AN ODONTOMETRIC STUDY OF MEDIAEVAL DANES.

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INTRODUCTION.

The late 18th century saw a rise of interest in physical anthropology, following upon the classification of Man within the animal kingdom by Linnaeus in 1755, and upon Buffon's description (1749) of the "Varietés Humaines". Many of the earlier anthropologists concentrated mainly upon qualitative features such as skin colour, hair colour and texture, and easily discernible differences in physiognomy, but Blumenbach and Camper were already turning their attention to metrical techniques. (Topinard, 1878).

By the middle of the nineteenth century, physical anthropology had attained the status of a science, with the introduction of accurate measuring techniques. As early as 1838 Sandifort published "Tabulae Craniorum Diversarum Nationum", and this was followed by Morton's "Crania Americana" (1839) and "Crania Aegyptiaca" (1844) and by the "Crania Britannica" of Davis and Thurnam (1865). As the subject developed, more and more measurements were made, and more indices were calculated as anthropologists endeavoured to discover those dimensions of the/

the head and body which would most readily allow them to distinguish between different human popul-:ations. By 1890 the Hungarian anthropologist A.v.Török was able to list about 5000 measurements which might be made upon a skull (Mühlmann, 1948).

During this period of intense interest in the evolution of anthropometric techniques, certain workers turned their attention to the possibility of finding in the dentition another source of in-:formation concerning racial differences. Mühlreiter (1874) was the first to measure a number of teeth from a particular population. Later work-:ers improved upon the techniques of measurement and upon the presentation of the results. Much later, statistical tests were applied to odontomet-:rical findings in order to evaluate their signific-:ance. A more detailed account of the development of odontometry will be given later.

Certain other aspects of the dentition, besides that of tooth size, began to interest some anthrop-:ologists. In 1879 the famous anthropologist Broca published a paper entitled "Instructions rel-:atives à l'étude anthropologique du système dentaire"/,

dentaire", which included a discussion of the dates and sequence of eruption of the teeth, and a description and classification of the effects of progressive wear on their occlusal surfaces. Broca also made a brief mention of tooth measurement, and advised the recording of certain morphological features of the dentition.

The early workers, however, paid little attention to the details of variation in tooth morphology. Topinard, in his "Anthropology" (1878), gave a very sketchy description of the human dentition, and Broca (1879) made some sweeping and scarcely accurate generalizations concerning cusp numbers in the molars. In the early years of the present century, the cusp numbers of the molars were more carefully studied, together with other morphological features such as shovel shape of the incisors, and certain racial differences could be detected in the distribution of these traits.

Numerous studies have now been made, of both tooth size and tooth morphology. Many of these have been carried out upon various coloured races, and relatively little work has been done on the dentition/

dentition of recent Europeans. There are serious difficulties in a study of modern white dentitions, since dental disease now causes early mutilation of the teeth. An additional disadvantage inherent in any study of a living population, is that it must be carried out upon plaster casts, which may suffer from serious distortion. A solution to this prob-:lem is to be found in the study of the dentition in European skulls. The writer has already made a survey of Scottish skulls from several prehistoric periods. The Scottish material is, however, scanty and in poor condition : thus the large collection of mediaeval skulls in Denmark offered an opportunity of carrying out a larger scale study of recent Euro-:pean teeth.

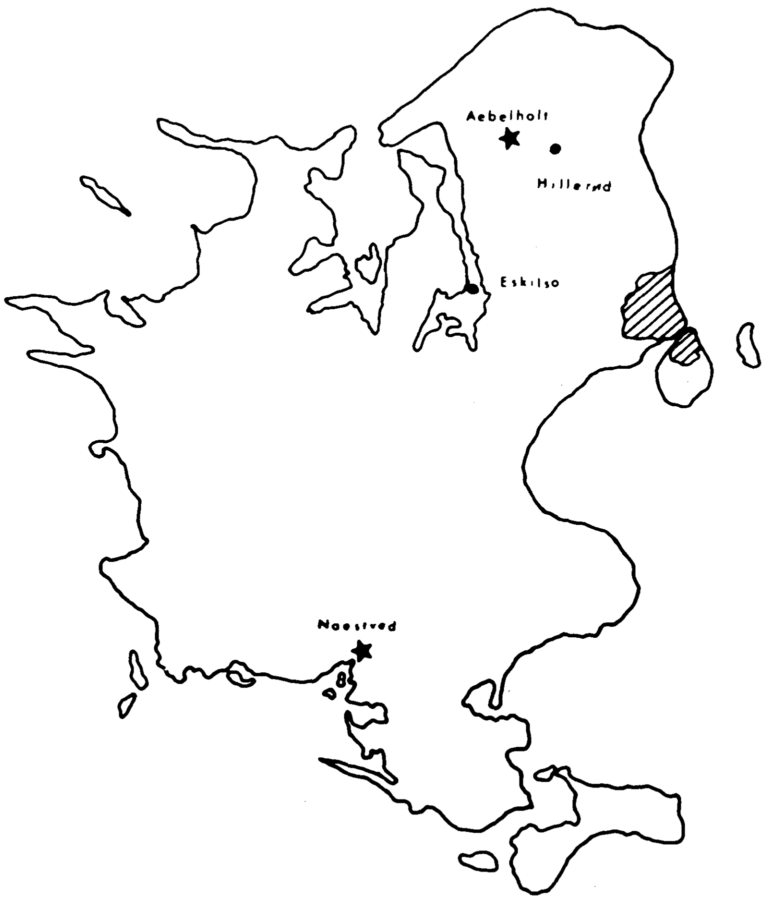

Fig. 1. Map of the island of Sjaelland, Denmark, to show the situations of the Aebelholt monas-:tery and the Naestved leper hospital. The position of the modern town of Hillerød and of the former site of the Aebelholt monastery on Eskilsø are also indicated.

MATERIAL

The mediaeval Danish skeletal material used in the present study was derived from three excavation sites in the islands of Sjaelland (Zealand) and Bornholm. These mediaeval cemeteries were all ex:cavated by Dr. V. Møller-Christensen, who is an authority on osteo-archaeology and who had a part:icular interest in the careful preservation of the skeletons. The excavations were in fact carried out with the chief object of acquiring skeletal material, and thus every tiny fragment of bone or tooth was collected. This skeletal material is therefore particularly suitable for dental studies.

The largest series of skulls was recovered from the cemetery of the Augustinian monastery of Aebelholt, which lay about four miles to the north:west of the present town of Hillerød in north Sjaelland. (Fig. 1.) In c.1175, the monastery was moved to this spot from its former situation on Eskilsø island in Roskilde fjord (Møller-:Christensen, 1958). This date is therefore the terminus a quo for burials in the Aebelholt ceme:tery. The monastery flourished as a community and/

and as a centre for pilgrimages until the Reform-:ation. In 1541 the abbey was forfeited by the king and became the seat of a vassal, but the abbey church remained in use as a parish church until 1561, when the final order was given to abolish the monastery. The buildings were not completely razed to the ground, as some remnants of them were still visible in the early 18th century. By the 19th century, however, the area had come under cul-:tivation, and the site of the monastery was put to agricultural uses until 1935, when excavations be-:gan. It seems unlikely that burials would be made in the abbey graveyard later than the third quarter of the 16th century.

