no reason to believe that molars with fusion of the roots would be held more firmly in their sockets than those without fusion. This would principally be dependent on the divergence of the roots, the presence of bends and the occurrence of hypercementosis.

Four out of 77 upper first molars had fusion of roots, *viz.* one of the lingual and mesio-facial roots, and three of the lingual and disto-facial roots (Table 51, p. 167). Fusion proper is to be distinguished from a number of cases which cannot be given by figures, because only few upper first molars could be examined outside their sockets. They are those teeth of a taurodont type (KEITH 163, 165), in which the facial roots do not divide until a considerable distance from the gingival enamel margin (Plate 13, Fig. 73). This condition is described more thoroughly later on.

In Dutchmen, according to VISSER (347, p. 4), no fusion of the roots (type I) occurs in 90 per cent of upper first molars, in Germans according to FABIAN (81, p. 96) in 81.65 per cent. Fusion was found by VISSER and FABIAN as follows: —

	Lingual with mesio-facial (II)	Lingual with disto-facial (III)	Both facial (IV)	All three (V)
VISSER (347)	*0.1* per cent	*7.2*	*3*	*0.2*
FABIAN (81).....	*0.2*	*14.87*	*1.97*	*1.31*

The comprehensive studies by VISSER and FABIAN disclose that MÜHLREITER—DE JONGE-COHEN (221, p. 98) are mistaken in stating that the lingual root will never fuse with the mesio-facial root. VISSER (l. c.) has demonstrated that this may occur even though it is extremely rare (3 M_1 supp. out of 2,861 studied). All studies on record, however, agree that the linguo-disto-facial fusion is more common than the linguo-mesio-facial fusion.

Considering the small number of Eskimo upper first molars examined the writer does not venture the conclusion that a difference exists between Eskimos and Europeans as far as incidence of root fusion in upper M_1s is concerned. Contrary to M_3 and M_2, the incidence would rather appear to be similar. The writer was able to confirm the finding by VISSER that on M_1 sup. the lingual root may occasionally fuse with the mesio-facial root.

The divergence of roots is more pronounced in Eskimo first upper molars than in the second upper molars. The spreading of the roots of M_1 is not, however, so marked as in Whites[1]). The following distances were measured in two cases (skulls) the roots of which spread more than usual: —

No. 170. M_1 sup. sin. apex of lingual to apex of mesio-facial 9.7 mm
— - — - — - disto-facial 9.5 mm
No. 174. M_1 sup. dext. apex of lingual to apex of mesio-facial 9.2 mm
— - — - — - disto-facial 9.1 mm

Thus the writer is not in a position to support the view held by KNOWLES (172, p. 11), that the lingual root of M_1 sup. in the Eskimo "is very large and divergent". RITCHIE (271, p. 64) arrived at the same conclusion as the present writer as far as divergence of roots is concerned.

KNOWLES (l. c.) on the other hand is right in saying that the lingual root is rather extensive in the mesio-distal direction. Like the Negro and some Whites the Eskimo sometimes exhibits on the lingual surface

[1]) DRENNAN (70, p. 74) says of the upper first molar roots in the Bushman, "Anything which might be classed as abnormal divergence of the roots was noticeably absent. The maximum divergence of the upper roots was 14.7 mm, measured between the apices of the two roots widest apart."

of this root a longitudinal depression coming from the crown and extending up the root (Plate 13, Fig. 74).

The roots are generally straight. Taken as a whole the tendency for the mesio-facial root to bend in the distal direction is less pronounced than in Whites.

Enamel nodules. Enamel nodules were not observed on East Greenland Eskimo upper first molars, but the writer observed two bilateral cases in skulls from West Greenland.

Pulp cavity. Quite naturally the pulp cavity in the first molar will become narrow earlier than in the posterior molars (posteruptive age, attrition). However, the pulp chamber is clearly seen to be wide and, in the young, also deep. Cases retaining a deep pulp chamber during the twenties and later are first molars with a pronounced taurodont shape (Plate 13, Fig. 75). M_1 supp. have three root canals in all cases. They do not diverge as much as in Whites and tend to be straight.

The Tubercle of Carabelli.

Tuberculum Carabelli (*tuberculum anomale s. impar*) was first described by Carabelli 1842. According to this author it is situated on the lingual surface opposite the antero-internal cusp of upper permanent molars. Instead of an eminence there may be a pit or groove (the pit of Carabelli, cf. Dietz (66, p. 785)). In Whites, the tubercle of Carabelli, as well as the pit, is much more common on the upper first permanent molar than on the posterior permanent molars. According to Bolk (38) and Adloff (11) the cusps are still more frequently found on the second upper deciduous molars than on the first upper permanent molars.

Considerable attention has been paid to the morphology, incidence and significance of the tubercle of Carabelli. A complete survey of the abundant literature on these subjects does not, however, fall within the scope of the present study.

An excellent classification of the varieties of Carabelli's cusp and a survey of their frequency distribution has recently been given by Dietz (66)[1]).

Its significance from an evolutionary point of view has been dealt with at length by Gorjanovic-Kramberger (102, 103), who found the cusp on the Krapina molars, as well as by Adloff (4, 11), Weidenreich (332), Batujeff (20), Bolk (38), Hjelmman (129), Hirsch (127), Carette-Pillot (52) and others.

[1]) Lobular type 55.33 %, ridged type 8.02 %, cuspid type 31.12 %, pitted type (*i. e.*, Carabelli's pit) 5.53 %.

As to the incidence recorded by various authors, Table 21 gives information. Additional data for comparison have been compiled by M. DE TERRA (313, p. 157) and HJELMMAN (129).

DIAMOND (65, p. 78) states that "this fifth lobe is entirely absent in about fifty per cent of the upper first molars and is always bilateral when present". As has been shown by HIRAKAWA (126) and DIETZ (66, p. 784), however, unilateral cases may occur although they are extremely rare.

WHEELER (337, p. 219) says, "the fifth cusp or traces of it may be used as an unfailing identification mark in establishing the identity of the maxillary first molar." As appears from literature (*e. g.* JANZER (151, p. 413)) and clinical experience, this is obviously wrong.

DIETZ (66, p. 787) who studied a thousand casts of the dentitions of young men in a U. S. Army laboratory, observes, "A cusp, hitherto undescribed, was found well expressed in twenty-two instances, in the same position as the cusp of CARABELLI, but on the maxillary second molar, and five times on the third molar." But CARABELLI himself had already pointed out that the cusp named after him may occur on any of the upper molars. Many later authors have found CARABELLI's cusp on the second and third molars (Table 21, p. 97). Nevertheless the findings by DIETZ are interesting because they confirm earlier observations on an extensive material. Nothing, however, is stated by DIETZ as to the racial origin of the American Army personnel examined by him.

SHAW (299, p. 47), in the Bantu observed the tubercle of CARABELLI on the upper first molar bilaterally in five skulls (141 skulls examined), and in four cases among 248 living Bantu. SHAW does not mention any to have been seen on the second and third molars. JANZER (151, p. 410), however, in skulls from "New Pomerania" (*i. e.* New Britain) found CARABELLI's tubercle on 22.9 per cent of 572 M_1 supp., on 1.3 per cent of 542 M_2 supp., and on 6—12 specimens out of 436 M_3 supp.

Whereas GORJANOVIC-KRAMBERGER (102) on Krapina (Neanderthal) upper molars observed some faint eminences supposed by him and by ADLOFF (but not by WEIDENREICH (332, p. 575)) to be tubercles of CARABELLI, WEIDENREICH (332) did not find any traces of that cusp on *Sinanthropus* upper molars.

In Mongolians the tubercle of CARABELLI on the whole seems to be a rare occurrence. M. DE TERRA (313, p. 296) says it is very seldom seen in Chinese skulls, and BATUJEFF (20) reports much lower incidence in "Mongols" than in Russians. OSHIMA (233) in 1,250 modern Chinese from Manchuria found the cusp of CARABELLI in 2.1 per cent of cases only. Higher incidence, however, has been reported by HIRAKAWA (126) for Japanese permanent maxillary molars. This author examined 946

TABLE 21.

Percentage incidence of upper molars with Carabelli's cusp (and pit) in various racial and ethnic groups[1]).

Group and author	Percentage with Carabelli's cusp		
	M_3	M_2	M_1
Russians (BATUJEFF) (20)	..	..	*10.3* (*53.8*)
Swiss (M. DE TERRA) (313)	*1.35* (*0.85*)	*0.22* (*0.85*)	*11.2* (*17.6*)
Dutch (BOLK) (38)	..	*21.7*[2])	*17.4* (*44.3*)
Hungarians (v. LENHOSSEK) (189)	..	*0* (*0*)	*37.5*[2])
Germans (FABIAN) (81)	*2.69* (*4.71*)	*1.06* (*7.17*)	*19.24* (*51.07*)
Finns (HJELMMAN) (129)	*3.9* (*5.4*)	*0.7* (*3.7*)	*12.9* (*9.2*)
U.S.A. (DIETZ) (66)	see p. 96	see p. 96	*72.3*[2])
Lapps (KAJAVA) (159)	*0* (*1.2*)	*0* (*0.7*)	*3.4* (*8.0*)
Pecos Pueblo Indians (NELSON) (225)	..	..	*8.8*[3])
New Pomeranians (JANZER) (151)	6—12 times on 436 teeth	*1.3*	*22.9*

[1]) The figures in brackets are additional percentages with Carabelli's pit.
[2]) Cusp + pit.
[3]) No pit mentioned.

Japanese out of whom 101 (10.7 per cent) exhibited the cusp of CARABELLI. In 401 Japanese children from Nagoya, HACHISUKA (113) recorded 20.63 per cent of upper second deciduous molars with CARABELLI's tubercle[1]). If the Japanese figures here quoted include the pitted type, they can still be considered to be very low.

When comparing the values for Mongols with those given in Table 21 for Whites, one is struck by the great difference between Mongols proper and Whites[2]). Rather low incidence is also met with in Lapps and Pecos Pueblo Indians. Regrettably the writer did not succeed in finding any further data on American Indians. It is to be hoped therefore, that such data concerning North American as well as South American Indians, will be made available.

In the East Greenland Eskimo skull material examined by the present writer no tubercle of CARABELLI *and no pit of* CARABELLI *whatsoever was found on examination of 34 M_3 supp., 44 M_2 supp., and 25 M_1 supp.* All teeth selected for this study were well preserved and but faintly worn on their occlusal surfaces.

On the casts made of the dentitions of living East Greenlanders the following very few instances were found: —

[1]) BOLK (38) found 86 per cent in Dutch children.

[2]) In a letter to the writer (received 1939) Professor TRATMAN (Singapore) says, "CARABELLI's tubercle is not nearly so commonly present in Mongolian stock as in European groups."

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On 98 M_3 supp. neither cusps nor pits of CARABELLI.
On 162 M_2 supp. one case (both M_2) with small cusps of CARABELLI.
On 106 M_1 supp. one M_1 dext. with faint pit of CARABELLI.
On seven casts of children aged 3 to 5 years no CARABELLI's cusps or pits were present on the deciduous molars.

In more than 400 West Greenland and 35 Central Eskimo skulls examined by the present writer, no pronounced tubercles of CARABELLI were found either, but these skulls have not as yet been scrutinized for traces of this cusp. That the cusp of CARABELLI, however, is not entirely absent on first upper molars of unmixed Eskimos, is borne out by the fact that the writer happened to come across one on an immature upper M_1 of established East Greenland Eskimo origin, which did not belong to any particular skull in the collections. This tooth exhibited a cusp of CARABELLI of medium size and typical location (Plate 14, Fig. 76).

Considering all facts we safely arrive at the conclusion that *the incidence of* CARABELLI*'s cusp* (*and pit*) *is practically nil in the East Greenland Eskimo, being absolutely the lowest heretofore recorded for any racial or local group of fair size.* It can also be accepted that low incidence of CARABELLI's tubercle is a typical feature in the dentition of Asiatic Mongols, although variations seem to occur. In this as in other dental respects the Eskimo shows his close affinity to ancient and modern branches of Mongolian stock.

In order to demonstrate the significance attributed to the cusp of CARABELLI by prominent authorities in the field of anthropology it may be of interest to recall that WEIDENREICH failed to find any on the upper molars of *Sinanthropus*. For this and other reasons WEIDENREICH considers this fossil hominid to be an ancestor of modern Mongols. ADLOFF (11, p. 533), quoting OSHIMA (233) and the present author (241), agrees that absence of CARABELLI's cusp in *Sinanthropus*, and the low incidence of that cusp in modern Mongols really point in that direction.

The tubercle of CARABELLI is inherited by the offspring according to laws not yet known. To find out whether white admixture will interfere with the incidence of this tubercle in the Eskimo, the writer made a survey of 176 casts of modern West Greenland dentitions in his possession as well as of extracted teeth from present-day West Greenland[1]). This material originates from the main trading station of Julianehaab, South-West Greenland and neighbouring settlements. White admixture is abundant in this area. The results were as follows: —

[1]) For efficient co-operation in providing this material the writer is indebted to Dr. AXEL LAURENT CHRISTENSEN of Julianehaab.

	Number examined	With cusp or pit of Carabelli
M_3 sup.	202	9 (*4.5* per cent)
M_2 sup.	221	5 (*2.0* per cent)
M_1 sup.	180	53 (*29.4* per cent)

Hence it may be considered well-established that white admixture brings about a much more frequent occurrence of Carabelli's cusp, than that which is found in the Eskimo without white admixture.

It would seem likely that valuable knowledge as to the mode of inheritance of the tubercle of Carabelli as well as of many other anatomical features could be obtained by students of genetics from comparative studies of mixed and unmixed Greenland Eskimo.

3. Description of the Mandibular Molars.

Lower Third Molar.

The lower third molar is the tooth most prone to variation in size and form in the lower arch. Variations both in size and form, however, are less extreme than in the upper jaw.

Size of crown. The average length and breadth as well as the mean module indicate that M_3 inf. tend to be rather massive in the East Greenland Eskimos (Table 22). As far as the average values go,

Table 22.

Dimensions of lower third molars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	11.4	10.9	*95.7*	*11.2*	*125.1*	11.5
	n	(22)	(22)	(22)	(22)	(22)	(6)
♀	M	11.1	10.3	*92.6*	*10.7*	*114.4*	12.2
	n	(5)	(5)	(5)	(5)	(5)	(2)
♂ + ♀	M	11.4	10.8	*95.2*	*11.1*	*123.1*	11.7
	n	(27)	(27)	(27)	(27)	(27)	(8)

they well compare with the other coloured races on record in Table 37 (p. 122). Once again, however, the Australian molar seems to be of superior size. The mean values for Whites are definitely lower than the Eskimo values.

Abnormally massive M_3 inff., found in four instances with supernumerary cusps on the facial or lingual surfaces (Table 43, p. 134), are

not included in the material dealt with in Tables 22 (p. 99), 35 (p. 120) and 37 (p. 122).

In modern East Greenlanders 11 lower third molars were small against 55 upper third molars (Table 39, p. 127). Here, however, it must be recalled that M_3 inff. are much more often congenitally missing (Table 12, pp. 52—53). Reduction in size of lower third molars was in no instance so extreme as of upper third molars. Real vestigial forms of M_3 inff. did not occur at all. In five cases, lower third molars were abnormally massive.

Form of crown. On an average the length is superior to the breadth, making a mean B.-L. index below 100. This applies to all human races listed in Table 37 (p. 122). Average crown form does not show material variation between racial groups although the M_3 inff. of the Bushman tend to have a somewhat higher index, and the Pecos Pueblo Indian M_3 inff. to be comparatively longer than the others. Table 35 (p. 120) shows that extremely long specimens (84.4) may occasionally occur in the East Greenlander.

Cusps. The majority of lower third molars have five cusps in the skulls (Table 40, p. 129) as well as in the modern East Greenlanders (Table 41, p. 129). The percentage for both is about 75. The remaining percentage has either four or six cusps, the latter condition being more common than the former.

Table 23 (p. 101) gives the percentage distribution of cusp numbers found by various students of Europeans and white Americans. Corresponding percentages for coloured races have been compiled in Table 24 (p. 101). Further data for comparison may be found in the paper by TOMINARD (324, p. 664), the book by MAXM. DE TERRA (313, p. 133) and the paper by GOLDSTEIN (98, p. 232). The latter author has compiled a very comprehensive material concerning all three lower molars.

When studying Table 23 (p. 101) one finds that in several groups not all cases are covered by the percentages given. The deficits are caused by small percentages of 6-cusped M_3 inff.

Although Tables 23 (p. 101) and 24 (p. 101) show considerable discrepancy of results for groups of identical racial origin, the following conclusions are clearly born out: —

In the Whites the incidence of four and five cusps tends to be equal, whereas five cusps are more frequently met with in the coloured races, the Bantu being a surprising exception from this general pattern. No white group in Table 23 (p. 101) shows an incidence of five cusps above 50 per cent, whereas only two (Bantu and Lapp) of the coloured groups in Table 24 (p. 101), show incidence below 50.

The Eskimo materials examined by GOLDSTEIN (153 lower third molars) and HELLMAN (29 lower third molars) show more similarity

TABLE 23.
Cusp numbers found on the lower third molars of Whites.

Group	Percentage with 3 cusps	Percentage with 4 cusps	Percentage with 5 cusps	Author
Austrians	*3*	*51*	*43*	ZUCKERKANDL (350)
Dutch	*2.25*	*46.45*	*49.03*	DE JONGE-COHEN (153)
Germans	*1.67*	*42.45*	*46.36*	FABIAN (81)
Dutch	..	*54.3*	*45.7*	BOLK (34, II)
French	*4.6*	*60.4*	*30.2*	TOPINARD (324)
Germans	*4.8*	*51.4*	*42.1*	RÖSE (272)
U. S. Whites	..	*62*	*38*	HELLMAN (121)
Alamanni	*5.0*	*63.0*	*25.0*	SCHWERZ (289)

with Whites than with the East Greenland Eskimos. The writer is not in a position to explain why. However, GOLDSTEIN (98, p. 224) states that the *second* lower molar is found to have five cusps somewhat more frequently in the northern—north-eastern Eskimo group (including the

TABLE 24.
The incidence of five cusps on the lower third molars of various coloured races.

Group and author	Per cent with 5 cusps	Group and author	Per cent with 5 cusps
Eskimo[1]) (LAMBERT) (179) ...	*75*	Chinese (HELLMAN) (121)	*50*
Eskimo[2]) (GOLDSTEIN) (98)...	*53*	Lapp (KAJAVA) (159).....	*37.5*
Eskimo[2]) (HELLMAN) (121) ...	*52*	Australian (CAMPBELL) (49) ..	*72.7*
American Indian (HELLMAN) (121).....	*75*	Bushman (DRENNAN) (70)....	*76*
Pecos Pueblo Indian (NELSON) (225).....	*59.4*	Bantu (SHAW) (299).....	*21.4*
Buriat (Central Mongolia) (HELLMAN) (121).....	*77*	Negro (HELLMAN) (121).....	*79*

[1]) Origin unknown.
[2]) U. S. National Museum, Washington, D. C.

East Greenlanders), than in the south-western and north-western groups[1]). This may, at least in part, account for the differences between the findings of GOLDSTEIN in his total Eskimo material (which mainly consists of American Continental Eskimos), and those of the present writer in

[1]) Groups according to HRDLICKA (146, p. 274).

East Greenlanders[1]). Regrettably the number of third molars originating from the northern—north-eastern Eskimo group in GOLDSTEIN's material is so small, that nothing can be seen directly from that. The Eskimo material examined by HELLMAN (121) is small for calculation of percentages. There is no definite indication as to its origin either, but as it has been studied in the U. S. National Museum, Washington, D. C. it is likely to be part of the material examined by GOLDSTEIN, *i. e.* principally south-western and north-western tribes. Finally it should not be overlooked that great difficulty is encountered in determining the number of (homologous) cusps in a way to secure comparison.

Seven out of nine East Greenland M_3 inff. examined by HOESSLY (130, p. 44) had five cusps. In the very small material from Scoresby-sund studied by KRANZ (174, p. 117) all lower third molars had five cusps.

Cusplets were found on five out of 20 M_3 inff. examined in the skull material (Table 42, p. 131). Three third molars had one, two had two cusplets. Cusplets were associated with four main cusps more frequently than with five.

The cusp pattern of lower molars has been thoroughly studied by HELLMAN (121) in various racial and local groups, including the Eskimo. For full details the reader is referred to the paper by HELLMAN which contains comparative data on American Whites, European Whites (ancient and modern), West African Negroes, Australians, Asiatic Mongols (Buriats), Chinese, American Indians and Eskimos. NELSON (225, p. 280), in his study of the Pecos Pueblo Indian dentition has followed on the line of HELLMAN. The present writer has also endeavoured to analyse the crown or cusp pattern in Eskimos from East Greenland (skulls and casts) in the same way as HELLMAN in order to obtain comparable data (see pp. 73—74).

20 M_3 inff. were available for study in the skulls, and 55 M_3 inff. were studied on the casts of modern East Greenland dentitions.

Whereas the Y 5 and Y 4 patterns were not at all present on the Eskimo lower third molars examined by HELLMAN (121, p. 171), they were found in no small number of cases by the present writer in East Greenlanders (Tables 31 (p. 116) and 32 (p. 117)), and also by NELSON (225, p. 282) in the Pecos Pueblo Indians. + 5 was found in 52 per cent by HELLMAN, in 51 per cent by NELSON (modern East Greenlanders 61.8 per cent). + 4 was observed in 48 per cent by HELLMAN, in 35.8 per cent by NELSON (modern East Greenlanders no + 4 types). In the

[1]) HOESSLY (130, p. 44) is also in favour of the idea that the East Greenland Eskimo shows a more primitive cusp pattern than the American Eskimo.

East Greenland skulls two lower third molars exhibited the + 4 pattern (Table 31, p. 116).

From this it appears that the cusp pattern is more primitive (*Dryopithecus* or Y 5 pattern as well as Y 4 pattern retained in several cases, almost no + 4 patterns) in the East Greenland Eskimo than in the Eskimo mandibles studied by HELLMAN. This fits very well into the different pictures of cusp numbers in American and Greenland Eskimos discussed on p. 101, the differences being towards the same direction. It is remarkable that the incidence of + 4 patterns is so low in the East Greenlander. This fact indicates an even more primitive stage of M_3 inf. in that group than in the Pecos Pueblo Indian (35.8 per cent with + 4 pattern).

Pronounced wrinkles on the occlusal surfaces were seen in seven out of 20 lower third molars in the skulls and in many cases of living East Greenland Eskimo. Examples are given on Pl. 14, Figs. 77 and 78.

Supernumerary facial and lingual cusps were present on four lower third molars in the skulls (Table 43, p. 134) and on ten M_3 inff. in the casts (Table 44, p. 135). They occurred in four and seven persons respectively.

Plate 14, Fig. 79 shows a distomolar (lingual) tubercle on M_3 inf. dext. (case No. 284) and there is also an extra lingual cusp on M_3 inf. sin. Plate 14, Fig. 80 is a photograph of a paramolar tubercle on M_3 inf. dext. (E. G. case No. 678).

During the field studies, four additional cases (all of them unilateral) with facial cusps were seen.

Pits and grooves. Foramina caeca (or pits) were found in the skulls as shown in Table 33 (p. 118). This table also gives the incidence of sulci (grooves) separating cusps 1 and 3 on the facial surface. If two sulci have been recorded on one tooth, the anterior sulcus separates cusp 1 from cusp 3, the posterior separates cusp 3 from cusp 5. These sulci or grooves, may or may not be associated with caecal foramina (pits) at their termination, which is generally situated a little below the middle of the facial surface of the crown.

On the casts of modern East Greenland dentitions 30 out of 106 M_3 inff. had either pit, or groove, or both. The pits were often quite large and deep (Plate 17, Fig. 91).

Enamel margin. In Eskimo skulls from all parts of Greenland PEDERSEN and THYSSEN (252, p. 464) found the following percentages of lower third molars with enamel extensions as compared with modern Danish M_3 inff.: —

		Total percentage with enamel extension	Percentage with pronounced enamel extension
Eskimo skulls	263 facial surfaces ...	*94.3*	*42.2*
	257 lingual surfaces ..	*73.9*	*3.5*
Danes	85 facial surfaces ...	*87.1*	*14.1*
	85 lingual surfaces ..	*42.3*	*0.0*

Accordingly, enamel extensions are more common and much more pronounced on the Eskimo lower third molar than on the corresponding molar in Denmark, especially so on the lingual surface of the tooth.

Roots. In the Eskimo skulls from East Greenland the lower third molars were found to have either one, two, three or four roots, two roots being, however, by far the most common occurrence (Table 45, p. 141). The "one-rooted" specimens have no grooves. In most cases with extra roots, the supernumerary root (*radix praemolarica* (BOLK) or *radix entomolaris* (LENHOSSEK)) is situated on the lingual surface opposite the distal root. Such increase in the number of roots may be more common than recorded in Table 45 (p. 141), because molars with supernumerary roots naturally are retained more firmly in their sockets than are two-rooted specimens, and because tiny supernumerary roots do not show very well on roentgenograms of Eskimo lower molars (massive jaws). One case was found with four roots, *viz.* one extra on the facial side and one on the lingual side.

On the X-ray series of modern East Greenlanders, two roots were seen to be the prevailing number. A few one-rooted teeth, however, were also recorded in this material, but the definite proportion is uncertain for reasons previously mentioned (massive jaws, cf. p. 71).

Fusion of the roots of the molars is said by FABIAN (81, p. 97) to be less frequent in the mandible than in the maxilla. FABIAN examined 184 German lower third molars and found 26 per cent of them to have more or less fusion of the roots. The incidence for Eskimo skulls is given in Table 51 (p. 167) which shows that fusions are less common in M_3 inf. than in M_3 sup. The incidence of fusion (78.8 per cent), however, is about three times that found by FABIAN in German lower third molars. It also exceeds that found by NELSON (225, p. 285) in Pecos Pueblo Indians who had partial fusion in 30 per cent of cases, and total fusion in 24.3 per cent. Still more, the Greenland percentages surpass those given by SHAW (299, p. 33) who in the Bantu recorded fusion in 17.7 per cent of lower third molars.

Fusion of lower third molar roots may therefore safely be said to be extremely frequent in the East Greenland Eskimo. The prevailing

type of fusion is that of all three roots (D)[1]). Next comes fusion of the lingual aspect of the roots leaving the facial parts separated (C). Less common is facial fusion leaving the lingual part of the roots separated (B). In types B and C there may or may not be a faint longitudinal groove on the fused side. Examples of lower third molar root fusion are given on Plate 15, Fig. 81.

The roots of lower third molars in the skulls were all straight except one, which had a tiny crook at the tip. In the X-ray series of present-day East Greenlanders no post-horn shaped roots were seen, but a few roots had abrupt bends near their apices.

The average root height is almost equal to that given by BLACK (30) for Whites (Table 58, p. 198), but it tends to be inferior to that calculated for other coloured groups. Extreme variations occur in the small material measured by the writer.

Enamel nodules. One skull (No. 284) had a big enamel drop on the distal surface of the root of M_3 inf. dext. at three millimeters distance from the enamel margin.

Pulp cavity. The pulp cavity is wide and the pulp chamber deep during the twenties and early thirties. In teeth with two roots it divides into two or more straight root canals. The exact number cannot be clearly seen on the roentgenograms. In molars with one root, the pulp canal is very wide right to the apex even in the mature Eskimo (Plate 15, Fig. 81). All kinds of secondary calcifications are widespread from young adult age.

LOWER SECOND MOLAR.

Thanks to the work of HRDLICKA (141, 142, 143, 144), DE JONGE-COHEN (153), GOLDSTEIN (98), HELLMAN (121) and others, the racial

TABLE 25.

Dimensions of lower second molars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	11.5	11.0	*96.7*	*11.3*	*126.9*	13.1
	n	(22)	(22)	(22)	(22)	(22)	(12)
♀	M	11.3	10.6	*94.7*	*11.1*	*119.9*	11.7
	n	(12)	(13)	(12)	(12)	(12)	(9)
♂ + ♀	M	11.4	10.9	*96.0*	*11.2*	*124.5*	12.5
	n	(34)	(35)	(34)	(34)	(34)	(21)

[1]) Classification p. 75.

anatomy of the second and first mandibular molars is better known than that of any other elements of the human dentition.

Size of crown. The data given in Table 25 (p. 105) indicate a comparatively massive M_2 inf. in the East Greenland Eskimo. Only the Australian molar is clearly superior to it as far as mass is concerned (Table 37, p. 122).

HRDLICKA (143, p. 424) has given average modules for Eskimo males and females separately. His values compare with those for East Greenland skulls as follows: —

	male Eskimo	female Eskimo
Eskimo (HRDLICKA)	*10.95*	*10.63*
East Gr. Eskimo (PEDERSEN)	*11.3*	*11.1*

Of a number of racial groups studied by HRDLICKA (143, p. 424) the Eskimos showed the highest mean modules for males as well as for females.

Abnormally small size of M_2 inff. was not met with in the East Greenland skulls, and in one case only in the modern Eskimo of East Greenland. In the latter case both M_1 supp. and M_3 sup. dext. were also below average size. Big M_2 inff. were seen in two modern Eskimos in both instances bilaterally.

Form of crown. As is the case of M_3 inf. the average B.-L. index is below 100, the length being on an average greater than the breadth. However, the average value for East Greenland skulls comes nearer to 100 than any other average index recorded in Table 37 (p. 122). Comprehensive data for comparison may be found in the publications by HRDLICKA (142, 143, 144) who made a thorough study of the second and first molars in modern humans, fossil hominids and in anthropoids (including fossil), in order to compare the findings with conditions in the Piltdown jaw.

The data collected by HRDLICKA (142) and previous students is given in his table p. 201 as far as modern man is concerned. From this table it appears that the average B.-L. index for East Greenland Eskimo second lower molars, is not materially different from that of other groups of any size on record. In fact the index of the Eskimo M_2 inf.-crown comes very close to others, including that for U. S. Whites, calculated by HRDLICKA.

Early Man in Europe according to HRDLICKA (142, p. 206) had individual B.—L. indices ranging from 104.8 down to 86.9. Below the East Greenland Eskimo average, are *e.g.* the Heidelberg jaw, the Le Moustier youth, the teeth from Krapina, and the Ehringsdorf child.

Cusps. More than half the number of lower second molars exhibit five cusps both in the skulls (Table 40, p. 129) and on the casts of modern

TABLE 26.
Cusp numbers found on the lower second molars of Whites.

Group	Percentage with 3 cusps	Percentage with 4 cusps	Percentage with 5 cusps	Author
Austrians	*0.2*	*83.3*	*16.5*	ZUCKERKANDL (350)
Dutch	*0.65*	*89.67*	*9.68*	DE JONGE-COHEN (153)
Germans	*0.48*	*90.31*	*8.47*	FABIAN (81)
Dutch	..	*98.0*	*2.0*	BOLK (34, II)
French	..	*90.0*	*10.0*	TOPINARD (324)
Germans	..	*83.0*	*15.9*	RÖSE (272)
U. S. Whites	..	*99.0*	*1.0*	HELLMAN (121)
Alamanni	*1.0*	*96.0*	*3.0*	SCHWERZ (289)
Swiss	..	*94.0*	*6.0*	MARTIN (199)

East Greenland dentitions (Table 41, p. 129). In fact so many cases had been observed during the field work in Greenland that the writer, even before computing the incidence, was convinced that this feature was typical of the Eskimo. Four cusps were seen more frequently than six cusps. The casts showed no more than one third of lower second molars to have four cusps. In Plate 15, Figs. 82, 83, and 84 the mandibular second molars carry five cusps.

Table 26 and Table 27 (p. 108) give the percentages of mandibular second molars with five cusps in white and coloured races respectively. Further comparative data were reported by MAX. DE TERRA (313), TOPINARD (324), GOLDSTEIN (98), KAJAVA (159) and SULLIVAN (308, 309).

While modern Europeans are uniform in showing a high percentage of cusp reduction, early man in Europe in several cases exhibits five cusps on the second mandibular molars, *viz. Homo heidelbergensis* (SCHOETENSACK (284)), the Le Moustier youth (HELLMAN (121)), and the Ehringsdorf child (H. VIRCHOW (342)). Out of eleven Krapina second lower molars, however, GORJANOVIC-KRAMBERGER (103) only found one with five genuine cusps.[1]) In *Sinanthropus* WEIDENREICH (332, p. 78) found five or six cusps on all lower molars.

In all groups of modern Whites (Table 26, p. 107) prominent odontographers have found percentages of five-cusped M_2 inff. below 20, whereas many coloured races (Table 27, p. 108) show much higher percentages. Very high incidence of five cusps has been recorded by SULLIVAN (308, 309) in certain American Indians, by DRENNAN (70) in Bushmen, and by HRDLICKA (136) in the Eskimo from America and Smith Sound. Other students of cusp numbers, *e. g.* GOLDSTEIN (98)

[1]) WEIDENREICH (332, p. 90), however, says that 45.5 per cent with $4^1/_2$ cusps ought to be added to these 9 per cent, making a total incidence of 54.5 per cent.

TABLE 27.

The incidence of five cusps on the lower second molars of various coloured races.

Group and author	Per cent with 5 cusps	Group and author	Per cent with 5 cusps
Eskimo[1]) (LAMBERT) (179).....	*12.5*	Buriat (HELLMAN) (121)	*31*
Eskimo[2]) (GOLDSTEIN) (98)....	*30.3*	Chinese (MONTELIUS) (219)	*56*
Eskimo[2]) (HELLMAN) (121)	*43.0*	Lapp (KAJAVA) (159).....	*21.2*
Eskimo[2]) (HRDLICKA) (136) ...	*83.3*	Australian (CAMPBELL) (49) ...	*32*
Amer. Indian (HELLMAN) (121)	*32*	Bushman (DRENNAN) (70).....	*85*[3])
Pecos Pueblo Indian (NELSON) (225).....	*32.6*	Bantu (SHAW) (297).....	*55.1*
American Indian (HRDLICKA) (135, 138).....	*21.0*	Negro (HELLMAN) (121).....	*25*
Sioux Indian (HRDLICKA) (135, 138).....	*68.7*	Southern Indian (India) (SULLIVAN) (308).....	*16.6*
Tarascan Indian (SULLIVAN) (308).....	*76.8*		

[1]) Origin unknown.
[2]) U. S. National Museum, Washington, D. C.
[3]) SHAW (297, p. 98) reports lower incidence.

report lower percentage incidence of five cusps in the Eskimo than the present writer. GOLDSTEIN (98, p. 224), however, is of opinion that the incidence of five cusps in north—north-eastern (including Greenland) tribes is well above the average of his total Eskimo material (see p. 101).

Previous students of Eskimo teeth have noticed the common occurrence of five cusps on the mandibular second molar. In American and Smith Sound Eskimos HRDLICKA (136) observed five cusps to be frequent, and RITCHIE (271, p. 65) says of the Copper Eskimo, "The lower second molar frequently carries five cusps." HOESSLY (130, p. 44) long ago made the same observation on the East Greenland skulls collected by the QUERVAIN Expedition in the vicinity of Angmagssalik. Without stating the number of teeth examined, this author reported that only two mandibles had lower second molars with four cusps. In three East Greenland Eskimo mandibles (Scoresbysund) thoroughly studied by KRANZ (174, p. 117), all second molars carried five cusps.

Cusplets occur on six out of 31 M_2 inff. in the East Greenland skull material (Table 42, p. 131), most of them on molars with four main cusps. Four molars had one cusplet. On two molars two cusplets were recorded.

The percentage distribution of various types of crown pattern (HELLMAN (121)), is given in Table 31 (p. 116) for skulls and in Table 32 (p. 117) for living subjects. The *Dryopithecus* (Y 5) pattern (Plate 15, Figs. 82 and 84) is retained at least as frequently on Eskimo lower second molars studied by the writer, as on third molars. The cruciform pattern with elimination of the hypoconulid is definitely more infrequent than the primitive stages of crown pattern.

HELLMAN (121, p. 171) in the Eskimo (origin not stated), and NELSON (225, p. 282), in the Pecos Pueblo Indian, found the following percentage distribution of second lower molar pattern: —

	Y 5	Y 4	+ 5	+ 4
Eskimo (HELLMAN (121))	*6*	*7*	*37*	*50*
Pecos Pueblo (NELSON (225))	*8.3*	*1.3*	*24.3*	*66.1*

Both groups thus show a more advanced degree of cusp reduction than does the Eskimo material from East Greenland (Tables 31 (p. 116) and 32 (p. 117)). This is in perfect accordance with the state of affairs in the third mandibular molar as well as other indications of primitive character of the East Greenland Eskimo tooth form previously touched upon. The difference from the figures of HELLMAN and NELSON, however, is not so pronounced as in the case of the third molar.

Pronounced enamel wrinkles on the occlusal surfaces were not seen in the skulls. It should be noticed, however, that even slight attrition will eradicate such wrinkles. On the casts, two instances were found. In one of them, all four second molars carried occlusal wrinkles.

The cast of one modern case (No. 4, male, aged 17) showed a peculiar nodule-like cusplet on the slope of the antero-internal cusp of M_2 inf. dext.

Supernumerary facial and lingual cusps were present in two skulls (Table 43, p. 134), one (No. 298) having an extra cusp on the facial surface of M_2 inf. sin., the other (No. 284) disto-lingually on both M_2 inff. (Plate 14, Fig. 79). On 121 casts of modern East Greenland dentitions two cases were met with (Nos. 636 (Plate 15, Fig. 85) and 702 (Table 44, p. 135)). Two additional cases (one unilateral and one bilateral) were seen in East Greenland.

Pits and grooves were present in the lower second molars of the skulls as shown in Table 33 (p. 118). Only two second lower molars had neither pits nor grooves. Out of a total of 193 modern East Greenland lower second molars eight were without either depression.

Enamel margin. In 312 Eskimo skulls from Greenland and on second molars from modern Danes, PEDERSEN and THYSSEN (252, p. 463) recorded the following percentages of enamel extensions: —

		Total percentage with enamel extension	Percentage with pronounced enamel extension
Eskimo skulls	396 facial surfaces ...	*94.2*	*74.7*
	381 lingual surfaces ..	*81.3*	*1.3*
Danes	55 facial surfaces ...	*83.6*	*16.4*
	53 lingual surfaces ..	*37.7*	*0.0*

Enamel extensions on the facial surfaces were not much more frequent in the Eskimo than in the Dane, but they were definitely more pronounced.

Roots. In the skull material, two roots—commonly more or less fused—were present in 62 out of 65 specimens (Table 45, p. 141). Three lower second molars had three roots. This is the minimum incidence. Probably more supernumerary (lingual) roots occur on teeth which could not be removed from their sockets although none were clearly seen on the roentgenograms (cf. p. 71).

The 130 X-ray series from East Greenland (almost all showing both M_2 inff. *in situ*) revealed eight cases with one-rooted second mandibular molars (one pulp cavity), either on one or both sides of the jaw. The vast majority of the remaining second molars had two roots. On seven second molars, supernumerary (distal) roots could be clearly seen. This figure indicates minimum occurrence of such roots.

Fusion of roots was found in the skulls as appears from Table 51 (p. 167). Fusion was less common in M_2 inf. than in M_3 inf. Contrary to the roots of the third molar, the second molar roots tend to fuse at least as often on their facial side as on their lingual side. Complete fusion (no grooves on either side) was found in two molars only.

FABIAN (81, p. 97) found more or less complete fusion of the roots in 11.55 per cent of 226 lower second molars from Germany (Hamburg). SHAW (299, p. 23) says, "The roots of the [Bantu] second molar are rarely fused and only occasionally exhibit a tendency in that direction." He records fusion in 4.4 per cent only (p. 33). NELSON (225, p. 285), in the Pecos Pueblo Indian registered more or less fusion in 30.4 per cent of M_2 inff. examined.

The percentage found by NELSON do not differ materially from that of the East Greenland Eskimo. However, the writer is of the opinion that if they are not more frequent, fusions are at any rate more complete, in the Eskimo of East Greenland, than in Danish patients seen in dental practice.

The roots of the second lower molar are either completely straight, or there is a slight tendency for the apical third of the mesial root to bend in the distal direction. Abrupt apical bends are rarely seen. In

the case of complete fusion, *i. e.* absence of grooves facially and lingually, the root is blunt, cone-shaped and straight.

As is the case in all Eskimo teeth, the height of the roots (Table 58, p. 198) is subject to considerable posteruptive changes causing extreme variations of dimensions. The East Greenland Eskimo average (12.5 mm) is below that of other racial groups (including Whites) listed in Table 58.

Enamel nodules. None were found on the mandibular second molar.

Pulp cavity. This is very wide and the pulp chamber quite deep during early adult age. Even in the mature Eskimo it is occasionally of considerable size. In 35 modern East Greenlanders[1]) the configuration of the pulp cavity comes very close to that of the Krapina molars shown in roentgenograms by Gorjanovic-Kramberger (103), Adloff (5), and Weidenreich (332), and to the type of pulp cavity in other taurodont molars (Keith (165, p. 685)).

The pulp chamber divides into two or three root canals. Even four may be found. Whereas the distal canal is generally straight, the mesial root canals tend to bend—although never very abruptly—in the distal direction. In cases of fusion (total, facial, or lingual), a very wide and lofty pulp chamber is seen on the roentgenograms to continue into one straight and very wide root canal (Plate 15, Fig. 86). In cases of complete facial fusion (no longitudinal groove on the facial aspect of the root), the configuration of the pulp cavity cross section is that shown in Plate 25, Figs. 143 d and 143 e.

Enormous pulp stones in young lower second molars are demonstrated on Plate 16, Figs. 87 and 88.

Lower First Molar.

Size of crown. As is the case in most other modern human races, this crown is on an average clearly more massive in the East Greenland Eskimo than the crown of the second mandibular molar (Tables 35 (p. 120) and 37 (p. 123)). The average size tends to be superior to the average size of mandibular first molars in the other races on record in Table 37 except for the Australian.

Hrdlicka (143, p. 424) has reported average modules for Eskimo males and females separately. His values compare as follows with those of East Greenland skulls: —

	Male Eskimo	Female Eskimo
Eskimo (Hrdlicka)	*11.13*	*10.99*
East Gr. Eskimo (Pedersen)	*11.9*	*11.2*

[1]) Minimum incidence because the pulp cavity becomes secondarily narrow during mature age.

TABLE 28.
Dimensions of lower first molars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	12.0	11.6	*96.8*	*11.9*	*140.2*	13.4
	n	(18)	(19)	(18)	(18)	(18)	(17)
♀	M	11.5	10.9	*94.7*	*11.2*	*124.7*	12.4
	n	(11)	(14)	(11)	(11)	(11)	(6)
♂ + ♀	M	11.8	11.3	*96.0*	*11.6*	*134.3*	13.2
	n	(29)	(33)	(29)	(29)	(29)	(23)

Among several racial groups studied by HRDLICKA (143, p. 424), the male Eskimo surpassed the Melanesians (11.24) and American Indians (11.15), but it seems very doubtful whether the differences are really significant. In females, only the Melanesian average module (face value) approaches that for Eskimo (Melanesian 11.15, Eskimo 11.2).

Abnormally small size of M_1 inf. was not found at all in the skulls, and in only two persons of the total number of Eskimos examined in East Greenland. Extraordinarily big lower first molars did not occur in either group of material. As in other races the first mandibular molar of the Eskimo is very constant in size.

Form of crown. The average B.-L. index of the crown is equal to that of M_2 inf. The dispersion range of the individual values, however, is a little wider (Table 35, p. 120). The variation between racial groups may be seen from Table 37 (p. 123). Here we learn that the average M_1 inf. comes nearer to the square type in the East Greenland Eskimo, than *e. g.* in the Pecos Pueblo Indian, in whom it tends to be remarkably long.

Comprehensive data for comparison were made available by HRDLICKA (142, 143, 144). His principal data as well as the findings of a number of previous workers are given in reference No. 142, p. 201 for modern man. HRDLICKA found an average crown index of 97.8 for Eskimos and of 98.9 for American Indians. For U. S. Whites and ancient Egyptians (XII. Dyn.) the average index was 98.

From the table of HRDLICKA it is seen that the average B.-L. index for the East Greenland Eskimo lower first molar, does not differ to any appreciable extent from that of racial groups of fair size studied by HRDLICKA. Older data for small groups, however, show considerable deviations.

Early man in Europe according to HRDLICKA (142, p. 206) had average crown indices ranging from 110.1 (Obercassel female) down to 84.6 (Ehringsdorf youth

and the Piltdown jaw[1])). Below our Eskimo average are the same specimens as mentioned p. 106.

Cusps. A total of 171 lower first molars were examined (Table 40 (p. 129) plus Table 41 (p. 129)). Four of these only, showed cusp numbers other than five, *viz.* two (same person) which had four cusps and two (from different individuals), which had six. The latter had the *tuberculum accessorium inferius mediale internum* of SELENKA (293).

TABLE 29.

Number of cusps found on the lower first molars of Whites.

Group	Percentage with 4 cusps	Percentage with 5 cusps	Percentage with 6 cusps	Author
Austrians	*4.6*	*95.4*	..	ZUCKERKANDL (350)
Dutch	*18.0*	*82.0*	..	JONGE-COHEN (153)
Germans	*10.88*	*87.77*	..	FABIAN (81)
Dutch	*27.6*	*72.4*	..	BOLK (34, II)
French	*36.5*	*61.5*	*1.9*	TOPINARD (324)
Germans	*7.7*	*92.3*	..	RÖSE (272)
U.S. Whites.....	*13*	*87*	..	HELLMAN (121)
Alamanni	*27*	*71*	..	SCHWERZ (289)

TABLE 30.

The incidence of five cusps on the lower first molars of various coloured races.

Group and author	Per cent with 5 cusps	Group and author	Per cent with 5 cusps
Eskimo[1]) (GOLDSTEIN) (98)....	*61.3*	Chinese (HELLMAN) (121)	*100*
Eskimo[1]) (HELLMAN) (121)....	*100*	Lapp (KAJAVA) (159).....	*84.8*
Amer. Indian (HELLMAN) (121)	*100*	Australian (CAMPBELL) (49) ...	*94*
Pecos Pueblo Indian (NELSON) (225).....	*99.4*	Bushman (DRENNAN) (70).....	*100*
Amer. Indian, various tribes (HRDLICKA) (135, 138).....	*100*	Bantu (SHAW) (299)	*96*
Amer. Indian, Sioux (HRDLICKA) (135, 138).....	*95.8*	Negro (HELLMAN) (121).....	*99*
Buriat (HELLMAN) (121)	*100*		

[1]) U. S. National Museum, Washington, D. C.

Tables 29 and 30 give the percentages of mandibular first molars with five cusps, in white and coloured racial groups respectively. For additional data the reader is referred to MAX. DE TERRA (313), TOPINARD (324), GOLDSTEIN (98) and KAJAVA (159). Generally speaking, four cusps are seen to occur more frequently in Whites than in coloured races on record.

[1]) By some anthropologists supposed to be a fossil anthropoid jaw.

The incidence of about 98 per cent with five cusps for the total East Greenland Eskimo material is similar to most percentages for coloured groups. A striking exception is the total Eskimo material examined by GOLDSTEIN (98). Once again, this author has a higher percentage for north-north-eastern Eskimos (86.7) than for south-western (58.7) and north-western (65.2). The more clearly, however, the very low incidence of five cusps in the Continental Eskimo stands out. The impression cannot be avoided, that some of the 4 cusp + cusplet cases in GOLDSTEIN's material would have been counted as five cusp cases, by at least some other students.

Cusplets occurred on four M_1 inff. (Table 42, p. 131).

The percentage distribution of the various stages of cusp pattern changes (HELLMAN) appears from Tables 31 (p. 116) and 32 (p. 117). The overwhelming majority of lower first molars retain the Y 5 (*Dryopithecus*) pattern.

The corresponding percentages found by HELLMAN (121, p. 170) in the Eskimo and by NELSON (225, p. 282) in the Pecos Pueblo Indian were as follows: —

	Y 5	Y 4	+ 5	+ 4
Eskimo (HELLMAN (121))	*97*	..	*3*	..
Pecos Pueblo Indian (NELSON (225)) ...	*88.6*	..	*10.8*	*0.6*

The crown pattern of M_1 inf. in the Eskimo from East Greenland seems to be very similar to that of Eskimo skulls examined by HELLMAN. In both Eskimo groups it tends to be less advanced than in the Pecos Pueblo Indian. The difference, however, is slight. From the study by HELLMAN (121, Table 7, p. 169) it is known that ancient and modern Europeans, as well as white Americans, have a definitely more advanced cusp pattern on their mandibular first molars than has the Eskimo (cf. cusp numbers). Accordingly, once more we learn that the Eskimo molar is more conservative in retaining a cusp pattern prevailing in remote ancestors of man, than is the homologous molar in white races.