During the excavations, which lasted until 1952, 760 skeletons or parts of skeletons were re-:covered. Of these, a few had been buried in a Romanesque type of brick-built grave, while others had been enclosed in wooden coffins, of which only the nails remained. The rest had been buried in the earth without any kind of cist or coffin. Burials were found in several parts of the monast-:ery grounds. Some of the bodies had been buried in/

in the cloister walk and cloister garth, and since there was an equal number of men and women, togeth:er with some forty children, these individuals would probably have been the married servants of the monastic community. Other burials were found in the nave of the church and in the churchyard to the north and west of the monastic complex of build:ings. Many of these were monks or lay brothers, but other burials undoubtedly represent lay persons who had, by gifts to the monastery, acquired the right to burial in its hallowed ground, or travell:ers who had died while on a pilgrimage. It is obvious that the monastery burial grounds also serv:ed as a cemetery for the surrounding countryside, since of the 760 individuals buried there, only 303 were recognisably male, while 209 were recognisably female and 135 were children under the age of 14 (Infans I and II; Martin, 1928).

It is debatable to what extent this series of skeletons represents the mediaeval population of the area round Aebelholt. A considerable number of the lay persons buried there may well have been of local Danish stock, and many of the monks could also/

also have been members of families in the immediate neighbourhood. On the other hand, monks frequent:ly travelled considerable distances from their home:land - indeed, Abbot Vilhelm, who was responsible for the translation of the Eskilsø community to Aebelholt, was himself of a noble French family and had been invited by the Danish bishop Absalon to take charge of the monastery at Eskilsø, where dis:cipline had become lax. It is also by no means impossible that a good many of the lay persons bur:ied at Aebelholt were of non-Danish origin. Abbot Vilhelm was canonised in 1224, some twenty years after his death, and his shrine at Aebelholt quickly became a famous centre for pilgrimages. The mona:stery housed and fed those who came as pilgrims, and also buried them in the abbey churchyard if they died. Some of these pilgrims, if not all of them, were sick persons seeking a cure at the shrine, and the death rate among them may have been relatively high.

It is therefore impossible to regard the Aebelholt skeletal collection as an unmixed sample of the mediaeval Danish population, though the ex:tent/

:tent to which it may have received admixture of other racial groups is of course unknown.

A somewhat smaller collection of skeletal mat-:erial from just over 350 individuals was excavated by Dr. Møller-Christensen from the burial ground of the mediaeval leper hospital of Naestved in south Sjaelland. (Fig.1.). In the Middle Ages there were at least 35 leper colonies in Denmark (Møller-:Christensen, 1953), each of which had its own church and burial ground. These leper hospitals were usually dedicated to St. George, and from this dedication has arisen their Danish name of "Skt. Jørgensgard".

There is no documentary evidence, such as ex-:ists for the monastery at Aebelholt, to provide details of the date of foundation of the Naestved hospital, of its subsequent history, or of its final closure, which probably occurred at the time of the Reformation. Church and hospital eventually disappeared and all knowledge of their existence was lost. There remained only a tradition that a mediaeval burying-ground had been situated in the vicinity of the farm of Skt.Jørgensgard on the outskirts/

outskirts of Naestved, but even the significance of the farm name was no longer recognised. It was due to this tradition and to the name of the farm that the hospital and its cemetery were rediscovered in 1949. The church which was revealed by excavation has been dated to the 14th century, and the period during which the hospital was in use is thought to be c.1250 to c.1550.

Of the skeletons excavated at Naestved, rather more than half were male. The remains of children made up only 5% of the total, in contrast to the Aebelholt collection in which 17.7% were children.

Since each leper hospital drew its inmates from the surrounding countryside, the Naestved skulls are much more likely to form a representative series of the mediaeval Danish population than are the Aebelholt skulls.

A small collection of just over 100 skulls was also available, from a similar leper hospital cemet-:ery on the Baltic island of Bornholm. This leper colony was probably founded about the middle of the 13th century, and the cemetery continued in use until the 17th century, when a plague struck the island, killing/

killing 30% of the population (Møller-Christensen, 1963). The bodies of the plague victims were bur-:ied in mass graves in the former leper cemetery. After the plague in 1656, no further burials were made in this cemetery.

From these three excavations we thus have coll-:ections of skulls which may be dated generally to the period between 1250 and 1550. The cemetery at Aebelholt came into use a little earlier, c.1180, and that on Bornholm remained in use a century longer, but the main bulk of the material derives from the three hundred years which occupy the span between the mid 13th century and the Reformation. The occupants of the leper cemeteries of Naestved and Bornholm may be considered as representative of the mediaeval Danish population. It is possible that there may be a considerable admixture of foreign elements at Aebelholt.

No general anthropological survey has been made of the material from Naestved or Bornholm and thus no information is available concerning the skull shape or facial proportions in these groups. Lundstrom and Lysell (1953) made a few cranial measurements/

measurements on some of the Aebelholt skulls and found them to be chiefly dolichocephalic or meso:cephalic, and mesoprosopic. Exhaustive studies have been made of the pathological conditions dis:played by the skeletons (Møller-Christensen, 1953, 1958) with some very interesting and important re:sults. In particular, notable additions have been made to knowledge concerning bone changes in leprosy (Møller-Christensen, 1953). Mutilating lesions of the extremities were common, and Møller-Christensen has also demonstrated a progressive resorption of the bone of the nasal floor, palate and anterior maxillary alveolar process resulting finally in loss of the anterior maxillary teeth and in perforation of the palate.

Certain studies of the dentition have already been carried out upon the Aebelholt material. Jørgensen (1956) based his detailed monograph on "The Deciduous Dentition" partly on the teeth of the Aebelholt children's skulls. Several studies have dealt with specific morphological features of the permanent dentition; e.g. those of Jørgensen (1955) on cusp numbers and fissure patterns of the mandibular molars;/

molars; of Alexandersen (1962a, 1962b, 1963) on the root form of the mandibular canines; and of Carbonell (1963) on the incidence of Carabelli's cusp in the maxillary molars. Brief reports on the incidence of caries in the Aebelholt material were published by Brinch and Møller-Christensen (1949) and Brinch (1952). The association between dental infection and rheumatoid disease (arthrosis) of the interver-:tebral articulations has also been investigated by Møller-Christensen (1958), who has shown a high de-:gree of correlation in this material between the two conditions. A study of dental arch size and occlusion was carried out by Lundstrom and Lysell (1953).

No investigation had, however, been made of tooth size, and many morphological features of the dentition remained for consideration. Attrition had not been studied, nor had a complete account of oral pathology been given.

HISTORY of ODONTOMETRY

It has already been mentioned (chap.1.) that in 1874 Mühlreiter published the first odontometric study of the human dentition; a study which consisted in measuring a quantity of teeth from the population of the Salzburg district of Austria. In this paper, Mühlreiter stated that he had searched through the literature for similar studies on human or related dentitions, and had been able to find only a few measurements made by Owen (1845) on the teeth of chimpanzees. Mühlreiter did not differentiate between the sexes in presenting his findings, and gave his results in the form of minimum and maximum values. A few years later Lambert (1877) took the next step forward, by measuring teeth from white, yellow and black races. Lambert's material was grouped on a very broad basis and no sex differentiation was made, yet he was able to show that there were differences in tooth size between these groups.

Though Broca (1879) advocated the use of tooth measurements in anthropological studies of the dentition, no further papers appeared for some time. Then/

Then Azoulay and Regnault (1893) and Regnault(1894) published papers in which tooth measurements were used to investigate differences in the shape of teeth from various races.

In the early years of the present century fur:ther publications began to appear. G.V. Black included in his book "Descriptive Anatomy of the Human Teeth", published in 1902, a series of mean values derived from measurements of the teeth of American Whites. The material had not been diff:erentiated as to sex, but these figures were for many years the standard values for tooth size in whites, and were the values with which tooth meas:urements made on coloured races were compared in various later works.

De Terra (1905) and Choquet (1908) attempted to extend the work of Lambert, by comparing tooth measurements from a very large number of races, both white and coloured. In both cases, however, the numbers of individuals in the racial groups were extremely small, and sex differentiation was not made. Little reliable information was there:fore obtained. De Terra also chose to present maximum/

maximum-minimum values instead of calculating the means, and his results cannot be used in comparison with those of other authors.

Subsequently, investigators tended to confine their attention rather to a single racial group, and during the first third of the 20th century sev:eral studies were made on individual white races. Hillebrand (1909) studied the dentition of Hungarian skulls from the time of the Völkerwanderung to the 20th century, and in presenting the results for the upper teeth (as mean values) gave separate tables for male and female, though no sex differentiation was made in dealing with the lower teeth. Kajava (1912) investigated Lapp teeth, giving the results as maximum and minimum values. Schwerz (1917) in:cluded tables of mean values for tooth measurements in his work on the dentition of Alamanni from the 5th to 10th centuries A.D. In 1918, de Jonge Cohen published the mean values obtained by measurement of the very large number of lower premolars and molars in Bolk's collection in Amsterdam, but re:stricted his study to the mesiodistal dimension of the teeth. Hjelmman (1928) measured the tooth crowns/

crowns of Finlanders, and published the results separately for the two sexes and in the form of mean values.

At the same time other workers were carrying out studies of tooth size in various coloured races. Miyabara (1916) measured Japanese teeth, Campbell (1925) those of Australian aborigines, Janzer(1927) those of New Pomeranians, Drennan (1929) those of South African Bushmen and Middleton Shaw (1931) those of Bantus. Hrdlicka (1923a; 1923b; 1935) published measurements of the mandibular molars in four groups of American Indians and in Eskimoes, Negroes, Melanesians, American Whites and ancient Egyptians of the XII Dynasty period. Only Miyabara and Janzer and Hrdlicka (1923b) made sex differen-:tiation of their material, but all of these work-:ers presented their results in the form of mean values and compared their findings with the mean figures already published for other racial groups. Thus they were able to show in a general way that racial differences in tooth size did in fact exist.

In all the papers published before 1931, no more was presented than the mean values obtained for/

for various tooth measurements. When comparisons were made between one race and another, no attempt was made to ascertain, by means of statistical tests, the significance of any differences observed.

In 1931, Mijsberg published the results of a study of the Javanese dentition. This study had been instituted with the definite object of discov:ering whether or not a sex difference in tooth size existed in this population, and Mijsberg therefore made a statistical preparation of his data and pub:lished the standard errors as well as the mean values calculated from tooth measurements. In this way he was able to show that there was a statistic:ally significant difference in tooth size between male and female Javanese.

Since the work of Mijsberg, all major odonto:metric investigations have included statistical preparation of the data. The most detailed of these studies have been carried out on modern races, and the majority of them have involved peoples of non-Indo-European origin. Yamada (1932) and Hosaka (1936) carried out metrical studies of the Japanese and of the Chinese dentitions respectively.

Yamada's/

Yamada's papers proved to be unobtainable, but it seems from the tables published by Moorrees (1957) that he made sex differentiation of his material. The Manchurian Chinese teeth studied by Hosaka were said by Moorrees (1957) to be derived entirely from males. The standard deviation and the standard error of the mean were quoted for each tooth dimen-:sion. Hosaka published tables showing comparisons between the Chinese teeth and those of other races, but did not make statistical evaluation of the diff-:erences observed, obviously because of the lack of statistical data provided by the other authors. The text of this paper is in Japanese and it is thus impossible to discover Hosaka's conclusions concern-:ing these racial comparisons, as the only statement included in his German summary is a brief note to the effect that the upper lateral incisor of the Chinese is much broader than the corresponding tooth in any race except the Japanese.

Nelson (1938) examined the dentition of American Indian skulls from Pecos Pueblo in New Mexico. It is perhaps scarcely accurate to include this study under the heading of "modern races". The exact date/

date of the Pecos Pueblo settlement is not known, but it is believed to have been occupied at some time during the period 1100 A.D. to 1830 A.D. Nelson made a statistical comparison between measurements of the Pecos dentition and measurements of the teeth of other races, by assuming that the standard devi-:ations for tooth measurements in these other races would be approximately equivalent to the standard deviations calculated by him for the Pecos skulls. He did not differentiate between male and female.

Pedersen (1949), in his work on the East Green-:land Eskimo dentition, included detailed inform-:ation concerning the dimensions of all the teeth except the incisors. The results were given separ-:ately for male and female, and also for right and left sides. Though Pedersen quoted the standard deviations which he calculated from his data, he did not give a statistical comparison of the size of Eskimo teeth with those of other races. The diff-:erences in size between the teeth of males and fe-:males were noted, but Pedersen stated that these differences could not be shown to be statistically significant, chiefly on account of the very small numbers/

numbers of measurements which were recorded.

Selmer-Olsen's highly detailed "Odontometric Study of the Norwegian Lapps" also appeared in 1949. Selmer-Olsen compared the Lapp dentition with those of various other races, and also made comparisons between Lapp skulls from the different find spots. His results were in general presented in the form of graphs, though statistical details such as stan-:dard deviations and standard errors were also pro-:vided. Sex differences in tooth size were shown to exist in the Lapps, and differences in the size and proportions of crown and root were demonstrated between Lapps and other races. It was even poss-:ible to observe differences in tooth size between Lapp skulls from different areas of northern Norway.

In 1955, Thomsen published a survey of the Tristanite dentition, including a section on odonto-:metry. Statistical preparation of the data was made, and a comparison of tooth size in males and females, which was published in full, showed stat-:istically significant differences. A comparison was also made between the dimensions of the teeth in the Tristanites, and the corresponding measurements which/

which had been published for certain other races, but the results of this comparison were not given fully. It was stated, however, that in one crown dimension the teeth of Tristanites showed consider:able differences from those of other races, while in other dimensions little difference could be found.

Moorrees (1957) employed odontometry in the course of his study of the Aleut dentition. A com:plete statistical preparation of the data was made, and for the first time the statistical significance of differences in tooth size between populations was calculated and the results given in full. Signific:ant sex differences in tooth size were observed among the Aleuts, and also some significant differ:ences between Aleuts and other races, though as Moorrees remarked "a different rank order of the populations is observed for each tooth class when the names of the populations are arranged on the basis of increasing crown diameters". Thus it was not possible to distinguish populations which had consistently larger or smaller teeth than the Aleuts.

An odontometric study of the teeth of American white children was also made by Moorrees et al. (1957),/

(1957), though only the mesiodistal diameters of the teeth were measured. Significant sex differences in this diameter of white teeth were demonstrated, and the mean figures obtained were also used in the series of racial comparisons with the Aleut dentit:ion. Goose (1963) also published measurements of teeth in Whites, this time from 17th - 19th century English skulls. Both dimensions of the maxillary teeth were measured, and the results were given separately for males and females.

Barrett, Brown and Macdonald (1963) and Barrett et al (1964) studied tooth dimensions as part of a wider investigation of the Australian aboriginal dentition. Males and females were treated separ:ately, statistical data were provided and results compared with those for other races. Significant sex differences were found in crown dimensions, and some significant differences in tooth size could also be detected between Australian aborigines and other races.