Pronounced occlusal wrinkles were not seen on any specimens of the mandibular first molar. However, attrition may be responsible for eradication of wrinkles in some cases as the occlusal surface of Eskimo first molars becomes markedly worn very soon after eruption.

Supernumerary facial and lingual cusps were neither present in the skulls nor in the living East Greenland Eskimo.

Pits and grooves. Either caecal foramina or facial grooves, or both, occurred on 43 M_1 inff. in the skulls (Table 33, p. 118), *i. e.* on all teeth examined. Out of 212 M_1 inff. studied on the casts of modern East Greenland dentitions, all except four had pits and/or grooves.

Enamel margin. PEDERSEN and THYSSEN (252, p. 462) found enamel extensions in Eskimo skulls and modern Danish M_1 inff. as follows: —

		Total percentage with enamel extension	Percentage with pronounced enamel extension
Eskimo skulls	493 facial surfaces ...	*96.8*	*46.5*
	477 lingual surfaces ..	*87.6*	*2.9*
Danes	37 facial surfaces ...	*86.5*	*13.5*
	36 lingual surfaces ..	*58.3*	*0.0*

Enamel extensions were found to be more common and much more pronounced in the Greenland Eskimo than in the modern Dane.

Roots. In the skull material, of 64 M_1 inff., 56 had two roots, eight had three roots (Table 45, p. 141). Further molars which could not be removed from the jaws may have had three roots, the incidence being likely to be higher in such molars which could not be taken out (divergence of extra root). However, the X-ray examination did not with certainty reveal more than three, which is no high incidence in the molars that could not be removed.

Supernumerary roots were situated on the lingual side opposite the distal root on seven molars, and lingually opposite the bifurcation, on one molar. Supernumerary roots in all cases were lower than the main roots.

All lower first molars studied on the roentgenograms of modern East Greenlanders had two roots, or two roots plus a disto-lingual extra root. In thirteen cases (out of 130) the latter could be seen either on one side or on both sides of the jaw. This, however, is the absolute minimum occurrence.

There were no bifurcations of the apical part of the mesial or distal roots.

CAMPBELL (49, p. 13), in the aboriginal Australian noted that the mesial root of M_1 inf. almost invariably exhibits "in its lower fourth a bifurcation which may extend upward to a greater distance." The same author also noted that the posterior root was very frequently bifurcated at its apex, but not so deeply as the anterior root. WEIDENREICH (332, p. 153) found the apex of the mesial root of M_1 inf. in *Sinanthropus* to be subdivided into two portions. SHAW (299) did not find any bifurcations in the Bantu specimens at his disposal.

In the skull material, no fusions of the roots were observed on the mandibular first molar (Table 51, p. 167). On X-ray examination of the living East Greenlanders, one (doubtful) case of total fusion, and none of partial fusion, was observed. In the case of total fusion (Plate 16, Fig. 89a and b) it could not be established with certainty that the teeth involved were really first molars. If they were second molars, the first molars were congenitally missing. The writer is inclined to think that this is the correct diagnosis of the case. However, he did not venture including it in Table 6 (p. 41).

FABIAN (81, p. 97), NELSON (225, p. 285), SHAW (299, p. 33) and DRENNAN (70, p. 74) in Germans, Indians, Bantu, and Bushmen respectively, failed to record any fusion of M_1 inf.-roots.

The root base (nearest to the crown) tends to be stouter in the East Greenland Eskimo than in Whites, giving a taurodont shape (KEITH (163, 165)) to the tooth, (Plate 16, Fig. 90), although this is generally less pronounced than in the second molar. From this stout stem two roots branch off with but little divergence. The roots of the first lower molar are less inclined to be straight, than the roots of the second and third lower molars. The mesial root is usually bent in the distal direction, but only very rarely, abruptly. The distal root, although more rarely than the mesial root, shows a tendency to slight and even distal drifting. Abrupt apical bends are not at all frequent, but more common than on the roots of the second molars. No small number of first molars, however, have absolutely straight roots.

The average root height of 13.2 millimeters is equal to that given by BLACK for Whites (Table 58, p. 198) and the range of variation is about the same. Higher roots seem to occur in Australians, lower roots in Bushmen.

Enamel nodules. None were seen on lower first molars.

Pulp cavity. This is very wide in most children, adolescents and young adults. The pulp chamber is, however, generally not so lofty as in the second lower molar. On the other hand it is more extended in the antero-posterior direction. It divides into root canals, the exact number of which cannot be clearly seen on the roentgenograms, still less so because the jaw is very massive in this region. The pulp canals —conforming with the roots—are more often bent in the distal direction than is the case in the second molar. This is especially true of the mesial canals.

TABLE 31.

Lower molar pattern in East Greenland Eskimo skulls.
(79 mandibular molars examined.)

Tooth	Number of teeth examined	Distribution of occlusal patterns					
		Y 5	Y 4	+ 5	+ 4	c 6	c 7
M_3 inf.	20	3	..	12	2	3	..
M_2 inf.	31	5	2	12	9	3	..
M_1 inf.	28	27	..	1	..	..	..

Legend (cf. p. 73): Y 5, *Dryopithecus* pattern; Y 4, *Dryopithecus* pattern less cusp 5; + 5 primitive number of cusps, but groove system changed to +; + 4, cusp formula reduced to 4 and groove system changed to +; c 6, cusp 6; c 7, cusp 7.

TABLE 32.

Lower molar pattern in the modern East Greenland Eskimo. 313 mandibular molars examined on casts.

Tooth		Number of teeth examined	Distribution of occlusal patterns					
			Y 5	Y 4	+5	+4	c 6	c 7
M_3 inf.	n	55	7	5	34	..	9	..
	%	..	*12.7*	*9.1*	*61.8*	*0*	*16.4*	*0*
M_2 inf.	n	115	19	4	42	35	12	3
	%	..	*16.5*	*3.5*	*36.5*	*30.4*	*10.4*	*2.6*
M_1 inf.	n	143	135	..	4	2	2	..
	%	..	*94.4*	*0*	*2.8*	*1.4*	*1.4*	*0*

Legend — See Table 31 (p. 116).

Enormous pulp stones were found in several cases one of which (male 17 years) is shown in Fig. 88 (Plate 16).

FACIAL PITS AND GROOVES.

More or less pronounced grooves separating the facial aspects of the outer cusps are a common occurrence on human mandibular molars. When three facial cusps are present, two grooves may be found, the anterior then being more marked than the posterior. At the lower termination of the (anterior) groove an invagination or pit (*foramen caecum Milleri*) is often found. Similar grooves and pits are frequently met with on upper molars. Here, however, they are situated lingually on the first upper molar, rarely on the posterior upper molars.

The incidence of pits and grooves of the aforementioned type has been studied in East Greenland Eskimo skulls, and on casts of modern East Greenland dentitions by the present writer, as far as the lower molars are concerned. He did so, because in the first place these conditions, especially the pits, were observed at an early date to be both common and pronounced in the Eskimo, and in the second place, because data on these features were made available by previous odontographers for other racial groups.

In the skull material pits and grooves occurred as seen from Table 33, p. 118.

On the casts the incidence was the following: —

Out of 106 M_3 inff. 76 had either pit, groove, or both
— - 185 M_2 inff. 185 — — — — - —
— - 212 M_1 inff. 208 — — — — - —

TABLE 33.
Numbers of lower molars with facial pits (foramina caeca) and grooves, in East Greenland Eskimo skulls.

Tooth	Number of teeth examined	Number with facial pits (*foramina caeca*)		Number with facial grooves		
		Faint to medium	Pronounced	Faint to medium	Pronounced	Two grooves
M_3 inf.	25	11	3	8	1	2
M_2 inf.	35	26	6	25	1	..
M_1 inf.	43	32	7	20	1	..

Among 121 casts, one only (No. 442) lacked pits and grooves on all mandibular molars. In another case (No. 84), there were faint grooves on the first molars, but neither pits nor grooves on the posterior molars. No. 4 had a pit of medium size on M_2 inf. sin., but neither pits nor grooves on the first molars or M_2 inf. dext. (M_3 inff. congenitally missing). In no small number of cases, pits and grooves were absent on M_3 inff. but present on M_2 inff. and M_1 inff.

As may be seen from the typical example in Fig. 91 (Plate 17), the pits on Eskimo lower molars may be of considerable size[1]). Sometimes the attrition happens to have reached the very level of the caecal foramen, thus permitting a closer study of the course and depth of the latter (Plate 17, Fig. 92). In such instances the canal may even be seen to penetrate right to the surface of the dentine, its walls but not its fundus, being covered with enamel. In the semi-civilized and civilized Eskimo such canals are favourite starting spots for acute dental caries. In fact they are the very first to be affected in the Eskimo.

The immediate surroundings of the caecal foramen are in no small proportion of cases hypoplastic, a fairly wide area around the pit being entirely without enamel. The margins of the enamel around such areas are below the level of the surrounding enamel surface, rounded, sometimes slightly indented and often pigmented. Plate 17, Figs. 93 and 94 are examples of "foramen caecum hypoplasia" a condition which does not seem to share the etiology of general enamel hypoplasia as described in the text-books.

The incidence of facial pits and grooves on lower molars of Finnish Lapps has been studied by KAJAVA (159, p. 35). MAX. DE TERRA (313, p. 190) made a survey of these phenomena in white and coloured races. HJELMMAN (128, p. 81) examined Finnish skulls, and ARKÖVY (17, p. 27)

[1]) Cf. R. SCHWARZ (287, Plate II, Fig. IV).

studied various racial groups including Hungarians, Maoris, Malays, Negroes and Eskimos. ARKÖVY found very low incidence in Maoris, Malays, Negroes and Eskimos, but high incidence in Hungarians. He claims that frequent occurrence of the *foramen caecum molarium* is indicative of advanced evolution of a human racial group.

As is clearly seen from the figures here given for the East Greenland Eskimo, the findings of ARKÖVY could not be corroborated as far as the Eskimo is concerned. On the contrary, the East Greenland Eskimo has a very high incidence of lower molar pits and grooves, and so have West Greenland and Central Eskimo skulls examined by the writer. In addition, the caecal foramina are often extraordinarily pronounced in the Eskimo.

What significance, if any, may be attached to the pits (and grooves) from an evolutionary or racial standpoint, seems as yet to be undecidable. On the evidence available the writer does not feel entitled to advance any conclusions—not even tentative—in this respect.

4. General Notes on Molars.

SIZE OF MOLAR CROWNS.

Tables 36 and 37 (p. 122) show that, on an average, the crowns of the East Greenland Eskimo molars tend to be stouter, than the molar crowns of several other racial and local groups listed in those tables. This conclusion holds good also when the dispersion of individual measurements is taken into consideration. However, all Australian molars exceed the Eskimo molars in size[1]).

According to M. DE TERRA (313, p. 203), THOMPSON was of opinion that the Eskimo is microdont. This is obviously wrong, especially as far as the molars are concerned. Taking the mean modules of lower first and second molars together, HRDLICKA (143, p. 424) found that the Eskimo surpasses even Melanesians and American Indians, well-known for their large teeth. HRDLICKA adds, "The largest molar mass is found in the Eskimo, which agrees with what we know of the demands he makes upon his teeth." RITCHIE (271, p. 64), referring to the measurements taken by him on Canadian Eskimo teeth, says that "they tend to be greater than those of more civilized races." The suggestions by HRDLICKA and RITCHIE, that the considerable size of Eskimo molars is a more or less direct consequence of the strenuous masticatory efforts characteristic of the Eskimo, are interesting, but it seems rather doubtful whether this line of thought is tenable. However, the fact

[1]) OWEN (234, p. 454) says 1840, "In the Australian race the true molars are relatively larger than in the Caucasian race."

TABLE 34.

Mean, minimum and maximum dimensions of upper

Tooth	Length of crown				Breadth of crown				Index of crown			
	No examined	Mean	Min.	Max.	No. examined	Mean	Min.	Max.	No. calculated	Mean	Min.	Max.
M_3	35	*9.6*	8.0	11.1	35	*11.1*	8.3	13.0	35	*117.2*	93.3	131.3
M_2	55	*10.2*	8.7	11.5	55	*11.5*	10.0	12.5	55	*113.4*	102.6	122.5
M_1	57	*10.7*	9.6	11.9	60	*11.6*	10.0	12.5	57	*108.8*	100.0	115.6
P_2.....	17	*6.8*	5.6	7.4	21	*9.2*	7.7	10.0	17	*130.8*	104.3	147.7
P_1.....	15	*7.5*	6.6	8.6	20	*9.2*	6.8	10.5	15	*122.9*	104.7	136.1
C	16	*7.8*	7.0	8.4	21	*8.4*	7.5	9.1	16	*106.2*	97.4	114.5

TABLE 35.

Mean, minimum and maximum dimensions of lower

Tooth	Length of crown				Breadth of crown				Index of crown			
	No. examined	Mean	Min.	Max.	No. examined	Mean	Min.	Max.	No. calculated	Mean	Min.	Max.
M_3	27	*11.4*	10.1	12.8	27	*10.8*	9.6	12.4	27	*95.2*	84.4	116.7
M_2	34	*11.4*	10.3	12.8	35	*10.9*	8.5	11.7	34	*96.0*	89.3	102.7
M_1	29	*11.8*	10.6	12.6	33	*11.3*	10.1	12.5	29	*96.0*	88.6	107.1
P_2.....	19	*7.1*	6.3	7.8	24	*8.2*	6.9	9.0	19	*115.7*	101.5	130.2
P_1.....	12	*7.1*	6.8	7.3	15	*7.7*	6.9	8.7	12	*108.6*	102.8	118.3
C	7	*7.1*	6.9	7.4	14	*7.8*	7.0	8.4	7	*103.2*	102.7	104.2

stands out that the Eskimo molar is above medium size, this fact being borne out by the studies of HRDLICKA, RITCHIE and the present writer. In order to make the individual measurements taken by RITCHIE in Canadian Eskimo skulls, comparable with the average East Greenland Eskimo values, the present writer calculated mean modules and mean indices (Tables 36 and 37, p. 122), on the basis of the measurements published by RITCHIE (271, pp. 60—63). Comparison shows that the Canadian and East Greenland Eskimos come very close to each other as far as molar crown mass is concerned.

SIZE PROPORTION OF MOLAR CROWNS.

In anthropological literature, close attention has been paid to the size proportion of the individual molars both in man and in anthropoids. In anthropoids the second molar is the largest, followed by the

East Greenland Eskimo teeth. Skulls, both sexes.

Module of crown				"Robustness" of crown				Height of root(s)			
No. calculated	Mean	Min.	Max.	No. calculated	Mean	Min.	Max.	No. examined	Mean	Min.	Max.
35	*10.4*	8.3	11.9	35	*107.3*	73.9	139.1	19	*12.0*	9.9	14.0
55	*10.9*	9.4	11.8	55	*117.7*	87.0	139.2	31	*12.3*	9.1	14.7
57	*11.2*	9.5	12.2	57	*124.6*	96.0	147.5	13	*12.7*	10.4	15.0
17	*7.9*	6.7	9.4	17	*61.5*	43.1	74.0	18	*13.6*	7.0	16.4
14	*8.4*	7.0	9.3	15	*68.7*	49.0	81.2	19	*13.1*	9.1	17.5
16	*8.1*	7.4	8.8	16	*65.8*	53.9	76.4	8	*16.3*	7.5	20.8

East Greenland Eskimo teeth. Skulls, both sexes.

Module of crown				"Robustness" of crown				Height of root(s)			
No. calculated	Mean	Min.	Max.	No. calculated	Mean	Min.	Max.	No. examined	Mean	Min.	Max.
27	*11.1*	9.9	12.3	27	*123.1*	98.0	151.3	8	*11.7*	7.9	14.0
34	*11.2*	10.0	12.2	34	*124.5*	97.8	147.2	21	*12.5*	9.0	14.6
29	*11.6*	10.5	12.4	29	*134.3*	110.2	153.8	23	*13.2*	11.2	15.5
19	*7.7*	6.9	8.3	19	*57.9*	46.9	67.9	18	*13.2*	9.2	16.6
12	*7.4*	7.2	7.8	12	*54.7*	51.7	59.6	9	*13.5*	8.7	15.1
7	*7.3*	7.0	7.5	7	*52.5*	49.0	56.2	12	*16.6*	14.9	21.1

third, and the first is the smallest. This sequence is the rule for the Gorilla and the Orang, while in the Chimpanzee occasionally, especially in female individuals, the first molar exceeds the third in size (WEIDENREICH (332, p. 97))[1]). In *Sinanthropus*, according to the robustness formulae calculated by WEIDENREICH (332, atlas p. 73) the average sequence of molar crown mass (both sexes) in the maxilla is: $M_1 > M_2 > M_3$, in the mandible: $M_2 > M_1 > M_3$. In early man in Europe, the M_2 is still perceptibly larger than the M_1. This is true of *e. g.* the Heidelberg mandible, the Le Moustier youth (left side), the Ehringsdorf adult and juvenile, some Krapina specimens and the Obercassel female (HRDLICKA (143, p. 428))[2]). In recent man the first molar is usually the largest of the three molars, followed by the second and the third

[1]) For further information *vide* GREGORY and HELLMAN (110, p. 54).

[2]) Exhaustive data are given by GREGORY and HELLMAN (110).

TABLE 36.

Average crown dimensions of maxillary

Group	Author	M_3 average				M_2 average			
		L.	B.	In.	Mo.	L.	B.	In.	Mo.
East Greenland Eskimos	Present study	9.6	11.1	*117.2*	*10.4*	10.2	11.5	*113.4*	*10.9*
Canadian Eskimos	RITCHIE (271)	9.6	11.2	*117.0*	*10.4*	10.3	11.9	*116.4*	*11.1*
Bantu	SHAW (299)	9.5	11.0	*118.4*	*10.0*	10.0	11.5	*111.1*	*10.0*
Pecos Pueblo Indians ..	NELSON (225)	9.4	10.6	*113.1*	*10.0*	10.0	11.2	*111.7*	*10.6*
Bushmen	DRENNAN (70)	8.2	10.3	*125.7*	..	9.7	10.6	*110.2*	..
Australians.....	CAMPBELL (49)	10.0	12.3	*123.0*	..	10.9	13.1	*120.2*	..
Melanesians	JANZER (151) ♂	9.4	11.8	..	..	10.2	12.3	..	..
	JANZER (151) ♀	9.2	11.3	..	..	9.3	11.8	..	..
American Whites	BLACK (30)	8.6	10.6	..	..	9.2	11.5	..	..
Finns.....	HJELMMAN (128) ♂	8.8	10.3	..	..	9.4	10.9	..	..
	HJELMMAN (128) ♀	8.5	9.5	..	..	9.1	10.4	..	..

L. = length (mesio-distal diameter); B. = breadth (facio-lingual diameter); In. = breadth-length index; Mo. = module.

TABLE 37.

Average crown dimensions of mandibular

Group	Author	M_3 average				M_2 average			
		L.	B.	In.	Mo.	L.	B.	In.	Mo.
East Greenland Eskimos	Present study	11.4	10.8	*95.2*	*11.1*	11.4	10.9	*96.0*	*11.2*
Canadian Eskimos	RITCHIE (271)	11.3	11.0	*97.1*	*11.2*	11.5	11.0	*95.3*	*11.1*
Bantu	SHAW (299)	11.1	10.4	*92.3*	*10.8*	11.0	10.3	*93.4*	*10.7*
Pecos Pueblo Indians..	NELSON (225)	11.1	10.1	*90.7*	*10.6*	11.4	10.5	*91.6*	*10.9*
Bushmen	DRENNAN (70)	9.9	9.6	*97.0*	..	10.6	10.1	*94.8*	..
Australians.....	CAMPBELL (49)	11.9	11.1	*93.3*	..	12.5	11.7	*93.6*	..
Melanesians	JANZER (151) ♂	11.2	10.6	..	..	11.2	10.7	..	..
	JANZER (151) ♀	10.9	10.2	..	..	10.6	10.3	..	..
American Whites	BLACK (30)	10.7	9.8	..	..	10.7	10.1	..	..
Finns.....	HJELMMAN (128) ♂	10.5	9.6	..	..	10.8	10.0	..	..
	HJELMMAN (128) ♀	9.3	9.5	..	..	10.6	9.5	..	..

L. = length (mesio-distal diameter); B. = breadth (facio-lingual diameter); In. = breadth-length index; Mo. = module.

(cf. KEITH (163, p. 115)). Many students of racial anatomy have demonstrated keen interest in the size proportion of the molars in modern man, and made more or less thorough observations thereof, principally in order to estimate the status of the dentition of the group or individual

teeth in various racial groups.

M_1 average				P_2 average				P_1 average				C average			
L.	B.	In.	Mo.	L.	B.	In.	Mo.	L.	B.	In.	Mo.	L.	B.	In.	Mo.
10.7	11.6	*108.8*	*11.2*	6.8	9.2	*130.8*	*7.9*	7.5	9.2	*122.9*	*8.4*	7.8	8.4	*106.2*	*8.1*
10.4	11.9	*114.9*	*11.5*	6.4	9.0	*141.5*	*7.7*	7.0	9.2	*133.0*	*8.1*	7.7	8.3	*109.8*	*8.0*
10.3	11.0	*107.3*	*10.8*	7.0	9.1	*136.3*	*8.1*	7.2	9.0	*131.1*	*8.3*	7.6	8.2	*104.5*	*7.9*
10.7	11.5	*107.6*	*11.2*	7.0	9.2	*130.4*	*8.1*	7.4	9.9	*133.1*	*8.7*	8.0	8.4	*104.0*	*8.2*
9.9	10.6	*107.2*	..	6.5	8.5	*131.1*	..	6.8	8.6	*126.0*	..	7.5	7.8	*104.1*	..
11.4	12.8	*112.3*	..	7.2	10.1	*140.3*	..	7.8	10.3	*132.1*	..	8.4	9.0	*107.1*	..
11.1	12.4	..	..	7.0	10.2	..	..	7.6	10.3	..	..	8.5	8.9	..	..
10.8	11.9	..	..	6.8	9.9	..	..	7.3	10.1	..	..	8.1	8.5	..	..
10.7	11.8	..	..	6.8	8.8	..	..	7.2	9.1	..	..	7.6	8.0	..	..
10.2	11.4	..	..	6.6	9.1	..	..	6.8	9.0	..	..	7.6	8.3	..	..
9.9	10.9	..	..	6.5	8.8	..	..	6.6	8.7	..	..	7.4	7.9	..	..

teeth in various racial groups.

M_1 average				P_2 average				P_1 average				C average			
L.	B.	In.	Mo.	L.	B.	In.	Mo.	L.	B.	In.	Mo.	L.	B.	In.	Mo.
11.8	11.3	*96.0*	*11.6*	7.1	8.2	*115.7*	*7.7*	7.1	7.7	*108.6*	*7.4*	7.1	7.8	*103.2*	*7.3*
11.2	11.2	*100.1*	*11.2*	6.6	8.1	*125.7*	*7.5*	6.9	7.3	*109.2*	*7.2*	7.0	7.4	*108.8*	*7.3*
11.0	10.5	*93.7*	*10.8*	7.2	8.1	*112.5*	*7.1*	7.1	8.2	*113.1*	*7.8*	7.3	8.0	*111.2*	*7.7*
12.0	10.7	*90.5*	*11.3*	7.4	8.4	*113.7*	*7.9*	7.1	7.9	*110.5*	*7.5*	7.3	7.7	*106.3*	*7.5*
10.9	10.2	*93.7*	..	7.0	7.8	*110.8*	..	6.9	7.6	*110.0*	..	6.8	7.0	*103.7*	..
12.3	11.9	*96.7*	..	7.7	8.9	*115.6*	..	7.6	8.8	*115.8*	..	7.6	8.3	*109.2*	..
11.7	11.2	..	..	7.4	9.1	..	..	7.2	8.6	..	..	7.3	8.2	..	..
11.3	11.0	..	..	7.2	8.8	..	..	7.1	8.3	..	..	6.8	7.7	..	..
11.2	10.3	..	..	7.1	8.0	..	..	6.9	7.7	..	..	6.9	7.9	..	..
11.2	10.4	..	..	6.9	8.0	..	..	6.8	7.5	..	..	7.8	6.8	..	..
10.8	9.9	..	..	6.8	7.7	..	..	6.6	7.2	..	..	7.5	6.6	..	..

in question, as being primitive or advanced. Data and comments in this field are in no small number of cases buried in the body of larger craniological treatises and are not easily accessible. Older literature, however, is excellently reviewed by Max. de Terra (313, p. 207).

In some—probably most—cases, statements concerning the size proportion of the molars have been based upon a mere visual estimate, which is of course not a very sound method. In other cases the measured length of the crown has been used, but it would seem more logical to utilize either the module or the "robustness", the average values of which enable one to obtain a better impression of the state of affairs. More sound still, is the working out of the sequence within the individual molar series, using *e. g.* the individual modules or robustness values as a criterion. In so doing, one does not miss any individual variations from the mean, from which valuable hints might be obtained. This procedure has been followed by few workers. The first of them was MAX. DE TERRA (313, p. 204) who availed himself of the module. In the majority of racial groups studied by DE TERRA, the molar series showed a marked tendency to decrease in the antero-posterior direction, although there were some exceptions. Using the same robustness criterion (length × breadth) as WEIDENREICH (332, p. 123) but at a much earlier date, KAJAVA (159, p. 14) worked out detailed information on proportion of size of molar crowns in Finnish Lapps. Following on the same line as KAJAVA, HJELMMAN (128, p. 29) made observations on Finnish molars (white race). Both Finnish authors found the vast majority of individual series to decrease evenly from mesial to distal. As to their detailed findings the reader is referred to the original reports.

In New Caledonians, REGNAULT (264, p. 18) estimated M_1 to be stouter than M_2. In the Bantu, SHAW (299, pp. 17 and 22) found upper as well as lower first molars to exceed second molars in size. DRENNAN (70, p. 71) in the Bushman found a general tendency towards decrease from M_1 to M_3 in both jaws, whereas he says, that in the Australian, according to CAMPBELL (49), the lower second molar is still larger than the first. DRENNAN, however, pays more attention to the length dimensions than to the mass, which is not necessarily the same. GREGORY and HELLMAN (110, p. 54), in their excellent comparative study of the dentition of *Dryopithecus* and higher primates, analyse the proportionate lengths of the molars, series by series, in a number of species of primates. They arrive at a wealth of interesting conclusions as far as changes of molar length and form are concerned and finally state, "that white males have experienced a marked reduction of M_3 so that the sequence is completely reversed from that of primitive anthropoids, M_1 being now the dominant member of the series. The white females are slightly more conservative."

As far as the Eskimo is concerned, RITCHIE (271, p. 64) maintains that "the molar series, unlike the civilized dentition, tends to revert to the generalized mammalian type, where the molars increase in size in the antero-posterior direction." As a matter of fact the average

TABLE 38.
Sequence of size (module) of molar crowns in East Greenland Eskimo skulls[1]).

Sequence	Complete series		Sequence	Series lacking one molar	
	Upper jaw	Lower jaw		Upper jaw	Lower jaw
$M_1 > M_2 > M_3$	7	5	$M_1 > M_2$	13	7
$M_1 > M_3 > M_2$	4	2	$M_1 > M_3$	5	2
			$M_2 > M_3$	9	4
$M_1 = M_2 > M_3$	2	0			
$M_1 = M_3 > M_2$	1	0	$M_1 = M_2$	5	1
			$M_2 = M_3$	1	1
$M_2 > M_1 > M_3$	3	0			
$M_3 > M_1 > M_2$	0	2	$M_2 > M_1$	4	4
			$M_3 > M_2$	3	3
Total examined....	17	9	Total examined....	40	22

[1]) Molars with supernumerary facial and lingual cusps not included.

measurements as well as the mean modules found by RITCHIE (Tables 36 and 37, p. 122) point in that direction. Especially, M_1 sup. is not superior to M_2 sup. in size.

HOESSLY (130, p. 44), on the other hand, in the East Greenland Eskimo observed, "dass die Backenzähne der Eskimos eine allmähliche Reduktion im Längenbreitenmasse erfahren, welche vom 1. zum 3. Backenzahn fortschreitet." HRDLICKA (143, p. 424) also recorded slightly higher mean modules for M_1 inff. than for M_2 inff. in Eskimo males as well as females. GORJANOVIC-KRAMBERGER (105, p. 1291) had the opportunity of studying Greenland Eskimo mandibles from The Copenhagen Museum of Anatomy. He noticed that "die Mahlzähne vom M_1 zum M_3 gehend, eine allmähliche Abnahme der Grösse bekunden."

In the East Greenland Eskimo skulls studied by the present writer, the mean modules also indicate the average sequence of $M_1 > M_2 > M_3$. When studying the complete individual molar series available, however, one becomes aware that no small variation is present (Table 38 left). Still, the general pattern is that of $M_1 > M_2 > M_3$.

Out of 39 series in the upper jaw having M_1 and M_2 *in situ*, 25 showed $M_1 > M_2$, 7 $M_1 = M_2$, and 7 $M_2 > M_1$ (Table 38, right). The corresponding distribution of 21 series in the lower jaw was: 16 $M_1 > M_2$; 1 $M_1 = M_2$; 4 $M_2 > M_1$. In all cases but one the sequence was the same on both sides of the jaw. Cases with supernumerary facial and lingual cusps were not included in this study.

When comparing our findings and those of RITCHIE (Tables 36 and 37, p. 122, as well as Table 38, p. 125), with those of KAJAVA (159, p. 14) and HJELMMAN (128, p. 29), we notice that in Lapps as well as in Finns the reduction in molar crown size from M_1 to M_3 is more advanced than in the Eskimo. Thus we may conclude that, although the bulk of molar series in East Greenland Eskimo skulls have the advanced type of molar size proportion (*i. e.* $M_1 > M_2 > M_3$), there is a tendency for the Eskimo, which is more pronounced than in the other groups on record, to exhibit a more primitive sequence. It is, however, not known whether a similar or perhaps a still more pronounced tendency would be revealed on closer study of other coloured racial or ethnic groups.

REDUCTION OF THIRD MOLARS.

In Chapter IV attention has been paid to the congenital absence of third molars. It was reported that M_3 is frequently missing in the Eskimo of East Greenland, especially so the mandibular third molar (Tables 8, p. 49; 10, p. 51; 11, p. 51; and 12, p. 52).

On examination of Greenland Eskimo skulls and during the field studies in East Greenland the writer observed that in quite a number of cases extreme reduction occurred in the size of the third-molar crown.

In the skull material from East Greenland there were only four cases in which third molars were well below average size, and none of them was extraordinarily small. Considering however, the extensive *post mortem* loss of teeth in these skulls, this incidence cannot be accepted as definite.

Among 257 adult Angmagssalik Eskimos ($\geqq 22$ years) 39, *i. e.* 15.2 per cent, exhibited microdont third molars, as specified in Table 39[1]). It should be noticed that nothing but real vestigial specimens are included. Examples of such types of third molars are shown in Figs. 56 and 57 (Plate 8). They are mostly peg-shaped, or abortive molariform elements. In the latter case they exhibit two or three cusp-like eminences on their occlusal aspects. Very few are of diminutive ordinary third molar form.

As appears from Table 39, p. 127, the majority of vestigial third molars were found in the upper jaw (55 out of 66). Thus, while third molars tend to be totally absent more frequently in the lower jaw, they are more frequently small-sized in the upper jaw. This would seem to indicate, perhaps, that the two phenomena are complementary, both resulting from the same etiological factors. By itself the above observation does not of course prove anything, but the interpretation just

[1]) Five cases (out of 40, aged $\geqq$ 22) were found in Scoresbysund. Here seven M_2 supp. were vestigial.

TABLE 39.
Distribution of modern Angmagssalik Eskimos, according to individual occurrence of microdont third molars.

	Eskimos with microdontia of										
	no M_3s	$\frac{M_3\|}{\|}$	$\frac{\|M_3}{\|}$	$\frac{M_3\|M_3}{\|}$	$\frac{\|}{M_3\|}$	$\frac{\|}{\|M_3}$	$\frac{\|}{M_3\|M_3}$	$\frac{M_3\|M_3}{M_3\|}$	$\frac{M_3\|M_3}{\|M_3}$	$\frac{M_3\|M_3}{M_3\|M_3}$	one or more M_3s
Total Eskimo ...	218	10	11	12	..	..	1	..	1	4	39
Per cent of total Eskimo (257)..	*84.8*	*3.9*	*4.3*	*4.7*	*0*	*0*	*0.4*	*0*	*0.4*	*1.6*	*15.2*

suggested is supported by the obvious correlation found between extremely small size and total absence of third molars: Out of 75 cases, with absence of one, two or three third molars, 20 had one or more of the existing third molars vestigial. In four additional cases all four third molars were vestigial. This makes 32 per cent with microdonty plus absence. Out of 153 cases with no congenital absence of third molars, microdonty of one or more M_3 was found in 15 (9.9 per cent). The difference is clearly significant[1]). Hence it can safely be accepted, that vestigial third molars more frequently occur in cases with congenital absence of other third molars, than in cases where no third molars are congenitally missing. This fact seems to be strongly in favour of the idea that common causative factors are involved in partial and total reduction of third molars in the East Greenland Eskimo. Several authors dealing with third molar reduction generally, or in definite races, seem to have taken for granted that reduction of size and non-development of M_3 run along the same line. STEWART (307, p. 51) directly says, "Reduction in size of the third molars is a stage in the evolutionary process leading to congenital absence." The present writer does not know of any definite evidence published so far to that effect. The data here presented for the East Greenland Eskimo, however, tend to corroborate the view held by STEWART and others, at least when extreme reduction of size is considered separately. As has been dealt with at some length in the chapter on congenital absence of third molars, the nature of the causative factor(s) is obscure. Accordingly, this may also be said of the extreme reduction in size. The findings just reported, however, tend to strengthen the conclusion that the East Greenland Eskimo is very far advanced in respect of elimination of the third molar.

As has been dealt with in the preceding section of this chapter, a general tendency towards reduction of third molar size is found in

[1]) $t = 3.1$ calculated according to YATES (cf. R. A. FISHER: Statistical Methods for Research Workers, 6. edit. 1936, p. 97). The four cases with all four third molars vestigial were not included in the test.

Eskimo skulls and in most other groups of modern man which have been studied in this respect. According to GREGORY and HELLMAN (110, p. 54) and others, this tendency was already present in early man. It is perceptible in the Heidelberg jaw and other European fossil hominids and was also found by WEIDENREICH (332, atlas, p. 30) in *Sinanthropus*, the female third upper molar of which is almost equal in size to M_3 sup. in East Greenland Eskimo skulls (both sexes).

OWEN (234, p. 454), in his unsurpassed Odontography says, "The wisdom-tooth is the smallest of the three molars in both jaws, but the difference is less in the Melanesian than in the Caucasian races."

HRDLICKA (138, p. 49) observed 3 diminutive third molars in 57 skulls of Delaware (Lenape) Indians.

As far as the Eskimo is concerned, TOMES (322, p. 566) at a very early date noticed that "the Esquimaux not uncommonly have the wisdom teeth small and crowded out of place." OETTEKING (228, p. 35), examining Eskimo skulls from Labrador and Greenland, found that, "Der dritte Molar ist kleiner als der erste und zweite, also auch hier wie bei den höheren Rassen ein in Reduktion begriffener Bestandteil des Skeletts." HRDLICKA (136, p. 211), in 17 Eskimo skulls from Southampton Island saw, "one case of diminutive last molar," and of the teeth in four Smith Sound skulls he says (136, p. 232), "There are no anomalies besides the diminutive conditions of the third molars." RITCHIE (271, p. 65) stated that frequently the third molars "vary appreciably in size on the two sides of the mouth." GOLDSTEIN (99, p. 385), in his study of congenital absence and impaction of the mandibular third molar in the Eskimo, mentioned that in a few cases he found the lower third molar "to be merely a stump. And in one case where the right third molar was diminished, the left was congenitally missing." LEIGH (185, p. 886), in 325 Eskimo skulls found the following instances of small third molars: —

	upper	lower
small	23 (17 skulls)	1
diminutive	10 (6 skulls)	1.

STEWART (307, p. 51) observed several cases of reduction of third molars but does not distinguish congenital absence from reduction of size.

The evidence accumulating from the aforementioned studies is that *extreme* reduction in size of third molars is a common feature in the Eskimo dentition. The lack of reliable data for Whites prohibits proper comparison, but the writer does not hesitate in stating that extreme reduction (real vestigial types) of third molars is more rarely seen in Danish dental patients[1]) than in the Angmagssalik Eskimo.

[1]) For some years the writer has seen at least 8,000 cases a year.

At the same time there is a *general* tendency in the Eskimo dentition to abandon the ancient trend of molar size proportion. This tendency, which has been discussed in the preceding section, has not resulted in very advanced reduction of third molars, if we disregard all typical vestigial forms.

Cusp Numbers and Crown Pattern.

In modern man the third upper molar and the second lower molar teeth are unstable in form, the former tending to become secondarily

Table 40.

Number of cusps on molars and premolars of East Greenland Eskimo skulls. Both sexes.

Tooth	Maxilla							Mandible						
	No. of teeth examined	Number of teeth carrying						No. of teeth examined	Number of teeth carrying					
		2 cusps	3 cusps	4 cusps	5 cusps	6 cusps	7 cusps		2 cusps	3 cusps	4 cusps	5 cusps	6 cusps	7 cusps
M_3	41	..	25	14	1	1	..	20	..	..	2	15	3	..
M_2	53	..	19	34	..	..	..	31	..	..	10	18	3	..
M_1	59	..	..	59	..	..	..	28	..	..	..	28	..	..
P_2	23	23	..	..	..	..	..	21	13	8	..	..	..	..
P_1	15	15	..	..	..	..	..	11	9	2	..	..	..	..

Table 41.

Number of cusps on casts of molars and premolars of modern East Greenland Eskimos. Both sexes.

Tooth		Maxilla							Mandible						
		No. of teeth examined	Number of teeth carrying						No. of teeth examined	Number of teeth carrying					
			2 cusps	3 cusps	4 cusps	5 cusps	6 cusps	peg-shape		2 cusps	3 cusps	4 cusps	5 cusps	6 cusps	7 cusps
M_3	n	101	3	62	31	1	1	3	55	..	..	5	41	9	..
	%	..	*3.0*	*61.4*	*30.7*	*1.0*	*1.0*	*3.0*	..	..	..	*9.1*	*74.5*	*16.4*	..
M_2	n	181	..	62	119	..	..	..	115	..	..	36	64	12	3
	%	..	..	*34.3*	*65.7*	..	..	..	..	..	..	*31.3*	*55.7*	*10.4*	*2.6*
M_1	n	186	..	..	186	..	..	..	143	..	..	2	139	2	..
	%	..	..	..	*100.0*	..	..	..	..	..	..	*1.4*	*97.2*	*1.4*	..
P_2	n	186	186	..	..	..	..	..	188	120	68	..	..	..	..
	%	..	*100.0*	..	..	..	..	..	..	*63.8*	*36.2*	..	..	..	..
P_1	n	188	188	..	..	..	..	..	187	187	..	..	..	..	..
	%	..	*100.0*	..	..	..	..	..	..	*100.0*	..	..	..	..	..

tritubercular, the latter secondarily quadritubercular. To a somewhat lesser extent this holds good for the second upper molar and the third lower molar respectively.

In most odontographical treatises the cusps of the molars are named according to the nomenclature devised by OSBORN (GREGORY (108, p. VIII)): In the upper jaw the anterior outer cusp is called paracone, the posterior outer cusp metacone, the anterior inner cusp protocone, and the posterior inner cusp hypocone. In the lower jaw the terms are as follows: the most anterior outer cusp is the protoconid (1), the following outer cusp is the hypoconid (3), and the last outer or middle cusp is the hypoconulid (5)[1]; the anterior inner cusp is the metaconid (2) and the posterior inner cusp the entoconid (4). The so-called sixth cusp is called *tuberculum sextum* (6). Fig. 18 shows the designation of molar cusps according to OSBORN.

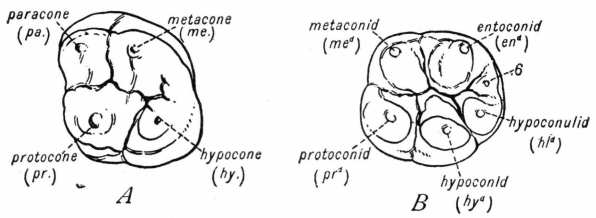


Fig. 18. The Osbornian nomenclature of the molar cusps. *A*. Second left upper molar of Kaffir. *B*. Second left lower molar of Australian. (GREGORY (108)).

The process of reduction taking place in man is mainly that of elimination of the hypocone and the hypoconulid (mesoconid of WEIDENREICH). The elimination of the hypoconulid in lower second molars is probably a late development, since the Heidelberg jaw and several Neanderthaloid mandibles show the primitive five cusp pattern on that tooth.

The frequency of retention of the hypocone and hypoconulid in the East Greenland Eskimo has been reported and discussed during the presentation of the description of the individual molars. It was demonstrated that the Eskimo lower molars, as far as cusp-numbers are concerned, tend to be more primitive than the molars of modern white groups on record, *i. e.* to come more close to the ancestral type of primate lower molar (*Dryopithecus*)[2]. Also, the retention of the hypocone on upper molars seemed to be more frequent in the Eskimo of Greenland than in modern Whites. Finally, it was mentioned that there is some indication of a less advanced reduction of cusp numbers in the Greenland Eskimo than in south-western and north-western Eskimo tribes (GOLDSTEIN (98)).

The best studies of crown pattern changes, within the hominid

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[1]) WEIDENREICH (332, p. 4) calls this cusp the mesoconid.

[2]) FÜRST and HANSEN (95, p. 177) say, "Molar teeth with five cusps occur often in the Greenland Eskimo."

and anthropoid branches from the primate stem, have been made by GREGORY and HELLMAN (109, 110); within modern human races by HELLMAN (121). In the hominid line these changes have been found by HELLMAN (121, p. 164) to fall into definite stages. The classification so well systematized by HELLMAN is shown in Fig. 17, p. 73, and described p. 74 in this work.

Using this system the writer examined the crown pattern of lower molars in East Greenland Eskimo skulls (Table 31, p. 116) and on suitable casts of modern East Greenland Eskimo dentitions (Table 32, p. 117).

TABLE 42.

Number of cusplets on molars and premolars of East Greenland Eskimo skulls. Both sexes.

Tooth	Maxilla					Mandible				
	No. of teeth examined	No. with cusplets	Number of teeth carrying			No. of teeth examined	No. with cusplets	Number of teeth carrying		
			1 cusplet	2 cusplets	3 cusplets			1 cusplet	2 cusplets	3 cusplets
M_3	40	19	11	7	1	20	5	3	2	..
M_2	52	17	13	4	..	31	6	4	2	..
M_1	59	..	..	..	..	28	4	3	1	..
P_2.....	19	..	..	..	..	18	2	2	..	..
P_1.....	13	1	1	..	..	10	..	..	..	..

Briefly his findings were that the primitive pattern as originally inherited from *Dryopithecus*, as well as comparatively slight modifications of this pattern, were met with in a high proportion of cases, whereas the cruciform pattern with four cusps on M_2 (and M_3) was less frequent in the Eskimo than in modern white and coloured races studied by HELLMAN (121) and NELSON (225).

Whether the high incidence of primitive lower molar patterns is associated with racial or functional factors is not quite clear, although the writer is in favour of the former idea. It is to be hoped that more data on Mongoloid groups will be forthcoming. Such evidence will facilitate an approach by future students to the interesting question of Mongoloid affinities, from the dental angle, which seems for several reasons discussed in this treatise, to be promising and worth closer attention.

The apparently primitive status of the Eskimo molars, as far as cusp numbers are concerned, does not at first sight seem to agree very well, *inter alia*, with their general tendency towards decrease of size in the antero-posterior direction. However, the cusp pattern may be

more conservative than the size of the molars. In fact this conception is supported by the conditions prevailing in *Sinanthropus*, *Homo heidelbergensis* and other fossil hominids. In the latter for instance, five cusps on the posterior mandibular molars coincide with a similar antero-posterior reduction in size of the molars, as that met with in the average East Greenland Eskimo dentition.

Occlusal Wrinkles.

The primary sulci and grooves formed through contact of cusps arising from adjacent centres of mineralisation are to be distinguished from crenations or wrinkles which arise through folding of the enamel. The wrinkles do not extend below the enamel and—especially in Eskimo—are worn off the crown surface early after eruption of the tooth.

Adloff (9) and Hrdlicka (140) are of opinion that immature unerupted molars often exhibit enamel folds or crenations which disappear later on, when the tooth reaches the stage of eruption. This smoothening, which is not caused by attrition, has also been observed by the writer during studies of some two thousand skulls of neolithic and mediaeval Danes, and Greenland and Central Eskimos etc., although at the moment he must refrain from explaining what is the reason. Fig. 95 (Plate 17) shows the occlusal aspect of an unerupted first lower Eskimo molar. The folding is rather more pronounced than on (newly) erupted first molars.

Limiting the following considerations to erupted teeth, we notice that occlusal enamel wrinkles are extremely difficult objects to study in the Eskimo, because they become worn off so early. Hence reliable incidence can be given for third molars only: —

Out of 45 M_3 supp. 11 showed marked wrinkles
— - 32 M_3 inff. 7 — — —

In the living East Greenlander the writer did not see irregular occlusal enamel folds very often, not even on newly erupted molars (general impression). A systematic study of the molars on the casts was attempted, but had to be abandoned, because the attrition seemed to interfere too much. The third molars on the casts, show occlusal wrinkles in a number of cases. There are also wrinkles on some of the second molars. In few cases, however, is the folding anything like that found on molars of the Orang (Weidenreich's atlas), *Pithecanthropus* (Dubois (71, p. 464 and Plate XI)) or *Sinanthropus* (Weidenreich's atlas).

A vivid discussion on the enamel wrinkles ("Runzeln") and their phylogenetic significance has taken place between Adloff and Weiden-

REICH. The views of a number of authorities on this condition are summed up by WEIDENREICH (332, p. 100). The latest views of ADLOFF were published in 1937 and 1938 (9 and 11, p. 512). ADLOFF does not share the opinion that the irregular wrinkles are of any major importance from a comparative odontological standpoint. He considers them to be rather recent acquisitions or specializations in anthropoids as well as in man, as do GREGORY, HELLMAN and LEWIS (111).

The present writer regrets that he is not in a position to put on record a more exact status of the East Greenland Eskimo dentition in this respect. He was in the same position when the late Professor ADLOFF (Königsberg) repeatedly asked him for information of this condition, in which he had for many years taken such great general interest.

FACIAL AND LINGUAL TUBERCLES.

From the description of the individual molar teeth it has already been seen that a considerable number of supernumerary facial and lingual cusps occur in the East Greenland Eskimo.

In Table 43 (p. 134) all cases found in the skulls are listed. Information as to teeth involved, location and size of cusps as well as to association with supernumerary roots (opposite the cusps) is given case by case.

In Table 44 (p. 135) the corresponding facts are reported for modern East Greenland dentitions examined on casts.

The percentage of molars with supernumerary facial and lingual cusps in the skulls may be assumed to be covered by the cases demonstrated in Table 43 (p. 134), since there is nothing to indicate that teeth with extra facial and lingual cusps will drop out more easily than teeth without. Calculated per head, however, the incidence of 10 cases out of 52 is minimum occurrence, (*post mortem* loss of many molars).

As to the casts, different conditions prevail. The 125 casts, 15 of which exhibit supernumerary external and internal cusps, were principally made of extraordinary cases. Therefore the incidence of supernumerary cusps on the casts is likely to be higher than that of the total number of individuals examined. On the other hand, tiny supernumerary cusps are of course more easily missed during the studies in the field than in the laboratory. Among the East Greenlanders of whom no dental casts were made, the following additional numbers and types of cases were recorded: —

Upper jaw

M_3	one unilateral case,	facial cusp
	two bilateral cases,	facial cusps
M_2	four unilateral cases,	facial cusps
M_1	one unilateral case,	facial cusp

TABLE 43.

Supernumerary facial and lingual cusps found on the molar teeth of East Greenland Eskimo skulls.