A few anthropological investigations of the teeth of modern races, published since 1931, do not provide statistical constants. These include the studies/

studies of Stein and Epstein (1934) on molar size in New Britain Melanesians, of de Jonge-Cohen (1940) on premolars and molars in Bolk's collection in Amsterdam, and of Brabant (1965) on a small collect-:ion of Pygmy skulls from Central Africa.

Certain investigations have also been made of tooth size in some prehistoric populations in Europe and the Near East. Carr (1960) included data on tooth measurement in his description of the dentition of the Middle Minoans of Crete, but neither sex diff-:erentiation of the material nor a full statistical analysis of the results could be made. In the same year Dahlberg published tooth measurements of unsexed Neolithic individuals from Jarmo in Iraq and compar-:ed them, though not statistically, with measure-:ments of Mesolithic Natufian teeth and of the teeth of male Whites from Chicago.

Brabant and his co-workers have also recorded tooth measurements from several groups of prehistor-:ic and mediaeval skulls from Belgium and France (Twiesselmann & Brabant, 1960; Brabant, Sahly & Bouyssou, 1961; Sahly, Brabant & Bouyssou, 1962; Brabant, 1963; Brabant & Nemeskeri, 1963).
Unfortunately/

Unfortunately, it was decided that no sex differentiation could be made in this Continental material. Except in the case of the Frankish skulls from Coxyde (Twiesselmann & Brabant, 1960), no statistical data have been published by these authors.

Most of the odontometric investigations so far described have been of a primarily anthropological nature, and the main purpose of the survey has been to discover sex or racial differences in tooth size. Other studies have however been made, in which measurement of the dentition has been employed, but in which there was some other object in view, such as the assessment of the relationship between tooth size and jaw size, or of the relationship in size between deciduous teeth and their permanent successors. In these studies the mesiodistal diameters of the teeth have been much more frequently measured than the labiolingual diameters. Keith (1924), Smyth & Young (1932), Lundström (1942, 1943, 1944), Ballard (1944), Seipel (1946), Nance (1947), Ballard & Wylie (1947), Neff (1949), Moorrees & Reed (1954), Bolton (1958), Ståhle (1959), Lysell (1960), Moorrees & Chadha(1962), Moorrees & Reed (1964) and Lundström (1964) have all measured the mesiodistal diameters/

diameters of some or all of the permanent teeth of various White races, in studies with an orthodontic bias. Lysell (1958 b) also measured the labiolin-:gual diameters of the teeth, and constructed a for-:mula which he believed could be used to calculate the mesiodistal diameters of teeth suffering from severe attrition.

Many of these studies were concerned with tooth size in relation to the size and shape of the arch and to spacing or crowding in the arch. Ballard (1944) studied asymmetry in tooth size in association with malocclusion. The papers of Ballard & Wylie (1947) and Ståhle (1959) dealt with the prediction of tooth size in orthodontic cases, while Neff(1949) and Bolton (1958) examined the size relationship between maxillary and mandibular teeth. Lysell (1960) and Moorrees & Chadha (1962) studied crown size in corresponding teeth of the deciduous and permanent dentitions. Of the authors listed in the previous paragraph, only Lundström(1944), Seipel (1946), Lysell (1958 b) and Ståhle (1959) have made sex differentiation in their material and have also quoted mean values and standard deviations of individual/

individual tooth dimensions.

Coefficients of correlation were used in many of these studies to evaluate relationships between tooth size and arch size, between deciduous and per:manent teeth or between the summed measurements of maxillary and mandibular teeth. Correlation coeff:icients have also been calculated for individual tooth measurements in several other papers. Ritter (1933) calculated correlation coefficients between the mesiodistal diameters of corresponding maxillary and mandibular teeth, while Arai (1939) worked out the correlation between mesiodistal and labiolingual diameters of the same tooth. Gabriel (1955) inves:tigated the correlation of the size of Australian aborigine teeth with one another and with certain jaw measurements, and Filipsson & Goldson (1963) studied the correlation between "tooth width , width of the head, length of the head and stature".

Tooth measurements have also been made for other reasons by a few workers. Begg (1954) and Lysell (1958 b) both used mesiodistal crown measurements to indicate the progress of attrition. Dahlberg (1961) studied the relationship between tooth size and morphological/

morphological patterns in molar teeth. In a study of occlusion and mastication in Australian aborigines Beyron (1964) measured the incisor teeth. A series of papers has recently been published by Garn,Lewis & Kerewsky (1964, 1965 a, 1965 b) on tooth size in white Ohio children. In the first of these a sex difference in mesiodistal diameters was demonstrated. In the subsequent papers these authors investigated size inter-relationships in an individual, and cor:relation in tooth size between siblings. This genetic aspect of odontometry has been pursued in the paper by Garn, Lewis, Kerewsky & Jegart (1965), in which the higher intra-individual tooth size cor:relations found in females were attributed to X-chromosomal linking of tooth size.

In this account of the development of the science of odontometry, attention has been confined to those works dealing with the dentition of various races of recent man. Studies have also been made of tooth size in Palaeolithic man (Hrdlicka, 1923 a, 1924; Carette-Pillot, 1947; de Vecchis, 1958; Brabant & Sahly, 1964) and in various of the fossil hominids (e.g. Hrdlicka, 1923 a, 1930; Weidenreich, 1937; Robinson/

Robinson, 1956; Garn & Lewis, 1958). Tooth measure-:ments have also been used in the comparison of human and anthropoid dentitions, e.g. by Hrdlicka (1923 b, 1924). Statistically significant differences in incisor size were shown by Clark, Zimmerman and Carbonell (1964) to exist between two species of marmoset monkeys.

The writer had already carried out a study of all the available Scottish prehistoric skeletal mat-:erial (Lunt, 1961). The Neolithic material proved too scanty for sex comparison to produce any worth-:while results. It was possible to show, however, that sex differences in tooth size had existed in Dark Age skulls, though no such difference could be demonstrated for the Bronze Age population, probably largely due to the poor state of preservation of these skulls. Further, there appeared to have been a difference in tooth size between the prehistoric populations of Scotland. These differences showed a gradual reduction in tooth size from the earliest (Neolithic) to the latest (Dark Age) period.

The aim of the present odontometric investigation was threefold - a) to discover whether sex difference in/

in tooth size or shape existed in the mediaeval Dan-
:ish population; b) in view of the fact that Selmer-
:Olsen (1949) was able to demonstrate differences in tooth size between several local populations of Lapps, to discover whether such differences existed between mediaeval Danish skulls from different excavation sites; c) to compare the results obtained for med-
:iaeval Danes with those already published for other races and to attempt to evaluate any racial differ-
:ences in tooth size.

ODONTOMETRIC METHODS.

Since the teeth are highly complex in shape, and since their surfaces are curved rather than plane, measuring points and techniques must be carefully selected in order to achieve reasonably uniform re:sults, which may be compared with the results of other workers. The most recent discussion of the selection of measuring techniques, of the difficult:ies found in applying them, and of the statistical analysis of the results, is to be found in Goose (1963).

It would be possible to make many different measurements on any tooth - indeed, Remane (1930) listed 22 measurements which could be taken on the crown of an upper molar, and 16 which might be made on the crown of a lower molar, though he admitted that some of these were only of value when dealing with the lower primates. In practice, however, it is usual to take one measurement of the crown of a tooth in the long axis of the dental arch (the mesio:distal diameter), and one at right angles to that axis (the buccolingual or labiolingual diameter), as well as the height of the crown above the amelocemental junction./

junction. The only measurement generally made of the root is its length, though Jepsen (1963) has re-:cently described methods by which the surface area of the root may be measured. Diagonal measurements of the crown, heights of individual cusps and minor variations of the longitudinal and transverse crown measurements are now usually omitted. Goose (1963) however, has recently revived the cervical mesiodis-:tal diameter, a measurement introduced by Azoulay and Regnault in 1893.

The terms "crown height" and "root length", used for those measurements made in the long axis of the tooth, do not lead to any confusion. Con-:siderable difficulty has, however, arisen over the nomenclature of the two measurements made of the occlusal surface. The terms "crown length", "crown breadth", "crown width" and "crown thickness" have been used by various workers in different senses. Martin (1928) put forward a general rule, that for all sagittal cranial measurements the term "length" should be used, and for all transverse cranial meas-:urements the term "breadth". In applying this terminology to the dentition there arises the difficulty/

difficulty that the teeth are not placed in a straight line but in a curve, and if correctly used, the terms are reversed in the molar and incisor segments. The use of words such as length or breadth has therefore been avoided in the present study, and following Moorrees (1957), the occlusal dimensions of the teeth have been named "mesiodistal diameter" and "labio-:lingual diameter". A recent example of the confus-:ion which may arise when non-specific terms are used, is the paper by Filipsson and Goldson (1963), where tooth measurements are referred to throughout as "tooth width" and no explanation is given of which dimension is meant.

In addition to differences in terminology, there have also been discrepancies in the definitions of the points to be used in making the measurements, particularly in the case of the mesiodistal diameter. For the incisors and canines, the maximum mesiodistal diameter is generally used. In some studies the greatest mesiodistal diameter has also been employed for molars and premolars, while other workers have used the distance between mesial and distal contact points.

Remane/

Remane (1930) gave instructions concerning the measurement of premolars and molars only, and des-:cribed the following variants of the mesiodistal diameter in the upper molars : "Mittellänge - dist-:ance from mesial to distal surfaces in the median plane of the occlusal surface; "mittlere Kauflächen-:länge" - distance from mesial to distal marginal ridge in the median plane; "grösste Länge" - maximum length, a projective measurement; "Aussenlänge" - the distance from the anterior slope of the paracone to the posterior slope of the metacone. The same four dimensions were described for all the premolars, while for the lower molars only "grösste Länge" and "Kauflächenlänge" were recommended. The contact points were not mentioned by Remane, but an equival-:ent to the contact point diameter is to be found in his "Mittellänge" (which should be translated "median length", rather than "mean length" as is done in most English works).

Martin (1928) recommended only one measurement in the mesiodistal direction, and this was to be measured as "der Abstand der beiden an den Approximal-:Flächen, d.h. an der vorderen und distalen Fläche am/

am meisten ausgeladenen Punkte" - i.e. the maximum mesiodistal diameter. Pedersen (1949) and Moorrees (1957) have also used the maximum mesiodistal dia-:meter. Theoretically, this measurement would appear to be the most valuable, but in practice there are certain difficulties concerning its use. It is a projective measurement and therefore, while it is easy to make this measurement on an extracted tooth, it is almost impossible to obtain the meas-:urement with complete accuracy when the teeth are _in situ_ in the jaw. For this reason, Selmer-Olsen (1949) made use of the mesial and distal contact points in obtaining measurements of teeth standing in their original positions in the jawbones. The contact point method has also been recommended by Hrdlicka (1952) and Goose (1963).

There is general agreement in defining the labiolingual diameter of a tooth as the greatest diameter in the labiolingual direction, in a plane at right angles to that of the mesiodistal diameter (Martin, 1928; Selmer-Olsen, 1949; Pedersen, 1949; Hrdlicka, 1952; Moorrees, 1957). Only Remane (1930) gave such variants as "Mittelbreite", "Kauflächenbreite",/

"Kauflächenbreite", "grösste Breite", "vordere Breite" and "hintere Breite".

The crown height is less frequently used than the mesiodistal and labiolingual diameters, since it is quickly rendered inaccurate by attrition. Remane (1930) gave numerous measurements of crown height for molars and premolars. Other authors have measured the greatest height of the crowns of incisors, can-:ines and premolars on the buccal surface (Martin, 1928). As far as the molars are concerned, some workers have preferred the crown height measured to the tip of the mesiobuccal cusp (e.g. Weidenreich, 1937) while others have made the measurement to the base of the fissure between the main buccal cusps (Martin, 1928; Selmer-Olsen, 1949). This latter method has the advantage of reducing the effect of attrition on the measurement.

The root length was defined by Remane as the greatest length parallel to the long axis of the tooth. Root length of molars has sometimes been obtained by measuring the longest root (Selmer-Olsen, 1949); sometimes by measuring all the roots and find-:ing the mean value (Nelson,1938). An arbitrary correction/

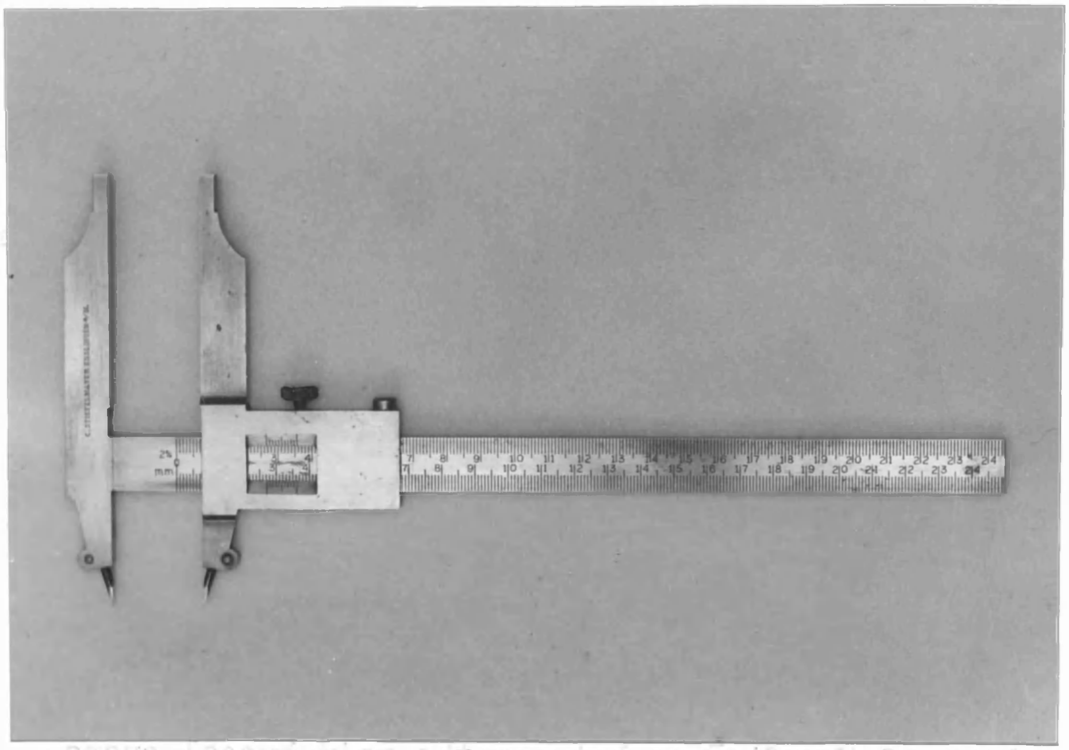

Fig. 2. Sliding caliper used for tooth measure-
:ments.

correction has sometimes been applied when the roots are curved or bent (Selmer-Olsen, 1949), while other workers have ignored any such bends in the roots (Remane, 1930; Weidenreich, 1937).