Skull No.	Sex	Facial cusps				Lingual cusps[1])			
		Tooth (Fig.)	Location	Size	Extra root present	Tooth (Fig.)	Location	Size	Extra root present
162	♂	M_2 sup. sin. (Fig. 34)	mesial	large	—	M_2 sup. sin.	mesial	very large	+
175	♂	M_3 inf. dext.	mesial	small	—	..	..	..	
178	♀	M_2 sup. dext.	central	medium	—	..	..	..	
233	♂	M_2 sup. dext.	mesial	very large	+	M_3 sup. sin.	central	large	—
267	♂	M_3 inf. sin.	mesial	large	+	..	..	..	
271	♀	M_3 inf. dext.	central	medium	+	..	..	..	
284	♂	..	..	..		M_3 inf. dext. (Fig. 79)	distal	large	+
—	—	..	..	..		M_2 inf. dext. et sin. (Fig. 79)	distal	large	both +
—	—	..	..	..		M_3 sup. dext. et sin. (Fig. 62)	M_3 dext. two; M_3 sin. distal	medium large	— —
291	♂	M_2 sup. sin.	central	large	—	..	..	..	
298	♀	M_2 inf. sin.	mesial	small	—	..	..	..	
299	♀	M_3 sup. dext.	central	small	—	..	..	..	

[1]) It seems uncertain whether the extra lingual cusps in cases Nos. 162, 233, and 284 are all homologous with distomolar tubercles of BOLK.

Lower jaw

M_3 { one unilateral case, distolingual cusp
three unilateral cases, facial cusps

M_2 { one unilateral case, facial cusp
one bilateral case, facial cusps.

Summing up, we find that out of a total of 340 modern East Greenlanders, 6—35 years of age, 29 (8.5 per cent) had supernumerary cusps, 27 (7.9 per cent) facially on one or both sides. Plate 2 (Fig. 34), Plate 9 (Fig. 58), Plate 10 (Figs. 61 and 62), Plate 12 (Figs. 67—69), Plate 14 (Figs. 79 and 80), and Plate 15 (Fig. 85) show supernumerary facial and lingual cusps in skulls and modern Eskimo.

In 325 American Eskimo skulls LEIGH (185, p. 887) noted, "Six cases in which the upper left third molar had an extra mesiobuccal

TABLE 44.

Supernumerary facial and lingual cusps found on the molar teeth of casts of modern East Greenland Eskimo dentitions.

Cast No.	Sex	Facial cusps			Lingual cusps		
		Tooth (Fig.)	Location	Size	Tooth (Fig.)	Location	Size
27	♀	M_3 sup. dext. (Fig. 61)	mesial	large	..	..	..
126	♀	M_2 sup. sin. (Fig. 67)	mesial	large	..	..	..
202	♀	M_3 sup. sin.	mesial	medium	..	..	..
283	♀	M_3 inf. dext. et sin.	mesial	M_3 inf. dext. small M_3 inf. sin. medium	..	..	..
291	♀	M_3 inf. dext. et sin.	mesial	medium	..	..	..
316	♀	M_3 inf. dext.	mesial	large	..	..	..
331[1]	♂	..	..	..	M_3 inf. dext. et sin.	mesial	small
364	♂	M_3 inf. sin.	mesial	small	..	..	..
385	♂	M_3 inf. sin.	mesial	small	..	..	..
510	♂	M_2 sup. sin[2] (Fig. 68)	central	medium	..	..	..
543	♂	M_3 sup. dext. (Fig. 58)	central	large	..	..	..
636	♀	M_2 inf. sin. (Fig. 85)	central	very large	..	..	..
678	♀	M_3 inf. dext. (Fig. 80)	central	large	..	..	..
693	♀	M_2 sup. dext. (Fig. 69a)	mesial[3]	medium	..	..	..
		M_2 sup. sin. (Fig. 69b)	central[3]	medium	..	..	..
702	♂	M_2 inf. dext.	mesial	large	..	..	..

[1]) This case has also paramolars opposite M_3 sup. dext. et sin.
[2]) M_1 sup. sin. lost long ago.
[3]) Asymmetrical location.

cusp, in two instances of which the extra cusp surmounted an extra mesiobuccal root. One right second lower molar had an extra buccal cusp; four lower third molars had an extra buccal cusp and root."

Extra cusps on the facial surface of upper molars were first described, not — as often stated — by ZUCKERKANDL, but by WINDLE and HUMPHREYS (340,

p. 14). They found one of fair size on an upper first molar. Later on such cusps were studied by ZUCKERKANDL (350), MAX. DE TERRA (313), BOLK (36), ADLOFF (6), GREVE (112), FABIAN (80, 81), VAN LOON (191) and others in white races. In coloured races they were observed by DE TERRA (313, p. 177), JANZER (151, p. 410), FABIAN (81, p. 89), R. SCHWARZ (287, p. 49), KAJAVA (159, p. 29) and SHAW (299, p. 47). The incidence was found by FABIAN to be very much higher in Melanesians than in Germans from Hamburg.

Judging from the evidence made available by the aforementioned authors and the present writer, the latter does not hesitate in proposing that the incidence of facial supernumerary cusps (*tubercula paramolaria* of BOLK, Plate 12, Fig. 68) is at least as high in the East Greenland Eskimo, as any incidence heretofore reported in literature for coloured races, and far above that reported for Whites (BOLK, FABIAN).

The paramolar tubercle is also met with in West Greenland natives of mixed Eskimo race. The writer frequently saw them in West Greenland 1935 and 1939. No definite data, however, have so far been collected as to their incidence in that area.

The extra lingual cusps are much more rare than the facial. They have been observed by the present writer on lower third and second molars. When situated distolingually, at any rate, they are the same type of cusps as those which BOLK, in his interesting essay (36, p. 101), called *tubercula distomolaria*. Plate 14, Fig. 79 (M_3 and M_2 dext.) shows one of the Eskimo cases.

BOLK (36), by means of his unique Amsterdam collections, found out that paramolar tubercles (*i. e.* facial extra cusps) were always situated opposite the antero-external cusps. This, however, has since been modified by R. SCHWARZ (287), who noted that they may also be located opposite the middle of the crowns. This was also observed by the present author (see Plate 12, Fig. 68).

BOLK did not find any extra facial cusps on the first molars, and holds the view that they never occur on that tooth. He was not aware that one had already been found on a M_1 sup. by WINDLE and HUMPHREYS (340) as well as by ZUCKERKANDL (350). Later on FABIAN (81), JANZER (151) and R. SCHWARZ (287) observed isolated cases, proving that BOLK was mistaken about this point, which is of major importance as far as his hypothesis of the deciduous character of M_1 is concerned. As appears from the aforementioned data the present writer also observed one first (upper) molar with a paramolar tubercle in the East Greenland Eskimo.

The majority of extra facial cusps, according to BOLK (36) and others, are found on the third upper molars. Next come the second upper molars. BOLK says, that in the lower jaw, the incidence of the paramolar cusp is lower and the incidence of the paramolar root higher,

than in the upper jaw. He could give no explanation. In the East Greenland Eskimo (Tables 43 (p. 134) and 44 (p. 135) plus additional data in the text), the incidence of the facial cusp on the third lower molar is unexpectedly high, absolutely, and in proportion to the other molars.

According to BOLK, the paramolar as well as the distomolar tubercle may or may not be associated with a supernumerary root. This observation was confirmed by FABIAN (81), SCHWARZ (287), LEIGH (185) and the present writer (Tables 43 (p. 134), 44 (p. 135), and 45 (p. 141). Supernumerary roots of this type are generally lower than the main roots.

The paramolar tubercle is supposed by BOLK to be homologous with the free paramolar tooth, both representing lost members of the deciduous dentition. The distomolar tubercles (which may have either a distal or a distolingual position on the third molars), according to the same author, are homologous with free distomolars, *i. e.* vestiges of the lost fourth molar. Against the views of BOLK, ADLOFF (6, 8) repeatedly has urged that he cannot subscribe to the idea that the paramolar tubercle be a paramolar, more or less fused with the ordinary molar. On the contrary he is of opinion that the tubercle has partly budded off the latter.

The problem of what kind of process is operating in the formation of supernumerary facial and lingual cusps has as yet not been solved. It also remains to be seen what is the reason why such cusps tend to occur more often in some coloured races, such as the Eskimo, than in Whites. Whether high incidence of facial (and lingual) cusps be typical of Mongols—as is *e. g.* the low incidence of CARABELLI's tubercle—seems to be an appropriate subject for study by odontographers in Eastern Asia and America.

THE ENAMEL MARGIN.

The configuration of the gingival enamel boundary, "the enamel line" of KLEINSCHMIDT (170), has been described by a number of workers, the majority of whom are quoted in a paper by PEDERSEN and THYSSEN (252, p. 446—453) dealing with the cervical enamel border in various racial groups of *Homo* and some *Anthropomorphae.*

A marked tendency for the enamel to extend more or less towards the bifurcations of the roots was first described in detail by WESKI and CONTRERAS (336, p. 228) who noticed this feature in Finnish Lapp skulls and Germans. About the same time, LEIGH (184, p. 193), studying the dental anatomy of North American Indian skulls (Algonquin, Sioux, Arikara and Zuni), found that, "on many molars the enamel margin is not sharply marked, there being a tendency for the enamel to stream

down the cervix to the bifurcation of the roots." Another study published the same year (1925) by LEIGH (185) concerns "modern Eskimo skulls from Alaska, Canada and a few from Greenland." LEIGH (185, p. 886) says of the enamel margin in this material, "The enamel of the molars almost universally streams down between the bifurcation of the roots, terminating in a sharp point. This unusual prolongation of the enamel margin has also been described by the writer as a characteristic of the teeth in the Sioux Indians, and probably is a feature of other primitive races." In later studies by LEIGH of Californian Aboriginal skulls (186) and skulls from prehistoric Guam (187), the enamel prolongation was named "enamel extension". It was found to be very frequent and pronounced in both the latter groups. In Polynesian skulls from Hawaii enamel extensions were observed by CHAPPEL (53). NELSON (225) saw no small number of them in Pecos Pueblo Indians from New Mexico.

Thus until now, pronounced enamel extensions have been found to be common in Eskimos, North American Indians and Polynesians. No data from other races and no further data on Mongoloid peoples have been made available so far. In 1942, however, PEDERSEN and THYSSEN (252) examined a number of groups including Greenland, Central and Alaskan Eskimo, ancient and modern Danes, Lagoa Santa a. o. They found it possible to classify the individual curves of the enamel line on the facial and lingual surfaces of the molars under six headings (see p. 74). Plate 18, Figs. 96—107 show the six types in question. Types 4 + 5 + 6 correspond to the enamel extensions described by LEIGH. Most of the molars shown on Plate 18, Figs. 96—107 are Greenland Eskimo teeth. The molars in Figs. 100 and 107 (Plate 18) originate from East Greenland.

As far as the Eskimo is concerned, PEDERSEN and THYSSEN confirmed the findings by LEIGH in greater detail and on a much more extensive material. Fig. 19 (p. 139) shows the percentage distribution of types on the facial surfaces of Greenland Eskimo and modern Danish molars, respectively. Pronounced enamel extensions (*i. e.* type 5 + type 6, *vide* p. 74) were found to be very common on Eskimo molars which carried either bifurcations or longitudinal grooves on the root surfaces involved. Where no bifurcations or grooves were present (as is the case especially in a number of lower second molars), no enamel extensions were seen, the enamel line being generally quite straight in such cases (Plate 18, Fig. 98). In other words, the absence of enamel extensions is suggestive of complete failure of the lower molar roots to divide (so-called fusion) on the surface in question. Examples of facial enamel line on Eskimo lower second molars are given on Plate 19, Figs. 108—13. Complete Eskimo molar series with pronounced enamel

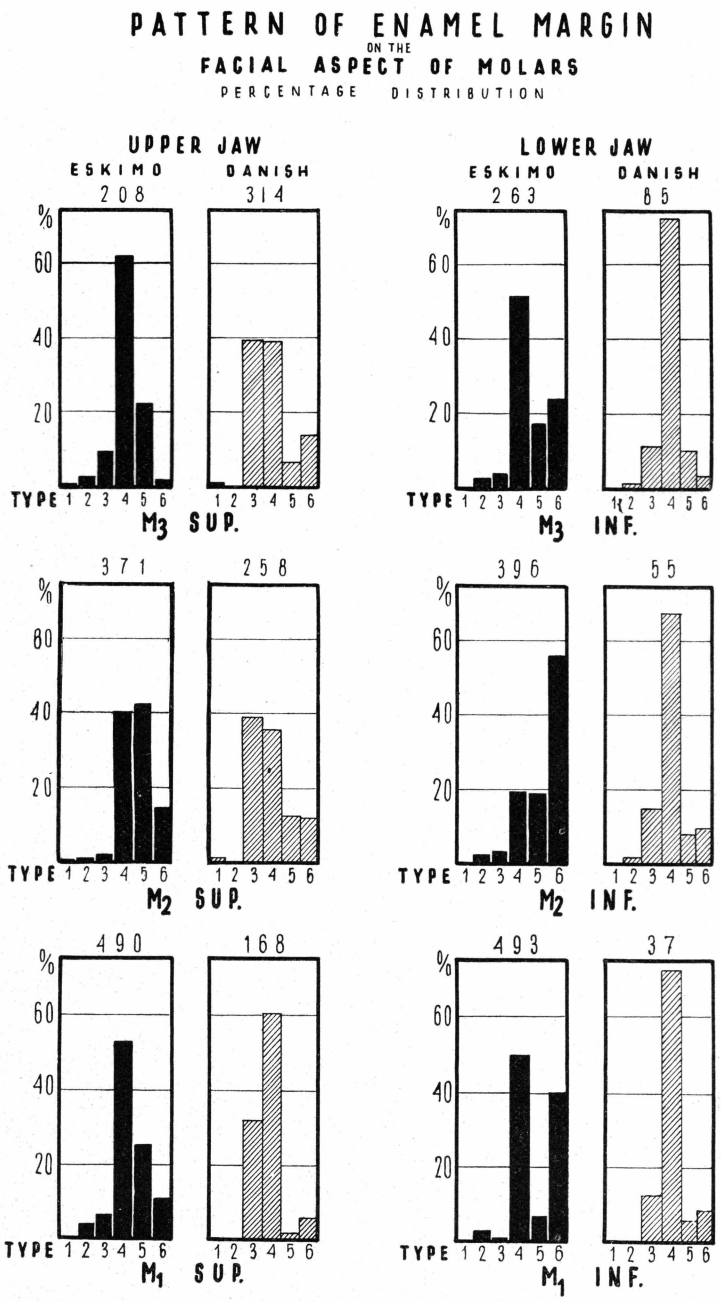


Fig. 19. Comparison of the configuration of the enamel margin on the facial aspect of molars in Greenland Eskimos and modern Danes. Legend on p. 74.

extensions (types 5 and 6) are seen in Figs. 114 (Plate 19) and 115 (Plate 20).

The enamel extensions sometimes have a very irregular shape (Plate 20, Fig. 116), a condition which has been observed by WATSON and WOOD (330) as well as by FUJITA and NAKAYAMA (94). The enamel extensions seem to be very closely related to enamel nodules which are likewise very frequent in the Eskimo, especially so on the upper third and second molars.

The high incidence of pronounced enamel extensions in the Eskimo seems to have a racial background. Just why and how the enamel extension comes into existence in this people is, however, not quite clear. It has been established by PEDERSEN and THYSSEN (252, p. 480) that a bifurcation (or a groove) is a *conditio sine qua non* for enamel extensions to develop[1]). The Eskimos are rather more prone to have roots without bifurcations or grooves than are *e. g.* Whites, but—as we have learnt—in such cases, they have no enamel extensions either. There must be in the Eskimo for some unknown reason an inherited tendency absent in Whites, for the epithelium extensions ("Epithelsporne")[2]) to form enamel in the apical direction opposite bifurcations and grooves. Judging from conditions prevailing in anthropoids and early man (252, p. 475), no significance can be attached to the enamel extensions from a phylogenetic point of view.

NUMBER OF ROOTS.

Until now the term fusion of roots has been used in a purely descriptive sense. The problem of fusion will be discussed later on. Here, however, attention is called to the interference of fusion with root numbers. When dealing with ethnic groups in which fusions are widespread, such as the Eskimo, one must be particularly concerned to keep in mind this source of error, which has of course far-reaching bearing upon the root numbers recorded.

For reasons previously given, the modern East Greenland material is not very suitable for systematic studies of root conditions.

In Table 45 (p. 141) the numbers of roots on individual molars are given for the East Greenland skulls.

The majority of upper molars have three roots. Only the third molar shows an appreciable number of specimens with one root. The lower molars generally have two roots. One root (no grooves) is a rare occurrence in the lower jaw, being present on three third molars only.

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[1]) Cf. DE JONGE-COHEN (154, p. 204).

[2]) Cf. WESKI and CONTRERAS (336), KANTOROWICZ (160), GÖLLNER (100) and PFLÜGER (256).

TABLE 45.

Number of roots on the teeth present at death in East Greenland Eskimo skulls. Both sexes.

Tooth	Maxilla					Mandible				
	No. exam.	1 root	2 roots	3 roots	4 roots	No. exam.	1 root	2 roots	3 roots	4 roots
M_3	77	10	..	62	5	38	3	29	5	1
M_2	79	3	..	74	2	65	..	62	3	..
M_1	77	..	..	77	..	64	..	56	8	..
P_2	97	96	1[1])	..	..	73	73	..	..	..
P_1	99	94	5[2])	..	..	74	73	1[3])	..	..
C	98	98	..	..	..	72	71	1[4])	..	..
I_2	100	100	..	..	..	77	77	..	..	..
I_1	105	105	..	..	..	75	75	..	..	..

[1]) bifurcation of apical $^1/_3$; [2]) bifurcation of apical $^1/_3$ or less; [3]) division lingually of apical $^1/_2$; [4]) C dext. bifurcation of apical $^1/_3$, but C sin. no bifurcation.

In both jaws, however, *supernumerary roots* were met with to no small extent. Maxillary third and second molars had supernumerary roots in seven instances (out of 156), but it is likely that further extra roots were present on the teeth that could not be removed from the jaws. All maxillary supernumerary roots were lower than the main roots. Generally they were thin and pointed. In the upper jaw, supernumerary roots were situated facially. One of them was associated with a paramolar tubercle (Table 43, p. 134). All the extra roots observed in the upper jaw seem to belong to the type of supernumerary roots named *radices paramolaricae* by BOLK (36, p. 98). According to BOLK such roots are constantly situated opposite the anterior facial cusp[1]). They may or may not be surmounted by a paramolar tubercle.

On the East Greenland Eskimo lower molars, five facial supernumerary roots were seen (Table 43, p. 134)[2]), but the favourite location of extra roots is lingually, opposite the distal root (Plate 20, Figs. 117 and 118). The disto-lingual extra root is in all cases lower and much less stout, than the ordinary distal root. The cross-section tends to be circular. The supernumerary root is slightly divergent from the distal root, its apical part being prone to bend toward the latter. When supernumerary lingual roots occur, the distal root is somewhat less stout than usual, but on the whole unaffected. Disto-lingual roots of this type are seen

[1]) FABIAN (81, p. 92) and HJELMMAN (128, p. 102) do not share that view.

[2]) BOLK (36, p. 97) says that whereas the paramolar tubercle is more frequent than the paramolar root in the upper jaw, conditions are reversed in the lower jaw. This is not in accordance with the present findings.

more frequently on first than on second and third molars. In all, nine first and second molars (out of 129) were found to have this disto-lingual extra root. Seven of them were first molars. The total incidence of disto-lingual roots on lower molars in the skulls may very well be higher than just reported, since some of the molars which could not be removed from the jaws, may have had such roots, even if they could not be picked out on the roentgenograms. Certainly the presence of the bent and divergent extra root would be a good reason for them not to come out[1]). In most Eskimo cases having supernumerary disto-lingual roots, such roots occur symmetrically (Plate 21, Fig. 119). This applies to East Greenland and West Greenland skulls as well as present-day natives in East and West Greenland. There are, however, exceptions. In skull No. 268 (Plate 21, Fig. 120), for instance M_1 inf. dext. carries two roots whereas M_1 inf. sin. exhibits three roots.

MÜHLREITER—DE JONGE-COHEN (221, p. 125) in their "Dental Anatomy" give the following description of the root in question, "Dieselbe tritt, wie schon CARABELLI beobachtet hat, gewöhnlich nur am ersten unteren Molaris auf und liegt immer an der lingualen Seite des Zahnes; besonders merkwürdig aber ist, dass sie fast konstant von der distalen Wurzel abzweigt. Unter acht Exemplare der Sammlung MÜHLREITER's befindet sich nur ein einziges, bei welchem diese akzessorische Zungenwurzel aus der Spalte zwischen den beiden normalen Wurzeln entspringt. Ihrer rundlichen und meist etwas hackenförmig gebogenen Gestalt nach hat sie grosse Ähnlichkeit mit der verkleinerten, gleichsam verkümmerten Gestalt eines oberen Mahlzahnes. BOLK beschrieb sie als *Radix praemolarica*, während VON LENHOSSEK von einer *Radix entomolaris* spricht." This description is in perfect accordance with the present findings in the Eskimo.

BOLK (37, p. 608) found the disto-lingual root on 18 out of 1,713 M_1 inff. from Amsterdam, but failed to find a single case when examining a similar number of M_2 inff. ADLOFF (6, p. 446), however, says that he saw the disto-lingual root on some second lower molars. Later on, his observation was confirmed by FABIAN (81, p. 92) who gives the following comment on extra lingual roots on lower molars, "Verfasser sah an allen drei Molaren solche Wurzeln, er fand unter den von ihm untersuchten Einheimischen[2]) 20 überzählige linguale Wurzeln, von denen vier (drei distal und eine von der Gabelstelle) dem unteren ersten Molaren, drei (zwei distal und eine von der Gabelstelle) dem unteren zweiten Molaren und dreizehn (sechs distal und sieben von der Gabelstelle) dem unteren dritten Molaren angehörten." The Swiss odontographer F. SCHWERZ (289, p. 28) recorded the following incidence of supernumerary roots on lower molars of Alamanni: M_3 2.8 per cent; M_2 0.7 per cent; M_1 1 per cent.

[1]) When force is exerted, they tend to break, as often experienced by the writer when extracting lower molars in West Greenland natives. Cf. TRATMAN (326, p. 267).

[2]) Germans from Hamburg (1,223 lower molars).

Middleton Shaw (299), in his book on the Bantu dentition, does not mention supernumerary roots on lower molars. He only recorded two instances of increase in number of roots (p. 34), "In both instances one additional root was present on the distal aspect of third upper molar teeth between the lingual and disto-buccal roots." Some cases of supernumerary molar roots were found in white and coloured races by Max. de Terra (313, p. 241), but he did not record any on first and second lower molars. In older literature quoted by de Terra (p. 242), however, several cases are mentioned. M. de Terra (p. 243) concludes that in the lower jaw, M_1 is more prone to carry extra roots than the posterior molars, whereas in the upper jaw the incidence of such roots is increasing from M_1 to M_3. Hjelmman (128, p. 102) examined 209 Finnish M_1 inff. as well as 210 M_2 inff. Distolingual roots were found by Hjelmman on two first molars and on one second molar. He found facial supernumerary roots to be more common in the lower jaw than lingual supernumerary roots (cf. Blok 36, p. 97).

Reports on supernumerary roots are scarce as far as coloured races are concerned[1]). The more interesting and valuable is the study published by Tratman (326). In Singapore ("the great melting-pot of races") Tratman took the opportunity of comparing dental anatomical features of various racial groups living in Malaya. Among other things, he studied the incidence of three-rooted lower molars (326, p. 264) and found the latter to be surprisingly high in peoples of Mongolian stock, whereas such teeth were rarely seen in Indians and Europeans. Three-rooted lower molars are present so often "in Southern Chinese, Malays, Javanese and allied races as to be regarded a variation within the range of normal." Tratman (326, p. 274) adds, "These races are all of Mongolian stock and a similar condition may be expected to occur in all races of that stock." He presented extensive tabulations on the frequency in various racial groups, from which tabulations the Chinese are seen to have the very highest incidence of three-rooted lower molars.

The findings by Tratman as to location (disto-lingual), shape, size etc. of the supernumerary roots on lower molars are in perfect accordance with what has been said above of the corresponding roots in the Eskimo. In one respect, however, there is a difference: hundreds of three-rooted lower first molars were seen by Tratman, but in one

[1]) Mac Curdy (196, p. 276) found some three-rooted M_3 and M_1 inff. in skulls of South American Indians. F. Laband (177, p. 998) who examined natives of Malayan stock in British North Borneo reports, "Something not observed among white people is a lower first molar with three well-formed and separated roots. They look more like the roots of upper first molars, with this exception, the mesial root is not longer than the others. (Among 134 extracted lower first molars, I found eleven with three roots)."

single case only, the second molar had three roots. As to asymmetrical location, TRATMAN on his large material (extracted teeth), made interesting observations. In males he found the extra root to occur much more frequently on the right side, whereas in females bilateral occurrence was prevalent.

On the background given by TRATMAN the common occurrence of supernumerary disto-lingual roots on the lower molars of the Eskimo, (which cannot be found to have been reported by previous students of Eskimo dentition[1]), becomes extremely interesting from a racial point of view. Once more we come across a dental feature, hitherto overlooked and in fact apparently insignificant, which is strongly suggestive of racial affinity between Asiatic Mongols and Greenland Eskimo.

When surveying the available evidence we arrive at the following conclusions as far as supernumerary roots are concerned: —

(1) Supernumerary roots are more frequent in the Eskimo than in Whites. This is especially true of disto-lingual roots in the lower jaw. They occur on lower first molars at least ten times as often in the Eskimo as in Whites (BOLK, SCHWERZ, FABIAN).

(2) Three-rooted lower molars are more frequent in Mongolian stock than in other racial groups on record (TRATMAN).

(3) Like various other dental features, the high incidence of disto-lingual roots on Eskimo lower molars suggests racial affinity of Greenland Eskimos with Asiatic Mongols.

(4) Disto-lingual roots may occur on all three lower molars. They seem to be more common on first molars than on third molars, and are more common on these two teeth than on second molars.

(5) Disto-lingual roots on lower molars do not always occur symmetrically.

(6) In the upper jaw, extra facial roots are more frequent than supernumerary lingual roots. In the lower jaw the proportion is reversed.

COURSE AND DIVERGENCE OF ROOTS.

When describing the individual molars, the writer pointed out that straight course of the molar roots is prevalent in the East Greenland Eskimo. This is the general picture in skulls as well as in the living.

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[1]) Referring to a preliminary report by the present writer (241) PYLE (Dental Supervisor, Office of Indian Affairs, U. S. A.) in a letter dated December 21, 1938 observed, "In your preliminary report I note that you mention the occurrence of a third root on lower 1st molars. The same condition is quite common in Alaska. It is always on the disto-oral side of the tooth and in some villages occurs in 20 % of all mouths."

As far as the skull material is concerned, no statistics have been worked out, because molars with straight roots were supposed to drop out more easily than molars the roots of which were bent and crooked.

Neither is the X-ray series of modern East Greenlanders a sound basis for statistical studies. The outlines of upper molar roots are quite often hard to decipher because of the massiveness of the alveolar bone supporting them. In the lower jaw, conditions are slightly more favourable, although the mandibular tori present in a high percentage of Eskimo mandibles, tend to cover the outlines of the roots beyond recognition. Still, there are in both jaws many series from which a good impression of root configuration can be gained.

When surveying such cases we notice that the upper molars tend to have straight roots with but little divergence. (The maximum distance between the apices of upper first molars in the skulls was measured as 9.7 mm). There are two reasons why this distance is so short. In the first place the roots do not spread very much, and in the second place the roots are rather low. (The height of the roots will be dealt with later on). Quite commonly there is no divergence at all of the roots of the posterior upper molars, which frequently are either parallel or slightly converging. Bends of the upper molar roots are generally confined to the anterior facial root on first molars. The apical third of this root shows a tendency to an even backward drift. Abrupt apical bends have been found on three upper (first and second) molars only.

The lower molar roots also tend to be straight, and the divergence is on the whole slight. With many second and third molars, the distance between the apices of the roots falls short of the length (mesio-distal diameter) of the root stem, measured at the cervix of the tooth, *i. e.* the roots are converging in the apical direction. Nearly parallel roots quite often occur, and divergence exceeding very moderate degrees, is totally absent. As is the case in the upper jaw the roots are often without bends. The principal exceptions from this general rule, are some of the roots on second and especially on first molars, which are inclined to bend backwards. On the first molar this bending (of the apical third) may even be rather abrupt. On the second and first molars, apical crooks are more frequent than on the corresponding upper molars.

It has been noticed that in the cases which showed a tendency toward distal drifting of molar roots, it was more or less universal in the molar and premolar regions of both jaws.

Contrary to the Eskimo of unmixed race, such as the East Greenlander, the West Greenland natives of mixed race quite often exhibit complicated course of molar and premolar roots with abrupt bends of all the awkward types so well known in Whites by the dental surgeon.

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In West Greenland the writer, much to his disadvantage, experienced really difficult extractions, only when treating natives with abundant white admixture, such as ministers, traders and midwives, *i. e.* "the upper ten" of the West Greenland settlement.

Judging from illustrations and brief comments in literature, complicated course of molar and premolar roots seems to be comparatively rare in unmixed coloured races (ADLOFF (4), SHAW (299), NELSON (225), WEIDENREICH (332)). Accordingly we can say that the Eskimo fits very well into the general pattern.

Straight roots also appear to have been prevailing in early man (WEIDENREICH (332), SCHOETENSACK (284), GORJANOVIC-KRAMBERGER (104) a. o.).

Comments on the degree of divergence of molar roots are scarce. According to BROCA (43), M_3 in the Negro shows considerable divergence. MAX. DE TERRA (313, p. 244) in an European skull measured a maximum distance of 15.5 mm between the facial root apices of M_1 sup. Of the Bushman DRENNAN (70, p. 74) says, "Anything which might be classed as abnormal divergence of the roots was noticeably absent. The maximum divergence of the upper roots was 14.7 mm, measured between the apices of the two roots widest apart, which is far from being extreme, and there was no abnormal divergence of the lower roots." In anthropoids as well as in *Pithecanthropus*[1]) and *Sinanthropus* the divergence of the molar roots is marked to extreme.

Conclusion: — The East Greenland Eskimo molar roots are on the whole straight. Their divergence seems to be less marked than usual in modern human races and is decisively less pronounced than in early man.

"TAURODONTISM".

In fossil hominids such as *Sinanthropus* and *Homo heidelbergensis*, it will be observed that the pulp cavity is larger—absolutely as well as relatively—than in modern man. It will further be seen that, in passing from the first to the third molar, the pulp chamber tends to enlarge in height at expence of the juxtacoronal part of the root. The pulp chamber in such cases is partly situated in the crown, partly in the stem or "body"[2]) of the root from which the root branches emerge. In some of the teeth from Krapina this tendency is so marked that the pulp chamber extends deeply into the region of the roots (Plate 21, Figs. 122 and 123). The tendency may culminate as shown in Fig. 121

[1]) WEIDENREICH (332, p. 145) consider the teeth to belong to a fossil Orang. M. DE TERRA (313, p. 244) reports that the distance of the apices of the *Pithecanthropus* M_3 roots is 17.0 mm.

[2]) KEITH (163), DAVIDSON BLACK (63).

(Plate 21) of Krapina C molars. In this Krapina jaw the first and second molars have prismatic roots, closed at their ends by mere caps or lids representing the abortive inner walls of the roots (GORJANOVIC-KRAMBERGER (103, p. 109)). In modern Europeans and in most other humans, as well as in anthropoids, the greater part of the pulp chamber remains within the crown, and the roots branch off distinctly, divergent from the proximity of the crown. In most anthropoids a root stem or body is absent. In modern man it is generally poorly developed. Modern white races show a smaller pulp cavity in proportion to the tooth than do fossil hominids. Certain present-day coloured races are said to have more extensive pulp cavities and a stouter root stem than Whites. As has been demonstrated in a preceding section of this chapter, this seems to be true of the Eskimo. (We shall be returning to this feature later on).

Molars with a high pulp chamber embedded in a stout root stem tend to be without a marked "neck", *i. e.* the junction of the crown and root is ill-defined. Because a somewhat similar type of molar tooth is found in the ox, Sir ARTHUR KEITH (163, p. 104) proposed that teeth exhibiting "a tendency to assume the condition seen in the teeth of ungulate or cud-chewing mammals be called "taurodont" teeth." The opposite condition—that seen in the carnivora—characterized by a well-defined neck and a relatively low pulp chamber, was proposed by KEITH to be called "cynodontism". MIDDLETON SHAW (298, p. 477 and 299, p. 126), needing "degrees" for classification purposes, subdivided taurodontism into hypotaurodontism (Bantu-Boskop bastards), mesotaurodontism (Heidelberg jaw), and hypertaurodontism (Krapina). The French anatomist RETTERER (267, p. 767), who wrote a noteworthy essay on taurodontism and cynodontism, pointed out that care must be taken in restricting the use of these terms. They may be applied *cum granu salis* for descriptive purposes, but of course the anatomy of the ox molar is quite different from that of the primate molars.

The entire conception of taurodontism as originally devised by KEITH has been strongly criticised by WEIDENREICH (332, p. 103), who is inclined to drop it altogether. The interesting history of taurodontism and the rôle played by the latter in odontology is outlined by WEIDENREICH (332, p. 103) in his criticism. The milestones are the vivid discussion between GORJANOVIC-KRAMBERGER (102, 103, 104) and ADLOFF (1, 2, 3, 5), the paper and books by KEITH (163, 165, 166), the paper by SHAW (298), the treatises by DAVIDSON BLACK (63, 64), the odontography by WEIDENREICH (332) and finally the criticism of the latter by ADLOFF (11). Through the work of these authorities the problem of taurodontism has been given great prominence in odontological literature. The main object of studies and discussions was to establish

the significance of taurodontism from an evolutionary point of view. So far, however, efforts to obtain unity of views have been in vain, and the main problems are still pending. This is not the proper place to wind up the lengthy discussion for and against the conception of taurodontism, nor is the writer inclined to embark upon a survey of the elaborate interpretations given by various authors of the prismatic root conditions of the molars from Krapina and allied subjects. It will be sufficient to sum up thus: —

(1) It is almost universally accepted that a moderate degree of taurodontism belongs to the primitive features of human dentition[1]), whereas hypertaurodontism (Krapina), especially specimen C, may be regarded as a specialization of fairly recent date.

(2) All authorities agree that a large pulp cavity is a characteristic criterion for primitive hominids.

Evidence to this effect has been presented by ADLOFF (5), KEITH (165), WEIDENREICH (332), GREGORY and HELLMAN (109, 110) a. o. The latter authors say of taurodontism (110, p. 64), "While in M_1 of *Dryopithecus frickæ* the degree of taurodonty, or depth of pulp cavity, is barely perceptible, in the Neanderthaloids this character varies from a moderate degree in the Ehringsdorf child, to an extreme degree in the typical Neanderthals. A moderate development of taurodonty both in *H. heidelbergensis* and the Ehringsdorf child is associated with a very primitive and *Dryopithecus*-like crown-pattern. Hence a moderate degree of taurodonty may be considered a primitive human character."

ADLOFF (12 and 5, p. 154) calls attention to the considerable size of the pulp cavity in human deciduous teeth, which are on the whole more primitive than their permanent successors.

It goes without saying that when estimating the size of the pulp cavity, the observer must give due consideration to the individual age of the person in question, as well as to the posteruptive age of the tooth. Studies in this line, concerning *inter alia* the Piltdown teeth, have been made by LYNE (194).

Quite early ADLOFF (5, p. 115) published skiagrams of two Eskimo mandibles (l. c. Figs. 19 and 20). He found the roots to be "gedrungenen und kurzen Gestalt" and the pulp cavity to be of considerable size. WINGATE TODD (320, p. 258) also commented on taurodontism and roots of Eskimo molars saying, "the necks of the teeth are not so much reduced in diameter from the crowns, but the roots display the most distinctive character, for they are short and stout and show a marked tendency to fusion."

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[1]) Cf. SENYÜREK (295) and GREGORY and HELLMAN (110, p. 64).

Returning to the aforementioned study by ADLOFF (5, p. 144) in which he included two Eskimo jaws, we find a number of interesting skiagrams of taurodont molars, mainly Krapina specimens. On Plate XXXII in the atlas of WEIDENREICH (332), further examples may be found. When comparing the taurodont molars of early man (*Sinanthropus*, Piltdown, Heidelberg, Krapina etc.) with East Greenland Eskimo molars, one is struck by the likeness of the total configuration of the teeth, as well as that of the pulp cavities. Plate 21, Figs. 122 and 123 of Krapina molars and Plate 22, Figs. 125—30 of Eskimo molars show this likeness in a convincing way[1]).

The conclusion is borne out that the average Eskimo molar, (of which Plate 22, Figs. 125—30 are typical examples), is taurodont in so far as the neck is ill-defined. This tends to lend a square shape to the X-ray picture of the coronal part of the tooth. The pulp cavity is larger than in Whites (cf. Plate 22, Fig. 124). The pulp chamber, in many cases, extends well below the level of the crown down into the root, which has a more or less marked stem below the alveolar limbus. From this stem the root branches leave the "corpus" of the tooth closer to the apices than is the case in white races. Now, not all Eskimo molars exhibit these conditions to a pronounced degree. Variations of stem and pulp chamber height occur.

As is the case in Neanderthals, *Sinanthropus* and modern Europeans, the pulp chamber is longer (mesio-distal diameter) and lower in the first molar than in the posterior molars, irrespective of secondary changes which are quite naturally more pronounced in the first molar.

The entire question of configuration of the pulp cavity is closely related to that of "fusion" of the roots, which will be discussed after the description of the premolars.

ENAMEL NODULES.

Enamel nodules or pearls are small enamel excrescences or droplets, occasionally met with on the roots of molar teeth. They are generally found upon multirooted teeth, being situated a little below the neck, and often at the junction of two roots. On section they are seen to consist of a cone of dentine covered with a rather thick layer of enamel (Plate 23, Fig. 131). Enamel nodules without a nucleus of dentine also occur, but they are generally so small that they can only be seen on magnification.

Enamel nodules are very common on posterior molars of the East

[1]) The Krapina mandible C (Fig. 121, Pl. 21) has prismatic roots and is excluded from the above considerations. The significance of prismatic roots is obscure. They are occasionally found in present-day white races, especially on M_1 sup. (cf. EULER 78, p. 20).

TABLE 46.
Incidence of enamel nodules on 5,190

Group of material[1])	No. of persons examined	Maxilla					
		M_3			M_2		
		No.	With enamel drop(s)		No.	With enamel drop(s)	
			No.	%		No.	%
I. Eskimo skulls, Greenland	312	223	52	*23.3*	381	52	*13.6*
II. Eskimo skulls, Canada	18	5	1	(*20.0*)	17	1	(*5.9*)
III. Eskimo skulls, Alaska	9	7	0	(*0*)	15	0	(*0*)
IV. West Greenlanders, extracted teeth	—	49	11	(*22.4*)	25	4	(*16.0*)
V. Modern Danes, extracted teeth	—	319	10	*3.1*	258	8	*3.1*
VI. Neolithic skulls, Denmark	57	45	3	(*6.7*)	78	0	(*0*)
VII. Bog skulls, Denmark	12	4	2	(*50.0*)	14	0	(*0*)
VIII. Mediaeval skulls, Denmark	23	23	0	(*0*)	34	4	(*11.8*)
IX. Mediaeval skulls, Norsemen Greenland	20	14	0	(*0*)	26	0	(*0*)
X. Negro skulls, Africa and West Indies	33	37	0	(*0*)	49	0	(*0*)
XI. Malabar skulls	11	9	0	(*0*)	13	0	(*0*)
XII. Lagoa Santa skulls, Brazil	—	5	0	(*0*)	9	1	(*11.1*)
XIII. Anthropoid skulls	20	21	0	(*0*)	31	0	(*0*)
Total...	..	761	..	..	950	..	..

[1]) comp. PEDERSEN and THYSSEN (252, p. 454).

Greenland Eskimo upper jaw. In the skull material the following enamel pearls were observed: —

On 6 M_3 supp. (out of 28 *i. e.* 21.4 per cent) 6 drops (2 mesial, 4 distal)
On 5 M_2 supp. (out of 44 *i. e.* 11.4 per cent) 6 drops (4 mesial, 2 distal)[1])

For this small material, 12 enamel drops of fair size is a surprisingly high incidence, especially when one considers that the excessive hypercementoses present on many mature molars may easily have overgrown several smaller drops (cf. GOTTLIEB (106)).

In two cases, enamel drops were incidentally seen on M_2 supp. (three teeth) during surveys of the roentgenograms from East Greenland.

In a skull collection from East Greenland not included in the present study, the writer found the tooth shown in Fig. 111 (Plate 19). It is a second left lower molar with a well-developed enamel pearl on the facial surface of the root.

West Greenland skulls examined by the writer exhibit a similar high proportion with enamel nodules, as do the skulls from East Green-

[1]) One M_2 had drops both mesially and distally.

permanent molars of different racial origin.

Mandible												
M_1			M_3			M_2			M_1			Total permanent molars examined
No.	With enamel drop(s)		No.	With enamel drop(s)		No.	With enamel drop(s)		No.	With enamel drop(s)		
	No.	%		No.	%		No.	%		No.	%	
532	6	*(1.1)*	270	1	*0.4*	412	7	*1.7*	522	3	*0.6*	2,340
27	0	*(0)*	7	0	*(0)*	15	0	*(0)*	21	0	*(0)*	92
16	0	*(0)*	13	0	*(0)*	15	0	*(0)*	12	0	*(0)*	78
43	1	*(2.3)*	42	0	*(0)*	38	1	*(2.6)*	40	0	*(0)*	237
168	1	*0.6*	85	0	*(0)*	57	0	*(0)*	37	0	*(0)*	924
83	0	*(0)*	52	0	*(0)*	94	1	*(1.1)*	95	0	*(0)*	447
11	0	*(0)*	15	0	*(0)*	23	0	*(0)*	20	0	*(0)*	87
37	0	*(0)*	36	0	*(0)*	43	0	*(0)*	41	0	*(0)*	214
31	0	*(0)*	26	0	*(0)*	36	0	*(0)*	39	0	*(0)*	172
50	0	*(0)*	37	0	*(0)*	44	0	*(0)*	42	0	*(0)*	259
11	0	*(0)*	14	0	*(0)*	11	0	*(0)*	12	1	*(8.3)*	70
11	0	*(0)*	18	0	*(0)*	22	0	*(0)*	21	0	*(0)*	86
38	0	*(0)*	24	0	*(0)*	32	0	*(0)*	38	0	*(0)*	184
1,058	..	..	639	..	..	842	..	..	940	..	..	5,190

land. Also, among a number of loose Eskimo molars which cannot be referred to definite skulls, there are many posterior upper molars with enamel drops mesially and/or distally.

On extracted teeth from West Greenland (natives of mixed blood), nodules are much more frequently seen than on extracted teeth sent to the Copenhagen Dental School by Danish dental practitioners (Table 46, p. 150). In Fig. 131 (Plate 23) an unusual case from West Greenland (Julianehaab District) is depicted. It is an upper third molar with enamel drops above medium size both distally and mesially. Fig. 132 (Plate 23) is of a West Greenland upper first molar with severe dental fluorosis (Pedersen (247, p. 625)). Although the enamel of the crown is severely affected (mottled enamel) the nodule is quite white and smooth!

In the material of 5,190 molars originating from 12 human groups and some *Anthropomorphae* examined by Pedersen and Thyssen (252, p. 455) for configuration of the cervical enamel boundary, enamel drops were noticed as shown in Table 46 (p. 150). The incidence of nodules was recorded by the aforementioned workers 1942, but the results remained unpublished until now. Enamel nodules occur much

more frequently in the Eskimo groups than in the other groups of skulls and extracted teeth studied (Table 46, p. 150). In fact as many as 84 Eskimo skulls (26.9 per cent) had from one to five enamel drops each. On the molars of apes, no enamel pearls were seen. It must be kept in mind however, that the molars of the anthropoids can very seldom be removed from the jaws for closer study. As far as the human groups are concerned this source of error is almost the same in all groups of skulls, while extracted teeth naturally present more favourable conditions. For the above reason the incidence of enamel drops given in Table 46 (p. 150) for groups represented by skulls, should be considered minimum incidence.

The records made by the present writer and THYSSEN were purely clinical, and included enamel nodules of fair size only. On microscopic examination of teeth, enamel pearls were found by GOTTLIEB (106) to occur on about ten per cent of all molars of Whites. However, the vast majority of enamel droplets detected in this way are exceedingly small. They are tiny solid enamel structures without a nucleus of dentine (cf. EULER-MEYER (79, p. 5) and THOMA (317, p. 947)).

It seems likely that the enamel nodules recorded during clinical examinations by the various workers mentioned below, are of the same type as recorded by the present writer and THYSSEN, and tabulated in Table 46, p. 150. In twenty cases studied in sections they were found to have a dentinal cone inside.

When looking out for data on the incidence of enamel drops detectable by the naked eye, we find that such data are not abundant in literature. On the other hand, a survey of literature does ascertain that enamel nodules occur in a variety of races: —

In the Eskimo, enamel drops have been seen by LEIGH (185, p. 886) who says, "Small pearl-like enamel nodules are frequently located one or two mm beyond the border of the enamel."

Enamel nodules have been found in American Indians by SEDWICK (290) who examined 48 skulls of Pre-Columbian Indians unearthed in the State of New York. SEDWICK (290, p. 766) writes, "One young child showed enamel nodules of fair size above the medial buccal roots of all the deciduous first molars." LEIGH (184), studying skulls of North American Indians, also found enamel nodules, *viz.* in 66 Kentucky Indians as follows (l. c. p. 191), "Small enamel nodules, about 1 mm above the enamel margin, were observed on two left upper second molars and on one upper third molar. These little pearl-like neoplasms result from ameloblasts which have become detached from the enamel organ." Out of 129 Arikara skulls four cases had one or more enamel nodules on the molars (l. c., p. 193).

In Melanesians, enamel drops were observed by JANZER (151), who studied 424 skulls from "New Pomerania" and 34 Australian skulls. JANZER (151, p. 415) says, "Anschliessend erwähne ich die Schmelztropfen, ich fand sie nur im Oberkiefer, distal und palatinal am M_3, einmal auch am M_1. Sie bieten keine Besonderheiten ..." R. SCHWARZ (287), in his interesting treatise on the dentition of Mela-

nesian skulls from New Caledonia and the New Hebrides, shows several examples of enamel drops, *e. g.* one on Plate VIII.

In the Bantu, SHAW (299, p. 52) only recorded three cases, "In all three cases the nodule was present on upper molar teeth; in one case on a second molar; in the other two cases on third molars."

RUFFER (275, p. 348), who examined the dentitions of ancient Egyptians, says that, "only one nodule was seen in the Egyptians, but as many of the molar teeth were lost, this cannot be taken as a proof of the rarity of this condition."

Enamel nodules have been dealt with in Europeans by R. VIRCHOW (346), BOLK (36), SCHWERZ (289), HILLEBRAND (124) and others. BOLK (36, p. 99) says of enamel drops in his large Dutch material, "Ich habe bis jetzt noch keinen einzigen unteren Molaren mit einem wirklichen Schmelztropfen auffinden können, und aus der oberen Zahnreihe am ersten Molaren nur zwei Exemplare, am zweiten Molaren fünf und am dritten eine ganze Menge." Among Hungarian upper molars (285 M_1 supp.; 315 M_2 supp.; 212 M_3 supp.), HILLEBRAND, according to SCHWERZ (289, p. 30), saw 31 teeth (2 M_1; 5 M_2; 24 M_3) with enamel drops. SCHWERZ (289, p. 31) gives the incidence of enamel drops in skulls of Alamanni as 4.3 per cent of 300 M_3 supp. On two specimens, he observed two drops. M. DE TERRA (313, p. 247) does not seem to have found more than two enamel drops on examination of more than 15,000 teeth of various races, but he mentions several older accounts of their occurrence (l. c., p. 247). HJELMMAN (128) examined about a third of this number and yet he found more enamel nodules than did DE TERRA. HJELMMAN (128, p. 88) gives the following account of his findings in Finnish skulls (white race), "Ich habe in dem von mir untersuchten Material diese Bildung je einmal an der Teilungsstelle der hinteren buccalen und der palatinalen Wurzel an allen drei oberen Molaren gefunden. Ausserdem bemerkte ich einmal an einem M_1 sup. zwei Schmelzperlen neben einander an der Teilungsstelle zwischen der vorderen buccalen und der palatinalen Wurzel. In den erstgenannten Fällen war die Perle an dem ersten und zweiten Molaren durch eine Schmelzbrücke mit dem Schmelz der Zahnkrone verbunden, während die Perlen an dem dritten Molaren, so wie auch die erwähnte doppelte Perle am ersten, vollständig isoliert waren. Die grösste der erwähnten Schmelzperlen befand sich am zweiten oberen Molaren."

Papers dealing with the histological aspects of enamel drops are numerous. Enamel nodules are described and depicted in many books including early treatises by MAURY (210, p. 36), SALTER (282), LINDERER (190, p. 116), WEDL (331, p. 101) and MAGITÔT (197, Pl. 17).

At least two Japanese studies have been made of the distribution of enamel nodules on the molars. TOKUMARU and UTIDA (321), on examination of 68 nodules (60 molars), found them to occur more frequently on upper third molars than on any other teeth. The sequence of molars affected was the following, M_3 sup., M_2 inf., M_3 inf., M_1 inf., M_2 sup. In the upper jaw, the nodules were almost always found on the distal surfaces of the roots. In the lower jaw, the buccal surfaces were more frequently affected than other surfaces. INOUE (149) studied 265 molars with "genuine enamel nodules", *i. e.* with a nucleus of dentine. They occurred more frequently in the upper jaw than in the lower jaw. Third molars were more often involved than were first and second molars. In the maxilla the favourite sites of enamel drops were the distal and mesial surfaces; in the mandible the buccal and lingual surfaces of the roots were more often affected.

In the total Eskimo skull material of 312 cases, enamel nodules were observed on molars of 84 skulls (26.9 per cent).

58 skulls had one molar each with nodule(s), 20 had two, 2 had three, 3 had four, and 1 had five molars affected. Out of 121 molars involved, 21 had two nodules each. As appears from Table 46 (p. 150), M_3 sup. and M_2 sup. were the teeth most frequently affected.

The location of the enamel nodules on Greenland Eskimo molars was as follows: —

M_3 sup.	60	surfaces	involved,	*viz.*	37	distal,	20	mesial,	1	facial,	2	lingual
M_2 sup.	64	—	—	-	34	—	25	—	4	—	1	—
M_1 sup.	6	—	—	-	3	—	0	—	3	—	0	—
M_3 inf.	1	—	—	-	0	—	0	—	1	—	0	—
M_2 inf.	7	—	—	-	0	—	0	—	6	—	1	—
M_1 inf.	4	—	—	-	1	—	0	—	3	—	0	—

These findings are in accordance with those of Japanese authors, in so far as we found the upper posterior molars to take a leading position, and the mesial and distal surfaces of these molars to be most frequently involved. It was also found that the incidence of enamel drops on lower molars is much lower than that on upper molars. When they are involved, the lower molars almost always exhibit the drops on their facial surfaces. There are, however, discrepancies between the above-mentioned Japanese findings and the present study. Thus TOKUMARU and UTIDA recorded a surprisingly low incidence for the upper second molar, whereas we find this tooth to come next to the upper third molar in frequency.

The very high incidence of enamel drops (genuine drops of INOUE) in the Eskimo, which has been definitely established by the present study, seems to be closely related to the marked tendency shown by the enamel in this people to stream down root bifurcations and grooves. The tendency towards formation of "enamel extensions" has been discussed at an earlier stage. Attention is called to the interesting case shown on Plate 19, Figs. 111 and 112. These teeth are M_2 inff. from the same East Greenland skull. The tooth in Fig. 111 is the left second molar, that in Fig. 112 the right second molar. Here the affinity of enamel drops and enamel extensions is demonstrated beyond dispute[1]). Further examples of this kind have been observed.

Plate 19, Fig. 113 and Plate 23, Figs. 133 and 135 recall the observations made by several students of enamel drops, *viz.* that they are sometimes connected with the enamel of the crown by a "bridge" of enamel tissue. According to WATSON and WOODS (330, p. 856), SALTER (282) as early as 1874 says of the enamel nodule, "very frequently there is a conical process of enamel passing down towards the nodule, the two resembling in form a note of exclamation, thus — !"

[1]) BOLK (36, p. 100) discussed "die Schmelzperlen und die mit diesen verwandten Schmelzsporne."

Hjelmman (128, p. 88) also described this condition. In the Eskimo, however, many nodules lack this connection with the enamel of the crown. Examples of the latter type are given on Plates 19 and 23 (Figs. 111, 132, and 134).

The number of Eskimo skulls with nodules was 84. Twenty-six of these skulls had enamel nodules on more than one molar. The maximum number of drops in one skull was five. Apparently, a constitutional factor is operating in providing some Eskimos with a wealth of enamel extensions and pearls, while others have none. Gottlieb (106, p. 517) has expressed a similar view in saying of enamel drops generally, "Es gibt Gebisse, bei deren mikroskopischer Perlustrierung man auf Schritt und Tritt auf Schmelztropfen stösst, während man bei anderen nur selten welche oder gar keine findet. Von einer befriedigenden Erklärung solcher und ähnlicher Tatsachen sind wir vorläufig noch weit entfernt und müssen sie daher auf weiteres auf das Konto besonderer Konstitution setzen."

As has been discussed by the writer in his paper with Thyssen (252, pp. 479—86) it is not clear why the enamel-forming epithelium shows a much more pronounced tendency to continue enamel formation in the apical direction opposite grooves and bifurcations in the Eskimo (and a few other groups), than in Whites. The same tendency being undoubtedly responsible for the high incidence of enamel nodules in the Eskimo, no definite explanation can be given of that either. It is noteworthy that enamel extensions as well as enamel nodules are likewise a common occurrence in North American Indians (Leigh). Further studies of American Indians and Asiatic Mongols are desiderata arising from what has been brought to light by the present study.

5. Description of the Maxillary Premolars.

Upper Second Premolar.

Size of crown. In the East Greenland Eskimo the upper second premolar tends to be small, especially so as compared with the molars. This is clearly seen on inspection of the skulls as well as the dentitions of the living East Greenlanders. Comparison of the length of Eskimo and White upper second premolars (Black) made in Fig. 22 (p. 190), shows that the Eskimo tends to fall short of Whites when the range of variation is taken into account, although the average length measurements are identical. As far as breadth is concerned (Fig. 23, p. 191), no difference can be seen between the two groups. Thus it is borne out that whereas the molars tend to be superior in size in the Eskimo (Tables 36 and 37 (p. 122), Figs. 22 and 23 (pp. 190—91)), the second premolar is about the same size in Eskimo and Whites or, perhaps, even a little

TABLE 47.

Dimensions of upper second premolars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	6.9	9.5	*132.4*	*8.2*	*64.9*	13.5
	n	(11)	(15)	(11)	(11)	(11)	(14)
♀	M	6.6	8.4	*128.0*	*7.4*	*55.3*	14.0
	n	(6)	(6)	(6)	(6)	(6)	(4)
♂ + ♀	M	6.8	9.2	*130.8*	*7.9*	*61.5*	13.6
	n	(17)	(21)	(17)	(17)	(17)	(18)

less massive in the former than in the latter. The range of variation is about the same in both groups.

Extraordinarily small specimens of P_2 sup. were not seen in the skulls nor on the casts of modern East Greenland Eskimo dentitions, except in cases having all eight premolars well below average size. Such cases, on the other hand, are not rare.

The upper P_2 of the East Greenland Eskimo is smaller than the Australian P_2 sup. The Eskimo mean module is a trifle below the mean modules of Bantu and Pecos Pueblo Indians (Table 36, p. 123). Comparison of the size proportion of molars and premolars in the East Greenland Eskimo on the one hand and the Bantu and Pecos on the other hand, once again seems to indicate a relatively small P_2 in the former. Thus there is sufficient evidence to substantiate that the average East Greenland Eskimo P_2 sup. tends to be small in proportion to the molars.

Form of crown. The average B.-L. index of 130.8 is not exceptional (Table 47). By DRENNAN (70, p. 67) values varying from 129.4 to 146.4 were recorded for various human groups.

Abnormal form of P_2 supp. was found in a modern East Greenland girl of 13 years (No. 9), who had abnormally broad and very short crowns (Table 56, p. 196).

Cusps. On all Eskimo P_2 supp. studied by the writer, two cusps were present (Tables 40 (p. 129) and 41 (p. 129)). They tended to be equal in size. Cusplets were not seen in the skull material (Table 42, p. 131).

One occlusal pearl was found on a P_2 sup. on examination of 121 casts. No further cases were recorded in the field.

Root. The number of roots found on P_2 supp. in the skull material appears from Table 45 (p. 141). Out of 97 P_2 supp., one only had a bifid root. On the X-ray series, out of 224 P_2 supp. which could be estimated with a fair degree of certainty, 4 only (1.8 per cent), had bifid roots. The four P_2s in question occurred bilaterally in cases No. 39 and 385. No. 385 had bifid roots on all four upper premolars. Grooves on the mesial and distal surfaces of the roots were rare and, when present, but faintly marked.

In Europeans, according to FABIAN (81, p. 68) one root is found on 81.89 per cent of P_2 supp. Roots carrying bifurcations at apices occur in 11.42 per cent, more pronounced bifurcations in 6.68 per cent. VISSER (348, p. 186) examined 4,100 upper second bicuspids[1]). He found 91.1 per cent with one root, 3.5 per cent with two separated roots. More or less fusion of roots occurred on 5.1 per cent, and three separated roots on 0.3 per cent of P_2 supp. According to VISSER, both HILLEBRAND and TAYLOR report much higher percentages of P_2 supp. with separated roots.

In Pecos Pueblo Indians NELSON (225, p. 284) found one root on 88.9 per cent of P_2 supp., two partially fused roots on 8.8 per cent, two separated roots on 1.7 per cent, and three roots on 0.6 per cent. SHAW (299, p. 34) in the Bantu saw one root on 40.8 per cent of P_2 supp., two partially fused roots on 18.4 per cent, two separated roots on 37.2 per cent, and three roots on 3.6 per cent.

Thus in the East Greenland Eskimo, one-rooted upper second premolars seem to occur in a higher proportion of cases than in most other racial groups on record. However, the enormous material of VISSER shows a similar high incidence of one-rooted P_2 supp. Real two-rooted upper second bicuspids (let alone three-rooted specimens) were absent in the Eskimo material studied by the present writer.

For reasons previously given no reliable statistics on the course of the roots can be worked out as far as the skull material is concerned. A survey of 223 roentgenograms of upper second premolars (modern East Greenlanders) revealed five teeth only (2.2 per cent) with apical bends (Table 57, p. 197). In all five cases the bends were very moderate and nothing like those demonstrated by G. V. BLACK (30, p. 47). On the whole, the roots of the upper second premolars in the Eskimo of East Greenland, are perfectly straight to the apices.

The height of upper second bicuspid roots ranges from 7.0 to 16.4 mm in the specimens measured (cf. Table 58, p. 198). These measurements are obviously of little value from a normal anatomical point of view, it being quite clear that excessive secondary changes have diminished the height of the roots in many, if not all, mature cases. The average is smaller than in Whites (BLACK) and most other racial groups listed in Table 58, p. 198.

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[1]) The total number of specimens examined by VISSER must be 4,100, not 4,000 as stated in his table (348, p. 186).

The pulp cavity is larger in young Eskimo upper second premolars than in Whites of the same age. In the vast majority of cases one root canal only, is present. Bifid root canals were found in two out of 35 P_2 supp. examined in the skulls, and were very rarely seen on the roentgenograms of present-day East Greenland dentitions.

According to CHURCHILL (56, p. 172) P_2 supp. in Europeans have one root canal in 56 per cent, two root canals in 42 per cent, and three root canals in 2 per cent of cases. Hence the Eskimo of East Greenland has one root canal in upper second premolars, more often than Whites examined by CHURCHILL.

UPPER FIRST PREMOLAR.

Size of crown. The crown of P_1 sup. is more massive than that of P_2 sup. (Table 34, p. 120). In the Eskimo, the average mass is slightly above the corresponding value for white Americans (Table 36, p. 123). The range of variation is wider (Table 34 (p. 120), Figs. 22 and 23 (pp. 190—91)). The Eskimo has on an average stouter P_1 supp. than the Bushman, but smaller P_1 supp. than the Australian. As far as the average values go, the Eskimo comes rather close to other coloured races on record in Tabel 36, p. 123.

No cases of isolated microdonty of P_1 supp. were observed.

TABLE 48.

Dimensions of upper first premolars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	7.7	9.6	*125.0*	*8.7*	*73.0*	14.1
	n	(10)	(14)	(10)	(10)	(10)	(13)
♀	M	7.3	8.1	*118.6*	*7.9*	*59.9*	11.1
	n	(5)	(6)	(5)	(5)	(5)	(6)
♂ + ♀	M	7.5	9.2	*122.9*	*8.4*	*68.7*	13.1
	n	(15)	(20)	(15)	(14)	(15)	(19)

Form of crown. The average B.-L. index tends to be low (122.9), which is no doubt the result of a tendency demonstrated by some P_1 supp. to be very long across the outer cusp, without being broad at the same time. Plate 24, Figs. 136 and 137 shows upper first premolars of that type. (The general shape of the occlusal surface tends to be

that of a kite). DRENNAN (70, p. 66), recording average indices for various racial groups, has no value below 126.4 (Europeans).

The depression at the neck which is almost always found on the mesial aspect of P_1 sup. in Whites, is rather faintly marked in the East Greenland Eskimo.

Cusps. All P_1 supp. examined in the skulls and on the casts from East Greenland, have two cusps of which the facial is constantly more stout than the lingual. In the skulls, the occlusal cusp pattern was well-preserved on 13 teeth only. One of these exhibited a cusplet mesially. No occlusal pearls were seen in either group of material.

Root. The writer was very surprised in finding that two distinctly separated roots were not exhibited by any one of 104 P_1 supp. or sockets of the latter in the skull material. Only five P_1 supp. present at death had bifurcated roots. Three of these are seen on Plate 24 (Figs. 138 and 139). Out of 223 P_1 supp. in the X-ray series from East Greenland, 20 (9 per cent) had more or less distinct bifurcations, but none seemed to have two separated roots branching off from the juxtacoronal third of the total root height. The bifurcations were nearly always quite close to the apices.

In about fifty per cent of the 104 upper first premolars examined in the skulls, there was a perceptible to marked groove on the mesial surface of the root. No facial grooves were seen[1]).

In Europeans according to FABIAN (81, p. 68) one root is present on 33.05 per cent of P_1 supp. Roots bifid at apex occur in 15.95 per cent, roots bifid to a more pronounced degree in 50.64 per cent, and three roots in 0.86 per cent of cases.

VISSER (348, p. 186) examined 3,213 Dutch upper first bicuspids. He found 56 per cent with one root, 30 per cent with two separated roots. More or less fusion of roots occurred in 12 per cent, and three roots in approximately 3 per cent of cases.

In Pecos Pueblo Indians, NELSON (225, p. 284) found one root in 66.6 per cent of P_1 supp., two partially fused roots in 19.7 per cent, two separated roots in 11.4 per cent, and three roots in 2.3 per cent. SHAW (299, p. 34) in the Bantu recorded one root in 17.4 per cent, two partially fused roots in 17.4 per cent, two separated roots in 59.9 per cent, and three roots in 6.1 per cent of upper first premolars.

Even disregarding what may have been meant by "partially fused" or "partly fused" roots, etc. by different students, we safely arrive at the conclusion that *the East Greenland Eskimo exhibits an astonishingly high incidence of one-rooted P_1 supp.* In fact, this incidence seems to surpass anything so far reported for a human group. While it is less surprising when one fails to find any genuine two-rooted specimens among P_2 supp., it is quite exceptional not to observe even a single case among

[1]) LEIGH (185, p. 887) observes, "In one Eskimo instance there was a deep bifurcation line on the buccal root of the first premolars."

P_1 supp. The incidence of about a tenth of upper first premolars with bifurcated root tips, (in the X-ray series), does not weaken this extraordinary finding which has disclosed yet another interesting feature of the Eskimo dentition.

In the skull material no crooked or markedly bent roots were seen. All first upper premolars could be taken out except four which had been glued to their sockets by a previous examiner. On the roentgenograms of the living East Greenlanders, however, it was observed that upper first premolars tend to be more susceptible to developing (moderate) bends of their roots than upper second premolars. The bends generally point distally and on the whole look like those depicted by KROGH-POULSEN (175, p. 141) in his text-book on Dental Anatomy. Extremely pronounced crooks as shown by BLACK (30, p. 43) were not seen in the Eskimo of unmixed race. Nine per cent of P_1 supp. had abrupt apical bends and one tooth showed a marked distal drifting of the entire root.

The height of the root ranges from 9.1 to 17.5 mm, being 13.1 mm on an average. This average value is below most others listed in Table 58 (p. 198). Secondary changes, however, undoubtedly account for part of the difference (cf. outlines of roots on Plate 24, Figs. 138 and 139).

The pulp cavity is large in young Eskimo and remains so, even in cases with considerable attrition. On Plate 24 (Figs. 138 and 139) roentgenograms of 22 first premolars are demonstrated[1]). Fig. 138 shows five pairs of P_1 supp. One pair only, has two root canals (top right). In the others, "islands" of dentine are seen in the pulp cavities. In some (bottom left), the configuration of the root canal is very complicated. It is, however, impossible to say what is original anatomy and what are secondary calcifications. Rather surprising is the considerable size of the pulp cavity in the pair below on the right side of Fig. 138. Although the crowns have been completely worn off, the pulp cavities are still large. The specimens shown on Plate 24, Fig. 139 are P_1 supp. of which the corresponding tooth on the other side was missing. Among these 12 P_1 supp. two only (middle of lower row), have two seperated root canals. The others have more or less distinct "islands" of dentine or extensive pulp calcifications, except the young tooth (top left). The root formation of this tooth has not been completed.

Considering that CHURCHILL (56, p. 172) found three root canals in 1.2 per cent, two canals in 79.3 per cent and one root canal in 19.5 per cent of P_1 supp. of Whites, we may safely say that the occurrence of two or more root canals in upper first premolars of East Greenland Eskimo is rare, irrespective of the scantiness of material at our disposal. This impression is substantiated by a survey of those X-ray series from

[1]) All teeth taken from the mesial side.

East Greenland, on which an eccentric projection of P_1 supp. happens to have been employed.

6. Description of the Mandibular Premolars.

In the text-book by MÜHLREITER—DE JONGE-COHEN (221, p. 78) two principal types of lower premolars are described[1]). One has two cusps, the other three cusps. Special descriptions of lower premolars given by de JONGE-COHEN (153) and BECKER (22) deal with a number of varieties which fall outside the common gross classification. DE JONGE-COHEN (153) who belongs to the Amsterdam school of odontology (BOLK), in a thorough essay of wide scope, points out (l. c., p. 10) that the lower "bicuspids" are in fact either sixtitubercular or quintitubercular representing the crown formulæ of BOLK $\frac{1\,P\,2}{2\,D\,4}$ and $\frac{1\,P\,2}{D\,4}$, respectively (theory of dimery). The material at the disposal of the present writer, however, does not justify attempts at close studies of the minute details of the occlusal pattern, because the latter has been eradicated by attrition in a majority of cases. Hence it is necessary to confine considerations to the principal types of lower premolars dealt with in the text-books.

LOWER SECOND PREMOLAR.

Size of crown. As is the case in the upper jaw, the crown of the mandibular P_2 tends to be rather small in proportion to the molars (Tables 35 (p. 120) and 37 (p. 123); Figs. 22 and 23 (pp. 190—91)). It is above the size of the Bushman P_2 inf.-crown but below that of the Australian P_2 inf. Apart from this, crown size of Eskimo P_2 inff. does not show

TABLE 49.

Dimensions of lower second premolars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	7.1	8.6	*119.1*	*7.8*	*60.5*	13.8
	n	(11)	(14)	(11)	(11)	(11)	(11)
♀	M	7.0	7.7	*111.1*	*7.4*	*54.3*	12.4
	n	(8)	(10)	(8)	(8)	(8)	(7)
♂+♀	M	7.1	8.2	*115.7*	*7.7*	*57.9*	13.2
	n	(19)	(24)	(19)	(19)	(19)	(18)

[1]) KROGH-POULSEN (175, p. 153) describes three types.

any great difference from P_2 inf.-crown size of racial groups listed in Table 37 (p. 123). Especially, the East Greenland Eskimo second lower premolar, contrary to the molars, does not differ materially in size from P_2 inff. in white Americans (BLACK). The average length is the same as in the Whites, but maximum as well as minimum values are inferior to those of white Americans (Fig. 22, p. 190). The breadth measurements come very close to one another (Fig. 23, p. 191). The range of variation of length and breadth measurements is about the same in the Eskimo as in the material examined by BLACK (30, p. 17).

No cases of isolated microdonty of P_2 inff. were observed.

Form of crown. Two principal types are found in the Eskimo. They are the same as those present in Whites, *viz.* one with two main cusps and a more or less circular cross-section of the crown, another with three main cusps tending to lend a longer mesio-distal diameter to the crown on the lingual than on the facial side.

The average B.-L. index of the crown (calculated for both types together) is 115.7, which is far from being extreme in either direction (Table 37, p. 123). DRENNAN (70, p. 69) records average indices between 110.8 (Bush) and 116.0 (Kaffirs). The average B.-L. index of 125.7 calculated for Canadian Eskimos on the basis of the individual measurements taken by RITCHIE (271), however, falls outside the range of variation of average values reported for the crown of P_2 inf. in human races by DRENNAN and others.

No aberrant forms of P_2 inf. have been met with in the East Greenland Eskimo.

Cusps. In Tables 40 and 41 (p. 129) the incidence of two and three cusps on lower second premolars is demonstrated. As appears from these tables about a third of P_2 inff. exhibit three cusps. For the casts, the percentage was calculated at 36.2.

According to BECKER (22, p. 369), 25.6 per cent of (modern) Finnish P_2 inff. belong to the tritubercular type. HJELMMAN (128, p. 32) also in Finns found 32.4 per cent of P_2 inff. to have either three cusps or three cusps + cusplets. The corresponding percentage found by M. DE TERRA (313, p. 146) in European skulls was 16.8. In skulls of Finnish Lapps KAJAVA (159, p. 17) recorded three cusps with or without cusplets on 25.2 per cent of P_2 inff.

It may be assumed that the incidence of tritubercular P_2 inff. is not definitely higher in the East Greenland Eskimo than in other racial groups studied so far. Certainly the percentage for the Eskimo is numerically higher, but the difference from the Finnish results is not statistically valid.

Cusplets were found in the skull material as shown in Table 42 (p. 131). They were noticed on the bicuspid type of P_2 inf. only.

Occlusal pearls were present unilaterally on lower second premolars of two casts (No. 189 (Plate 24, Fig. 140), and No. 238). Case No. 481 examined in the field had occlusal enamel pearls on both P_2 inff.

Root. All P_2 inff. examined in the skull material and on the roentgenograms of modern East Greenlanders exhibit one root.

The mesial and facial grooves mentioned by MÜHLREITER— DE JONGE-COHEN (221, p. 88), FABIAN (81, p. 74), VISSER (349, p. 32) and others, were not perceptible on the Eskimo lower second premolar roots, except for some very faint mesial depressions on one or two teeth of young adults.

M. DE TERRA (313, p. 240) observed one-rooted P_2 inff. in 95 per cent of cases. VISSER (Amsterdam) studied 2,089 P_2 inff. (349, p. 22): One conical root was found in 97 per cent, marked mesio-lingual grooves in 0.9 per cent, mesio-lingual and facial grooves in 2 per cent. Two roots were present on one specimen and three roots were seen on two specimens. HJELMMAN (128, p. 99) and KAJAVA (159, p. 42) did not find two-rooted or bifurcated P_2 inff. in Finns and Lapps, respectively. KAJAVA says, "Die Wurzel des zweiten unteren Prämolaren zeigte kein einziges Mal Spuren einer Teilung." SHAW (299, p. 35) among 72 Bantu P_2 inff. found as many as six with "Tomes' abnormal root" (*vide* description of P_1 inf.). In the Bantu 91.6 per cent of the lower second premolars had one root. NELSON (225, p. 284), examining 145 lower second premolars of Pecos Pueblo Indians noticed "Tomes' abnormal root" on six specimens. 95.8 per cent had one root.

Practically all P_2 inff. could be taken out of their sockets. Only two had slightly crooked roots near their apices. On the X-ray series from East Greenland apical bends were observed as shown in Table 57 (p. 197). The 5.9 per cent with apical bends exhibit such bends to a moderate degree, and all bends are in the distal direction.

The height of the lower second premolar roots ranges from 9.2 to 16.6 millimeters. The average height is 13.2 mm (Table 58, p. 198). This average is the lowest on record in Table 58 as far as P_2 inf. is concerned. However, as is the case with all Eskimo teeth, decrease of height occurs during adult age. In some cases this decrease is very considerable.

The pulp cavity is large during young adult age and remains of fair size even during mature age. Secondary changes are widespread from the late twenties, especially formation of secondary dentine and pulp stones. In no case was more than one root canal observed. This compares with 92.5 per cent of P_2 inff. with one root canal and 7.5 per cent of P_2 inff. with two root canals in Europeans (CHURCHILL (56, p. 172)).

LOWER FIRST PREMOLAR.

Size of crown. While the average length is the same for P_2 inf. and P_1 inf., the average breadth of P_1 is inferior to that of P_2. The mass of P_2, as expressed by its mean module, exceeds that of P_1 (Table 35,

TABLE 50.
Dimensions of lower first premolars in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	7.1	7.9	*109.1*	*7.5*	*55.6*	13.1
	n	(7)	(8)	(7)	(7)	(7)	(5)
♀	M	7.0	7.4	*107.8*	*7.3*	*53.4*	14.0
	n	(5)	(7)	(5)	(5)	(5)	(4)
♂ + ♀	M	7.1	7.7	*108.6*	*7.4*	*54.7*	13.5
	n	(12)	(15)	(12)	(12)	(12)	(9)

p. 121). On an average, the size of the P_1 inf. crown is not materially different from that found in other races, including American Whites (Table 37, p. 123). On the whole, the Eskimo P_1 inf. is rather small in proportion to the Eskimo molars. The range of variation of length measurements is very narrow as compared with that reported for Whites by BLACK (30, p. 17). This is clearly seen on Fig. 22 (p. 190). Fig. 23, p. 191 shows that conditions are reversed as far as the variation of breadth measurements is concerned.

No cases of isolated microdonty of P_1 inff. were met with in the East Greenland Eskimo.

Form of crown. According to BECKER (22, p. 369), a cuspid-like appearance of the crown is exhibited by 19 per cent of Finnish P_1 inff. examined by that author. In the East Greenland Eskimo material some specimens were likewise seen to have a pronounced reduction of the lingual cusp, lending a canine-like configuration to the crown. However, as accurate criteria are difficult to establish, the present writer made no attempt to calculate the incidence of the cuspid type of P_1 inf. in the East Greenland Eskimo.

The average B.-L. index of the crown is 108.6 (Table 35, p. 120). Average B.-L. indices are given between 106.0 and 115.8 by DRENNAN (70, p. 68) for a number of racial groups. Hence it may be said that the average value for the East Greenland Eskimo is not extreme, although his P_1 inf.-crown tends to be a little longer in proportion to breadth than the corresponding crown in most other racial groups hitherto studied (Table 37 (p. 123) and the data given by DRENNAN).

No aberrant forms of P_1 inff. were seen in the East Greenlander.

Cusps. Tables 40 (p. 129) and 41 (p. 129) show that two principal cusps are present in almost all cases. Three cusps are rarely met with (Table 40, p. 129). As is the case in Whites the facial cusp is much stouter and considerably higher than the lingual cusp. The latter may even be quite vestigial.

Occlusal enamel pearls occurred on P_1 inff. bilaterally in one Eskimo examined in Scoresbysund.

Root. Out of 74 P_1 inff. in the skull material one only, showed division of the root: In skull No. 377, P_1 inf. dext. had a very pronounced mesio-lingual groove on the apical part of the root dividing this part of the lingual surface into two branches. The mesio-facial branch was shorter and less stout than the disto-lingual branch and slightly bent at its tip toward the stout disto-lingual part of the root (Plate 24, Fig. 141). No division whatever was seen on the facial aspect of the root. P_1 inf. sin. in this skull had one conical root without partial division, but with a moderate groove mesio-lingually.

On the roentgenograms no division of roots was seen. However, as partial divisions of the aforementioned type are difficult to decipher on roentgenograms, some may have been missed.

The partial root division here mentioned, corresponds to a tendency shown by some P_1 inff. of Whites to exhibit two more or less fused roots. This tendency has been described by Tomes, for which reason Shaw (299, p. 34) and Nelson (225, p. 284) use the term "Tomes' abnormal root". The same condition has been paid attention to by Visser (349, p. 22) a. o.

On a few Eskimo P_1 inff. there are faint to moderately marked longitudinal grooves on the rather flat mesial aspect of the roots, whereas there are none on the rounded distal and facial surfaces (cf. Mühlreiter—de Jonge-Cohen (221, p. 83) and Visser (349, p. 23).

M. de Terra (313, p. 240) reported 84 per cent of P_1 inff. to have one root. Visser (Amsterdam) examined 2,369 P_1 inff. (349, p. 22), 75.6 per cent of which had one conical root. 23 per cent showed marked mesio-lingual grooves, and 0.7 per cent had marked mesio-lingual as well as facial grooves. Another 0.7 per cent exhibited two separated roots. Hjelmman (128, p. 99) says of Finnish P_1 inff., "in 6 von 128 Fällen trug der erste untere Backenzahn eine unvollständig geteilte Wurzel." Kajava (159, p. 42) gives the following account of his findings in skulls of Finnish Lapps, "Die Alveole des ersten unteren Prämolaren war einmal durch ein Kamm unvollständig zweigeteilt; ausserdem beobachtete ich 5mal entweder eine zweiästige Wurzel oder eine Alveole mit zwei Ausläufern. Sonst war der Zahn regelmässig einwurzelig, ohne Längsfurche." Shaw (299, p. 35) in the Bantu found as many as 36.7 per cent with "Tomes' abnormal root". Nelson (225, p. 284) among 158 P_1 inff. of Pecos Pueblo Indians observed 16 (10.1 per cent) which exhibited "Tomes' abnormal root".

Hence it is borne out that the East Greenland Eskimo is less prone to have divisions of mandibular first premolar roots than are several other racial groups dealt with in dental literature.

Apical bends of lower first premolar roots were observed on the roentgenograms from East Greenland as demonstrated in Table 57 (p. 197), *i. e.* were not infrequently met with. In the skull material four teeth carried apical bends, all of them very moderate. Bends of the roots of P_1 inf. tend to point more often in the distal, than in the mesial direction.

The height of lower first premolar roots was measured at 8.7 mm as a minimum and 15.1 mm as a maximum. The average height of 13.5 mm is below most corresponding values for racial groups given in Table 58 (p. 198). Secondary shortening no doubt accounts for at least part of this difference.

The pulp cavity is of considerable size in the 19 specimens present in the skulls, as well as in the lower first bicuspids on the X-ray series of modern East Greenland dentitions. Two root canals (found in 2.3 per cent of Europeans by CHURCHILL (56, p. 172)), were only seen in the aforementioned case with Tomes' abnormal root (Plate 24, Fig. 141 b).

7. General Notes on Premolars.

The number of premolars examined in the skull material being rather small, the description of their crowns had to be based largely on the casts from East Greenland. Root conditions have been studied by means of the teeth and the sockets in the skulls, supplemented by roentgenograms of the skulls and the modern East Greenland dentitions.

The crowns of the Eskimo premolars, taken as a whole, are comparatively small. Whereas the Eskimo molars—or at least most of them—show a definite tendency to be larger than the corresponding teeth in Whites (Tables 36 and 37 (p. 122), Figs. 22 and 23 (pp. 190—91)), the Eskimo premolar crowns come closer to those of Whites as far as mass is concerned.

During the field work, all premolars of 20 modern East Greenlanders were noticed to be well below average size. The same applies to two of the skulls.

The size proportion of premolar crowns is the same as in Whites: In the upper jaw the average P_1 is stouter than the average P_2. In the lower jaw conditions are the reverse. Occasionally, however, the upper premolar crowns are almost equal in size (Plate 25, Fig. 142).

The general pattern of premolar crowns also seems to be largely the same in Eskimos and Whites, in so far as cusp numbers and arrange-

ment of the cusps are almost identical. The only feature suggesting difference of crown form, is found in P_1 sup., which in some cases has a larger mesio-distal diameter across the facial cusp as compared with that across the lingual cusp, than has the average P_1 sup. in Whites.

The root conditions are interesting, especially so, as far as P_1 sup. is concerned. The general tendency toward root-fusion of the Eskimo post-cuspid teeth, so to say, culminates in this tooth which in no case was found to carry two completely separated root branches, and in very few cases only was seen to have a bifurcated root tip. The incidence of two root canals in P_1 sup. is also far below that recorded for Europeans. Taken as a whole the premolars of the East Greenland Eskimo show a still more pronounced tendency to be one-rooted—with one wide root canal—than do premolars of white races.

8. Fusion of Molar and Premolar Roots.

From the description of the individual post-cuspid teeth and from Table 51, fusion of the roots is seen to be widespread in the East Greenland Eskimo dentition.

TABLE 51.

Incidence of fusion of molar roots in East Greenland Eskimo skulls. Both sexes.

Tooth		Maxilla							Mandible					
		No. examined	No. fusion	fusion of[1]					No. examined	No. fusion	fusion of[2]			no fusion
			three roots	lingual and mesio-facial	lingual and disto-facial	both facial	all three	supernum.		two roots	facial aspect	lingual aspect	total roots	three roots
			(I)	(II)	(III)	(IV)	(V)	(VI)		(A)	(B)	(C)	(D)	(E)
M_3	n	69	3	26	9	2	27[3])	2	33	7	2	7	14[4])	3
	%	..	*4.4*	*37.7*	*13.0*	*2.9*	*39.1*	*2.9*	..	*21.2*	*6.1*	*21.2*	*42.4*	*9.1*
M_2	n	76	18	37	2	4	13[5])	2	63	46	7	5	2	3
	%	..	*23.7*	*48.7*	*2.6*	*5.3*	*17.1*	*2.6*	..	*73.0*	*11.1*	*7.9*	*3.2*	*4.8*
M_1	n	77	73	1	3	..	..	..	64	56	..	..	..	8
	%	..	*94.8*	*1.3*	*3.9*	..	..	..	..	*87.5*	..	..	..	*12.5*

[1]) Types according to VISSER (347). Cf. p. 75.
[2]) Cf. p. 75.
[3]) Including 10 molars with "one root" (Table 45, p. 141).
[4]) Including 3 molars with "one root" (Table 45, p. 141).
[5]) Including 3 molars with "one root" (Table 45, p. 141).

Previous students of Eskimo teeth have made observations to the same effect:—

OETTEKING (228, p. 36) says, "Interessant ist am Schädel Nr. 3921 (Labrador) die vollständige Verschmelzung der Molarenwurzeln zu pris-

matischen Gebilden. GORJANOVIC-KRAMBERGER (1907) konstatierte derartige Verschmelzung beim Krapinamenschen bis zu 50 %." GORJANOVIC-KRAMBERGER (105, p. 1293) does not, however, share the view of OETTEKING. He is of the opinion that the Eskimo molar roots are not prismatic, they being rather of a fused conical shape, not at all resembling that of the prismatic Krapina roots. No doubt this view of KRAMBERGER is fully justified. (As has been mentioned by the present writer at an earlier stage, interpretations of the nature and significance of the real prismatic Krapina molar roots go widely apart.) HANTZSCH (120, p. 58) alludes to fusion of Eskimo roots in saying, "Die Zähne, die ja so wenig zerteilte Wurzeln haben . . ." LEIGH (185, p. 887) reports of American Eskimo skulls that, "there was noted a tendency for the roots of many teeth to be quite broad on their facial and lingual aspects," which may mean that a good deal of fusion occurred (cf. Plate 18, Fig. 98). WINGATE TODD (320, p. 258) directly says that the roots of the Eskimo "show a marked tendency to fusion." Quite recently ASHLEY MONTAGU (218, p. 105) expressed a similar view. RITCHIE (271, p. 64), however, failed to confirm the statement by TODD. On examination of the dentitions of Canadian Eskimo skulls, RITCHIE found that "with exception of the third molar, where variation is world-wide, there is no indication of fusion of molar roots." Considering the common occurrence of fusions in East Greenland Eskimos, one is surprised that the opposite state of affairs prevails in the Canadian Eskimo. The present writer is not in a position to explain this remarkable difference which does not seem to be artificial, since both RITCHIE and the present writer have seen quite a number of teeth outside their sockets[1]).

Fusion of roots has been observed and thoroughly studied in Whites by several authors (HJELMMAN (128), SCHWERZ (289), FABIAN (81), VISSER (347—49) a. o.). OWEN (234, p. 455), as early as 1840 made the following comment, "In Europeans it is not unusual to find the fangs of second and third inferior molars connate along a great part of their extent." In his atlas, OWEN shows the mandibular dentition of an European with partial fusion of the roots of M_2 and M_3 (l. c. Plate 119, Fig. 3) as well as upper M_2s and M_3s with fused roots (l. c. Plate 118).

In coloured races, fusion of roots was described by KAJAVA (159), who examined Finnish Lapps, by CAMPBELL (49), who studied Australian aboriginal skulls, by SHAW (299) on Bantu teeth, by DRENNAN (70) on teeth of Bushmen, by NELSON (225) on teeth of Pecos Pueblo Indians, by JANZER (151) on Melanesian teeth, and by NAKAYAMA on Japanese lower molars. NAKAYAMA (224, p. 1) found facial fusion in 6 per cent of M_3 inff., 32 per cent of M_2 inff., and 0 per cent of M_1 inff.

[1]) RITCHIE measured the roots of a fair number.

As far as can be seen from descriptions and illustrations, fusion is largely of the same type in all human groups on record. What is typical of the East Greenland Eskimo is a high incidence of fusions. Their very

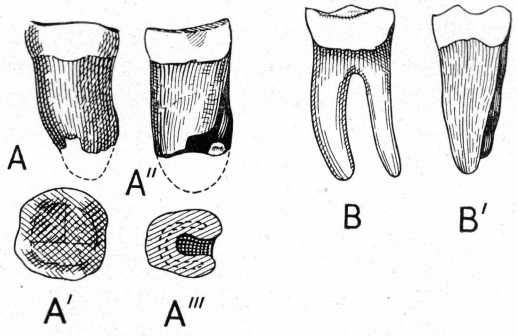


Fig. 20a. A, Labial aspect of second lower molar of Brelade dentition (Jersey); A′, Its chewing surface; A″, Distal aspect; A‴, Section of root; B, Labial aspect of the same tooth of a modern English dentition; B′, The distal aspect of the same. (Natural size). (KEITH (163)).

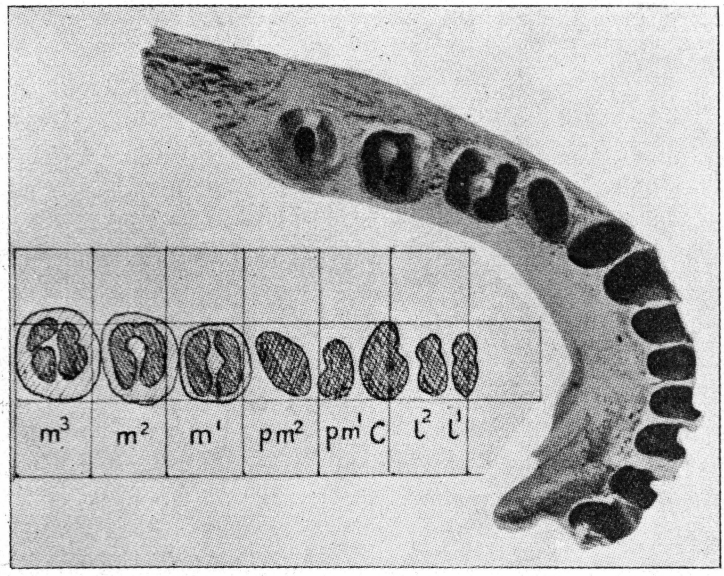


Fig. 20b. The tooth sockets of the Naulette mandible (KEITH (163)).

nature in the East Greenlander is hardly otherwise than in other racial groups, although they tend to be more complete, especially so as far as the lower second molar and the wisdom teeth are concerned.

Sir ARTHUR KEITH (163, p. 106 and 165, p. 685) has discussed the shape of the molar roots in various specimens of early man in Europe. With KNOWLES (168) he has given a thorough description of the Neander-

thaloid dentition from St. Brelade, Jersey. He also depicts the Neanderthal jaw from Naulette (163, p. 107). Both Neanderthals show fusion of lower second molar roots quite similar to what has been seen by the present writer on many Eskimo lower second molars. In fact, perfect identity of root conditions is found on comparison of cross sections of such East Greenland Eskimo M_2 inff. (Plate 25, Fig. 143e) with Fig. 20a (Jersey) and Fig. 20b (Naulette) taken from the original essay by KEITH (163, p. 106—07). In all three instances complete fusion of the facial aspect of the roots (no groove), is associated with a very deep longitudinal groove on the lingual side, lending more or less the shape of a horse-shoe to the cross-section at mid-root level. In the East Greenland Eskimo this type of "fusion", *i. e.* complete failure of division of roots on the facial side, associated with partial division of the lingual side, is found on the posterior lower molars (Table 51, p. 167). However, the reverse conditions are also met with, (complete failure of division lingually, deep groove facially) (Table 51, p. 167). Finally, on lower second molar roots, two low fangs may be branching off from a very high stem as described on p. 149, where it was shown by means of comparison with Plate 21, Fig. 122 and Plate 21, Fig. 123 from a paper by ADLOFF (5, p. 144), that this type of root condition reminds one of Neanderthal molar roots (Krapina non-prismatic cases). Summing up, we arrive at the conclusion, that root conditions in M_2 inf.—which is the tooth most suitable for comparison—are largely of the same type in various European Neanderthals and modern East Greenland Eskimo, as far as fusion of roots and shape of pulp cavities are concerned.

Whereas KEITH (165, p. 685) regarded taurodontism and allied conditions (fusion of roots, large pulp cavities) as specializations typical of European Neanderthal man, excluding him from the ancestry of modern man[1]), evidence has been forthcoming, *e. g.* through the present study, that a modern ethnic group may exhibit very similar conditions. Suggestions to this effect have from time to time been made by several authors, but so far no systematic studies of the Eskimo dentition have substantiated the general impression acquired by *e. g.* WINGATE TODD (320, p. 258) and ASHLEY MONTAGU (218, p. 105), that root fusions are common in the Eskimo. At any rate, no data on their incidence and no descriptions of their morphology have heretofore been made available.

It might be supposed now, that fusions of the facial—or lingual—aspects of the roots, and a high stem with low branches are entirely different conditions. This is, however, hardly so, because some of the skulls involved are found to exhibit one of the two former types of

[1]) KEITH (165, p. 686) says, "By the middle of the Pleistocene period there was a race of man which showed a very aberrant and highly specialized mode of tooth development."

fusion on one side, and the latter type on the other side of the mandible. An example of this is given on Plate 19, Figs. 111 and 112. Also, cases have been observed with this or that type of fusion on the one side, and no fusion at all on the other side (Plate 25, Fig. 144a and b). Such observations make it difficult to accept the idea that a general phylogenetic or racial factor governs the whole question. In fact such cases prove, that besides a general tendency—of whatever nature this is—local factors of some strength must be operating, when fusion of roots of the individual Eskimo post-cuspid teeth comes into existence. This, of course, is no extraordinary discovery. The material available, however, presents an excellent opportunity to point out and to stress the importance of ontogenetic (local) conditions which have hitherto been totally neglected in favour of phylogenetic considerations.

Before proceeding with the discussion of etiology of root fusion in the Eskimo, it may be appropriate to recall what is really happening when roots of multi-rooted teeth become "fused". The term "fusion", for the sake of comparison, has been used until now in the same descriptive sense in which it has been used by several previous authors who have recorded their findings in English[1]). *Sensu strictori* it is erroneous to speak of "fusion", because the condition under discussion is not the secondary coalescence of separated root branches brought about by overgrowth of cementum during adult life, but the state of affairs arising when roots fail to divide into branches during the development of the tooth. In other words, when genuine "fusion" occurs, a division has never existed. (It goes without saying that it may be difficult—not least so in mature Eskimo cases—to distinguish between non-division and secondary coalescence of root branches).

Histological work demonstrating the mechanism operating during the formation of separate roots has been made by Weski and Contreras (336, p. 238), and—much more thoroughly (in rats)—by Orban and Mueller (232, p. 297). The latter authors found that Hertwig's epithelial sheath at the future cement-enamel junction, will bend into a horizontal plane narrowing the wide cervical opening of the tooth germ and forming a diaphragm. Extensions from this diaphragm will grow towards each other and fuse, before the formation of the roots begins. The single opening of the coronal enamel organ thus becomes divided into two or three openings. On the pulpal surface of the dividing bridges, dentine formation will start, and on the periphery of each opening the root development will follow (Schour and Massler (285, p. 46—48)). In the case of "fusion", the events here recalled, fail to function in the ordinary way. Why and how the epithelial extensions in such cases do not develop, or fail to fuse in the bifurcation area, is not seen to have

[1]) German writers use "Verschmelzung" in a similar broad sense.

been established. In fact, proper material elucidating this question has not been published so far. The diagrammatic drawing by KEITH (165, p. 687) reproduced in Fig. 21 shows the principle of root division in modern man, (top), and the abortive division in Neanderthal man, (bottom). It must, however, be emphasized that the latter phenomenon is only typical of the most extreme (prismatic) Krapina cases.

Returning to the question of root fusion in the Eskimo, we consult a treatise by KNOWLES (172) on the glenoid fossa in the Eskimo skull.

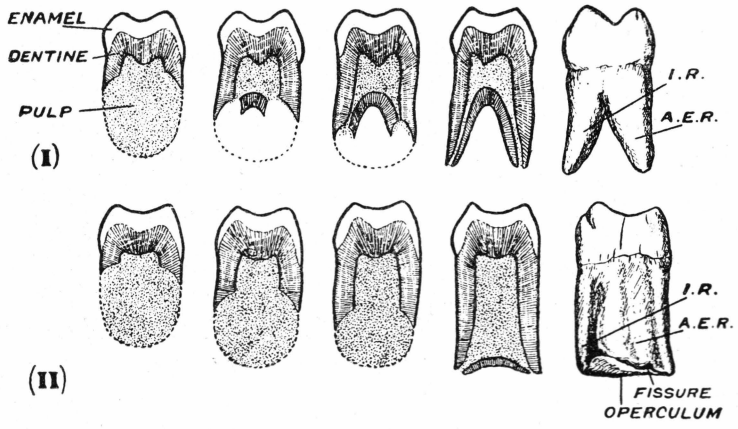


Fig. 21. (I), Stages in the growth of the upper second molar of modern man; (II), Corresponding stages in the growth or development of the same tooth in Neanderthal man. (KEITH (165)).

(He found this fossa to be shallow, which agrees very well with the findings by the present author in Greenland Eskimo skulls). Discussing the chewing habits of the Eskimo, KNOWLES (172, p. 7) touches upon root fusion. He seems to be of opinion that the fusions occurring in European Neanderthals as well as in modern Eskimo are due to "the great lateral strain thrown on the teeth in side to side mastication." On the whole, KNOWLES adopts the views of KEITH upon root fusion. There are, however, several points to indicate that the abovementioned explanation is likely to be incorrect: First, the second and third molars are much more prone to exhibit root fusion than the first molars, which receive at least as heavy strain of mastication. Next, as previously mentioned, the fusions of molar roots are not uniform in type. The latter fact seems to indicate a more complicated mechanism of etiology than that suggested by KNOWLES. Finally, as we have found quite a few unilateral cases of root fusion, they cannot all be due to excessive lateral strain. At least for the reasons mentioned here, the way of chewing does not seem to be an essential causative factor in Eskimo root fusion.

In the writer's opinion no satisfactory explanation can be given of the common occurrence of "fusion" of root branches in the East Greenland Eskimo dentition. Obviously the Eskimo has a general—inherited—tendency to develop this condition, but when and in which way this tendency was acquired by his ancestors, is obscure. No doubt —in the Eskimo as well as in other ethnic groups—local factors join in determining whether the individual tooth is going to develop separated root branches or not. The nature of that (or these) factor(s) is likewise unknown.

9. Description of the Canines.

Upper Canine.