The tooth measurements recorded in the present study were made by means of a sliding caliper, with sharpened points and a vernier scale reading to 0.1 m.m. (Fig.2.).

The tooth crowns were measured in two dimensions - the mesiodistal diameter and the labiolingual diameter. The greater part of the Danish material consisted of skulls in which the teeth remained in position in their sockets. For the mesiodistal diameter, there-:fore, the method used was that of measuring the greatest distance between the normal contact areas on the proximal surfaces in a plane parallel to the occ-:lusal surface (Selmer-Olsen, 1949). The resulting measurements of incisors, canines and premolars were usually equivalent to the maximum mesiodistal measure-:ment. In the case of the molars, the measurement was sometimes less than the maximum mesiodistal mea-:surement, due to the buccal flare, particularly in the lower molars. (Fig. 3.). If the teeth were found/

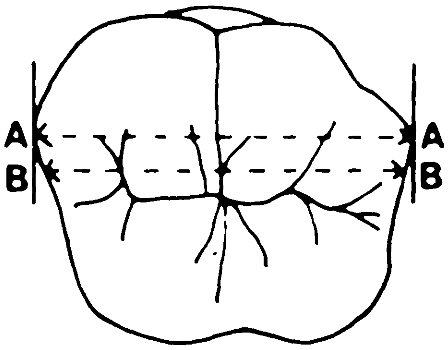

Fig. 3. Occlusal surface of a molar. The line A - A indicates the maximum (i.e. projective) mesiodistal diameter, and the line B - B the contact point diameter which was used in the present study.

found to be rotated in the jaw, the measuring points used were the areas which under normal circumstances would have been in contact with the neighbouring teeth. If any tooth were rotated or tilted in such a way that one of the normal contact points was hid-:den, no measurement was made. In the case of the third molars, the distal measuring point had to be determined separately for each tooth.

The labiolingual diameter was measured at right angles to the mesiodistal diameter, and was taken as the greatest measurement which could be obtained by direct application of the calipers (following the description by Selmer-Olsen, 1949). While this mea-:surement should, for strict accuracy, be a project-:ive one, it was not possible to make projective mea-:surements on the teeth <u>in situ</u>, and it is felt that the measurement as made is probably little different from the projective measurement.

In the Aebelholt collection, there existed a large group of children's skulls, in which the devel-:oping or newly erupted permanent teeth had already been removed from their crypts or sockets. Since these teeth were loose, it would have been possible to/

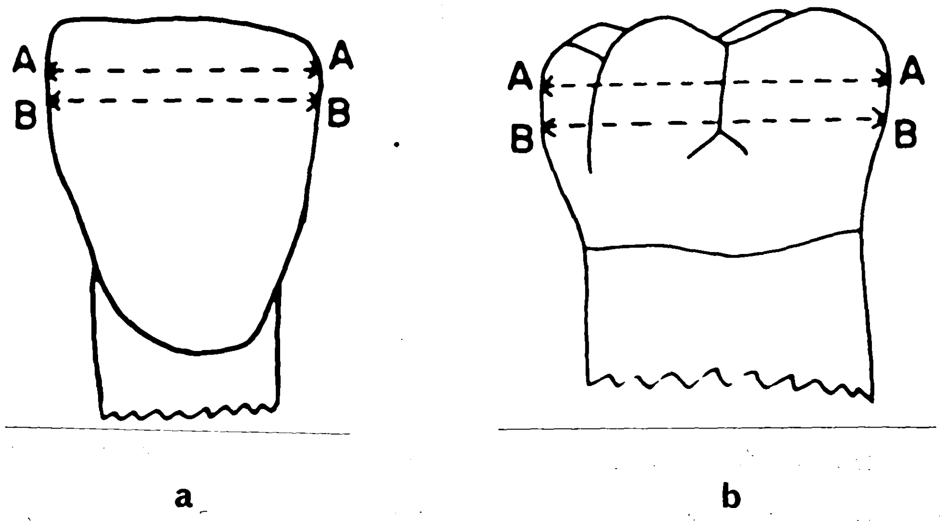

Fig. 4. Illustrates the effect of attrition on the accuracy of measurement of the mesiodistal diameter of a. an incisor, and b. a molar.: The line A - A indicates the level at which measurement is usually made. Between the lines A - A and B - B measurements can be made with reasonable accuracy. When attri-:tion has progressed beyond the level B - B, inaccuracy in the measurements will result.

to obtain maximum (i.e. projective) measurements from them. In order to obtain results comparable with those for the adult teeth, however, the same measur:ing points and techniques were used as those employ:ed for teeth _in situ_ in the jaws.

A factor which complicated the making of these measurements in the adult skulls, was the severe attrition which many of the teeth had undergone. The diet of mediaeval times was rough and coarse, and wearing away of tooth substance progressed rapidly from the time of eruption of the teeth. This attrit:ion took place on the occlusal surface and also on the proximal surfaces of the tooth. It is obvious that any considerable amount of interproximal attrit:ion will render inaccurate the mesiodistal diameter of the tooth. Loss from the occlusal surface will also affect the mesiodistal diameter if it has prog:ressed far enough (Fig. 4.). The labiolingual dia:meter is much less seriously affected by attrition. There is relatively little wear taking place on the buccal and lingual surfaces of a tooth. Even loss by attrition on the occlusal surface does not affect the labiolingual diameter as seriously as the mesiodistal/

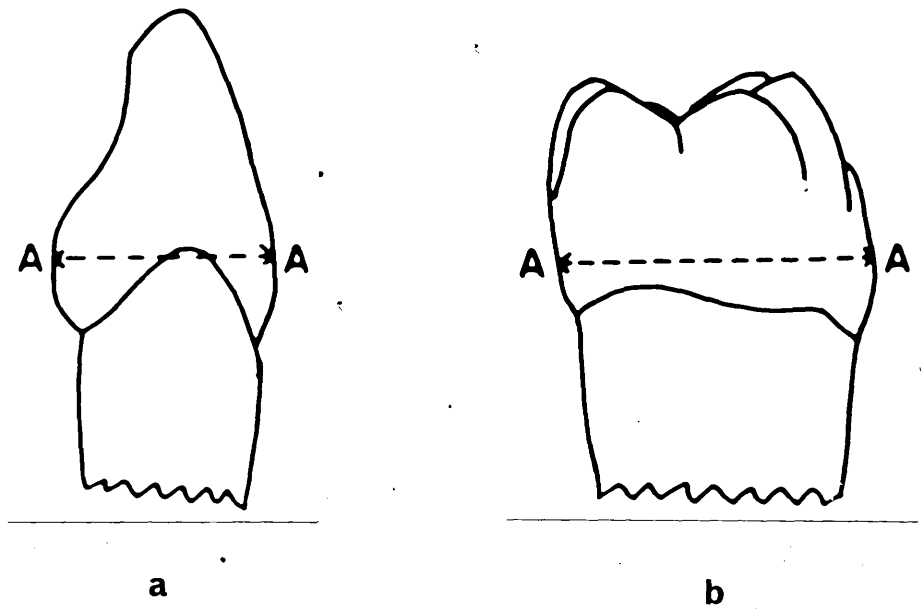

Fig. 5. Illustrates the effect of attrition on the accuracy of measurement of the labiolingual diameter of a. an incisor and b. a molar. The line A - A indicates the level at which the measurement is usually made. A very great deal of attrition must take place before the accuracy of this measurement will be affected.

mesiodistal diameter, since the greatest labiolingual dimension lies much closer to the amelocemental junction than do the normal contact points (Fig.5.).