Size of crown. The average length is calculated at 7.8 mm (min. 7.0, max. 8.4). The average breadth is 8.4 mm (min. 7.5, max. 9.1). The mean module of the crown is 8.1 (min. 7.4, max. 8.8). The measurements, however, are few in number, this circumstance imparting considerable uncertainty to the average values. On comparison with C supp. of other racial groups (Table 36, p. 123) the Eskimo upper canine takes no extreme position, being neither very stout nor very small on an average. On the other hand the extensive material examined and compiled by Remane (266, pp. 457—58) seems to indicate a tendency for the Eskimo upper canine tooth to be less stout than the corresponding tooth in many other racial groups. The impression acquired by the writer during his field studies in Greenland, is one of some variation in the size of upper canines, but in general the canine teeth of the East Greenland Eskimos did not seem to be large (Plate 26, Fig. 145). (Here of course it is the question of unworn canines only.) A survey of the casts of young Eskimo dentitions confirms that the canines (upper as well as lower) are, on the whole, of moderate size. On Plate 26, Fig. 146, C supp. are of exceptional size and projecting well above the level of the neighbouring teeth.

Table 52.

Dimensions of upper canines in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	8.1	8.6	*105.5*	*8.3*	*68.9*	17.3
	n	(9)	(13)	(9)	(9)	(9)	(5)
♀	M	7.6	8.0	*107.1*	*7.9*	*61.7*	14.8
	n	(7)	(8)	(7)	(7)	(7)	(3)
♂ + ♀	M	7.8	8.4	*106.2*	*8.1*	*65.8*	16.3
	n	(16)	(21)	(16)	(16)	(16)	(8)

Form of crown. According to SØREN HANSEN (116, pp. 25—26) and KNUD POULSEN (258, p. 142), the maxillary canines of the East Greenland Eskimo tend to be chisel-shaped. The present author has not been able to confirm this general statement. The general form of the crown is the same as in Whites (BLACK (30, p. 34) and MÜHLREITER—DE JONGE-COHEN (221, p. 55)), although there is a tendency for the East Greenland Eskimo upper canines to carry a more pronounced basal eminence on the lingual side of their crowns, as well as to exhibit fairly marked ridges along the outer limits of the lingual surface. Also, the middle lingual ridges tend to be strong in many cases (Plate 26, Fig. 147). According to SCHWERZ (289, p. 8), 19 per cent of 283 C supp. of Alamanni showed a basal eminence or tubercle ("Basalwulst"). In the Eskimo this feature is decisively more frequent. Reliable incidence, however, cannot be worked out on the basis of the material at the writer's disposal, and definitions are also too vague for proper statistical comparisons to be made. In no case had the basal eminence the character of a well-defined tubercle, let alone that of a cusp[1]). As far as this point is concerned, the writer did not feel justified in confirming the observations by SØREN HANSEN and HRDLICKA: The former worker (116, p. 25) reported that in an Anoritôq (South-East Greenland) skull "the left upper canine is somewhat chisel-form with a broad talon, resembling a first premolar." HRDLICKA (136, p. 232) made the comment on four Eskimo skulls from Smith Sound that, "the canines have each a short rudimentary ventral cusp."

Very peculiar is the high incidence of inciso-lingual enamel pearls of the type shown on Plate 26, Fig. 148. In East Greenland, the writer saw such pearls on both upper canines in two young cases (Nos. 39 and 314) and on one upper canine in another two cases (C sup. sin. in No. 50 and C sup. dext. in No. 54). In case No. 314, P_2 sup. sin. also had a pearl situated on the occlusal surface. Such pearls will be worn off the canines no later than during the early twenties, for which reason further cases are likely to have been present years ago among the mature East Greenlanders.

Root. All C supp. examined in the skulls and on the X-ray series of modern East Greenland dentitions have one root without divisions of any kind.

In the vast majority of cases the root is quite straight. No bends were met with in the skull material (Table 57, p. 197). On the roentgenograms from East Greenland 1.1 per cent of C supp. showed apical bends, *viz.* very slight distal deviations.

[1]) Such cusps were seen by BOLK (34, II, p. 35) on Dutch C supp. ("premolarisation"). In the Eskimo they were met with on I_2 supp. only.

The average height of the root is 16.3 millimeters (min. 7.5, max. 20.8). This range of variation is by far the greatest found in any Eskimo tooth, although a smaller number of C supp. were examined than of any other tooth (Table 58 (p. 198), cf. Plate 26, Fig. 147).

Many mature specimens show considerable resorption of the apical part of the root. Not infrequently, material difference between the height of the roots of the two canines has been found by the writer in Eskimo jaws. There are quite a number of teeth or sockets showing such a variation (Plate 26, Fig. 149). On examination of Central Eskimo skulls, he observed the same phenomenon. Fig. 150 (Plate 27) is the photograph of the upper canines of a young adult Central Eskimo. The teeth are not strongly worn and otherwise sound. The root of C sup. sin. (Plate 27, Fig. 150b) has experienced considerable resorption with compensatory hypercementosis of the remaining part. Slight resorption at the apex is also seen to have occurred on C sup. dext. (Plate 27, Fig. 150a). Notwithstanding the presence of such specimens among the canines left in the East Greenland skulls, the average root height is not very much below the general mean of root height recorded for other racial groups in Table 58 (p. 198).

A note on maxillary canine roots has been given by SCHENK (283, p. 171), who examined two Eskimo skulls from Labrador. He observed, "la racine des canines très developpée atteint le niveau de l'épine nasale."

The pulp cavity is of considerable size in the young Eskimo canines, and remains of fair size during mature age. In the crown, formation of secondary dentine starts very early and continues throughout life in pace with the progress of attrition.

LOWER CANINE.

Size of crown. The average length of the crown is 7.1 mm (min. 6.9, max. 7.4). The average breadth is 7.8 mm (min. 7.0, max. 8.4). The mean module is 7.3 (min. 7.0, max. 7.5). The small material examined makes comparison with other racial groups difficult. The Australian and Bantu seem to have stouter crowns on C inff. than most of the other racial groups on record including the Eskimo (Table 37, p. 123). The general impression gained by clinical work and a survey of the casts, is that of the moderate size of C inff. In some cases they even seem to be rather small.

Form of crown. The form of the crown is the same as in Whites (MÜHLREITER—DE JONGE-COHEN (221, p. 60), BLACK (30, p. 41)) except for a somewhat more marked tendency to develop (moderate) ridges along the margins of the lingual surface (Plate 27, Fig. 151).

TABLE 53.
Dimensions of lower canines in East Greenland Eskimo skulls.

Sex		Average crown					Average root height (max.)
		Length	Breadth	Index	Module	"Robustness"	
♂	M	7.3	8.0	*103.5*	*7.4*	*54.8*	16.9
	n	(4)	(11)	(4)	(4)	(4)	(7)
♀	M	6.9	7.1	*102.9*	*7.0*	*49.5*	16.1
	n	(3)	(3)	(3)	(3)	(3)	(3)
♂ + ♀	M	7.1	7.8	*103.2*	*7.3*	*52.5*	16.6
	n	(7)	(14)	(7)	(7)	(7)	(12)

Root. Among 72 C inff. in the skull material, one only had a bifurcated root (Table 45, p. 141). This tooth carried two separated root branches corresponding to the apical third of the total root height. The lower canine of the other side had one undivided root. Bifurcated roots were not observed in the X-ray series of modern East Greenland dentitions.

There were no cases with bent roots in the skull material. Only one of the lower canines which could be clearly seen on the roentgenograms of modern East Greenland dentitions had a crook (bent distally) at the apex (Table 57, p. 197).

The average height of the root is almost the same as for C sup., *viz.* 16.6 mm, but the range of variation (min. 14.9, max. 21.1 mm), though wide, is much narrower than for C sup. The highest root found on any Eskimo tooth, is that of a lower canine which measured 21.1 millimeters. The average root height exceeds that of Whites (BLACK), Bushmen (DRENNAN) and Pecos Pueblo Indians (NELSON), but is surpassed by that of Australians (CAMPBELL) and Bantu (SHAW).

Plate 27, Fig. 152 is an example of root resorption in a strongly worn Eskimo lower canine tooth (without opening of the pulp cavity by attrition).

Pulp cavity. What has been said of C sup. is true also of C inf.

10. General Notes on Canine Teeth.

Although molars, especially lower molars, are generally considered the most characteristic teeth, in classifying a given species, in the case of hominids, still more attention has been paid to the canines. Literature on the so-called canine problem is abundant. This problem has been dealt with at length by REMANE (266), WEIDENREICH (332, p. 51),

ADLOFF (7) and others. The search-light has been directed towards the morphology, size, position etc. of the anthropoid canine, and the corresponding conditions in early and modern man, with the ultimate purpose of providing evidence for or against the various views upon man's ancestry and his relations to the anthropoid stock. Nowadays, the comparatively small canine tooth of modern man is generally supposed to have been inherited from a remote ancestral form in which the canines had not yet specialized in the anthropoid direction. By some students of man's evolution, *Parapithecus* or *Propliopithecus* are presumed to be the fossil primates, from which hominids (as well are as anthropoids) have developed. A principal reason for this assumption is the absence of anthropoid specialization of their canines.

Among modern human races there is a considerable individual variation in size of canines[1]), but there does not seem to be any evidence to the effect that one modern racial group has definitely more robust canines—as compared with the other teeth—than have others. In modern human races, the size of the canine crown on the whole tends to be in harmony with the robustness of the neighbouring members of the dentition. In early hominids, such as *Sinanthropus*, however, the robustness of the canines in proportion to the neighbouring teeth is very conspicuous.

No doubt a thorough study of the Eskimo canine as to size proportions and anatomical details would have been worth-while. Regrettably, however, the material at our disposal is not suitable for anything but a mere orientation. In the skull material most of the canine teeth have been lost *post mortem*. The casts of young Eskimo dentitions are rather few in number. Moreover, one is not inclined to rely too much upon the accuracy of impressions of undercut tooth crowns taken under field conditions in 1937, when dental impression technique was less perfect than it is to-day. Therefore, no measurements were taken of the canine teeth on the casts.

In the section on premolars, the latter were said to be smaller in proportion to the molars in the Eskimo, than in Whites. This also seems to hold good of the canines. Hence the possibility suggests itself, that the size of premolars and canines may to some extent be governed by factors, which are not absolutely identical with those determining the size of the molars.

The form of the Eskimo canine crowns does not differ appreciably from that met with in Whites. Yet, the tendency shown to such a great extent by the incisors, to develop pronounced marginal ridges, is also present in the canines, but to a much less marked degree. This typical

[1]) Cf. REGNAULT (264, p. 16).

feature of Eskimo anterior teeth is characteristic of Mongols and will be dealt with more thoroughly later on.

The roots of the canines are rather stout. In the young Eskimo they do not seem to be lower than the canine roots of Whites, but definite information on "normal" root conditions cannot be given on the basis of the present material, in the first place because it is too small, and in the second place because considerable secondary changes are noticed already to start during young adult age (cf. Plate 26, Fig. 149 and Plate 27, Fig. 150).

11. Description of the Maxillary Incisors.

The number of upper—as well as lower—incisor teeth present in the skull material is very small (Table 16, p. 69), and the incisors which are left are in almost every instance extremely worn. For the above reasons no complete information can be given of the dimensions of the East Greenland Eskimo incisors. To make up for this, however, the mesio-distal diameters of a series of upper incisors were measured on casts of 45 dentitions of modern East Greenlanders aged 7 to 20 years. These measurements will be presented and discussed after the description of the individual incisors.

Upper Lateral Incisor.

The form and size of this tooth is much more constant in the East Greenland Eskimo than in Whites. As has been shown in the chapter on dental numerical variations, the Eskimo, although very prone to congenital absence of lower incisors and third molars, seldom fails to develop the upper lateral incisors. In perfect accordance with this fact is the rare occurrence of real vestigial forms of upper lateral incisors. Out of 305 East Greenland Eskimos aged 6—21 years, two only had peg-shaped upper lateral incisors. Both cases were bilaterally affected (Table 56, p. 196). There was one additional case with two small teeth replacing the left upper lateral incisor (Plate 1, Fig. 28).

According to Mühlreiter—de Jonge-Cohen (221, p. 42) and de Jonge-Cohen (155, p. 287), four types of upper lateral incisors occur. In the Eskimo, the first three types are difficult to distinguish on account of early pronounced attrition, whereas the fourth type—the peg-shaped—is easily recognized even in mature cases. Noteworthy secondary changes of form brought about by attrition, however, are absent in Eskimo children, and a sufficient number of casts of young dentitions are available, to secure the impression of a prevailing incidence of lateral incisors, very similar in form to median incisors (type I of Mühlreiter).

The condition described by HRDLICKA (139) as "shovel-shaped incisors" or "keilo-koilomorphy", *i. e.* the typical rim and fossa configuration of the incisors dealt with later on, is almost constantly found on East Greenland Eskimo maxillary lateral incisors.

The facial surface of the crown is rather flat. In some cases two faint longitudinal depressions can be seen. The lingual surface presents features distinctly different in quantity from those prevailing in Whites (cf. DE JONGE-COHEN (155, p. 288)): —

In a very high percentage of cases, the lingual surface on the Eskimo upper lateral incisor, exhibits a hollow which is bounded mesio-distally by more or less well-developed elevations or marginal ridges[1]). The latter converge towards the summit of the crown, and here fuse with a more or less pronounced heel or tuberosity, the *tuberculum dentale* (Plate 27, Fig. 153). The dental tubercle, however, is not constant. It may be totally absent; it may be represented merely by a slight thickening between the meeting marginal welts or by one or more small tubercles or ridges. Finally, there may be a low to pronounced tubercle, which in a few instances develops into a more or less free lingual cusp of considerable size (Plate 30, Fig. 183). On some lateral incisors, a faint ridge is seen to connect the middle of the incisal edge with the meeting point of the marginal ridges, at the summit of the lingual surface (Plate 11, Fig. 66).

One hundred I_2 supp. present at death in the skull material (teeth or sockets) in all instances carried one undivided root (Table 45, p. 141). On the X-ray series 230 I_2 supp. appeared to be one-rooted. Three of them (1.3 per cent), showed a tendency to have a distal drifting of the apical part of their roots (Table 57, p. 197). The roots of the upper lateral incisors seemed to have been subject to even greater secondary shortening than the roots described up till now. Although some variation occurred, the roots of the maxillary lateral incisors on the whole were low.

The pulp cavity is large in young teeth, but during mature age becomes more or less obliterated. When the crown has been entirely worn off, the pulp canal may be totally filled with secondary dentine, but generally the root canal remains visible (Plate 30, Fig. 189).

UPPER CENTRAL INCISOR.

On the whole, the difference in size of lateral and median incisors is not very conspicuous in the East Greenland Eskimo; therefore when the difference is marked, this is readily observed. During the examination of 305 Eskimos aged 6—21 years, 32 cases of the latter type were noted.

[1]) Marginal ridge = *limbus dentalis.*

The central incisor crown in many cases shows two longitudinal grooves on the facial surface. They may be bounded by faint ridge-like longitudinal eminences near the mesial and distal margins. On the whole the facial surface of Eskimo median incisors is less convex in either direction than on the corresponding teeth in Whites.

In several respects the lingual surface of I_1 sup. resembles that of I_2 sup. Marginal ridges are almost universally present, often to a pronounced degree. The *tuberculum dentale* is less constant than on I_2 sup. When present, it shows a tendency to divide into several small flame- or finger-like extensions. No well-developed lingual cusps have been seen on I_1 supp. The median ridge is very pronounced in a considerable number of cases, of which Figs. 155—57 (Plate 27) are examples. Instead of one, there may be two ridges.

In one case, the left upper median incisor was observed to consist of two specimens fused into one tooth of very considerable mesio-distal diameter, or perhaps, rather, to be partially divided into two lobes (BOLK (39, p. 210), DE JONGE-COHEN (157, p. 313 and 158, p. 753)). An incisal notch and a lingual longitudinal groove were noted[1]).

The root was never seen to have divided (Table 45, p. 141). Out of 232 specimens on the roentgenograms of modern East Greenland dentitions, three (1.3 per cent) had slight bends of the apical part of their roots (Table 57, p. 197).

The height of the roots has not been measured. In many adult and mature cases, however, the sockets of the median incisors were of extremely small dimensions measuring, at most, 6 to 7 millimeters. In such cases, the sockets of the lateral incisors, and other teeth lost *post mortem*, were deeper. The extreme shortening of the median incisors is not exceeded by that of any other tooth in the East Greenland Eskimo dentition. When X-ray series of increasing individual age are studied, it is clearly borne out that progressive resorption of the root apices takes place in Eskimo teeth. This progressive shortening is especially pronounced on the upper median incisors. Plate 28, Figs. 158—67, and Plate 30, Figs. 184—86 are roentgenograms of modern East Greenlanders, (increasing age), showing various degrees of resorption of the roots of otherwise sound incisor teeth.

The pulp cavity is of the same relative size as that of I_2 sup. What has been said of secondary narrowing of the pulp cavity in I_2 sup. also applies to I_1 sup., the only difference being that it occurs a little earlier in the central incisor.

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[1]) HRDLICKA (138, p. 49) reported on an Indian case with this condition, and TRATMAN (327) found several cases among Chinese patients.

12. Description of the Mandibular Incisors.

On account of their bad state of preservation, no measurements were taken of lower incisors.

In almost all respects the East Greenland lower incisor crowns come so close to the corresponding crowns in Whites, that a special description can be dispensed with. The lateral incisor crowns are clearly more robust than the crowns of the median incisors. The form differs a little from that found in white races, in so far as there is a tendency with the Eskimo to develop slightly shovel-shaped lower incisors. In the majority of shovel-shaped cases the lingual surfaces are bounded by ridges which are just perceptible. No instance of marked dental tubercle has been observed.

All lower incisors examined in the skull material and on the X-ray series have one root (Table 45, p. 141), which is straight in almost all cases (Table 57, p. 197). The pulp cavity, originally of good size, becomes narrow rather early, especially so in central incisors.

13. General Notes on Incisors.

Size and Size Proportion of Upper Incisors.

The metrical examination of the incisors is, for reasons previously given, very incomplete. To get some impression of the size of the upper incisors, however, their mesio-distal diameters (lengths of crowns) were measured on casts made of the dentitions of 21 male and 24 female East Greenland Eskimos, aged 7 to 20 years. Of course the objections made against metrical examination of the canines on casts (p. 177) may also be made against metrical examination of the incisors. However, on account of the shape of the latter, the possibility of deformation is less likely.

In Table 54 (p. 182) the average mesio-distal diameters of Eskimo incisors, as well as minimum and maximum values, are being compared with corresponding values reported for racial groups by various well-known authors. No definite conclusions can be arrived at, but comparison suggests that the upper median incisors of the Eskimo, are rather below than above average, as far as the mesio-distal diameter is concerned. On the other hand, the Eskimo upper lateral incisor tends to have a longer mesio-distal diameter than the corresponding tooth in most other groups, especially so as compared with the data given for American Whites by Black.

By the comparison in Table 54 (p. 182)—the significance of which must not be overestimated—the general very persistent impression acquired during the field work, is substantiated, *viz.* that (1) the Eskimo

TABLE 54.

Racial survey of mesio-distal diameters of maxillary incisors.

Group and Author		I_2				I_1			
		No. exam.	Mesio-distal diameter of crown			No. exam.	Mesio-distal diameter of crown		
			Mean	Min.	Max.		Mean	Min.	Max.
East Greenland Eskimos (present study)	♂	39	*6.92*	5.0	7.8	42	*8.46*	7.0	9.3
	♀	48	*7.16*	6.6	8.2	47	*8.36*	7.8	9.9
	♂+♀	87	*7.05*	5.0	8.2	89	*8.41*	7.0	9.9
Bantu (SHAW) (299)		66	*7.2*	5.8	8.0	66	*8.9*	7.5	10.0
Pecos Pueblo Indians (NELSON) (225)		84	*7.06*	6.17	8.00	105	*8.67*	7.56	9.84
Bushmen (DRENNAN) (70)		24	*6.7*	..	..	25	*8.3*	..	..
Australians (CAMPBELL) (49)		78	*7.7*	..	..	56	*9.4*	..	..
Javanese (MIJSBERG) (215)	♂	131	*7.0*	..	..	129	*8.6*	..	..
	♀	38	*6.7*	..	..	35	*8.2*	..	..
Melanesians (JANZER) (151)	♂	62	*7.6*	6.5	9.0	57	*9.1*	8.0	10.1
	♀	69	*7.4*	6.0	9.3	59	*8.9*	8.0	10.1
American Whites (BLACK) (30)		?	*6.4*	5.0	7.0	..	*9.0*	8.0	10.0
Finns (HJELMMAN) (128)		61	*6.6*	5.0	7.7	15	*8.5*	7.6	9.9
Germans (MÜHLREITER) (221)		?	..	5.0	8.0	..	..	6.9	10.6
Alamanni (SCHWERZ) (289)		?	*6.7*	5.0	9.0	..	*8.7*	5.0	10.9
European Whites[1] (CHOQUET) (55)		19	*6.4*	5	7.6	17	*8.5*	7	10
Swedes (SEIPEL) (292)	♂	469	*6.81*	..	..	483	*8.84*	..	..
	♀	476	*6.64*	..	..	490	*8.62*	..	..

[1]) Principally French.

upper incisors—like the premolars and canines—are of modest size compared with the molars, and that (2) the central and lateral incisors tend to be more equal in size (mesio-distal diameter), than in Whites.

The mean difference between the mesio-distal diameters of neighbouring upper lateral and upper central incisors in the Eskimo of East Greenland is 1.36 mm (against 2.7 to 1.4 mm in the other groups in Table 54). When going over the individual series, we find the minimum difference between a central incisor and the neighbouring lateral incisor to be 0.6 millimeters (Plate 28, Fig. 168). The corresponding maximum value of 3.0 mm (Plate 26, Fig. 146) is one of a few exceptions from what has been said of the size proportion of median and lateral maxillary incisors in the Eskimo.

The apparent sex differences (Table 54) do not survive statistical scrutiny. They are discussed in a following section of this chapter.

The Lingual Surface of Incisors.

In early publications on physical anthropology of the American Indian, Hrdlicka (132, 133, 134, 135) called attention to *the shovel-shape of the upper incisors.* Later on, he also found this condition in the Eskimo (136). In 1920—21, Hrdlicka (139, 140) made thorough studies of the entire question of lingual configuration of human and anthropoid incisors. Thanks to the work by Hrdlicka, shovel-shaped teeth and their racial distribution have been given great prominence in anthropological literature, especially so in America, whereas his work on the whole has been disregarded in European dental literature.

Shovel-shaped incisors have been described in great detail by Hrdlicka (139, p. 446). The lingual surface of a shovel-shaped incisor is more or less hollow. The central fossa—which may be crossed by one or two longitudinal ridges—is bounded by elevations along the distal and mesial margins (Plate 29, Figs. 169—79, and Plate 30, Figs. 180—82). In pronounced cases with marked attrition, these welts are clearly seen to consist of dentinal ridges covered on three sides by a thick layer of enamel[1]) (Plate 29, Fig. 175). As they converge gingivally, the marginal ridges merge into the tuberculum, if the latter is present or, if not, fuse with one another. The shovel-shape of the incisors is mostly confined to the upper jaw. When present in the lower jaw, the shovel-shape is always less pronounced.

Hrdlicka (139, pp. 449—58) made an extensive survey of the incidence of shovel-shaped incisors in various racial groups. He found them to occur almost universally and to a pronounced degree, in American Indian, Eskimo and Mongolian skulls as well as in Chinese and Japanese examined in their native countries. In Hawaiian natives the incidence was considerably lower. Still lower incidence was found in the American Negro. In white Americans the incidence was negligible. Hrdlicka used a classification in "shovel-shaped", "semi-shovel-shaped" and "trace shovel-shaped" forms, which has been adopted by some later students (Shaw, Nelson a. o.). This classification enabled him to draw a more complete and hence more valuable picture of racial distribution of shovel-shaped teeth, than that obtainable by merely recording the percentage incidence. The skulls of American Indians and Asiatic Mongols, besides exhibiting an almost 100 per cent incidence of shovel-shaped incisors, showed the highest percentages of pronounced forms. The Eskimo, though showing a similar universal occurrence of the condition in question, had a perceptibly lower proportion of typically developed shovel-shaped incisors than had either the Indians or the Asiatic Mongols (139, p. 449). Among American Whites, studied by Hrdlicka, shovel-shaped and semi-shovel-shaped types together, involved 5 per cent of the persons examined, while fully 50 per cent were without any trace of this condition. In 38 per cent of American Negroes, 10 per cent of Hawaiians, 6 per cent of Chinese and 3 per cent of Japanese (all males), shovel-shape was absent. The typical shovel-shape was seen in 1 per cent of white Americans, 4 per cent of American Negroes, 33 per cent of Hawaiians and well above 50 per cent of Chinese

[1]) Hrdlicka apparently did not notice that the dentine is involved.

and Japanese (all males). Further data on American Indians (Pecos Pueblo) have been provided by NELSON (225, p. 288) who found 2.2 per cent of I_1 supp. and 1.4 per cent of I_2 supp. to be without shovel-shape. Typical shovel-shape occurred in 74.1 and 72.0 per cent, respectively. MONTELIUS (219, p. 506) to whom we are indebted for a good deal of valuable information of the dentition of the Chinese, reported that 79 per cent of 4,474 Chinese were found to have shovel-shaped incisors. As has been pointed out by WEIDENREICH (332, p. 23), however, the real percentage is still higher, since among the remaining 21 per cent there were many natives with extensive loss of anteriors, and severe attrition.

In the Bantu, SHAW (299, p. 45) recorded shovel-shape of 16.6 per cent of upper incisors, but 1.5 per cent only were typically shovel-shaped.

Shovel-shape of maxillary incisors occasionally occurs — even to a pronounced degree — in modern Whites. DE JONGE-COHEN (155), on examination of the large Amsterdam collections, found quite a number of beautiful specimens.

Some European Neanderthals exhibited shovel-shaped incisors, *e. g.* the teeth from Krapina (ADLOFF (11, p. 493)). In *Sinanthropus*, according to WEIDENREICH (332, p. 22), the upper incisors show the shovel-shape pattern to a very pronounced degree. From this fact WEIDENREICH (332, p. 23) concluded that *Sinanthropus* must be more closely related to present-day Mongols than to any other modern human group.

The brief review of literature just given, bears out that the shovel-shape is a normal tooth pattern among at least the following ethnic groups of yellow-brown stock: Chinese, Japanese, American Indian and Eskimo[1]), whereas shovel-shaped incisors are exceptions in Whites. This view is shared by most anthropologists. Authors of recent treatises on human races such as BEAN (21, p. 92) and ASHLEY MONTAGU (218, p. 105) consider it an universally accepted fact that shovel-shaped incisors are a typical racial character of yellow-brown races.

As far as the Eskimo is concerned, shovel-shaped incisor teeth were alluded to by HRDLICKA long before he made his comparative survey. In his "Contribution to the Anthropology of Central and Smith Sound Eskimo" (1910), HRDLICKA (136) mentioned this condition several times, although the term "shovel-shape" had not yet come into being, "Upper incisors spade-like, as in Indians" (p. 225); "the upper incisors are ventrally all spade-like in shape" (pp. 226 and 227); "the upper incisors are seen, in all cases where they have not been too far worn down, to have the peculiar spade-shaped ventral appearance common to the Eskimo and the Indians" (p. 261). On examination in 1920 of 40 I_1 supp. of Eskimo (origin not stated), HRDLICKA (139, p. 446) found 37.5 per cent shovel-shaped, 47.5 per cent semi-shovel-shaped, and 15 per cent trace shovel-shaped. The corresponding percentages for 37 I_2 supp. were 57 and 43 and 0 respectively. In a more recent publication on the Alaskan Eskimo from the Kuskokwim area, HRDLICKA

[1]) In a letter to the writer Professor TRATMAN (Singapore) says, "The Mongolian stock exhibits a high percentage of shovel-shaped upper incisors: the lower are also occasionally affected."

(147, p. 100) says, "Morphologically the main peculiarity of the teeth is the general more or less shovel-shaped form of the upper incisors in the young."

While RITCHIE (271) does not mention shovel-shaped incisors in his report on the Canadian Eskimo dentition, LEIGH (185, p. 887) gives the following description of conditions prevailing in the skulls of 325 Eskimos, principally from the American Continent, "The marginal ridges and cingulum of the upper incisors of the Eskimo are prominent in a large number of cases; this convex elevated margin produces a

TABLE 55.

Incidence of shovel-shaped incisors in modern East Greenland Eskimos. 116 casts, both sexes.

Number of casts examined		Upper jaws with shovel-shaped incisors pronounced	Upper jaws with shovel-shaped incisors faint to moderate	Upper jaws. Incisors not shovel-shaped
116	n	97	17	2
	%	*83.6*	*14.7*	*1.7*

roughly triangular concave central fossa on the lingual aspect . . . The elevation of the marginal ridges is not so prominent in the Eskimo as in the Indians and the occurrence not so constant."

The configuration of the lingual surface dealt with by the aforementioned authors under the caption of shovel-shaped incisors, has been examined by the present writer in the East Greenland Eskimo material at his disposal. As far as the skulls are concerned, the unsatisfactory condition of the anterior teeth prevented a statistical survey. By means of the casts, however, a reliable impression of the incidence could be obtained, since no selection of cases had been made in this respect, when it was decided which natives were going to have impressions taken. The data thus obtained on incidence and degree of shovel-shaped maxillary incisors is given in Table 55. It bears out that 98.3 per cent of the upper casts show shovel-shaped incisors to a more or less pronounced degree. The classification of degrees is based on a personal estimate. The latter may very well differ considerably from that of HRDLICKA and others, the more so because none of them told what was exactly meant by "pronounced shovel-shape", "semi-shovel-shape" etc. Plate 29, Figs. 169 and 170, and Plate 30, Fig. 182 (central incisors) show types classified by the present writer as being "pronounced", "moderate", and "faint", respectively. To test the diagnosis "shovel-shape" and to augment the number of observations, the writer

also surveyed the roentgenograms from East Greenland[1]). In the latter material of 124 maxillae, 120 (96.8 per cent) exhibit shovel-shaped incisors. This is very nearly the same as found on the casts (Table 55, p. 185). Roentgenograms of shovel-shaped incisors are presented on Plate 29, Figs. 176 and 177. As did HRDLICKA, we found that, on an average, lateral incisors are affected a little more frequently and have slightly more pronounced marginal ridges than central incisors. Judging from the appearance of Indian incisors shown by HRDLICKA (139, Plate I), the writer agrees with HRDLICKA as well as with LEIGH (185, p. 887), that the shovel-shape is, on the whole, less pronounced in the Eskimo than in the American Indian.

No systematic study was made of East Greenland Eskimo lower incisors. As has previously been said, there is a tendency also for the lower incisors to exhibit this condition. In no instance, however, does this tendency lead to marked shovel-shape.

Another structure on the lingual aspect of the Eskimo upper incisors which deserves attention is the *tuberculum dentale* (Plate 29, Figs. 178—79, and Plate 30, Figs. 180—81). It is not always present in the Eskimo. As is the case in Whites (DE JONGE-COHEN, 155, p. 289), it occurs much more often, and also tends to be more pronounced, on the lateral than on the median incisor. The tubercle has been described separately, for the individual East Greenland Eskimo upper incisors.

The tubercle, as emphazised by ADLOFF (11, p. 493) and HRDLICKA (139, p. 465; 140, p. 173), has *per se* nothing to do with the shovel-shape, although of course they may coincide. The dental tubercle represents the cingulum or basal heel of primate teeth (HRDLICKA (139, p. 465)). According to BOLK (39, p. 283) it is the equivalent of the deuteromere of the post-cuspid teeth. In the Eskimo as well as in Whites, the tubercle may still be divided into several cusplets (Plate 27, Fig. 153, and Plate 29, Fig. 178) and occasionally may develop into an accessory lingual cusp of considerable robustness. Lingual tubercles on upper incisors were discussed by M. DE TERRA (313, p. 235) who gave a good review of older literature on this subject. The incidence of dental tubercles in Finns has been reported by HJELMMAN (128, p. 20). The dental tubercle has been dealt with by many authors from morphological and evolutionary points of view (*e. g.* by MÜHLREITER—DE JONGE-COHEN (221, p. 32), BOLK (39, p. 223), SCHWERZ (289, p. 2), HRDLICKA (140, p. 172), ADLOFF (4, p. 11), DE JONGE-COHEN (155, p. 285) and WEIDENREICH (332, p. 18)). ADLOFF (4, p. 11) and

[1]) The cases of which impressions were taken are not in all instances identical with those of which roentgenograms are available.

WEIDENREICH (332, p. 18) consider the tubercle to be a decisively primitive character.

No accounts of the development of the dental tubercle in the Eskimo have been published so far. Hence it might seem appropriate to endeavour to establish the incidence of the latter on the casts at our disposal. However, this cannot be done with any certainty, because, on account of the frequent shovel-shape, it is not possible to decide what is a trace of tubercle and what is mere basal confluence of marginal ridges. On the other hand, if we confine ourselves to count basal eminences, equal to, or beyond the size of that shown in Plate 27, Fig. 157, we may arrive at a fairly accurate incidence of what may be designated "marked tubercles". In so doing, we exclude what may be considered "lingual cusps" proper, and leave them for separate consideration.

Marked dental tubercles were found on the upper incisors of the casts as follows: —

On 224 I_2 supp. 32 times, *i. e.* 14.3 per cent of upper lateral incisors
- 232 I_1 supp. 10 — — 4.3 — — - upper central incisors

Strongly developed lingual cusps were seen on I_2 supp. only, *viz.* in six cases (two unilateral, four bilateral) out of 586 Eskimos examined in East Greenland (6—35 years of age), *i. e.* 1.0 per cent of cases. A bilateral case, a woman of 28 years, is shown on Plate 30, Fig. 183.

HRDLICKA (140, p. 173) says, "these accessory cusps have been known in dental literature, but their exact frequency and racial distribution have never been determined. Such determinations moreover are not easy, the difficulty, lying in what to and what not to include under the term "cusp", particularly in the case of the median incisors. As a result, probably no two observers would reach precisely the same results on the same series of specimens; but the difference would in all probability not be serious enough to obscure the main facts." Strange to say, HRDLICKA himself does not give any hints whatever as to the criteria employed during his comparative study of the incidence of "lingual cusps" on upper incisors (140, p. 174). From the results of his study, however, it is clear that he included a good many dental tubercles in his statistics on the frequency of "lingual cusps". For this reason no proper comparisons can be made between HRDLICKA's findings and those of the present writer. It is interesting, however, that HRDLICKA (140, p. 174) says, "The writer's impression is that these cusps are not more frequent among the yellow-brown peoples than among the whites. Data on Indian teeth indicate conditions but little different from those in the Whites and American Negroes."

Finally, attention is called to the presence of *median ridges* on the lingual aspects of a rather high proportion of East Greenland upper incisors. Such ridges have been studied and described in modern man by HRDLICKA (140, p. 163) and DE JONGE-COHEN (155, Fig. 5). They are very strong on the anterior Krapina teeth (M. DE TERRA (313, p. 236)) and occur to a pronounced degree in anthropoids (HRDLICKA (139, p. 460)). In the East Greenland Eskimo they seem to be more common than in Whites, but it is impossible to give anything like accurate incidence because many teeth exhibit only faint traces of median ridges. Moreover, no data are available for comparison. Plate 27, Figs. 154—57 show median ridges on upper central incisors, where they are more marked than on the lateral incisors.

The significance of the structures dealt with in this section, is more or less obscure. Whereas the frequent shovel-shape (keilo-koilomorphy) is known to be an inherited racial characteristic, or specialization, definitely establishing affinity of Eskimos, Indians and Asiatic Mongols, the significance of the dental tubercles is less clear. We have it on the authority of prominent anthropologists, that high incidence of pronounced dental tubercles is suggestive of primitive status of the dentition of a human group. As far as can be estimated from the material available to the present writer, the East Greenland Eskimo does not show any very high incidence of dental tubercles. On the contrary, it seems to be very much the same as in other modern human groups on record. Certainly, it is not known to what extent comparison with the data given in literature is justified.

According to HRDLICKA (140, p. 166), the median ridge (or ridges, for occasionally there may be two or even three), is quite a separate, and yet apparently, functionally, related feature, which like the marginal ridges tends to strengthen the teeth. Both types of ridges, according to the same author (139, p. 465), have been lost in modern white races due to decreasing function, while they are still present to a pronounced degree in early man, who made greater demands upon his teeth. Of the shovel-shape (marginal ridges) HRDLICKA (139, p. 465) says, "The great frequency of this condition in the present day yellow-brown peoples, may on the other hand probably be explained, not so much by the great call upon the teeth in these races, as by hereditary persistence from earlier times, together possibly with the play of selection." It is not easy to see the harmony of these views, and the present writer strongly feels that there is a great need for additional facts to be forthcoming before general conclusions can be drawn.

14. General Notes on the East Greenland Eskimo Dentition.

Size of Crowns.

The general impression acquired by observers of Eskimo anterior teeth *in situ*, is one of small, or rather small teeth (cf. pp. 60—63). Considering the very impressive attrition of the front teeth, however, one cannot rely too much upon the non-professional observer who quite naturally relates what he has actually seen, *i. e.* incisor crowns more or less worn down. Consequently very little, if anything, is learnt of anatomical tooth-size from general statements by arctic explorers, ethnographers etc.

Turning to dental and anthropological literature, we find that M. de Terra (313, p. 84) measured a few teeth in two skulls from Greenland. He says, "Die Zahnmasse sind sehr klein." Judging from the measurements given by M. de Terra, the teeth must have been considerably worn. Hrdlicka (136) examined Eskimo skulls from Southampton Island and other Canadian territories as well as from Etah in Greenland. As far as the Canadian skulls were concerned, Hrdlicka (136, p. 211) arrived at the conclusion, that, "the teeth are generally slightly larger than the average teeth of Whites." Of four skulls from Smith Sound Hrdlicka (136, p. 260) says, "The size of the teeth is generally medium or but slightly above." In a later publication, Hrdlicka (143, p. 424), reporting measurements of lower molars from various racial groups, was of the opinion that Eskimo molars are of considerable size. He calculated mean modules and concluded, "The largest molar mass is found in the Eskimo, which agrees with what we know of the demands he makes upon his teeth." Leigh (185, p. 886) says, "The teeth of the Eskimo are quite large and well developed," and Ritchie (271, p. 64), referring to his measurements of Canadian Eskimo teeth, makes the following comment, "The average measurements of the Eskimo teeth tend to be greater than those of more civilized races. This is particularly true of the molar series." Among East Greenland Eskimo skulls examined by Søren Hansen (116, p. 24) there is one from Anoritôq (South-East Greenland), of which the author says that, "the teeth are on the whole small." Søren Hansen made no general comments on tooth-size in his East Greenland material and made no measurements.

The size of East Greenland Eskimo molars, premolars, canines and incisors has been discussed in earlier sections of this chapter. It has been pointed out that while the Eskimo molar crowns tend to be—on an average—above the size reported by Black for Whites, the premolars, canines and incisors tend to be relatively smaller, *i. e.* on the whole about the same size or even slightly below the size of crowns

registered by BLACK for Whites. Certainly no definite conclusions can be drawn tooth by tooth on the basis of the material at our disposal as to size of molars, premolars etc. in Eskimo versus Whites. For neither group is the evidence available absolutely convincing in a quantitative respect (cf. Figs. 22, p. 190 and 23, p. 191).

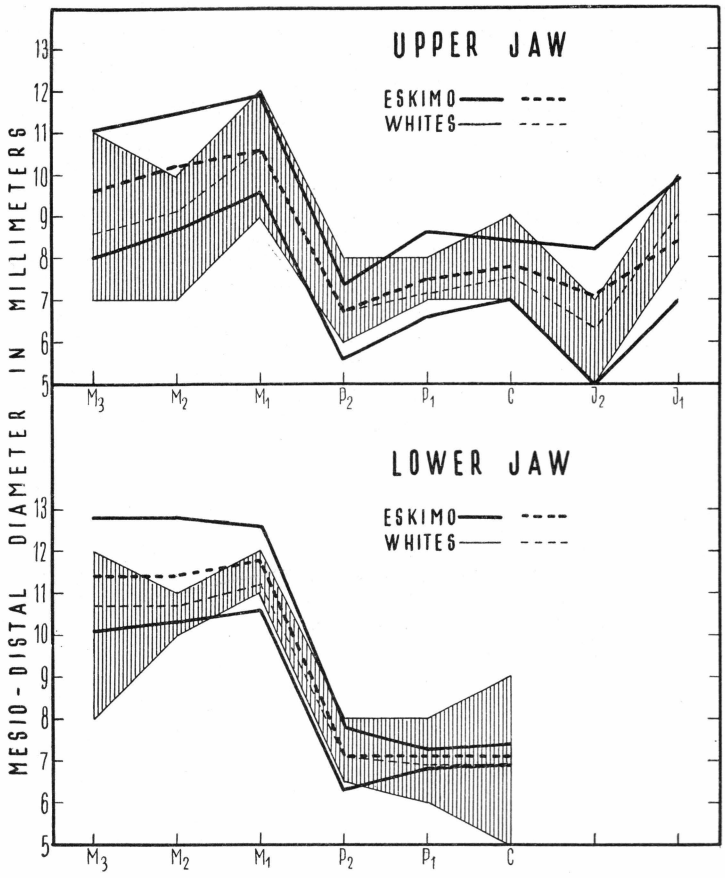


Fig. 22. Length of crowns in East Greenland Eskimos (skulls, present study) and American Whites (BLACK (30)). Maximum and minimum values full lines. Mean values interrupted lines. |||||||||| Range of variation in Whites.

After all, this is not our point either. More interesting is the strong suggestion of absence of a universal human trend in the proportion between size of molar crowns on the one hand and size of the crowns of pre-molar teeth on the other. REGNAULT (264, p. 17) found the molars to be more robust in Melanesians than in Whites, whereas no difference was noticed in the case of the premolars. Indications to the same effect are obtained from the diagrams pp. 75 and 77 in the atlas of WEIDENREICH (332). Here we find that the difference in size between molar

crowns and the crowns of the pre-molar teeth is distinctly greater in the Australian than *e. g.*, in the Bushman dentition.

The material published by WEIDENREICH (332, Atlas) deserves closer attention: It is not directly comparable with the Eskimo material of the present writer. The "average robustness"—which is probably the best indication of crown mass—is

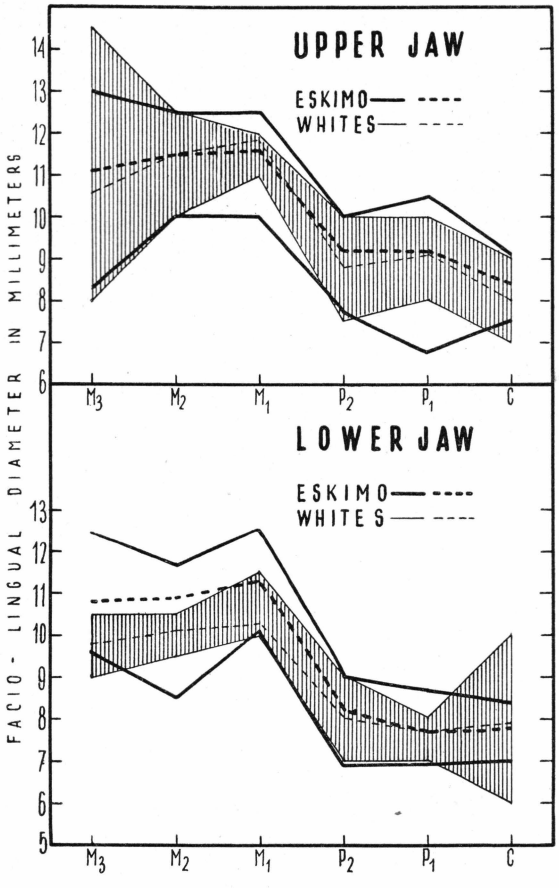


Fig. 23. Breadth of crowns in East Greenland Eskimos (skulls, present study) and American Whites (BLACK (30)). Maximum and minimum values full lines. Mean values interrupted lines. |||||||||| Range of variation in Whites.

calculated by WEIDENREICH by means of the average length and breadth dimensions reported by the original students for their entire groups of material, while the corresponding average values were worked out by the present writer on the basis of individual "robustness figures". It is subject to statistical discussion, how far-reaching may be the effects of this discrepancy, but to make sure not to err, the writer has not relied upon direct comparisons of his figures and those of WEIDENREICH. The study of the interesting diagrams published by WEIDENREICH was made altogether separately from that of the present material.

Thus it seems to be borne out from two entirely independent sources, that the proportionate size of molar and pre-molar crowns is not necessarily the same in all ethnic groups or under all circumstances.[1])

In other words, there does not seem to exist a proportion of size between the human teeth which is valid for all races or groups. The

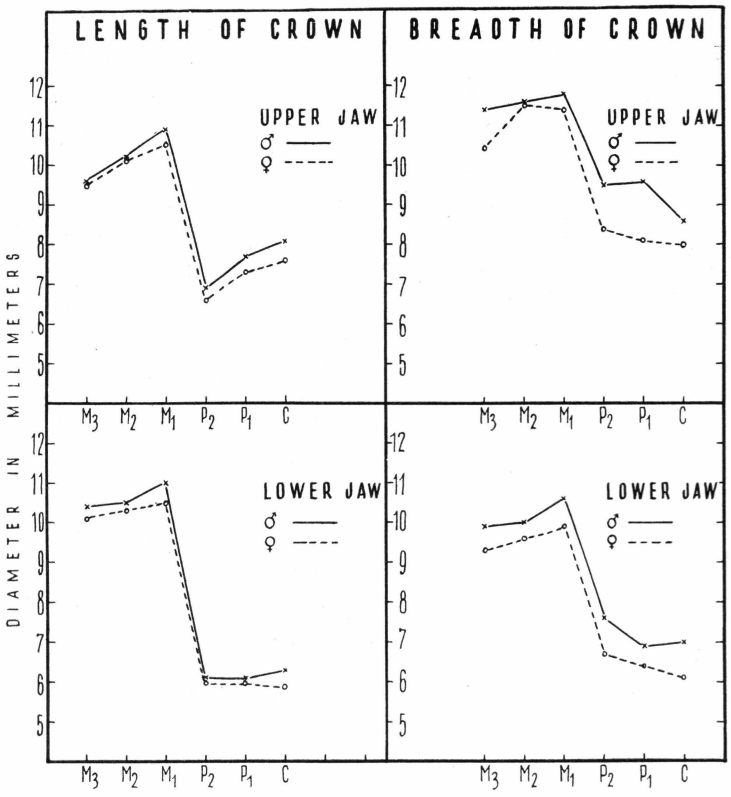


Fig. 24. Crown dimensions of male (———) and female (– – – –) East Greenland Eskimo skulls.

reason for the differences between racial groups in this respect, is obscure.

It has been suggested by HRDLICKA (143, p. 424) and by RITCHIE (271, p. 64) that the—absolute and relative—stoutness of the Eskimo molar teeth is due to excessive function. The present writer, however, cannot see why then, the premolars, canines and incisors should not likewise be of extraordinary size, since the demands put upon them are probably higher than in any other ethnic group. As a matter of fact, even a superficial consideration of the problems arising from the aforementioned evidence, makes quite clear that conditions are likely

[1]) Cf. the studies made by ANDERS LUNDSTRÖM (193) of Swedish dentitions.

to be more complicated than suggested by Hrdlicka and Ritchie. Support to this view is lent by the fact, that decrease or increase in size of tooth crowns, does not necessarily take place by even reduction, or augmentation of all dimensions. This is well-known, and hints to

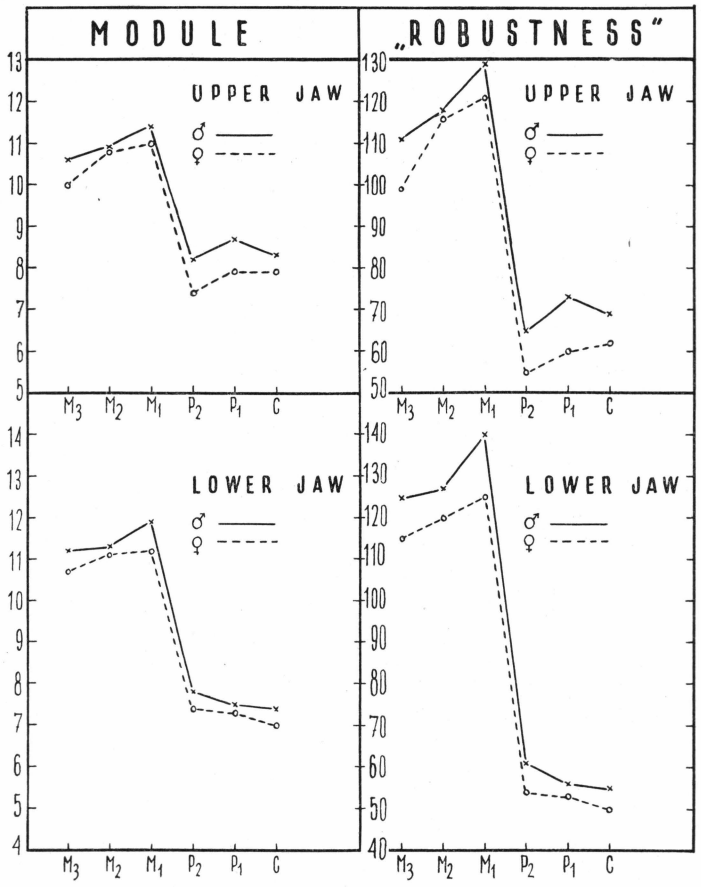


Fig. 25. Crown mass of male (———) and female (– – – –) East Greenland Eskimo skulls.

that effect may also be obtained from the present study as is discussed in the following section.

The question of sex differences in crown size has not been dealt with until now. This question has been studied in the Javanese by Mijsberg (215, p. 1111) and in Melanesians by Janzer (151, p. 317). It has also been given attention by Mühlreiter—de Jonge-Cohen (221, p. 172), Hrdlicka (143, p. 427), Weidenreich (332, p. 131) and others. All authors agree that the teeth of males are on the whole more robust than are the teeth of females.

In the East Greenland Eskimo, as shown in Fig. 24, p. 192 (average length, average breadth) and Fig. 25, p. 193 (average module, average "robustness"), there is an unquestionable systematic trend of molar, premolar and canine crowns to be stouter in males than in females. JANZER (151, p. 317) found sexual differences of the same magnitude in Melanesians. In the writer's opinion there is no doubt about the superiority in size of male Eskimo crowns when considered as a whole, but the material is too small to provide statistical proofs for individual teeth (cf. MIJSBERG (215, p. 1112)). As a matter of fact, the differences were tested tooth by tooth (M_3 sup. dext., M_2 sup. dext. etc.).[1]) It was found that not one of them survives. It is useless to increase the number of specimens by making the test for right and left side together (M_3 sup. dext. + M_3 sup. sin. etc.), because a strong correlation (bringing about too small values of the standard deviation), must be expected to exist between the size of right and left teeth in the same person. This does not seem to have occurred to MIJSBERG (215, p. 1112) when he made his analysis of sex differences in the size of teeth of the Javanese.

As far as the mesio-distal diameters (length) of the East Greenland Eskimo upper incisors is concerned, Table 54 (p. 182) suggests that the female Eskimo exhibits "longer" lateral incisors than does the male, whereas the opposite ratio seems to exist in the case of the median incisors. However, neither difference turns out to be valid when submitted to a statistical test[1]).

Hence we may conclude that sex differences in the mesio-distal diameters of the upper incisor crowns cannot be proved by means of the material examined. This however, does not mean that such differences do not exist.

FORM OF CROWNS.

An impression of average crown form is obtained from the average Breadth-Length index. A survey of the East Greenland Eskimo crown indices, and those for some other coloured racial groups given in Tables 36 and 37 (pp. 122—23), does not support the assumption of any material difference in general crown form. During the description of the individual molars, data for comparison have been given on early man. The important difference between the molars in man and the apes (including fossil apes such as *Dryopithecus*), is their relative shortness in man which gives rise to a high crown index. There is nothing in Tables 36 and 37 (pp. 122—23) or the data previously given for early man, to indicate a comparatively long molar in the East Green-

[1]) Cf. R. A. FISHER: Statistical Methods for Research Workers. 6 edit., 1936, p. 128.

land Eskimo. In Tables 36 and 37, however, no Breadth-Length indices have been given for Whites, because in literature none can be found which have been calculated as averages of individual indices such as are those computed by the present writer for the East Greenlanders. Consequently, if we want to get an impression of the breadth-length proportion in the White for comparison with corresponding conditions in the Eskimo, we have to resort to the average length and breadth dimensions:

In Figs. 22 (p. 190) and 23 (p. 191) the range of variation, as well as the average values for length and breadth, respectively, are compared for Whites (measurements by BLACK) and East Greenland Eskimos. The Eskimo molar-length measurements in Fig. 22 (p. 190) tend to exceed the values for Whites, both in the upper and lower jaw, whereas the length of premolars and canines are more equal in both ethnic groups, especially so in the lower jaw. The conditions of the upper incisors have already been discussed. As far as the breadth measurements (Fig. 23, p. 191) are concerned, no difference between Eskimo and White is seen in the upper jaw. In the lower jaw, however, the molars are clearly broader in the Eskimo.

The comparisons made here are of little value when the question is of direct comparison of crown form in Eskimos and Whites. What should be noticed, however, is the suggestion of a different trend in the two racial groups as far as crown form of upper and lower molars is concerned. There seems to be a tendency for the upper molars to be longer in the Eskimo without being broader at the same time. This tendency is absent in the lower jaw. Here, the more massive Eskimo molars seem to be both longer and broader than the corresponding teeth in Whites. Hence it is seen that not only is the proportionate size of the teeth subject to variations from race to race, but there are apparently no constant proportions of form either. In other words, crown form does not seem to be constant in modern human dentitions.

Whereas much valuable research work has been performed in studies of molar crown form in early man (*e. g.* by HRDLICKA (141, 142, 143) and WEIDENREICH (332)) and in anthropoids (*e. g.* by HRDLICKA (141, 142, 143), GREGORY and HELLMAN (109, 110), and WEIDENREICH (332)), very little has been done in this field on modern human races[1]). It is to be hoped that studies of proper material of sufficient size will be made, in order to elucidate the problems touched upon in the present study, which has been so greatly handicapped by insufficient numbers of teeth and, especially, of complete dentitions.

The general tooth form of the Eskimo was described by LEIGH

[1]) Some studies in these relations were made of Japanese molars by ARAI (16).

TABLE 56.

Aberrant tooth forms observed in the modern East Greenland Eskimo[1]).

No.	Sex.	Tooth	Morphology	Illustration
9	♀	P_2 sup. dext. et sin.	Facio-lingual diameter excessive as compared with mesio-distal	..
168	♂	I_2 sup. sin.	Replaced by two tiny dysmorph elements	Plate 1, Fig. 28
232	♂	P_3 inf. sin.	Crown blunt and of minor size	Plate 1, Fig. 31
245	♀	I_3 sup.	Conical supernumerary incisor.....	Plate 1, Fig. 29
296	♂	I_2 sup. dext. et sin.	Peg-shaped.....	..
297	♂	I_2 sup. dext. et sin.	Peg-shaped.....	..
331	♂	M_4 sup. dext. et sin.	Peg-shaped paramolars facially to upper third molars	Plate 1, Fig. 32a and 32b
529	♂	I_1 sup. sin.	Gemination; crown very large with incisal notch	..
594	♂	C. sup. sin.	Long slender and pointed cusp.....	..

[1]) Exclusive of molars with facial and lingual tubercles (Tables 43 (p. 134) and 44 (p. 135)).

(185, p. 886) as follows, "The size and morphology of the Eskimo teeth are, on the whole, uniform and true to type." RITCHIE (271, p. 64) also makes a general statement to that effect saying, "The teeth as a whole are more symmetrical and stick closer to the ideal typical form than do those of the white races." As appears from Figs. 22 and 23 (pp. 190—91) one is hardly entitled to say that the range of variation in size is, on the whole, narrower in the East Greenland Eskimo than in the Whites. When it is the question of form, the present writer agrees that real aberrant forms are not met with very often. With few exceptions, aberrant forms are confined to microdont wisdom teeth (especially maxillary third molars), and supernumerary elements. In Table 56 are listed all cases of aberrant forms (exclusive of third molars and molars with facial and lingual cusps), seen in the total material of modern East Greenlanders. On the other hand, tooth form, as indicated by the Breadth-Length indices of the crowns, is subject to considerable variation (Tables 34 and 35, p. 120). This variation, however, is of the same magnitude as that found by SHAW (299, p. 27) in the Bantu, and by NELSON (225, p. 273) in the Pecos Pueblo Indian.

TABLE 57.

Incidence of bent roots on the modern Angmagssalik Eskimo premolars, canines, and incisors (X-ray series, both sexes).

Tooth		Maxilla			Mandible		
		No. of teeth examined	Bend		No. of teeth examined	Bend	
			slight to medium	pronounced		slight to medium	pronounced
P_2	n	223	5	..	220	13	..
	%		*2.2*	..		*5.9*	..
P_1	n	224	20	1[1])	221	14	3
	%		*8.9*	*0.4*		*6.3*	*1.4*
C	n	180[2])	2	..	171[2])	1	..
	%		*1.1*	..		*0.6*	..
I_2	n	230	3	..	228	2	..
	%		*1.3*	..		*0.9*	..
I_1	n	232	3	..	231	..	1
	%		*1.3*	..		..	*0.4*

[1]) In No. 283 P_1 sup. sin. bayonet-shaped, pointing mesially.
[2]) Number reduced on account of artificial distortion in X-ray series.

HEIGHT OF ROOTS.

There are very few comments on root height of Eskimo teeth in literature. ADLOFF (5, p. 155) was the first to call attention to the "short and blunt" shape of the roots in the Eskimo mandible (two mandibles X-rayed by DIEK on request of ADLOFF). HRDLICKA (136, p. 258) makes the following comment *en passant*, on four Eskimo skulls from Smith Sound, "The upper incisors, particularly the median, are characterized by short roots, a feature frequently observed also in the Indian. In No. 5 . . . the length of the root of the right median incisor in 8 mm." WINGATE TODD (320, p. 258) says that the roots of the Eskimo "are short and stout". The root heights of Eskimo teeth from Canada were measured by RITCHIE (271, p. 60). As is the case in the present material (Tables 34—35, p. 121), the range of variation is strikingly wide in the Canadian Eskimo. The average values calculated by RITCHIE are given in Table 58 (p. 198) together with those for East Greenland Eskimos and a few other racial groups dealt with in literature. It is borne out that, on an average, the roots of the Australians and Bantu are superior to those of the other racial groups, as far as height is concerned. Between the latter groups no material differences can be seen as to actual root

TABLE 58.
Average root height in various racial groups. Both sexes.

Group	Author	Maxilla						Mandible					
		M_3	M_2	M_1	P_2	P_1	C	M_3	M_2	M_1	P_2	P_1	C
East Greenl. Eskimos..	Present study	12.0	12.3	12.7	13.6	13.1	16.3	11.7	12.5	13.2	13.2	13.5	16.6
Canadian Eskimos..	RITCHIE (271)	13.1	11.8	10.5	13.2	13.2	16.4	13.7	12.7	13.5	13.0	13.5	16.6
Bantu.....	SHAW (299)	11.5	12.5	13.5	14.6	13.9	17.3	12.0	13.5	13.5	15.2	15.0	17.0
Pecos Pueblo Indians...	NELSON (225)	12.20	12.90	13.22	13.27	12.95	15.46	12.59	13.77	13.60	14.51	13.39	15.26
Bushmen ...	DRENNAN(70)	12.6	12.6	11.6	14.8	14.5	16.3	12.5	13.1	12.4	14.8	14.1	15.3
Australians .	CAMPBELL(49)	13.9	13.6	13.5	16.9	16.3	19.9	14.0	15.0	14.2	16.5	16.3	18.1
American Whites ...	BLACK (30)	11.4	13.0	13.2	14.0	12.4	17.3	11.8	12.9	13.2	14.4	14.0	15.3

height[1]). Fig. 26 compares average root heights of East Greenland Eskimos, Whites (BLACK), Australians (CAMPBELL) and *Sinanthropus* (WEIDENREICH).

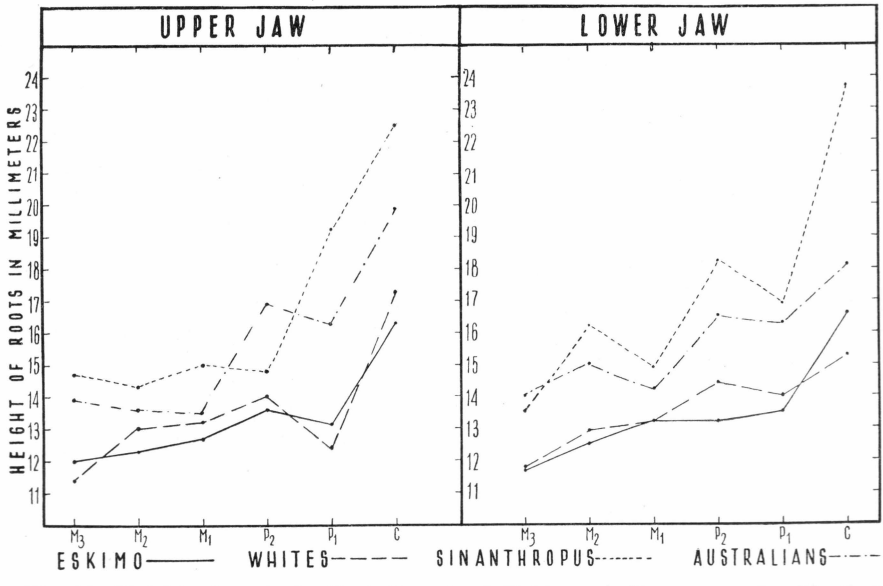


Fig. 26. Height of roots in East Greenland Eskimo skulls compared with that of Whites (BLACK (30)), *Sinanthropus* (WEIDENREICH (332)), and Australians (CAMPBELL (49)).

[1]) It should be noted, however, that average values for Finns (HJELMMAN (128, p. 97)) are higher than those given by BLACK (30, p. 16—17) for Whites.

It has already been mentioned that the Eskimo roots undergo secondary changes during adult life. Such changes (resorption and hypercementosis) are of a nature generally considered pathological, but in the Eskimo they are so widespread that they should rather be considered normal. The apical resorption leads to decrease of height which

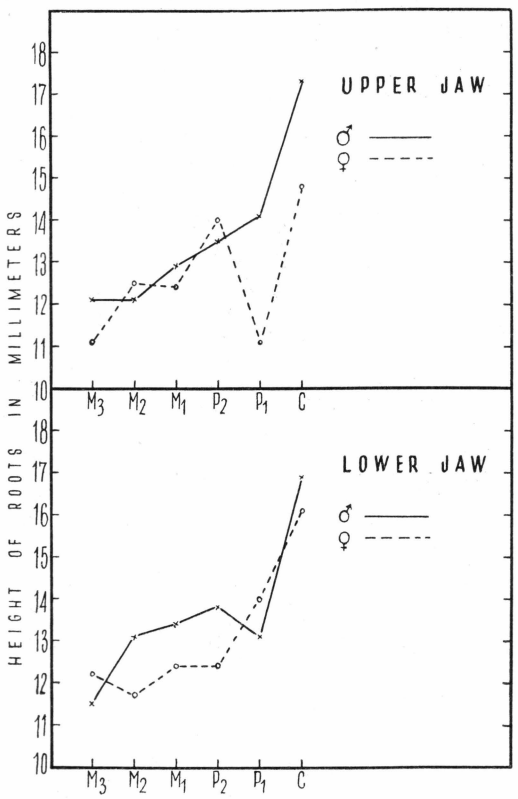


Fig. 27. Height of roots in male (———) and female (– – – –) East Greenland Eskimo skulls.

is quite often considerable. The individual adult tooth under examination may have experienced such decrease of height of root(s) to any—unknown—extent. Consequently, the original average root height of a particular tooth—the average anatomical height—is not necessarily identical with the average root height observed in the skull material as being the height at death—the average actual height.

For this reason no significance can be attached to slight differences in average root height between the Eskimo and other racial groups from an anatomical point of view, still less so because it is absolutely unknown whether more or less pronounced decrease of root height may also have taken place in other ethnic groups.

No doubt the varying decrease in height is responsible for a good deal of the extreme dispersion of measurements seen from Tables 34 and 35 (p. 121).

In Fig. 27 (p. 199) the average root heights are shown for male and female East Greenlanders separately. The absence of a systematic difference in favour of the males may be due to the circumstance that no difference exists between male and female anatomical root heights, but it is more likely perhaps, that the results are affected by secondary changes obscuring the original proportions. Finally the small number of specimens examined may have some influence.

The question of secondary changes of root height, heretofore completely disregarded in comparative odontology, is one of first rate importance from an anatomical standpoint. The Eskimo example demonstrates that such changes may seriously affect studies of "normal" root height. This secondary reduction of root height deserves much closer attention when further metrical examinations are going to be made of teeth of skulls or isolated teeth, especially so if strenuous mastication is indicated by pronounced attrition of the crowns, because heavy strain on the teeth is likely to be the principal cause of the apical resorptions. The problem of decreasing height of the roots, also brings the individual age of the specimens into play as a factor to be carefully considered in attempts at comparative evaluation. As a matter of fact, the roots of mature and old Eskimos (Plate 30, Figs. 184—86) are definitely lower than in children, adolescents and young adults.

CHAPTER VI

GENERAL DISCUSSION

The following conditions occurring in the dentition of the East Greenland Eskimo are strongly suggestive of his Mongolian affinities,

(1) High incidence of shovel-shaped incisors,
(2) Very low incidence of tubercles of CARABELLI,
(3) High incidence of three-rooted lower molars,
(4) The pattern of congenital absence of teeth, and
(5) The high incidence of congenital absence of third molars.

There are some indications that high incidence of extensions from the gingival margin of the enamel—and most likely also of enamel drops, which are so closely related to the enamel extensions—are racial characters typical of Mongolian stock. At least they seem to culminate in certain Mongoloid peoples.

Most anthropological and odontological workers agree that the following conditions present in the East Greenland Eskimo dentition, are indicative of primitive status of the dentition,

(1) Frequent retention of remote ancestral cusp numbers and crown pattern (*Dryopithecus* pattern),
(2) Large size of the pulp cavity and moderate taurodontism.

On the other hand, the East Greenland Eskimo exhibit dental characters, generally but not universally, considered advanced, or late stages in evolutionary respect such as,

(1) Reduction in size of the posterior molars,
(2) High incidence of vestigial third molars, and
(3) Frequent absence of third molars.

Finally, in the East Greenland Eskimo dentition, we meet with anatomical features the significance of which, if any, is obscure, *viz.*

(1) The occlusal pearl-like excrescences,
(2) The common fusion of root branches,
(3) The high frequency of facial pits and grooves on lower molars, and
(4) The high incidence of supernumerary facial and lingual cusps on the molars.

It is open to discussion to what extent the latter conditions, as well as the aforementioned Mongolian dental characters, be late specializations[1]), but there is no doubt that some dental structures may be more conservative than others[2]). No wonder therefore that some characters in the Eskimo dentition tend to be "advanced" while others still forcibly recall the great remoteness of their origin.

It has been suggested by HRDLICKA (146, p. 360), and by GOLDSTEIN (98, 99), that the farther East in the Eskimo territory the observer proceeds, the more highly differentiated and divergent the Eskimo becomes. A few dental findings to that effect have been published, but established dental facts are, in the opinion of the present writer, too scarce to be anything more than hints in that direction. On the other hand, HRDLICKA (146, p. 359) on the basis of evidence available to him in 1928 arrived at the conclusion, "Size and characteristics of the teeth are remarkably alike over the whole Eskimo territory." The dental studies by GOLDSTEIN (98, 99) during the early thirties tend to modify this conclusion. Yet, it remains to be seen what will be the issue of closer studies of the American Eskimo dentition. Before such studies are made, nothing can be said for certain of a West-East dental trend in the Eskimo.

Taking all findings into account, we arrive at the final conclusion that *there is no definite trend in the dentition of the East Greenland Eskimo to lend decisive support to the view that he be either very primitive or very far advanced. What is definitely borne out, however, is the substantiation of his Mongoloid ancestry.*

Unfortunately, dental evidence on the American Indian is so scarce that it is not yet possible to pursue the question of his affinity to the Eskimo from that angle. However, the frequent occurrence of shovel-shaped incisors and pronounced enamel extensions in both groups is a hint worthy of notice. The writer is convinced that a close study of the American Indian dentition along the lines followed in this work would yield at least some information of Indian-Eskimo affinity and ancestry.

It is interesting to compare the findings of the present study with anthropological evidence supplied by HRDLICKA (146, p. 359), as well as

[1]) GREGORY, HELLMAN and LEWIS (111, p. 25) hold the following view, "We cannot find any convincing evidence that the peculiar features of the teeth in *Sinanthropus* and later hominids (such as irregular folds and wrinkles of the enamel surface of the molars, taurodontism of the molars, the shovel-shaped form of upper incisors, the lowness and bluntness of the canines etc.), are ever anything more than specializations of later date than the opposite characters found in the Tertiary anthropoids of the Siwaliks." (Siwalik is a locality in India where several species of *Dryopithecus* have been found).

[2]) Cf. HRDLICKA (139, p. 464), "The teeth are at once the most plastic and most conservative of structures."

with recent discoveries by HELGE LARSEN and F. G. RAINEY (182, 183, 262)) of the *Ipiutak culture* near Point Hope in Alaska, which seems to be the best direct evidence provided so far, of an Eskimo immigration across the Bering Strait from Asia. However, the results of the anthropological study of the skeletons unearthed by these archæologists are not yet available, and it remains to be seen how they will fit into the cultural picture. As has been quite recently pointed out by AITCHISON (13, p. 31), it is extremely important that the dental aspects be thoroughly studied in these extraordinary finds, because so much valuable information may be expected from their dentitions.

Teeth, small and insignificant as they are, are pregnant with meaning. They have proved on numerous occasions to be clues to evolution, and are now known to reveal, on close study, typical racial traits as well. Hence, in the light of newer knowledge, the following statement by HRDLICKA (137, p. 412) is subject to revision, "The type of human denture can be said to be to-day, with a few exceptions, radically everywhere the same." So far, however, we know but little for certain in these relations. There is urgent need for co-operative studies to be made by anthropologists and members of the dental profession, so as to throw fuller and more revealing light upon this interesting and promising field of research.

SUMMARY

The aim of the present work is that of contributing to human odontography by describing dental numerical variations and dental anatomy of the East Greenland Eskimo. The work falls into the following main sections, I) Introduction; II) Author's Studies of Greenland Native Dentitions; III) The East Greenland Material; IV) Dental Numerical Variations; V) Dental Anatomy; and VI) General Discussion.

Chapter I. Introduction.

A synopsis is given of Eskimo distribution and subdivisions, physical anthropology of the Eskimo with special reference to craniology, the theories concerning origin and antiquity of the Eskimos as well as Eskimo culture.

In a section on Greenland and the Greenlanders some principal facts relating to geography of and general conditions in the Danish Arctic Colony are recalled, and the racial status and migrations of the native population briefly outlined. Special attention is given to the origin, racial status and demography of the East Greenland Eskimos.

Chapter II. The Author's Studies of Greenland Native Dentitions.

The following dental studies were made: —

(1) Julianehaab District, South-West Greenland 1935: Clinical examination of 1,634 natives.

(2) The Copenhagen University Department of Anatomy 1936 and later: Examination of 525 Greenland Eskimo skulls. X-ray examination of 52 East Greenland Eskimo skulls.

(3) Angmagssalik and Scoresbysund Districts, East Greenland 1937: Clinical examination of 860 unmixed Eskimos. X-ray examination of 134 cases. Casts of 142 dentitions.

(4) Julianehaab District, South-West Greenland 1939: Clinical examination of 702 natives. 1,250 dental roentgenograms. Casts of 245 dentitions.

Chapter III. The East Greenland Material.

Particulars are given of the East Greenland material of skulls and living subjects dealt with in the following chapters IV, V, and VI.

Chapter IV. Dental Numerical Variations.

In order to establish the incidence and character of numerical variations in the East Greenland Eskimo dentition, the writer examined the following groups of material,

(1) 52 sexed Pre-Danish East Greenland Eskimo skulls, and

(2) 702 East Greenland Eskimos $\geq$ 7 years of age, living in the territories of Angmagssalik and Scoresbysund 1937.

(3) Additional material of (unsexed) East Greenland skulls was examined for congenital absence of third molars.

(4) Congenital absence of third molars was also studied in 210 South-West Greenland natives of almost unmixed Eskimo race.

The report on the investigations deals with the following conditions,

(1) Increase in number of permanent teeth,

(2) Decrease in number of permanent teeth with exception of third molars,

(3) Decrease in number of third molars.

Increase in number of teeth.

Previous accounts of the occurrence of supernumerary teeth in Eskimos and Indians are surveyed.

Inspection and complete X-ray examination disclosed one supernumerary tooth in 52 East Greenland Eskimo skulls.

On clinical examination of 702 East Greenland Eskimos aged $\geq$ 7 years, eight supernumerary erupted teeth were found in seven persons. Complete X-ray examination of 130 Angmagssalik Eskimo dentitions revealed four non-erupted supernumerary dental elements in the premaxillae of three natives.

Comparison of incidence of supernumerary teeth in various racial groups, made with reservation in Table 5 (p. 37) (methods insufficient in several instances), bears out that the incidence of supernumerary

teeth in the East Greenland Eskimo is hardly higher than that in other ethnic or racial groups of fair size examined so far.

Special attention has been paid to fourth molars which do not seem to be definitely more frequent in coloured races, including Eskimos, than in Whites.

Decrease in number of teeth (excl. third molars).

Previous observations of congenital absence of teeth in the Eskimo and Indian are reported.

On inspection and complete dental X-ray examination of 52 East Greenland Eskimo skulls, one case of congenital absence of upper lateral incisors, coinciding with other anomalies of the dentition, was found.

Clinical survey—and in a majority of cases—X-ray examination, showed 18 Angmagssalik Eskimos (out of 603 aged $\geq$ 7 years, *i. e.* 3.0 per cent) to have congenital absence of one or more teeth, exclusive of third molars.

The general incidence of congenital absence of teeth (excl. of M_3) seems to be of the same order in the East Greenland Eskimo as in Whites.

Upper lateral incisors seem to be congenitally missing more often in female Eskimo than in males.

When unilateral, congenital absence of upper lateral incisors in all cases concerned the right side.

The incidence of congenitally missing upper lateral incisors in the East Greenland Eskimo tends to be inferior to that reported in literature of Whites, whereas the incidence of congenitally missing lower incisors is surprisingly high in East Greenlanders.

Premolars are rarely congenitally absent in the East Greenland Eskimo, whereas molars tend to be more frequently missing than in Whites.

The general pattern of congenital absence of permanent teeth in the East Greenland Eskimo seems to come closer to that of Mongols reported by Japanese authors, than to that of Whites.

The writer felt unable to confirm the statement by RÖSE (273), that upper lateral incisors are more frequently congenitally missing in dolichocephalic than in brachycephalic races. He also was unable to corroborate the inverse ratio of missing upper lateral incisors and missing third molars reported by RÖSE (l. c.).

Decrease in number of third molars.

Previous studies and accounts of third-molar absence in Eskimos are reviewed and quoted.

Inspection and partial dental X-ray examination was made of

(1) 109 maxillae and 81 mandibles of East Greenland Eskimo skulls,

(2) 257 Eskimos, $\geq$ 22 years of age, living in the Angmagssalik District, East Greenland 1937, and

(3) 210 South-West Greenland natives, 25—50 years of age, living in the Nanortalik—Kap Farvel area, Julianehaab District 1935. These natives are of practically unmixed Eskimo blood, being in part immigrated East Greenlanders, or descendants of the latter.

The incidence of congenital absence of third molars is high in the East Greenland Eskimo, ranging among the very highest reported for any racial or local group. The modern East Greenland group showed congenital absence of one or more third molars in 36.6 per cent of adults examined. 31.1 per cent of mandibles and 20.6 per cent of maxillae showed absence of third molar(s). 26.7 per cent of lower third molars and 15.2 per cent of upper third molars were congenitally missing.

There are some indications that congenital absence of third molars is less frequent in Western American Eskimo tribes (GOLDSTEIN (99)) than in the East Greenland Eskimo.

Congenital absence of third molars is definitely less frequent in West Greenland natives with abundant white admixture than in the East Greenland Eskimo and other unmixed Eskimo groups. Thus, white admixture tends to lower the incidence of congenitally missing third molars in Eskimos.

According to literature, Asiatic Mongols generally show high incidence of congenitally missing third molars.

Congenital absence of third molars in the Eskimo is neither caused by lack of space brought about by decrease of function ("civilization"), nor by elimination of these dental elements as a direct consequence of decreased function. Retrogression of the human dentition seems to be a question of phylogeny, and the numerical reduction tends to occur preferably at the posterior termination of the molar series.

It is doubtful what significance can be attached to differences in incidence of congenital absence of third molars in modern racial and local groups, but if high incidence of this condition really is an indication of advanced evolution of a human race, evidence has been presented by the present study that the Eskimo of East Greenland has reached a very advanced stage of evolution.

Chapter IV. Dental Anatomy.

A. Previous Accounts and Studies.

The general impression of the Eskimo dentition acquired by arctic explorers, ethnographers etc. is outlined by means of quotations from their accounts.

Following a survey of previous studies of Eskimo dental anatomy, which are few in number, a report is given of

B. The Author's Investigations of East Greenland Eskimo Dentitions.

a. MATERIAL.

The material comprised,

(1) 52 sexed Pre-Danish Eskimo skulls from East Greenland.

(2) Records on 860 present-day East Greenland Eskimo dentitions.

(3) Casts of 142 present-day East Greenland Eskimo dentitions.

(4) Complete roentgenograms of 130 present-day Angmagssalik Eskimo dentitions.

(5) Additional material of West Greenland origin was used for comparison in a few respects.

In the skull material, the *post mortem* loss of teeth is very considerable, *viz.* 60.5 per cent of the teeth present at death. While artificial damage to the remaining teeth is no serious obstacle, the heavy attrition and other posteruptive changes greatly hamper the study of crown dimensions as well as of the occlusal pattern. Widespread root resorption interferes with the study of root dimensions.

b. METHODS.

The studies were partly of a descriptive character, partly metrical. Measurements were, on the whole, confined to the skull material. Complete X-ray examination was made of the teeth and jaws of the latter.

The following details have been studied in the skull material and present-day East Greenlanders, respectively: —

Measurements of: —	Skulls	Living
crown length (mesio-distal)	M_3—C	I_2 sup.; I_1 sup.
crown breadth (facio-lingual)	M_3—C	
root height	M_3—C	
Description or incidence of: —		
tubercle of CARABELLI	upper molars[1])	upper molars[1])
facial pits and grooves	lower molars	lower molars
number of cusps	M_3—P_1	M_3—P_1
crown pattern	lower molars	lower molars
occlusal wrinkles	molars	molars
facial and lingual tubercles	molars	molars
enamel margin	molars[1])	molars[1])

[1]) West Greenland material examined for comparison.

	Skulls	Living
number of roots	teeth and sockets	teeth and sockets
course and divergence of roots	teeth and sockets	teeth and sockets
pulp cavity	roentgenograms	roentgenograms
enamel nodules	molars[1])	
fusion of roots	teeth and sockets	teeth and sockets
lingual surface of upper incisors	(I_2 sup.; I_1 sup.)	I_2 sup.; I_1 sup.

c. The East Greenland Eskimo Permanent Dentition.

On the basis of the aforementioned details, a description is given of the East Greenland Eskimo permanent dentition, tooth by tooth, beginning with the third molars. The description of each tooth is given according to the following pattern, 1) size of crown, 2) form of crown, 3) cusps, 4) enamel margin, 5) root(s), 6) enamel nodules, 7) pulp cavity. The data on which the descriptions rest are tabulated throughout the text. A number of comparative data on other racial groups have been compiled and are given either in the text, or in the tables.

1. *Data on dimensions*

are given in Tables 17 (p. 80), 18 (p. 83), 19 (p. 88), 20 (p. 92), 22 (p. 99), 25 (p. 105), 28 (p. 112), 34–35 (p. 120), 36–37 (p. 122), 47 (p. 156), 48 (p. 158), 49 (p. 161), 50 (p. 164), 52 (p. 173), 53 (p. 176), 54 (p. 182), and 58 (p. 198), as well as in Figs. 22 (p. 190), 23 (p.191), 24 (p. 192), 25 (p. 193), 26 (p. 198),and 27 (p. 199).

2. *Description of the maxillary molars.*

The systematic description of the upper molars is followed by a special section on the tubercle of Carabelli. This tubercle is practically absent in the East Greenland Eskimo. It is also rare in Asiatic Mongols, but is present in a rather high percentage of West Greenland mixed-bloods.

3. *Description of the mandibular molars.*

To the description of the individual mandibular molars is attached a section on the occurrence of facial pits and grooves in these molars. Pits and grooves are frequent and quite often pronounced. The pits may be surrounded by a hypoplastic area.

4. *General notes on molars.*

In brief, the following results were borne out,

The East Greenland Eskimo molars decrease in size from M_1 to M_3, but there seem to be more exceptions to this general pattern than in white peoples on record.

[1]) West Greenland material examined for comparison.

The third molars seem to be vestigial in a higher proportion of cases than in other racial groups. Extreme reduction of third-molar crown size is definitely more common in the upper jaw than in the lower jaw.

Vestigial forms of third molars coincide with congenital absence of third molars in a definitely higher percentage of cases, than with presence of the other third molars. This seems to indicate common causative factors to be involved in extreme reduction of size, and congenital absence of third molars.

Apart from frequent occurrence of real vestigial forms, a general tendency for third molars to experience reduction of size has been noted. This tendency, however, has gone no further than, that the third upper molars in the skull material are on an average almost equal in robustness to *Sinanthropus* female maxillary third molars.

Cusp numbers and crown pattern of the molars on the whole come closer to conditions found in fossil apes, such as *Dryopithecus*, than do cusp numbers and crown pattern in other modern ethnic groups studied so far. The maxillary molars tend to retain the quadritubercular form, and the mandibular molars are definitely more frequently quintitubercular than in Whites and other modern human groups of fair size, dealt with in literature.

Occlusal wrinkles occur to no small extent on the molars, especially the third molars, but they cannot with any certainty be established to be more frequent in the East Greenland Eskimo than in other present-day human groups.

Facial and lingual cusps are very frequently met with on molars, especially so is the paramolar tubercle of BOLK.

The configuration of the gingival enamel margin on the molars is distinctly different from that of white races. Enamel extensions (LEIGH) are found opposite root bifurcations and root grooves in a very high percentage of cases, and are often extraordinarily pronounced.

Supernumerary roots are frequent on molars. On the lower first molar an extra disto-lingual root is present at least ten times as often as in Whites. Similar roots have been found, although more rarely, on the posterior lower molars. High incidence of disto-lingual roots on lower first molars has also been recorded in Asiatic peoples of Mongolian stock (TRATMAN (326)).

The roots of the East Greenland Eskimo teeth are generally straight and the divergence of root branches less marked, than in Whites. The incidence of apical bends of the roots is on the whole insignificant. When present, bends are moderate. Complicated course of roots has been met with much more frequently in West Greenland mixed-bloods.

The pulp cavity is of considerable size until the late twenties. The pulp chamber, especially in the posterior molars, tends to be deep. The pulp cavity will become narrower in adults, and in old age will be more or less filled with secondary dentine. Calcifications of the pulps, including big pulp stones, are observed to develop from adolescence onwards.

The East Greenland Eskimo molars are moderately taurodont, their necks being generally ill-defined. Many molars, especially lower second molars, exhibit a taurodont shape and a configuration of pulp cavity resembling conditions in moderately taurodont European Neanderthal molars (Krapina non-prismatic cases).

Enamel nodules are definitely more frequent in the Greenland Eskimo than in any other ethnic or local group heretofore studied. The enamel nodules are closely related to the enamel extensions.

Enamel nodules occur the most frequently on upper third and second Eskimo molars. On upper posterior molars they are generally observed on the distal and mesial surfaces of the roots. On lower molars the nodules are rare and, when present, situated either facially or lingually.

5. *Description of the maxillary premolars.*

6. *Description of the mandibular premolars.*

7. *General notes on premolars.*

The premolars exhibit, on the whole, the same crown form as in Whites. On an average, their proportionate size in both jaws is the same as in Whites.

The premolars tend to have one root and one root canal more often than in Whites. The incidence of two-rooted upper first premolars is surprisingly low.

8. *Fusion of molar and premolar roots.*

Multi-rooted teeth on the whole exhibit fusion, *i. e.* failure of the roots to divide into branches, in a higher proportion of cases than the homologous teeth in Whites. Such fusion of the lower molar roots seem to be basically of the same type as that observed in various specimens of early man.

9. *Description of the canines.*

In the skull material few specimens were available for study. On the casts of present-day young East Greenland Eskimo dentitions, the canines could be inspected but not measured.

10. *General notes on canine teeth.*

The crown of the canines are on an average not very stout as compared with those of the neighbouring teeth. There are, however,

exceptions from this general rule. The canine crown-form does not differ materially from that of white races, apart from a somewhat more pronounced tendency for the crown to exhibit (moderate) marginal ridges and a basal eminence lingually.

11. *The description of the maxillary incisors*

is based upon the casts of modern East Greenland Eskimo dentitions, as is

12. *The description of the mandibular incisors.*

13. *General notes on incisors.*

As far as the mesio-distal diameters are concerned, the upper lateral and central incisors generally seem to come closer to one another than the upper incisors of Whites.

Shovel-shape of maxillary incisors is almost universally met with in the East Greenland Eskimo. It is more pronounced in the upper lateral incisors than in the upper central incisors. Generally speaking, the shovel-shape of Eskimo upper incisors is less pronounced than the shovel-shape of American Indian upper incisors. Shovel-shaped incisors are a normal feature in peoples of Mongolian stock.

Dental tubercles on the upper anterior teeth are frequent, though they have not been found to any excessive extent. The same applies to lingual cusps on anterior teeth. In the Eskimo, as in Whites, dental tubercles and lingual cusps are more common on lateral than on central incisors.

Median ridges are present on the lingual aspects of many East Greenland Eskimo upper incisor crowns. This is especially true of central incisors.

14. *General notes on the East Greenland Eskimo dentition.*

On an average, the size of molar crowns tends to be superior to the size of molar crowns in Whites (BLACK (30)).

The average size of the crowns of premolars, canines and incisors tends to come closer to the size of the corresponding crowns in Whites, thus,

in the East Greenland Eskimo the average proportion of the size of the molar crowns, and the size of the pre-molar crowns, seems to be different from that prevalent in Whites. This finding suggests that

there is no constant size proportion between the molar series and the other series in human dentition.

The general form of tooth crowns, as indicated by their Breadth-Length index, although on the whole not materially different in Eskimos and Whites, tends to support the view that there is no constant proportion in form of the teeth within the dentitions of modern human races.

Aberrant tooth forms are rare in the East Greenland Eskimo, being on the whole confined to vestigial third molars and supernumerary teeth.

There is a tendency for the Eskimo to develop small pearl-like enamel excrescences or drops on the occlusal surfaces of molars and premolars, as well as on the lingual aspects of the canine cusps.

Average root height is comparatively small. In the adult Eskimo of East Greenland, the average height of the roots (actual height) is not identical with the average anatomical height, because in many cases, if not all, shortening of the roots has taken place during life. This shortening is quite often considerable. The extreme dispersion of the measurements of root height, which has been found, probably indicates root resorption to have occurred to a more or less pronounced degree. This finding is suggested to be of far-reaching bearing upon comparative evaluation of average root height of human teeth, especially so, if function is strenuous.

Chapter VI. General Discussion.

The following conditions observed in the dentition of the East Greenland Eskimo are strongly suggestive of his Mongolian affinities,

(1) High incidence of shovel-shaped incisors,
(2) Very low incidence of CARABELLI's tubercle,
(3) High incidence of three-rooted lower molars,
(4) The pattern of congenital absence of teeth, and
(5) The high incidence of congenital absence of third molars.

Furthermore

(6) The high incidence of pronounced enamel extensions on the molars, and
(7) The high incidence of enamel nodules on the molars

may be supposed to be racial characteristics typical of Mongolian stock.

The following conditions present in the East Greenland Eskimo dentition are generally considered primitive characters,

(1) Frequent retention of remote ancestral cusp numbers and crown patterns (*Dryopithecus* pattern),
(2) Large size of the pulp cavity and moderate taurodontism.

On the other hand, the following conditions exhibited by the East Greenland Eskimo are generally considered advanced, or late stages in evolutionary respect,

(1) Reduction in size of the posterior molars,
(2) High incidence of vestigial third molars, and
(3) Frequent absence of third molars.

Finally, in the East Greenland Eskimo dentition we meet with anatomical features the significance of which, if any, is obscure, *viz.*

(1) The occlusal pearl-like excrescences,
(2) The common fusion of root branches,
(3) The high incidence of facial pits and grooves on lower molars, and
(4) The high incidence of supernumerary facial and lingual cusps on the molars.

There are some indications that dental anatomy is not exactly the same in all Eskimo groups, but further studies are necessary, especially of American Eskimos, before any conclusions can be drawn in this respect.

Taking all dental findings of the present study into account, we arrive at the following final conclusion,

There is no definite trend in the dentition of the East Greenland Eskimo to lend decisive support to the view that he be either very primitive or very far advanced. What is definitely borne out, however, is the substantiation of his Mongoloid ancestry.

In conclusion, the writer calls attention to the desirability of extending dental studies of the type here presented, to other American aboriginal groups, including American Indians and Eskimos. Special attention ought to be paid to the skull material from Ipiutak in Alaska, because recent discoveries by HELGE LARSEN and RAINEY of an ancient Eskimo culture in this region suggest abundant Asiatic influence.

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PLATES

Plate 1.

Fig. 28. Two small atypical teeth replacing upper left lateral incisor. E. G. male aged 16 (No. 168), (nanism).

Fig. 29. Conical supernumerary incisor palatal to upper left central incisor, causing crowding. E. G. female aged 18 (No. 245).

Fig. 30. Supernumerary tooth between the upper central incisors has recently been lost. E. G. male aged 43 (No. 364).

Fig. 31. Blunt supernumerary tooth lingual to lower left first premolar. E. G. male aged 27 (No. 232).

Fig. 32. (See also Plate 2). Coincidence of plus and minus variations. a. Two peg-shaped upper paramolars; b. The upper left paramolar. E. G. male aged 36 (No. 331).



Fig. 28 (1:1).

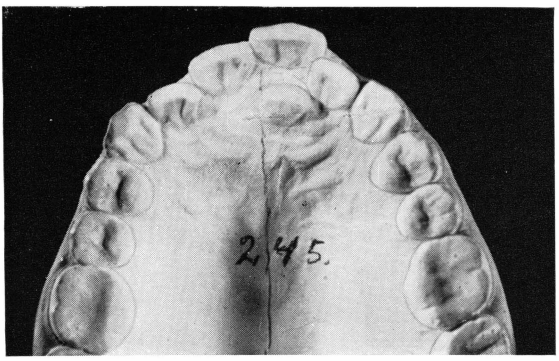


Fig. 29 (1:1).

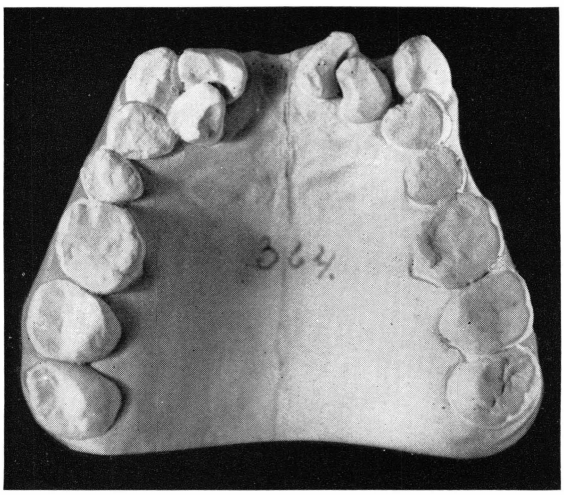


Fig. 30 (1:1).

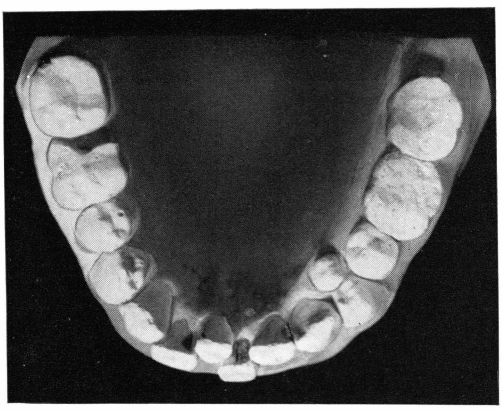


Fig. 31 (1:1).

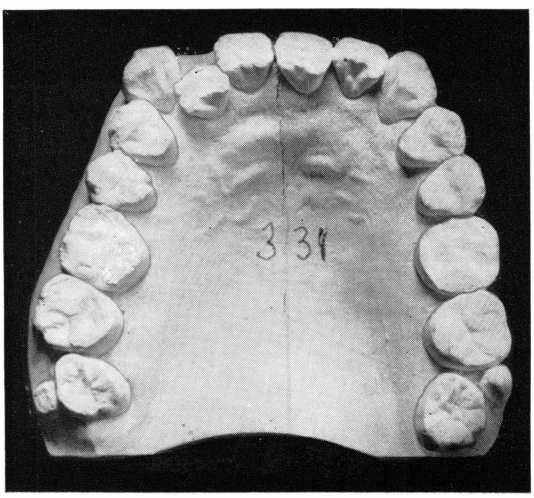


Fig. 32a (1:1).

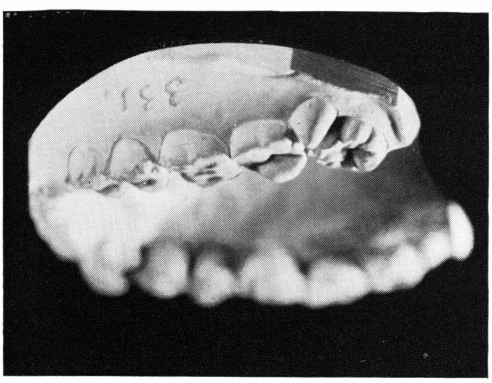


Fig. 32b (1:1).

Plate 2.

Fig. 32. (See also Plate 1). Coincidence of plus and minus variations. c. Congenital absence of lower lateral incisors. E. G. male aged 36 (No. 331).

Fig. 33. Non-erupted and inverted upper incisiform element above and palatal to left upper lateral and central incisors. E. G. male aged 44 (No. 139).

Fig. 34. Upper lateral incisors congenitally missing. Upper right third molar small. Upper left third molar congenitally missing. Upper left second molar having extra facial and lingual cusps. Same individual as Plate 4, Fig. 42. Adult male skull from Anoritôq (No. 162).

Fig. 35. Upper lateral incisors congenitally missing. E. G. female aged 29 (No. 513).

Fig. 36. Upper lateral incisors congenitally missing. Retention of deciduous lateral incisors and left deciduous canine. Left permanent canine non-erupted. E. G. female aged 23 (No. 535).

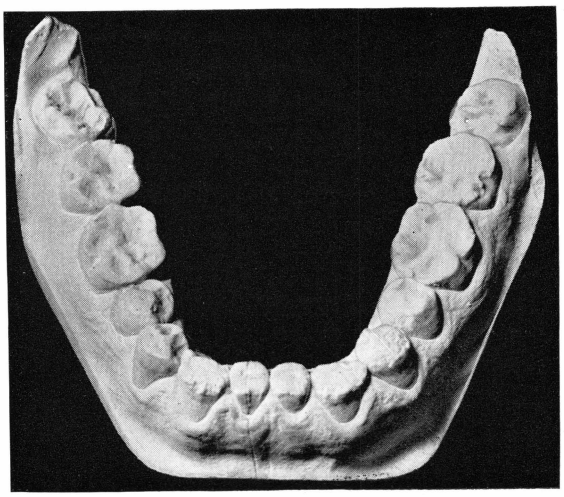


Fig. 32c (1:1).

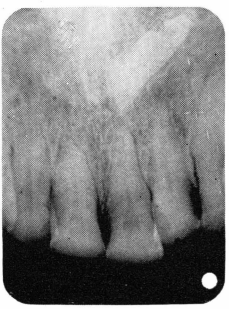


Fig. 33.