In order to ensure complete accuracy of tooth measurements, only newly erupted teeth should be measured. But this would mean that no adult skulls could be employed, and in the case of the present study, measurements could only have been obtained from the Aebelholt children's skulls. No sex comparison would then be feasible, and the study would have become so restricted as to be meaningless. Therefore, adult skulls were used in the study of tooth size. The teeth measured had undergone some slight attrition, but care was taken to exclude mesiodistal measurements of all teeth where it appeared that attrition had involved the loss of more than the very thinnest surface layer of enamel on the proximal surfaces. Similarly, no tooth was measured in the mesiodistal dimension if it was judged that occlusal attrition had removed tooth substance beyond the level of the normal contact points. The choice of which teeth to measure and which to exclude from the study, was a matter of subjective judgment in each case. No attempt/

attempt was made to correct the recorded measurements for loss by attrition, as the writer agrees with the statement by Goose (1963) that "an arbitrary correction cannot be really satisfactory, since it is too subjective, and an age correction may be too inaccurate for the comparison of different populations, since attrition is not only a function of age but is also dictated by the type of diet".

Labiolingual measurements were less frequently affected by attrition, but often had to be excluded because of heavy deposits of calculus, especially on the lingual surfaces of the teeth. Since very few of the teeth had not suffered from at least a slight degree of occlusal attrition, no measurements were made of crown height. Root dimensions could not be recorded, as most of the teeth were firmly embedded in the jaws and could not be removed without causing damage to the specimens.

During collection of the data all suitable teeth were measured, including many pairs of teeth from opposite sides of the same jaw. The measurement of such pairs of teeth acted partly as a check to prevent errors arising from an accidental misreading of the caliper/

caliper scale. If a discrepancy greater than 0.2 m.m. was observed between measurements of a pair, both teeth were carefully remeasured.

As a test of the extent to which the measurements might vary due to the method of recording, double de-:terminations of both dimensions were made on 25 ex-:amples of each tooth class. The "error of the meth-:od", σi, was then calculated using the formula:

$$\sigma i = \sqrt{\frac{\Sigma d^2}{2n}}$$

where 'd' is the difference between measurements of the same tooth, and 'n' is the number of teeth measured. The results of this test are shown in Table 1. Since 'n' had a uniform value throughout of 25, it has not been included in the table.

Table 1./

Table 1. Error of the method by double determination.

	Maxillary		Mandibular	
	M.D.	L.L.	M.D.	L.L.
I 1	0.07	0.08	0.06	0.06
I 2	0.08	0.08	0.06	0.05
C	0.06	0.06	0.07	0.09
P 1	0.06	0.06	0.09	0.07
P 2	0.06	0.05	0.07	0.09
M 1	0.10	0.06	0.09	0.07
M 2	0.12	0.10	0.11	0.07
M 3	0.14	0.06	0.13	0.07

These results establish the unit of measurement as 0.1 m.m., and are similar to those published by other workers who have investigated the error of the method by means of double determinations. Lundström (1943) published detailed tables of σi for mesiodistal measurements made directly on incisors and canines. These values of σi lay between 0.04 m.m. and 0.08 m.m. When double measurements were made on incisors, can-:ines, premolars and molars of plaster models, the error was rather higher, ranging from 0.06 to 0.25 m.m., with two-thirds/

two-thirds of the results lying between 0.06 and 0.11 m.m. Lysell (1958b) found the average error of measure- :ments on models to be 0.13 m.m., and Moorrees et al (1957), also working on models, calculated that the average error was 0.09 m.m. Barrett et al (1963) found that the error, in a study in which models were used, ranged between 0.09 and 0.13 m.m. Seipel(1946) also published a table of σi, in which the values cal- :culated for incisors and canines were stated for each tooth separately, but those for premolars and molars were grouped. Seipel's calculated values for σi range from 0.06 to 0.31 m.m. The errors for the in- :cisors and canines mostly lie between 0.06 and 0.11 m.m. Those for the premolars and molars are consider- :ably higher, but it must be remembered that Seipel collected his data by direct measurements in the mouth, and difficulty of access in the posterior region must be partly responsible for these larger errors of meas- :urement.

Other workers in odontometry have published no in- :formation concerning the error of the method.

It is a basic rule of statistical procedure that only one measurement of any given feature or part should be/

be used for each individual. This rule has frequently been disregarded in odontometric investigations. Selmer-Olsen (1949) and Moorrees (1957) state that the measurements of teeth from both sides of the jaws were used in the calculations, and it is obvious from the numbers of individuals and observations quoted by Mijsberg (1931) and Thomsen (1955) that they have followed the same procedure. Other writers do not state whether one or both teeth were used (e.g.Hosaka, 1936; Nelson, 1938) and it is not possible to discover from their publications which method was employed. Pedersen (1949) and Lundström (1944) published the results for both right and left sides separately. Gabriel (1955) presented the measurements of the right side, substituting from the left if the right measurement was unobtainable. Moorrees et al (1957), Lysell (1960) and Barrett et al (1963, 1964) averaged the figures for right and left sides in each individual. Those authors who studied the difference between teeth from right and left sides found no significant difference between the sides (Gabriel, 1955; Lysell, 1960; Barrett et al, 1963, 1964).

In/

In dealing with the Scottish prehistoric teeth, the writer employed pooled measurements from both sides, solely because of the extremely small quan:tity of material which existed. The Danish skull collections were much larger and it was therefore possible to avoid pooling of data from the two sides. Since little difference had previously been demon:strated between teeth from right and left sides, and since, though there were occasional differences, there appeared to be a considerable degree of corr:elation between opposing teeth in the Danish mater:ial, it was decided that the method of choice would be to use one measurement per individual for each tooth dimension, and those from the right side were chosen. There was no statistical proof as yet whether the measurement from the right side would be truly representative of any particular dimension in this population.

Frequently it proved impossible to obtain a measurement from a tooth on the right side, while an acceptable measurement could be made on its opp:onent from the left side. The question then arose as to whether it would be statistically permissible to/

to replace missing measurements from the right side by the corresponding measurements from the left side. Tests were carried out in the case of four dimensions chosen at random, in which measurements were avail:able for a number of pairs of teeth from right and left sides. A comparison of right and left measure:ments showed that there was no significant differ:ence between the sides - i.e. the amount by which right measurements exceeded left was equalled by the amount by which left measurements exceeded right. These results are in accordance with the reports of Gabriel and Lysell mentioned above. In view of these findings, measurements from the right side could be regarded as truly representative of tooth size in the Danish mediaeval material, while measure:ments from the left side could be used in further statistical preparation of the data, where the corr:esponding measurement on the right side was missing.

Recently, some highly complex statistical meth:ods have been used in the evaluation of data on tooth measurement, and such techniques as multivariate analysis have provided valuable information in cer:tain cases (Bronowski and Long, 1951, 1953; Ashton/

Ashton et al, 1957). Yates and Healy (1951) however, pointed out that "an examination of the value of each individual measurement ...... is an essential first step", and gave a warning against placing reliance upon complex statistical procedures before the basic, simpler methods had been fully employed. The method chosen for analysis of the tooth measurements coll-:ected in the present study has therefore been that of the 't' test, by means of which the significance of differences between mean values may be estimated.