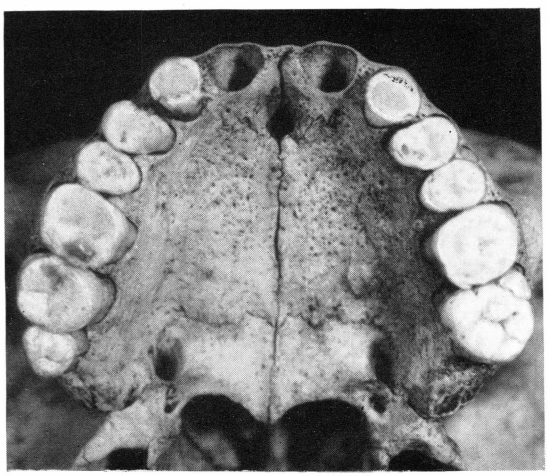


Fig. 34 (1:1).

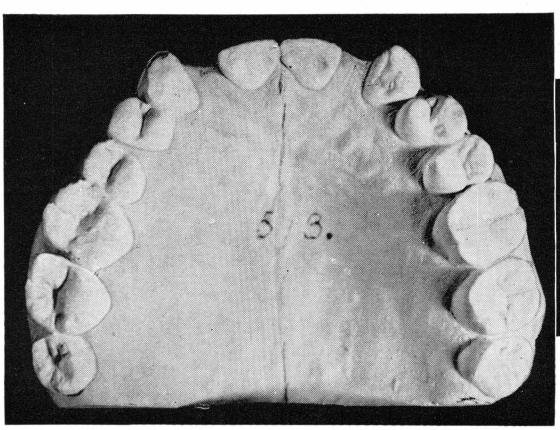


Fig. 35 (1:1).

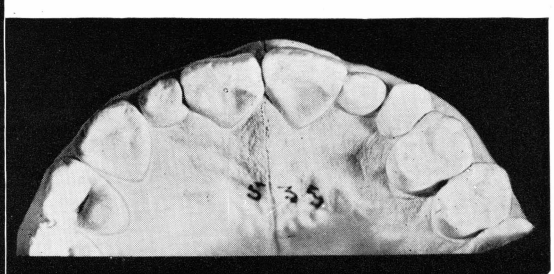


Fig. 36 (1.5:1).

Plate 3.

Fig. 37. Lower central incisors congenitally missing. E. G. male aged 21 (No. 338).

Fig. 38. Lower left central incisor congenitally missing. E. G. female aged 15 (No. 416).

Fig. 39. Lower right central incisor congenitally missing. E. G. male aged 40 (No. 524).

Fig. 40. Upper left first and third molars congenitally missing. E. G. female aged 27 (No. 183).

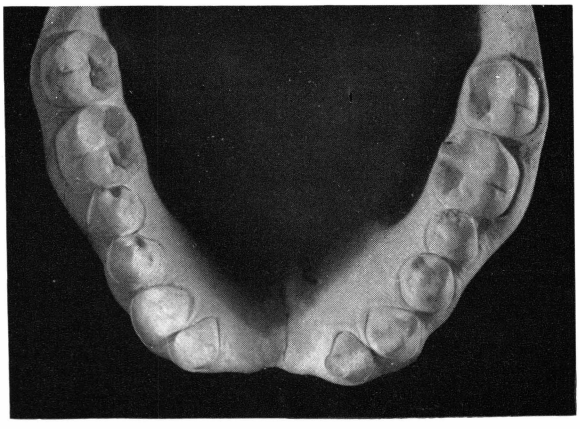


Fig. 37 (1:1).



Fig. 38 (1.5:1).

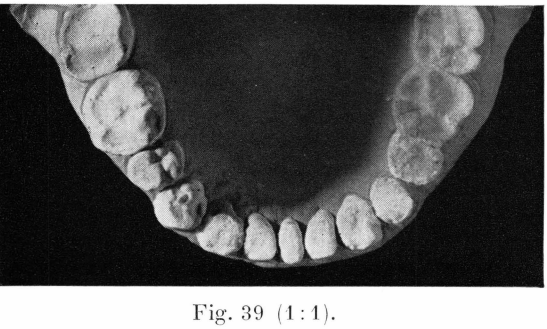


Fig. 39 (1:1).

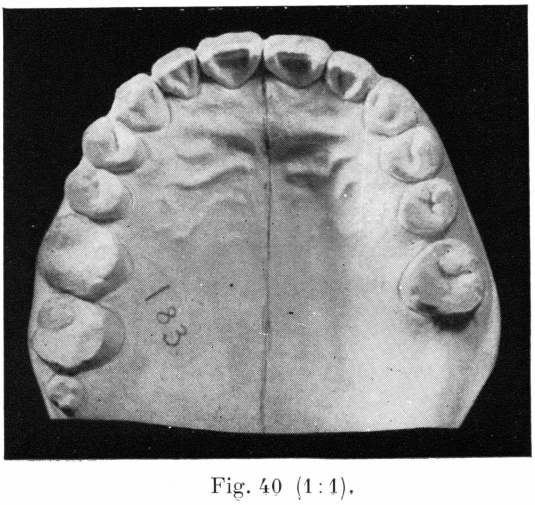


Fig. 40 (1:1).

Plate 4.

Fig. 41. West Greenland Eskimo skull described and depicted by WINSLOW (341) in 1722. One maxillary right postcanine tooth is missing.

Fig. 42. Lower left third molar embedded below second molar. Severe hypercementosis on the third molar. Large pulp stones in all three molars. Adult male skull from Anoritôq (No. 162). Same case as Plate 2, Fig. 34.

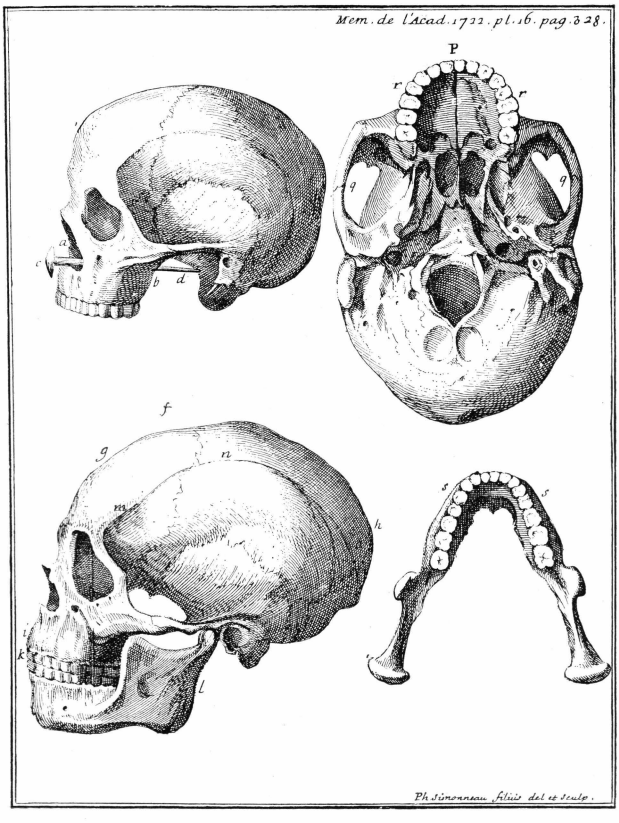

Mem. de l'Acad. 1722. pl. 16. pag. 328.
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Fig. 41.



Fig. 42.

Plate 5.

Fig. 43. Lower right third molar non-erupted. E. G. male aged 36 (No. 323).

Fig. 44. Lower left third molar non-erupted. E. G. male aged 48 (No. 319).

Fig. 45. Lower left third molar non-erupted. E. G. female aged 24 (No. 433).

Fig. 46. Congenital absence of third molars in Greenland Eskimo mandible. Abundant space available for accommodation of wisdom teeth.

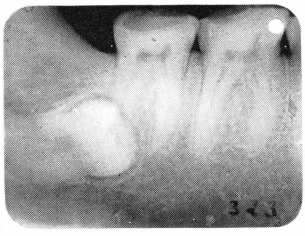


Fig. 43.

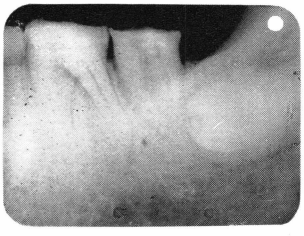


Fig. 44.

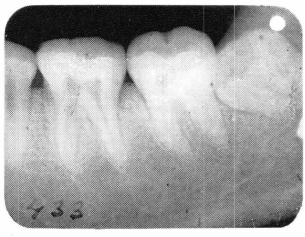


Fig. 45.

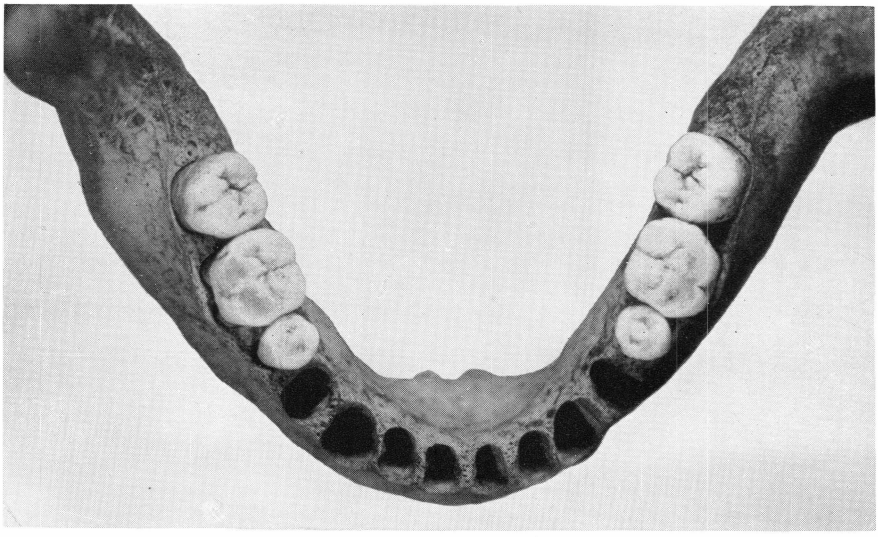


Fig. 46 (1:1).

Plate 6.

Fig. 47. Disintegration of the teeth on the left side of a Greenland Eskimo skull. The teeth on the right side are undamaged.

Fig. 48. Disintegration of the hard tissues of Eskimo teeth with demineralization and shrinkage of the dentine.

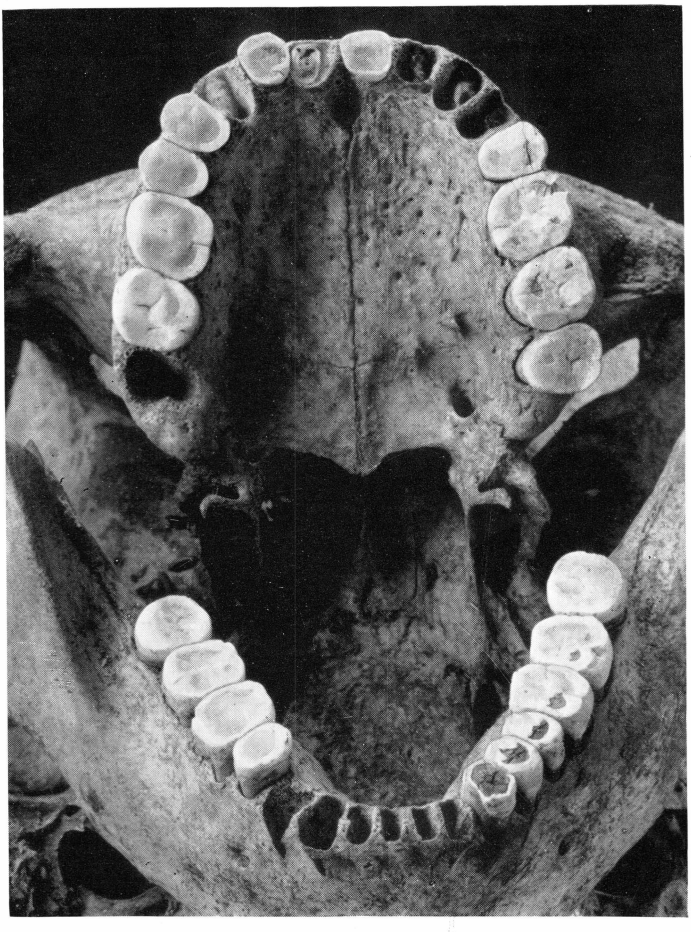


Fig. 47 (1:1).



Fig. 48 (2.2:1).

Plate 7.

Fig. 49. *Post mortem* loss of teeth in Eskimo upper jaw.

Fig. 50. Occlusal attrition of Eskimo lower second molar. Degree 1 according to BROCA (43).

Fig. 51. Occlusal attrition of Eskimo lower molars. Degree 2 according to BROCA (43).

Fig. 52. Proximal wear of Eskimo lower P_2, M_1, and M_2. Slight separation of the teeth undertaken by the examiner.

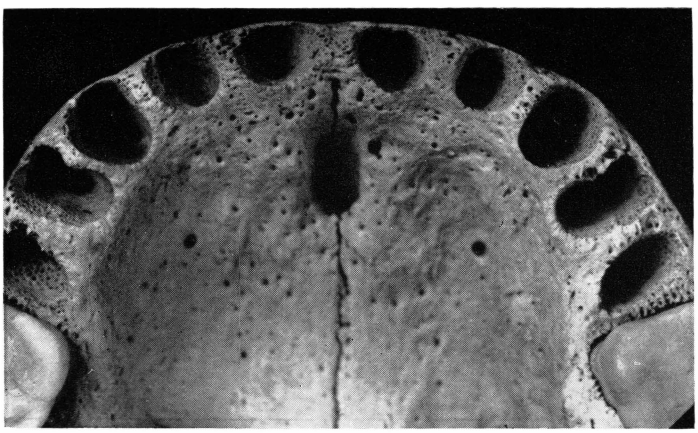


Fig. 49 (2 : 1).



Fig. 50 (2 : 1).



Fig. 51 (2 : 1).



Fig. 52 (2 : 1).

Plate 8.

Fig. 53. Greenland Eskimo upper jaw showing multiple small fractures of the teeth. The lesion on the distal surface of the right second premolar is a fracture, not caries.

Fig. 54. Small fractures of premolars and first molar due to abuse of the teeth. E. G. male aged 34 (No. 540).

Fig. 55. The upper right third molar extraordinarily massive. Rotation and facial deviation. E. G. male aged 18 (No. 297).

Fig. 56. Upper left third molar vestigial, but molariform. Upper right third molar congenitally missing. E. G. male aged 19 (No. 50).

Fig. 57. Upper left third molar vestigial and peg-shaped. Upper right third molar congenitally missing. E. G. male aged 38 (No. 346).

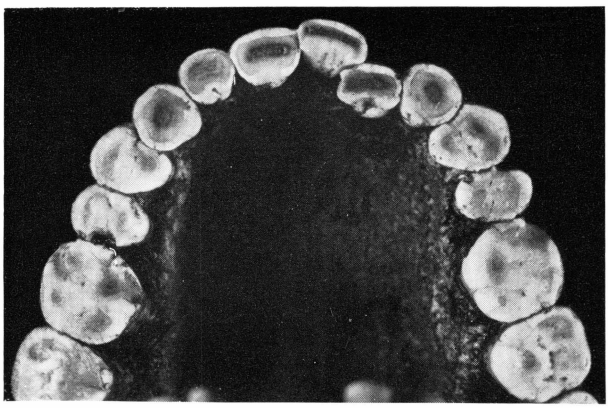


Fig. 53 (1:1).

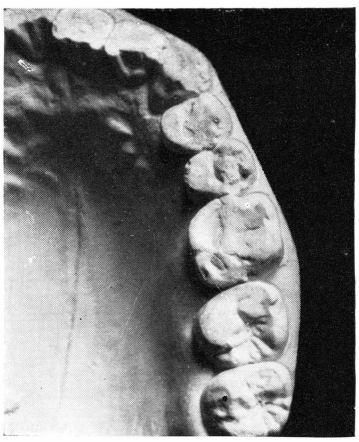


Fig. 54 (1:1).

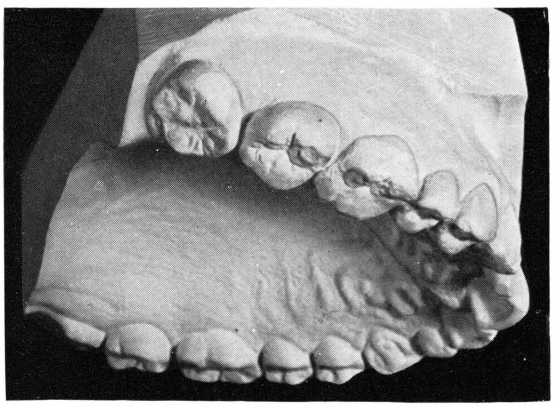


Fig. 55 (1:1).

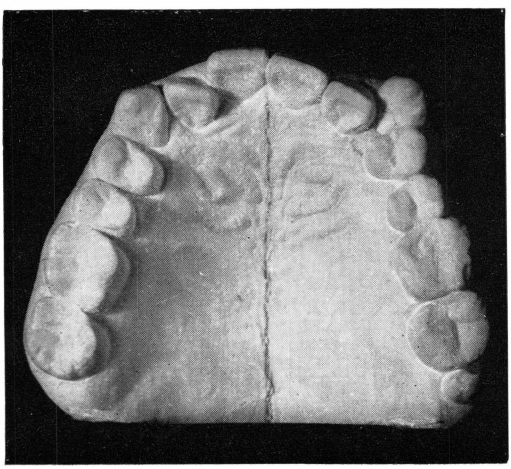


Fig. 56 (1:1).

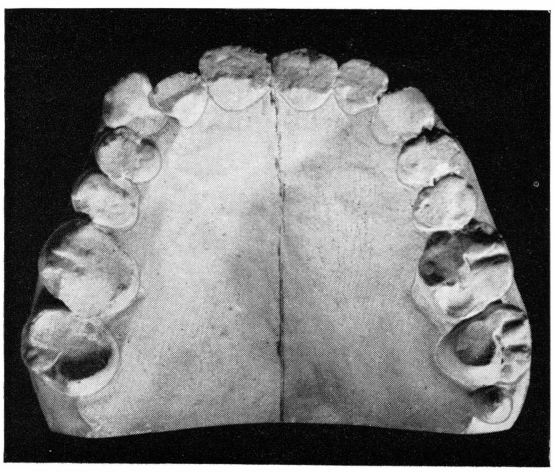


Fig. 57 (1:1).

Plate 9.

Fig. 58. Upper right third molar extraordinarily massive and of oblong ovoid shape with stout paramolar tubercle. E. G. male aged 18 (No. 543).

Fig. 59. Greenland Eskimo upper jaw with pronounced occlusal wrinkles on the third molars.

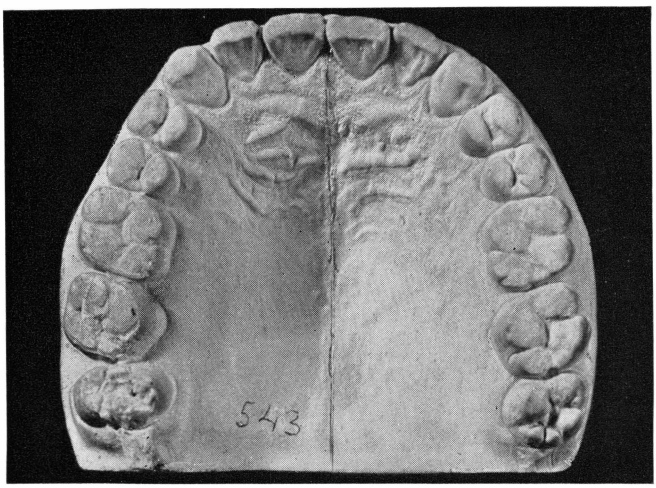


Fig. 58 (1:1).

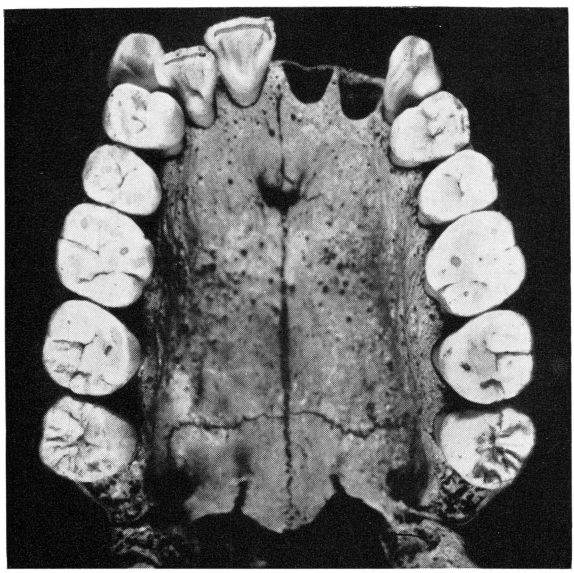


Fig. 59 (1:1).

Plate 10.

Fig. 60. Occlusal enamel pearl on the upper right third molar. E. G. male aged 29 (No. 516).

Fig. 61. Large paramolar tubercle on the upper right third molar. E. G. female aged 23 (No. 27).

Fig. 62. Both upper third molars have supernumerary lingual cusps. (Lingual surfaces facing one another, mesial surfaces facing top). Adult male skull from East Greenland (No. 284). Same skull as Plate 14, Fig. 79.

Fig. 63. Eskimo upper right third molar (skull) with one root and one wide root canal.

Fig. 64. Upper left third molar has one root and one wide root canal. E. G. male aged 25 (No. 147).

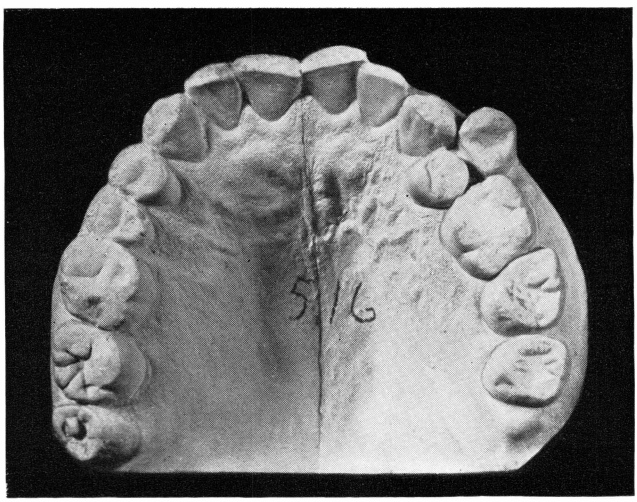


Fig. 60 (1:1).

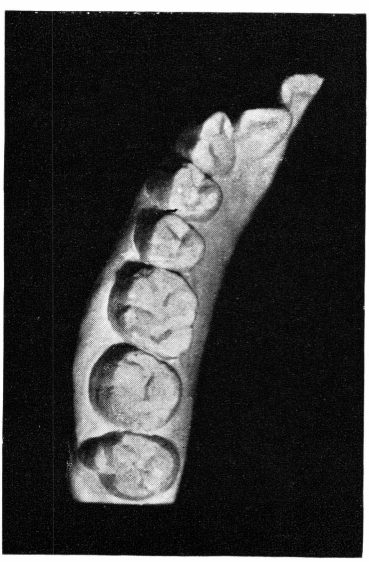
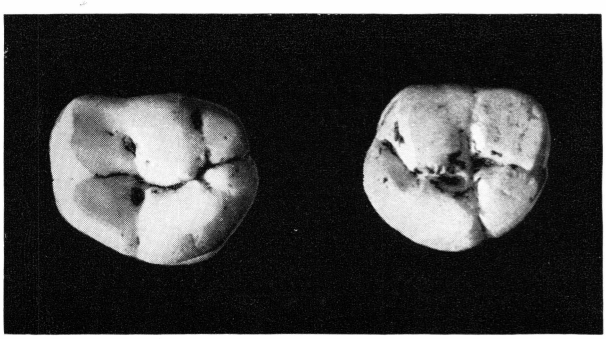


Fig. 61 (1:1).



M_3 sup. dext. M_3 sup. sin.

Fig. 61 (2:1).

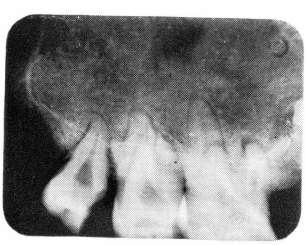


Fig. 63.

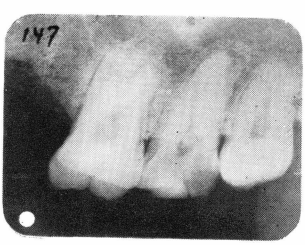


Fig. 64.

Plate 11.

Fig. 65. Eskimo skull with quadritubercular upper second molars (hypocone reduced). The right canine displaced and impacted.

Fig. 66. Occlusal wrinkles on all four second molars. E. G. male aged 14 (No. 394).



Fig. 65 (1:1).

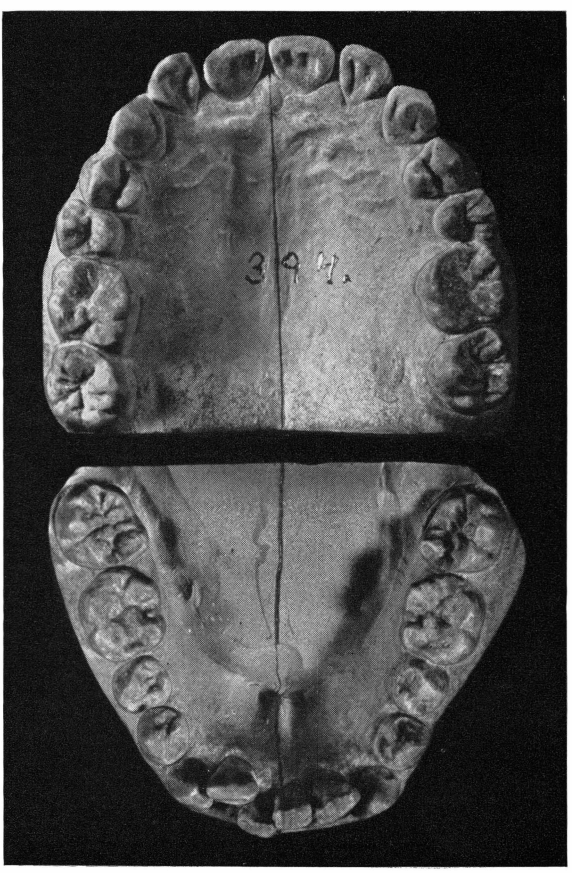


Fig. 66 (1:1).

Plate 12.

Fig. 67. Large paramolar tubercle on the upper left second molar. E. G. female aged 19 (No. 126).

Fig. 68. Paramolar tubercle of medium size on the upper left second molar. The first molar was lost long ago. E. G. male aged 17 (No. 510).

Fig. 69. Asymmetrical location of paramolar tubercles (medium size) on upper second molars. a, Mesio-facial location on right M_2; b, Central location on facial surface of left M_2. E. G. female aged 14 (No. 693).

Fig. 70. Upper second molars of East Greenland Eskimo skull (No. 138, juvenile). Fusion of palatal and mesio-facial roots.

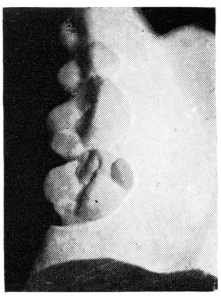


Fig. 67 (1:1).

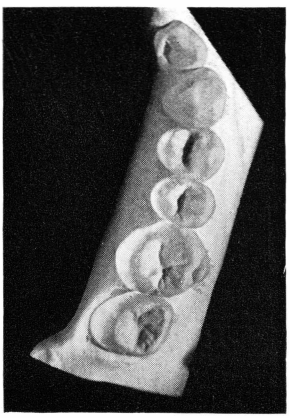


Fig. 68 (1:1).

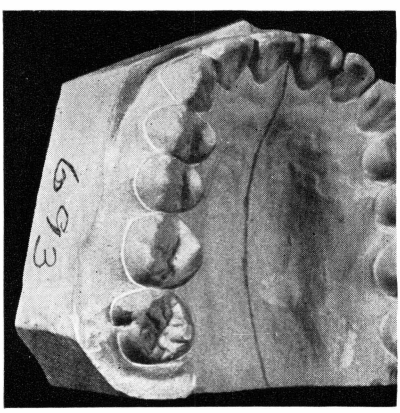


Fig. 69a (ca. 1:1).

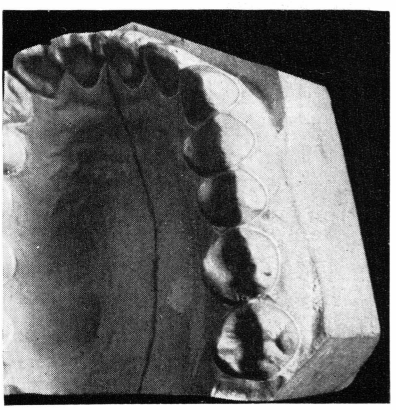


Fig. 69b (ca. 1:1).

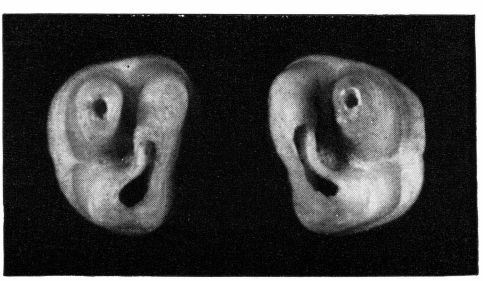


Fig. 70 (2:1).

Plate 13.

Fig. 71. East Greenland Eskimo upper right second molar with total fusion of roots. One wide root canal. (Roentgenogram taken from the mesial side).

Fig. 72. The upper left second and third molars exhibit total fusion of roots, and one wide root canal. The same conditions are found on the right side of the upper jaw. E. G. female aged 15 (No. 288).

Fig. 73. Four taurodont upper first molars of East Greenland Eskimo origin. The high root stem should be noticed. The molar to the left displays resorption of the facial root apices.

Fig. 74. Palatal aspect of East Greenland Eskimo upper right first molar with longitudinal groove.

Fig. 75. Roentgenogram of East Greenland Eskimo taurodont upper right first molar (high root stem and pulp chamber).

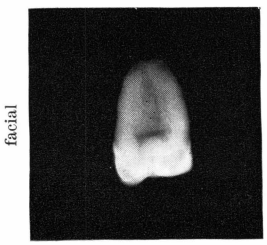


Fig. 71.

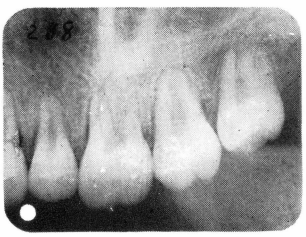


Fig. 72.

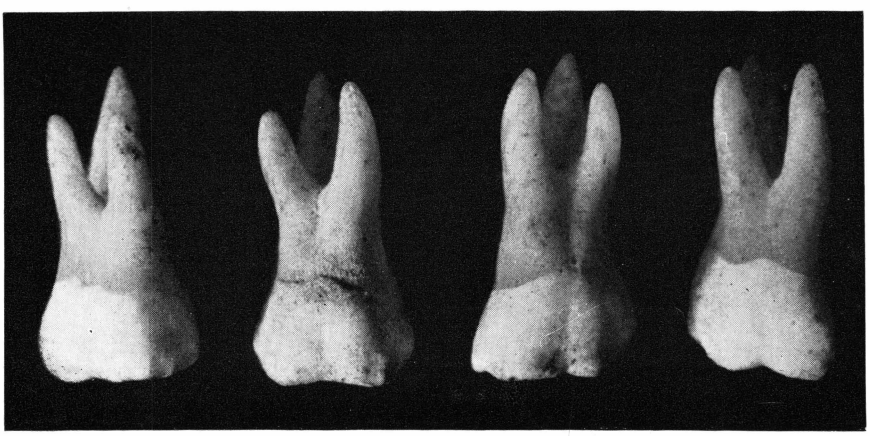


Fig. 73 (2 : 1).

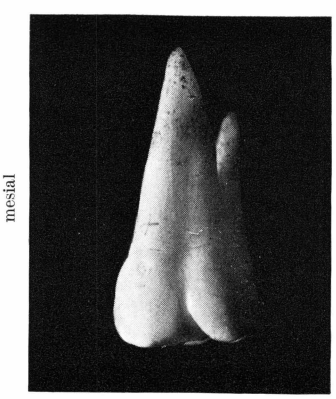


Fig. 74 (2 : 1).

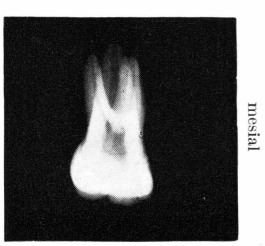


Fig. 75.

Plate 14.

Fig. 76. Palatal aspect of East Greenland Eskimo upper left first molar (immature) with CARABELLI's tubercle of fair size.

Fig. 77. Occlusal wrinkles on East Greenland Eskimo lower left third molar.

Fig. 78. Occlusal wrinkles on lower right third molar. E. G. female aged 24 (No. 189).

Fig. 79. Disto-lingual supernumerary tubercles on M_3 inf. dext. and both M_2 inff. Adult male skull (No. 284). Same skull as Plate 10, Fig. 62.

Fig. 80. Large paramolar tubercle (central location) and occlusal wrinkles on lower right third molar. E. G. female aged 20 (No. 678).

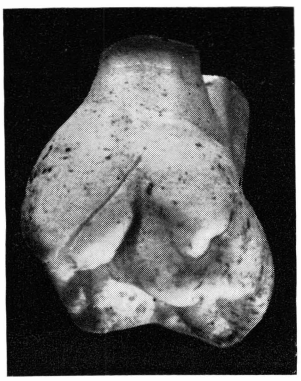


Fig. 76 (3 : 1).



Fig. 77 (2 : 1).

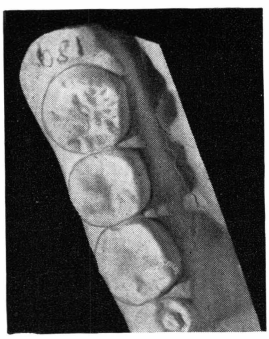


Fig. 78 (1 : 1).



Fig. 79 (1.5 : 1).

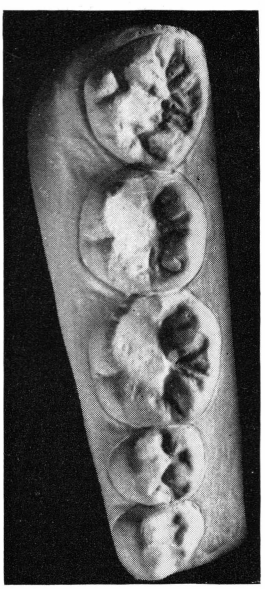


Fig. 80 (1.5 : 1).

Plate 15.

Fig. 81. The lower third molars of East Greenland Eskimo skull. One root and one wide root canal. (Roentgenogram taken from the facial side).

Fig. 82. Slightly modified *Dryopithecus* pattern on quintitubercular lower left second molar of juvenile East Greenland Eskimo skull (No. 138).

Fig. 83. East Greenland Eskimo mandible (No. 233) exhibiting five cusps on all three molars (right side).

Fig. 84. *Dryopithecus* pattern retained on lower second molar. E. G. female aged 11 (No. 309).

Fig. 85. Very large paramolar tubercle (central location) on lower left second molar. E. G. female aged 11 (No. 636).

Fig. 86. The lower second molars have total fusion of roots and one wide root canal. E. G. female aged 13 (No. 372). a, Right side; b, Left side.

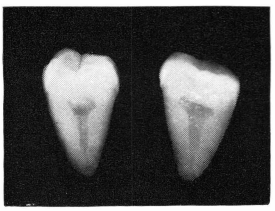


Fig. 81.

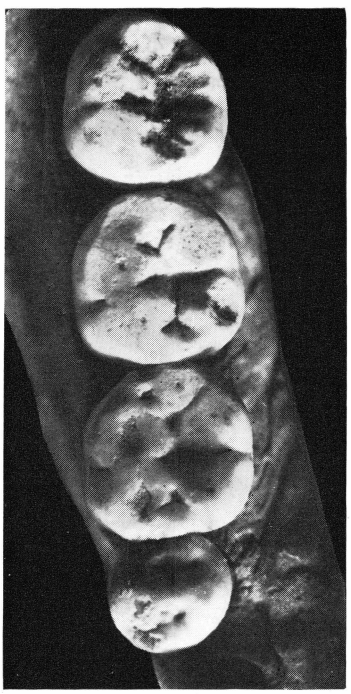


Fig. 83 (2 : 1).

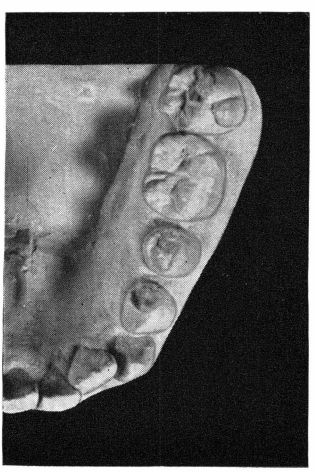


Fig. 85 (1 : 1).

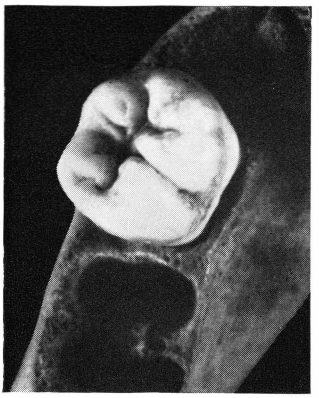


Fig. 82 (2 : 1).

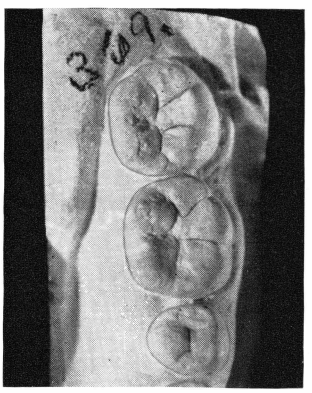


Fig. 84 (1.5 : 1).

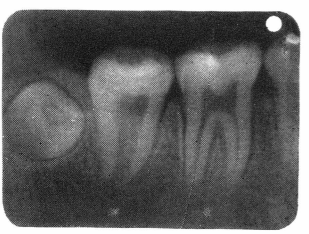


Fig. 86a.



Fig. 86b.

Plate 16.

Fig. 87. Enormous pulp stones in the lower second molars of adolescent Greenland Eskimo skull.

Fig. 88. Very large pulp stones in the lower first and second molars of young Angmagssalik Eskimo. E. G. male aged 17 (No. 119). a, Right side; b, Left side.

Fig. 89. The anterior lower molars (probably the second molars) show fusion of the roots and one wide root canal. The posterior molars, if third molars, show early development. As no molars were extracted, the first molars are presumed to be congenitally missing. E. G. female aged 16 (No. 334). a, Right side; b, Left side.

Fig. 90. Lingual aspect of East Greenland Eskimo lower right first molar of pronounced taurodont type. The root stem is very high. The pulp chamber extends well down into the root region.

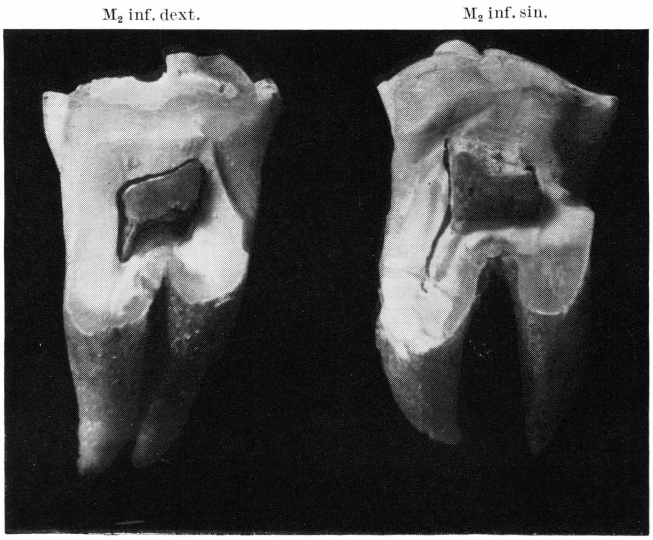


Fig. 87 (ca. 3 : 1).



Fig. 88a.



Fig. 88b.

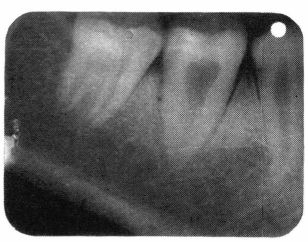


Fig. 89a.



Fig. 89b.

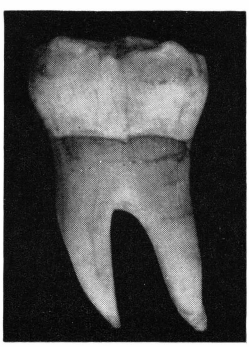


Fig. 90 (2 : 1).

Plate 17.

Fig. 91. Greenland Eskimo lower right molars with pronounced facial pits (*foramina caeca*). Perfect *Dryopithecus* pattern on the second molar.

Fig. 92. Eskimo lower left molars worn down to the level of the *foramina caeca* which in this case do not penetrate to the dentine.

Fig. 93. "Foramen caecum-hypoplasia" (irregular type) on the left first and second molars of East Greenland Eskimo mandible (No. 162).

Fig. 94. "Foramen caecum-hypoplasia" (regular type) on the lower left second molar of Eskimo skull.

Fig. 95. Mandible of 4 or 5 years old East Greenland Eskimo child, showing pronounced folding of the occlusal enamel on the immature left first molar.

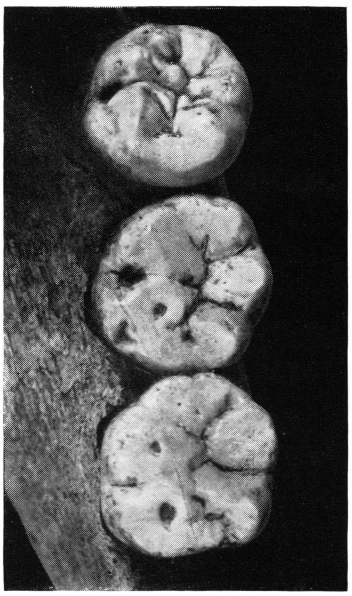


Fig. 91 (2:1).

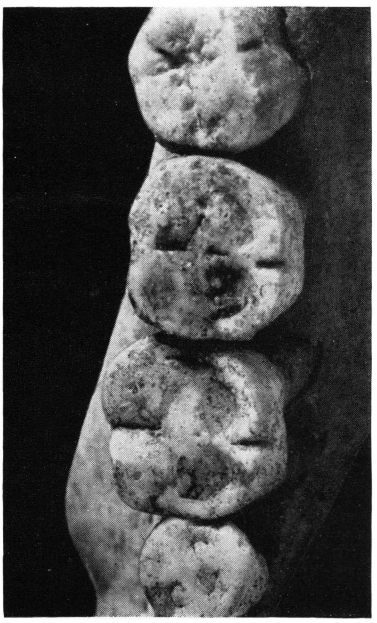


Fig. 92 (2:1).

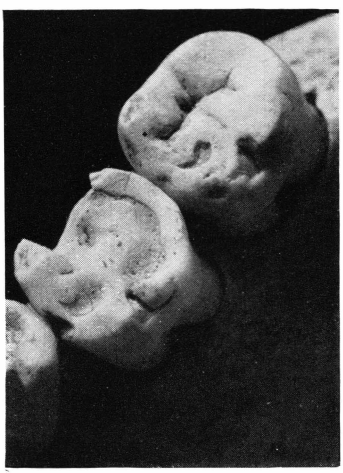


Fig. 93 (2:1).

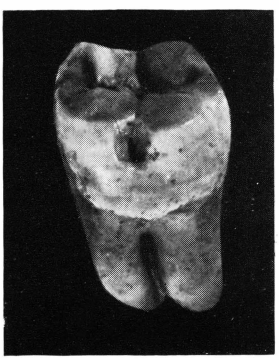


Fig. 94 (2:1).



Fig. 95 (2:1).

Plate 18.

(all Figures are 2:1).

Figs. 96—107. Different types of "enamel line".

Fig. 96. *Enamel margin type 1.* Facial aspect of M_2 sup. dext. Neolithic Dane.

Fig. 97. *Enamel margin type 2.* Facial aspect of M_2 sup. dext. African Negro.

Fig. 98. *Enamel margin type 3.* Facial aspect of M_2 inf. dext. West Greenland Eskimo.

Fig. 99. *Enamel margin type 4.* Facial aspect of M_2 inf. sin. African Negro.

Fig. 100. *Enamel margin type 4.* Facial aspect of M_1 inf. sin. East Greenland Eskimo.

Fig. 101. *Enamel margin type 4.* Facial aspect of M_1 inf. dext. Modern West Greenlander.

Fig. 102. *Enamel margin type 5.* Facial aspect of M_2 inf. dext. Modern Dane.

Fig. 103. *Enamel margin type 5.* Facial aspect of M_1 sup. dext. West Greenland Eskimo.

Fig. 104. *Enamel margin type 5.* Facial aspect of M_1 inf. sin. West Greenland Eskimo.

Fig. 105. *Enamel margin type 6.* Facial aspect of M_2 sup. dext. West Greenland Eskimo.

Fig. 106. *Enamel margin type 6.* Facial aspect of M_1 inf. dext. West Greenland Eskimo.

Fig. 107. *Enamel margin type 6.* Facial aspect of M_2 inf. sin. East Greenland Eskimo.

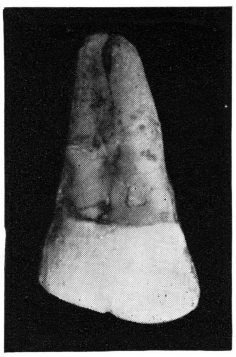


Fig. 96.

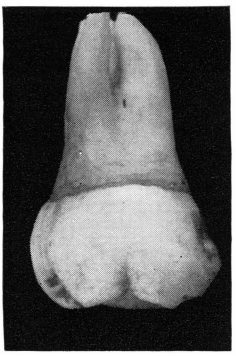


Fig. 97.

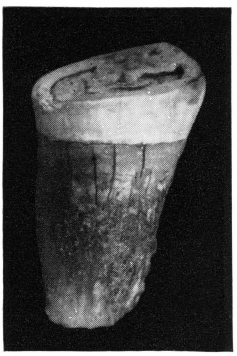


Fig. 98.

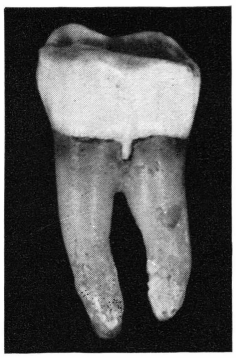


Fig. 99.

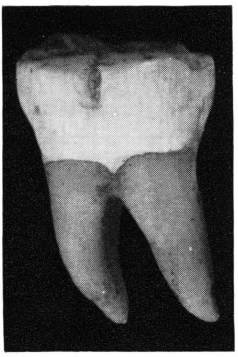


Fig. 100.

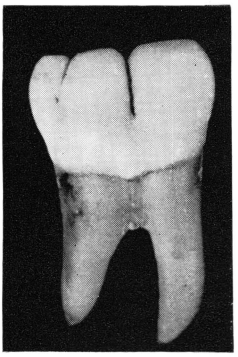


Fig. 101.



Fig. 102.

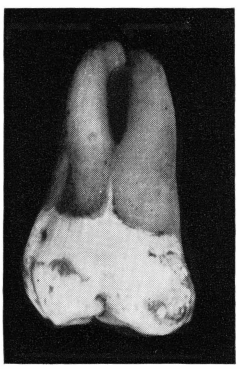


Fig. 103.

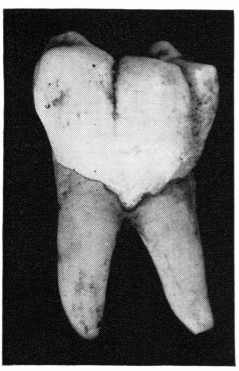


Fig. 104.

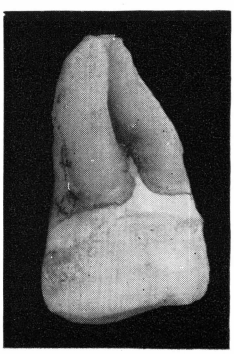


Fig. 105.

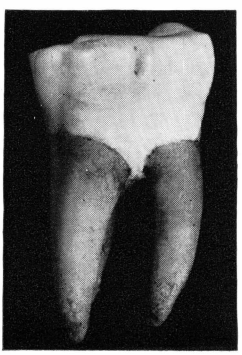


Fig. 106.



Fig. 107.

Plate 19.

(all Figures are 2:1).

Fig. 108. M_2 inf. sin. of West Greenland Eskimo. Complete fusion of the facial aspect of the root. No enamel extension.

Fig. 109. M_2 inf. sin. of West Greenland Eskimo. Longitudinal groove on the facial aspect of the root. Enamel extension moderate (type 4). Hypercementosis.

Fig. 110. M_2 inf. dext. of West Greenland Eskimo. Longitudinal groove on the facial aspect of the root. Enamel extension pronounced (type 5).

Fig. 111. M_2 inf. sin. of East Greenland Eskimo (skull No. 175). Fusion of the facial aspect of the root (faint groove). Enamel nodule.

Fig. 112. M_2 inf. dext. of the same East Greenland Eskimo skull as Fig. 111 (skull No. 175). Separated root branches. Facial enamel extension (type 5).

Fig. 113. M_2 inf. sin. of West Greenland Eskimo. Enamel nodule attached to the enamel of the crown. Facial aspect.

Fig. 114. Pronounced enamel extensions on all right molars of a West Greenland Eskimo skull.

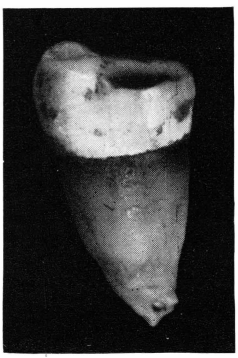


Fig. 108.

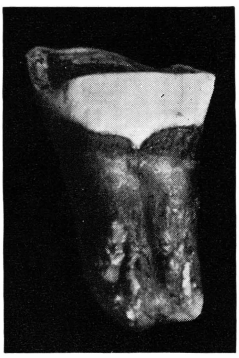


Fig. 109.



Fig. 110.

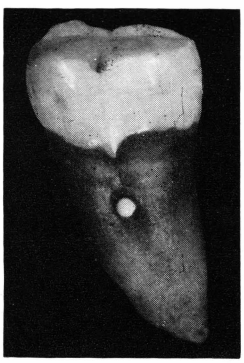


Fig. 111.

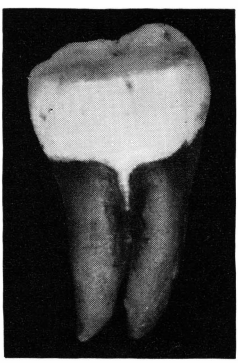


Fig. 112.

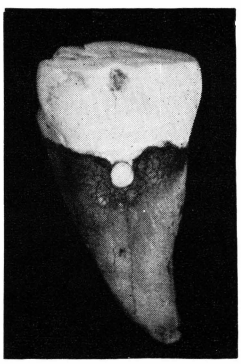


Fig. 113.

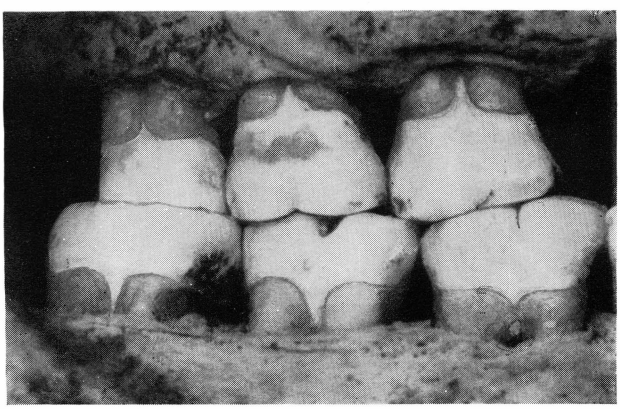


Fig. 114.

Plate 20.

Fig. 115. Pronounced enamel extensions on the lower left molars of an Eskimo skull.

Fig. 116. M_1 inf. dext. of Alaskan Eskimo. Very irregular shape of the enamel margin.

Fig. 117. Three-rooted lower first molars from Greenland. a and b, M_1 inff. of East Greenland Eskimos; c, M_1 inff. of West Greenland natives from Northern Julianehaab District (caries).

Fig. 118. Greenland Eskimo lower left first molar seen from the distal side. Typical shape of supernumerary disto-lingual root.

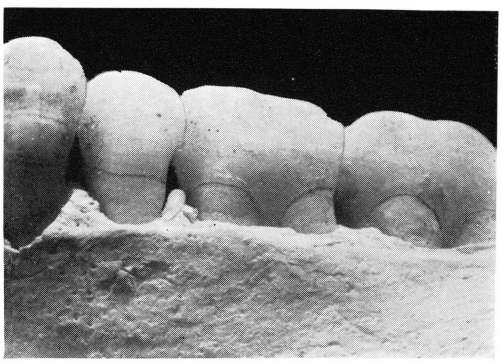


Fig. 115 (2 : 1).

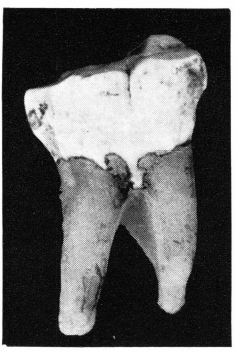


Fig. 116 (2 : 1).

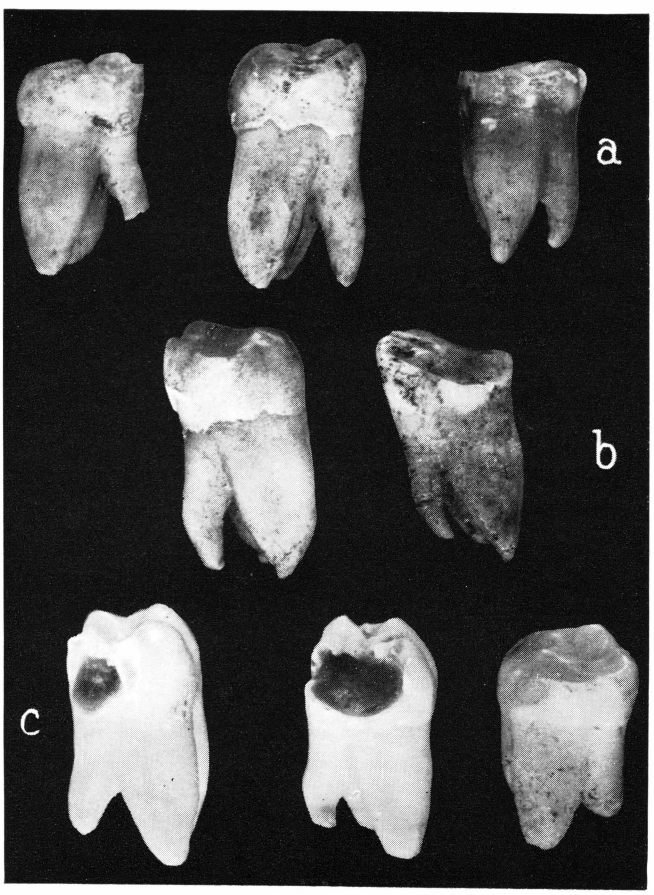


Fig. 117 (1.5 : 1).

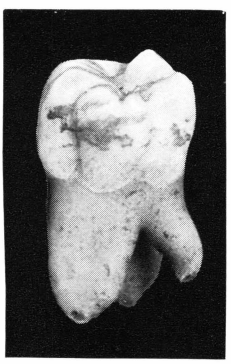


Fig. 118 (ca. 2 : 1).

Plate 21.

Fig. 119. Bilateral occurrence of supernumerary disto-lingual roots on lower first molars of Greenland Eskimo mandible (between 8 and 10 years of age).

Fig. 120. East Greenland Eskimo mandible (skull No. 268) showing socket of two-rooted lower first molar on the right side, and socket of three-rooted lower first molar on the left side.

Fig. 121. Roentgenogram of the Krapina mandible C with hypertaurodont molars (prismatic roots). (ADLOFF (5)).

Fig. 122. Roentgenogram of the Krapina mandible E with mesotaurodont molars. High root stems and deep pulp chambers in the molars. (ADLOFF (5)).

Fig. 123. Roentgenogram of the Krapina mandible G with mesotaurodont molars. High root stems and deep pulp chambers. (ADLOFF (5)).

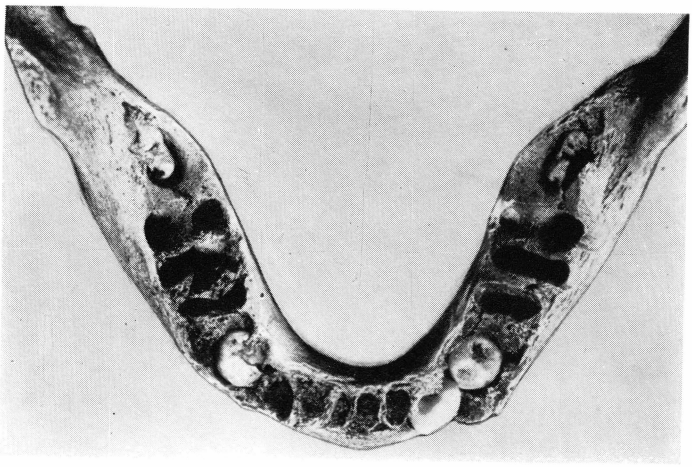


Fig. 119 (1 : 1).

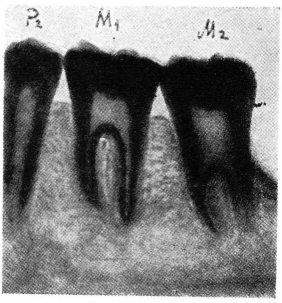


Fig. 122.

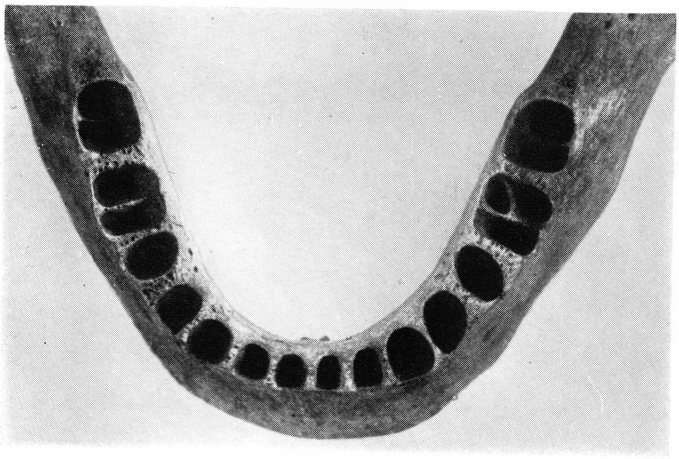


Fig. 120 (1 : 1).



Fig. 121.

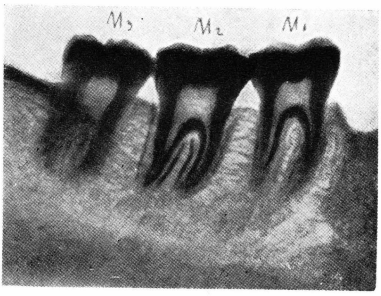


Fig. 123.

Plate 22.

Fig. 124. The configuration of roots and pulp chambers in the lower molars of mediaeval Norseman (white race) from Greenland. The teeth are cynodont. The roots are higher and more slender than in the Eskimo.

Figs. 125—130.
Large pulp cavities in East Greenland Eskimo lower molars.
a, Right side; b, Left side.

Fig. 125. E. G. female aged 13 (No. 289).

Fig. 126. E. G. female aged 18 (No. 291).

Fig. 127. E. G. male aged 19 (No. 534).

Fig. 128. E. G. female aged 20 (No. 294).

Fig. 129. E. G. male aged 35 (No. 411).

Fig. 130. E. G. male aged 40 (No. 524).



Fig. 124.

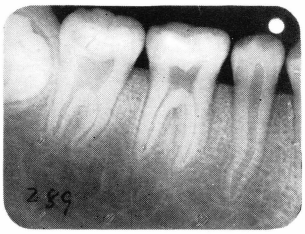


Fig. 125a.

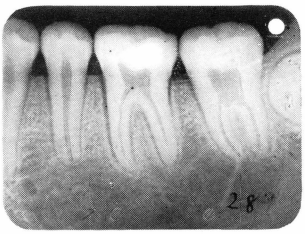


Fig. 125b.

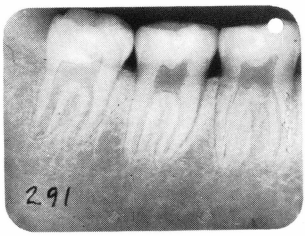


Fig. 126a.



Fig. 126b.

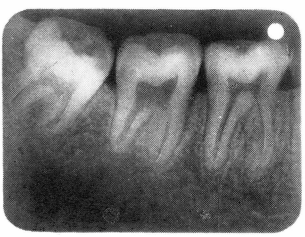


Fig. 127a.



Fig. 127b.

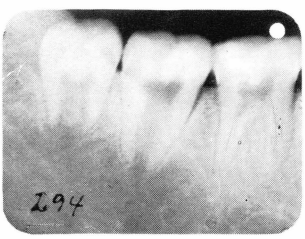


Fig. 128a.

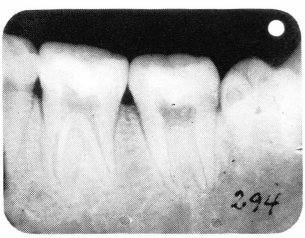


Fig. 128b.

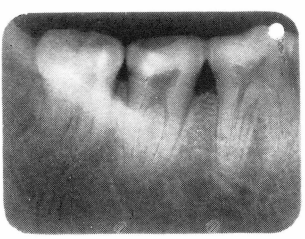


Fig. 129a.



Fig. 129b.



Fig. 130a.



Fig. 130b.

Plate 23.

Figs. 131—135. Enamel nodules.

Fig. 131. Section of Greenland Eskimo upper third molar with large enamel nodules on the distal and mesial surfaces of the root. Facial aspect stained with methylene blue.

Fig. 132. Dental fluorosis (mottled enamel) in upper first molar of West Greenland native living near the cryolite mine at Ivigtut, South-West Greenland (PEDERSEN (247)). On the distal surface of the root there is a nodule, the enamel layer of which seems to be unaffected by the fluorine intake during early childhood.

Fig. 133. Eskimo enamel nodule connected with the enamel of the crown by a bridge of enamel (! - type).

Fig. 134. Eskimo enamel nodule having no connection with the enamel of the crown.

Fig. 135. Peculiar nodule-like structure on the lingual aspect of West Greenland Eskimo upper left third molar.

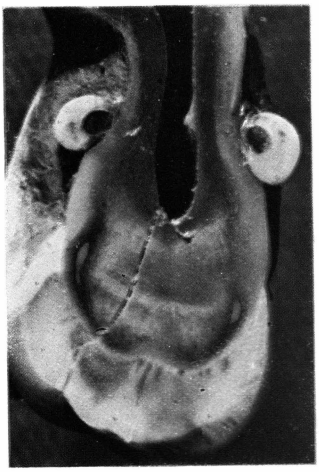


Fig. 131 (5 : 1).

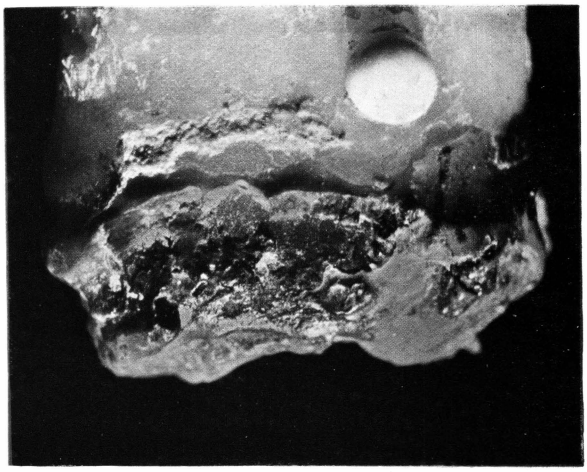


Fig. 132 (5 : 1).

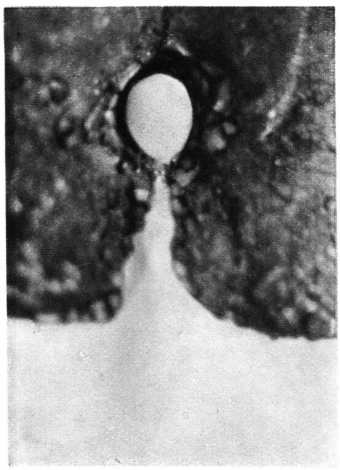


Fig. 133 (5 : 1).

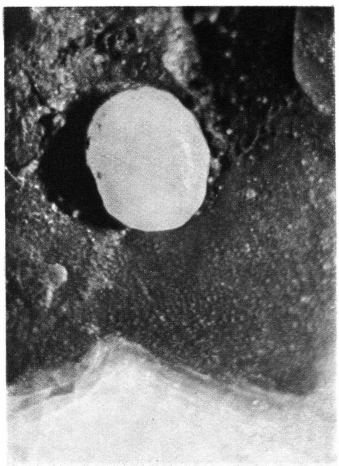


Fig. 134 (7 : 1).

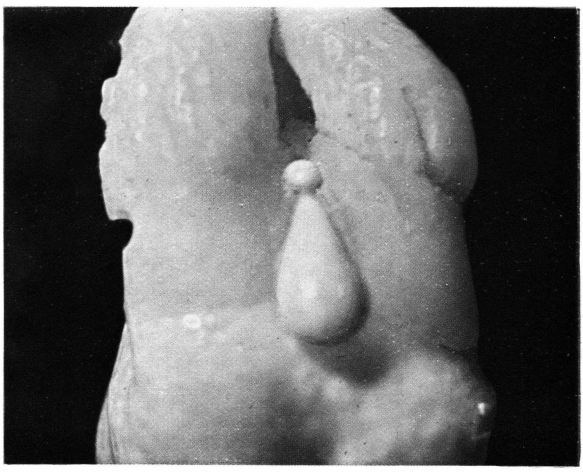


Fig. 135 (5 : 1).

Gösta Gustafson phot.

Plate 24.

Fig. 136. Greenland Eskimo upper left first premolar. Great difference between facial and lingual length of crown.

Fig. 137. The upper left first premolar displays great difference between facial and lingual length of crown. E. G. female aged 36 (No. 285).

Fig. 138. Five pairs of upper first premolars of East Greenland Eskimo skulls. One pair only (top right), exhibits bifurcated roots.

Fig. 139. Twelve unmatched upper first premolars of East Greenland Eskimo skulls. One specimen only, exhibits bifurcated root, and two only (middle of lower row), have two root canals.

Fig. 140. Occlusal pearl on lower right second premolar. E. G. female aged 24 (No. 189).

Fig. 141. The lower right first premolar of East Greenland Eskimo skull No. 377. a, Mesial aspect showing abnormal root conditions ("Tomes' abnormal root"); b, Roentgenogram showing two root canals in the apical part.



Fig. 136 (2.2 : 1).

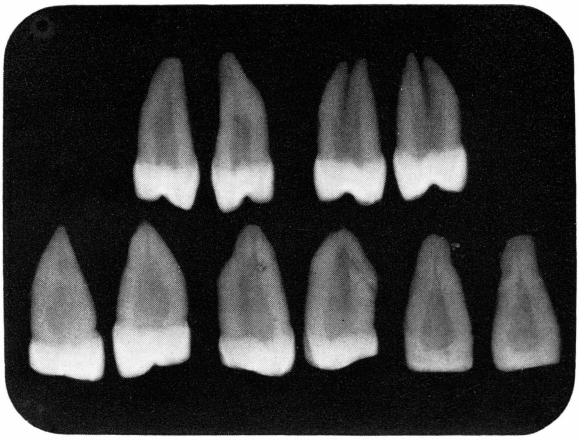


Fig. 138.

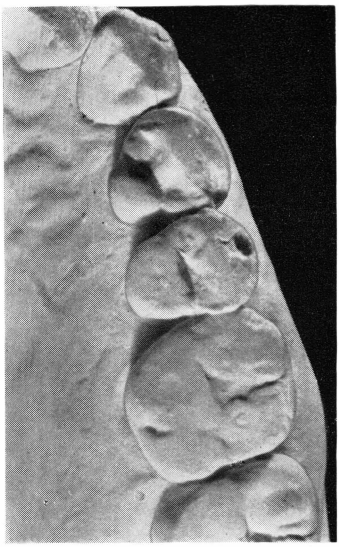


Fig. 137 (2 : 1).

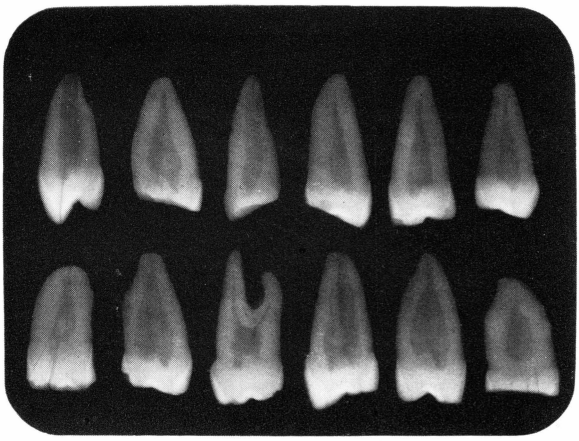


Fig. 139.



Fig. 140 (2 : 1).

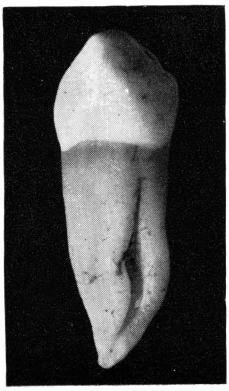


Fig. 141a (2 : 1).

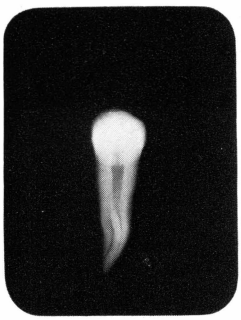


Fig. 141b.

Plate 25.

Fig. 142. Right side of East Greenland maxilla. The premolar crowns are almost equal in size in this case.

Fig. 143. East Greenland Eskimo lower left second molar with complete fusion of roots facially, and with lingual groove. a, Facial aspect; b, Roentgenogram of the same tooth; c, Longitudinal section of another M_2 inf. displaying similar root and pulp conditions; d, Transversal section of Fig. 143 a at x; e, Transversal section of Fig. 143 a at y. The surface seen in Fig. 143 d is the coronal surface of the sector between the dotted lines in Fig. 143 a. The surface seen in Fig. 143 e is the apical surface of the same sector.

Fig. 144. Asymmetrical root and pulp conditions of lower second molars. a, Right side, root branches separated near apices, deep pulp chamber; b, Left side, root branches entirely separated, pulp chamber less extended in the vertical direction. E. G. female aged 37 (No. 547).

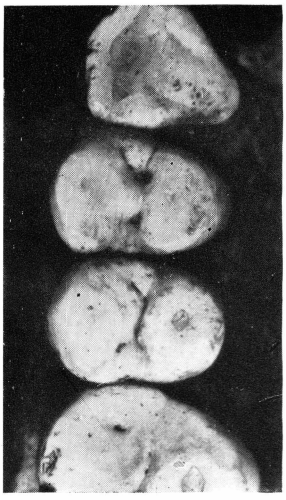


Fig. 142 (2 : 1).

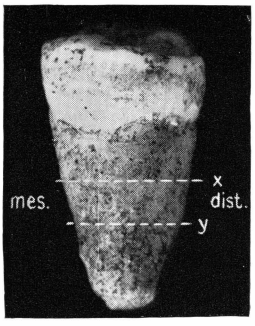


Fig. 143a (2 : 1).

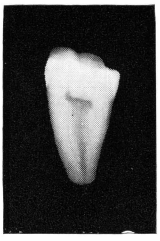


Fig. 143b.

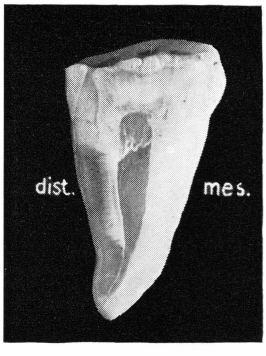


Fig. 143c (2 : 1).

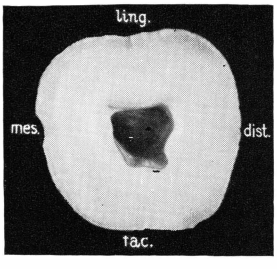


Fig. 143d (3 : 1).

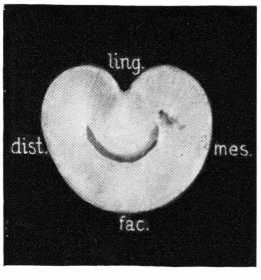


Fig. 143e (3 : 1).



Fig. 144a.

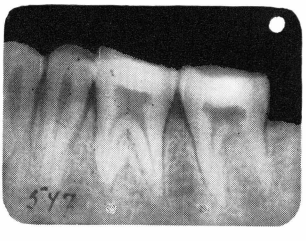


Fig. 144b.

Plate 26.

Fig. 145. Upper canine of moderate size. E. G. female aged 14 (No. 311).

Fig. 146. Canines large and projecting. Mesio-distal diameters of upper central incisors considerably larger than those of upper lateral incisors. E. G. male aged 18 (No. 642).

Fig. 147. Lingual aspects of four East Greenland Eskimo upper canine teeth.

Fig. 148. Enamel pearls on inciso-lingual surface of the upper canine crowns. E. G. male aged 12 (No. 39).

Fig. 149. The upper canine teeth of an adolescent Eskimo skull. Considerable difference in height of roots (resorption).

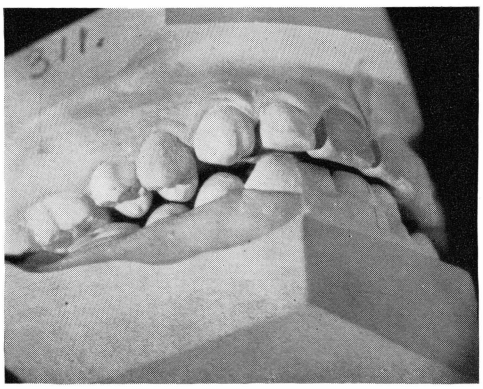


Fig. 145 (1 : 1).

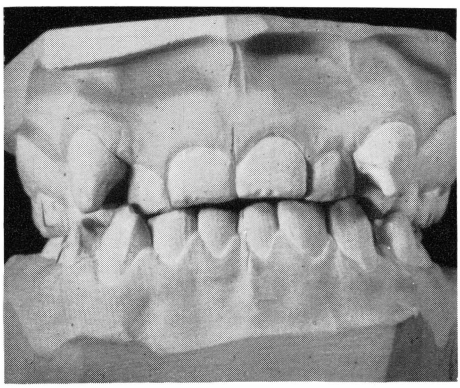


Fig. 146 (1 : 1).



Fig. 147 (2 : 1).

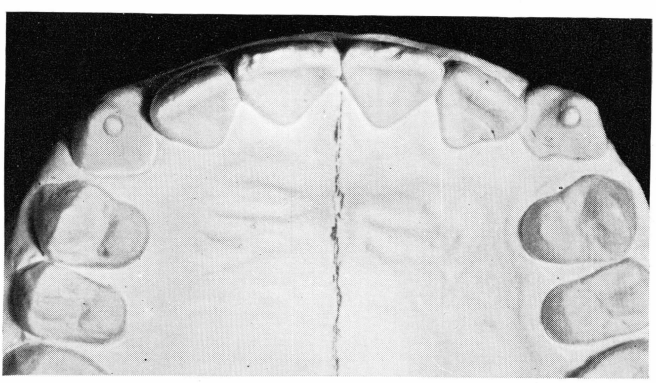


Fig. 148 (1.5 : 1).

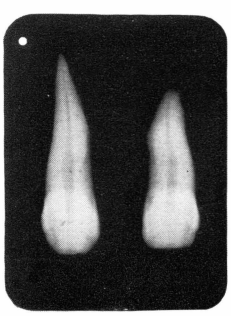


Fig. 149.

Plate 27.

Fig. 150. The upper canine teeth of young Central Eskimo skull showing extreme difference of root height. On the tooth to the right (b) the resorption of the apical part of the root is more advanced than on that to the left (a). b also displays considerable hypercementosis on the remaining part of the root.

Fig. 151. Moderate shovel-shape and median ridge on East Greenland Eskimo lower left canine. Lingual aspect of C inf. sin.

Fig. 152. Typical root resorption of lower canine tooth from adult Eskimo skull. a, Mesial view (facial surface to the left); d, Skiagram of same.

Fig. 153. Pronounced dental tubercles on upper lateral incisors. The left lateral incisor shows the tubercle to be divided into three cusplets, and there is a similar tendency on the right lateral incisor. Shovel-shape of all four incisors. E. G. female aged 26 (No. 471).

Fig. 154. Traces of median ridges on the lingual surfaces of the upper central incisors. Faint shovel-shape of upper incisors. E. G. male aged 10 (No. 60).

Fig. 155. Moderate median ridges on the lingual surfaces of the upper central incisors. Moderate shovel-shape of upper incisors. E. G. male aged 9 (No. 306).

Fig. 156. Pronounced median ridges on the lingual surfaces of the upper central incisors. Moderate shovel-shape of lateral incisors, faint shovel-shape of central incisors. E. G. male aged 34 (No. 540).

Fig. 157. Pronounced median ridges on the lingual surfaces of the upper central incisors. Dental tubercles on the lateral incisors. Moderate shovel-shape of all four incisors. E. G. female aged 18 (No. 291).



Fig. 150 (2 : 1).

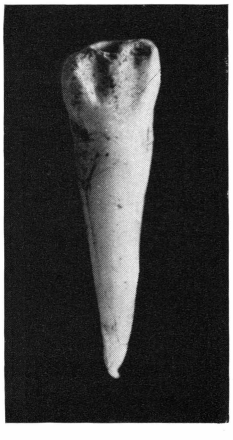


Fig. 151 (2 : 1).



Fig. 152a (2 : 1).

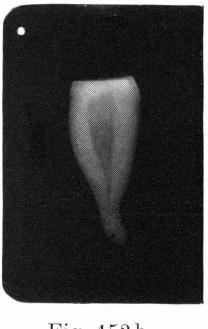


Fig. 152b.

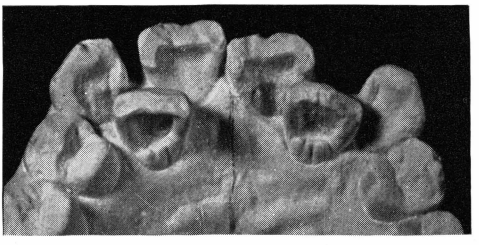


Fig. 153 (1.5 : 1).

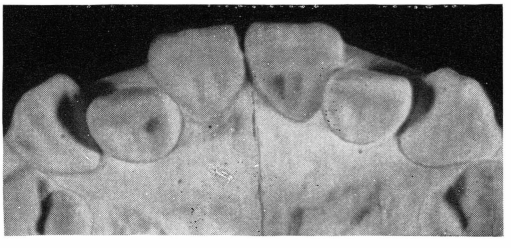


Fig. 154 (1.5 : 1).

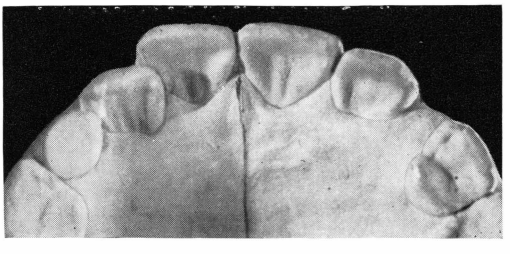


Fig. 155 (1.5 : 1).

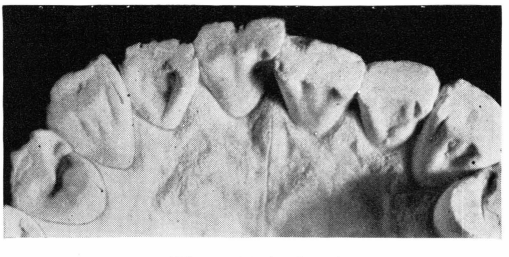


Fig. 156 (1.5 : 1).

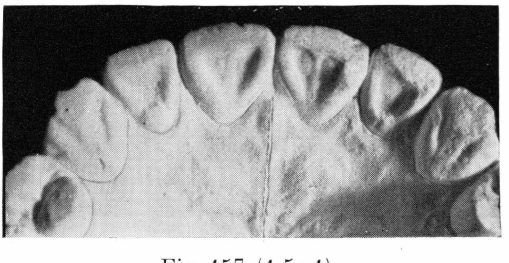


Fig. 157 (1.5 : 1).

Plate 28.

Figs. 158—167. Root resorption of upper incisors. Cases arranged according to increasing age.

Fig. 158. Root resorption of upper central incisors. E. G. male aged 12 (No. 39).

Fig. 159. Root resorption, especially of upper left central incisor. Large pulp stones in both I_1 supp. E. G. male aged 12 (No. 502).

Fig. 160. Root resorption, especially of upper left central incisor. E. G. female aged 15 (No. 295).

Fig. 161. Root resorption of upper central incisors. E. G. male aged 15 (No. 702).

Fig. 162. Root resorption of upper central incisors. E. G. female aged 24 (No. 511).

Fig. 163. Root resorption of upper right central and left lateral incisors. E. G. female aged 25 (No. 35).

Fig. 164. Root resorption of upper right central and left lateral incisors. E. G. female aged 27 (No. 157).

Fig. 165. Root resorption of upper central incisors. Two supernumerary elements above and palatal to central incisors. E. G. male aged 42 (No. 149).

Fig. 166. Root resorption of upper central incisors. E. G. female aged 44 (No. 204).

Fig. 167. Root resorption of upper central incisors. Hypercementosis of remaining part of the roots. E. G. female aged 54 (No. 449).

Fig. 168. The crowns of the upper incisors tend to be equal in size. The canine crowns are of moderate size. E. G. male aged 18 (No. 543).

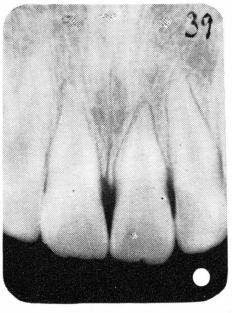


Fig. 158.

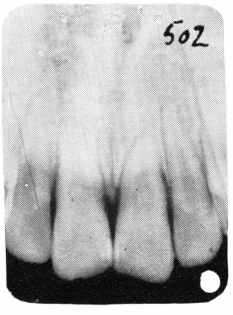


Fig. 159.

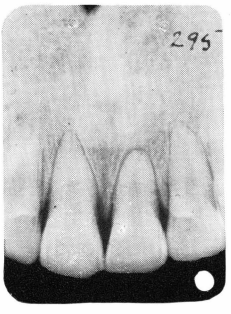


Fig. 160.

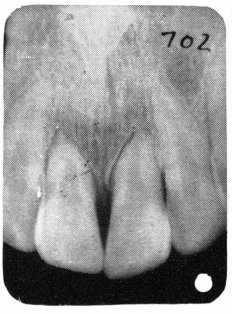


Fig. 161.

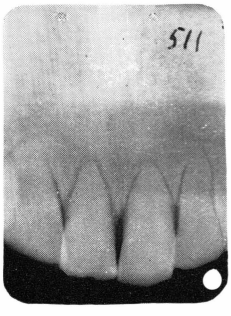


Fig. 162.

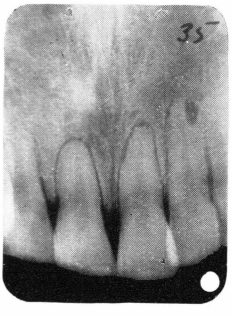


Fig. 163.

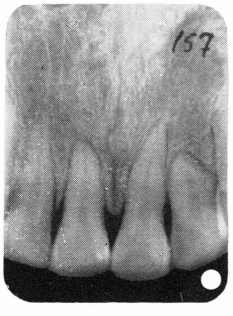


Fig. 164.

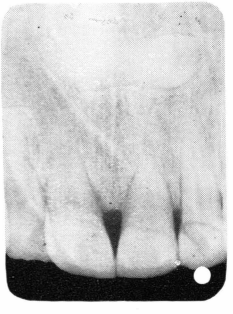


Fig. 165.

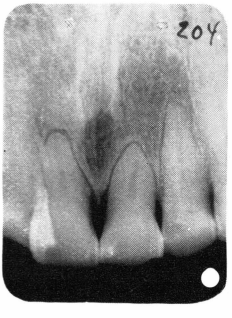


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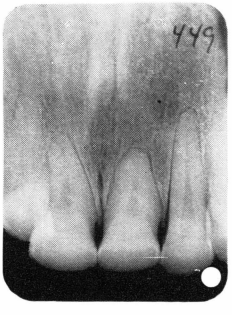


Fig. 167.

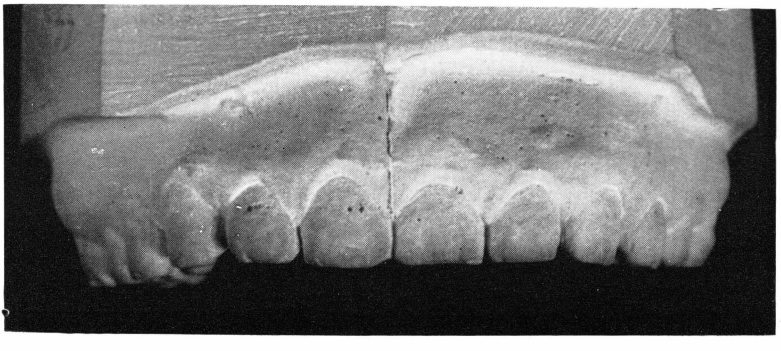


Fig. 168 (1.5 : 1).

Plate 29.

Fig. 169. Pronounced shovel-shape of upper incisors. E. G. female aged 27 (No. 183).

Fig. 170. Moderate shovel-shape of upper incisors. E. G. male aged 25 (No. 238).

Fig. 171. Moderate shovel-shape of upper incisors. E. G. male aged 35 (No. 411).

Fig. 172. Moderate shovel-shape of upper incisors. Dental tubercles on lateral incisors. E. G. female aged 21 (No. 690).

Fig. 173. Pronounced shovel-shape of upper incisors. Median ridges on central incisors. E. G. male aged 26 (No. 699).

Fig. 174. Faint shovel-shape of upper incisors. E. G. male aged 17 (No. 4).

Fig. 175. Two East Greenland Eskimo upper lateral incisors, showing the dentine to be involved in the formation of marginal ridges (pronounced shovel-shape).

Fig. 176. Shovel-shape of upper incisors. E. G. male aged 13 (No. 475).

Fig. 177. Shovel-shape of upper incisors. E. G. male aged 12 (No. 373).

Fig. 178. Dental tubercles on the upper lateral incisors. Pronounced shovel-shape of lateral incisors. Moderate shovel-shape of central incisors. E. G. female aged 19 (No. 212).

Fig. 179. Dental tubercle is pronounced on the upper left lateral incisor. Moderate shovel-shape of lateral incisors. Faint shovel-shape of central incisors. E. G. female aged 28 (No. 43).

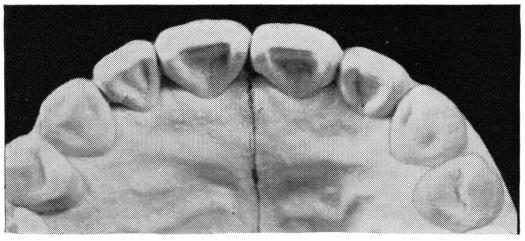


Fig. 169 (1.5 : 1).

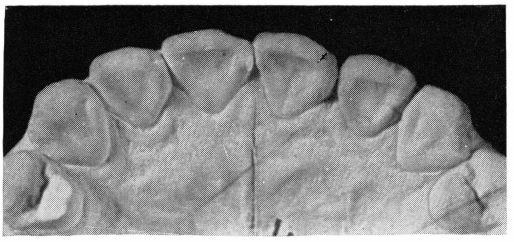


Fig. 174 (1.5 : 1).

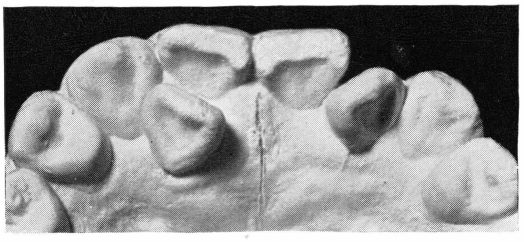


Fig. 170 (1.5 : 1).

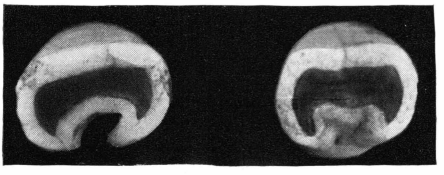


Fig. 175 (3 : 1).

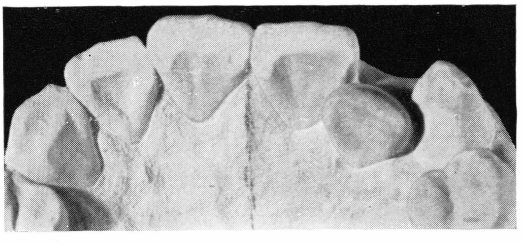


Fig. 171 (1.5 : 1).

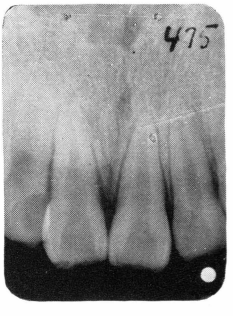


Fig 176.

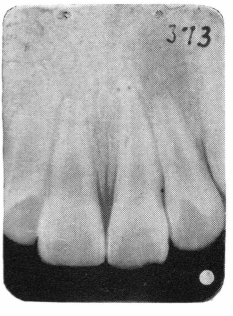


Fig. 177.

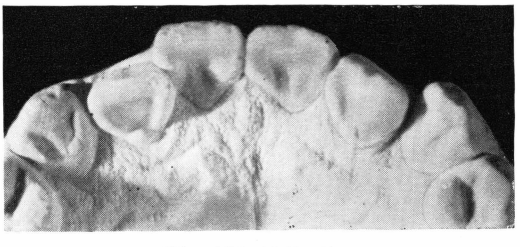


Fig. 172 (1.5 : 1).

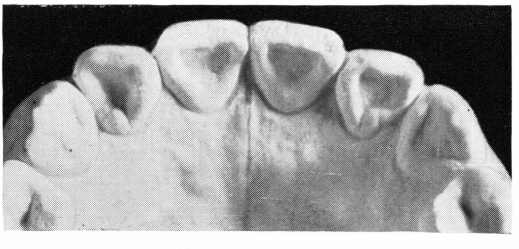


Fig. 178 (1.5 : 1).

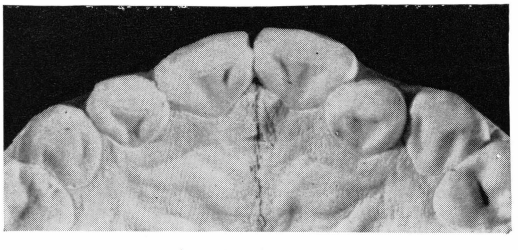


Fig. 173 (1.5 : 1).

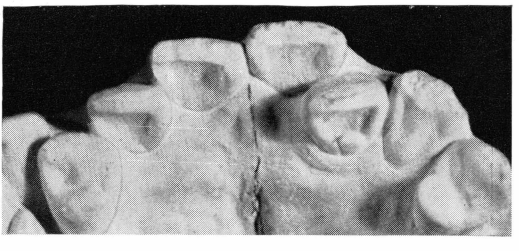


Fig. 179 (1.5 : 1).

Plate 30.

Fig. 180. Dental tubercles on upper lateral incisors and canines. Faint shovel-shape of upper incisors. E. G. female aged 15 (No. 295).

Fig. 181. Dental tubercles on upper lateral incisors. Moderate shovel-shape of upper incisors. E. G. female aged 13 (No. 372).

Fig. 182. Trace of dental tubercle on the upper left lateral incisor. Faint shovel-shape of incisors. E. G. male aged 16 (No. 32).

Fig. 183. Lingual cusps on both upper lateral incisors. E. G. female aged 28 (No. 130 Scoresbysund).

Fig. 184. Extremely low roots in middle-aged East Greenland Eskimo female (root resorption). E. G. female aged 38 (No. 137).

Fig. 185. Extremely low roots in middle-aged East Greenland Eskimo male (root resorption). Irregular hypercementosis. E. G. male aged 48 (No. 319).

Fig. 186. Extremely low roots in middle-aged East Greenland Eskimo male (root resorption). E. G. male aged 52 (No. 539).

Fig. 187. Sockets of incisors and canines in adult undamaged Eskimo maxilla. Teeth lost *post mortem*.

Fig. 188. Sockets of incisors in adult undamaged Eskimo maxilla. Teeth lost *post mortem*.

Fig. 189. Sections of Eskimo teeth with severe attrition (degree 4, according to Broca (43)). Secondary dentine formation has narrowed the pulp cavities. Root resorptions as well as hypercementoses and transparency of root dentine are evident.

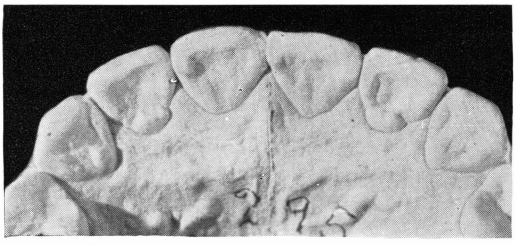


Fig. 180 (1.5 : 1).

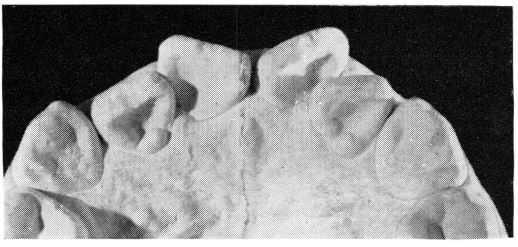


Fig. 181 (1.5 : 1).

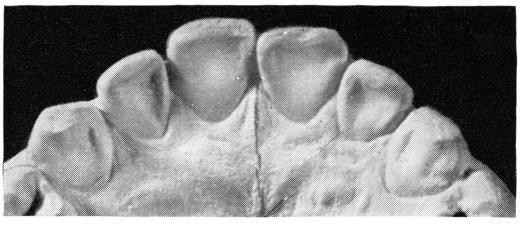


Fig. 182 (1.5 : 1).

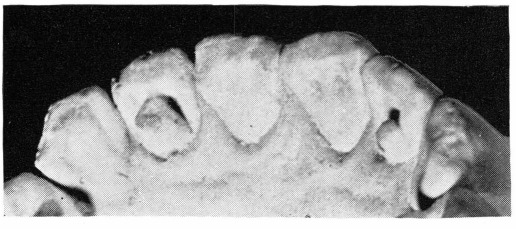


Fig. 183 (ca. 1.5 : 1)

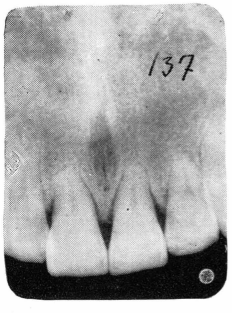


Fig. 184.

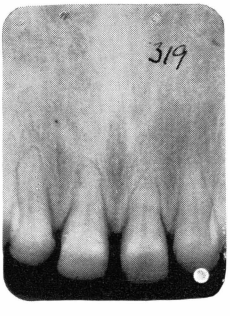


Fig. 185.

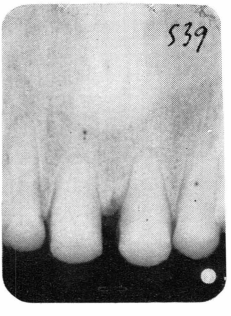


Fig. 186.



Fig. 187.

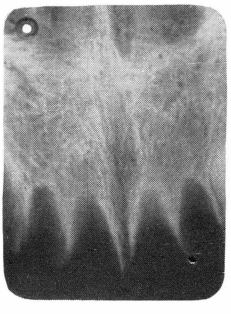


Fig. 188.

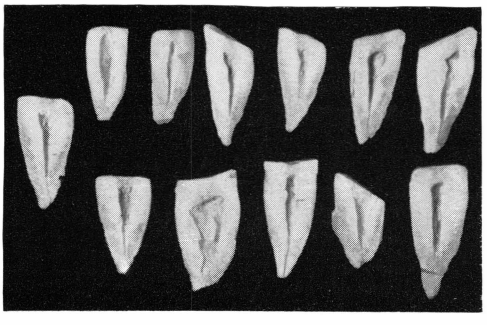


Fig. 189 (1 : 1).