The standard deviation of each mean value ob-:tained was calculated by means of the formula :

$$s = \sqrt{\frac{1}{n-1}\left[S(x^2) - \frac{(Sx)^2}{n}\right]}$$

No calculation of the standard deviation was made if there were fewer than five observations recorded. The coefficient of variation, which indicates the degree of variability of the particular measurement, was calculated using the formula $v = \frac{100.s}{x}$

Differences between mean values recorded for the various/

various groups of skulls were assessed by means of the 't' test, the formula employed being:

$$t = \frac{\bar{x} - \bar{x}'}{\sqrt{\frac{S(x-\bar{x})^2 + S(x'-\bar{x}')^2}{n + n' - 2}\left[\frac{1}{n} + \frac{1}{n'}\right]}}$$

The significance of the values of 't' obtained was read from "Statistical Tables for Biological, Agri:cultural and Medical Research" (Fisher and Yates, 1943).

In the tables of results, the symbols 'n','$\bar{x}$', 's' and 'v' have been employed to represent respect:ively the number of observations (equals the number of individuals from which the particular measurement could be recorded), the mean value calculated from the observations, the standard deviation of these observations about the mean, and the coefficient of variation of the observations. The letter 'd' in:dicates the difference observed between two groups in respect of a particular dimension. All measure:ments are recorded in millimeters.

Statistical significance of differences eval:uated by the 't' test has been indicated in the usual/

usual manner, by a system of asterisks.

* = significance at the level $P < 0.05$, i.e. there is a probability of 1 in 20 that the observed difference could have occurred by chance. This is considered "significant".

** = significance at the level $P < 0.01$, i.e. there is a probability of 1 in 100 that the observed difference could have occurred by chance. This is considered to be "highly significant".

*** = significance at the level $P < 0.001$, i.e. there is a probability of 1 in 1000 that the observed difference could have occurred by chance. This is considered to be "very highly significant".

CROWN SIZE IN MEDIAEVAL DANES.

For purposes of comparison the data obtained were classified according to sex and place of excav-:ation of the material. Sex grouping had been per-:formed by the excavator and his co-workers according to the instructions given in Martin's "Lehrbuch der Anthropologie" (1928). The writer felt that it would be wise to adhere to the sexing as already car-:ried out, in order not to introduce any personal bias which might distort the final results. In some in-:stances the pelvis had been preserved, but in the majority the assessment of sex had rested upon other features of skull or skeleton. No decision had been reached in some cases, while in others the individual had been classified as ?male or ?female. Any skull about which doubt was expressed concerning the sex was excluded from the statistical comparisons.

The study of tooth size had to be confined to the material from Aebelholt and Naestved. The coll-:ection of skulls from Bornholm was small, and in addition many of the teeth were so severely worn as to be useless for anatomical studies. This was un-:fortunate, since Bornholm has always been isolated by/

by its position in the Baltic, far from the other Danish islands and also from the Scandinavian main-:land, and its inhabitants might therefore have shown some differences from the population of Sjaelland.

In the case of the material from Aebelholt and Naestved, there was a sufficiently large collection of skulls to provide reasonable numbers of measure-:ments, after allowing for "wastage" for various reasons. Of the total of 1019 skulls in these two groups, 212 had no jaws. Of the remainder, 397 had suffered from attrition, caries or post-mortem damage to such an extent that no measurements of the dentition could be made. A further 149 skulls had to be eliminated, as their sex had not been determin-:ed with certainty. Many more skulls from the Aebelholt group than from the Naestved group contri-:buted to this 'sex unknown or uncertain' category, because of the large number of children buried at Aebelholt.

The remaining 261 skulls provided measurements of varying numbers of teeth. In both groups, more female skulls than male skulls were suitable for tooth measurements, and this was particularly marked in/

in the case of the Naestved material. It was very seldom that anything approaching a complete metrical record could be made from any one individual, as either attrition, calculus, caries, in vivo loss or post-mortem loss or damage of teeth affected almost every skull to some extent. Measurements were not recorded if there was any doubt concerning their accuracy. The decision whether or not to include measurements of teeth showing slight attrition was, as has been mentioned above, a purely subjective one, and there is the possibility that a few measurements which are a little too low have been included, in spite of all efforts to exclude them.

A. Sex comparison of crown size in the Aebelholt group and in the Naestved group.

The first comparison made was between tooth di-:mensions in males and females, the data from Aebelholt and Naestved being treated separately. The results of the sex comparison of the Aebelholt material are presented in Tables 2 - 5, and are also shown graphically in Figs. 6 - 9.

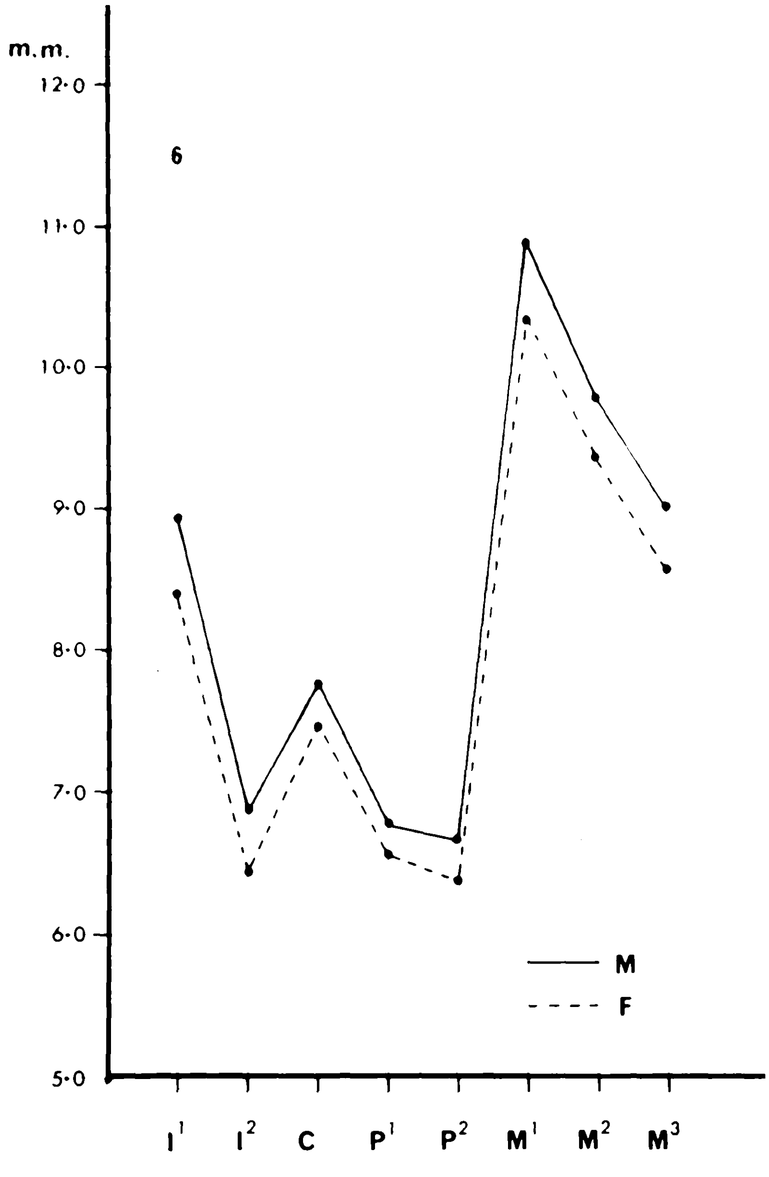

Fig. 6. Mean values of the mesiodistal diameters of the maxillary teeth in males and females of the Aebelholt group.

TABLE 2.

Mean mesiodistal diameters of maxillary teeth in the Aebelholt group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	11	8.95	0.47	5.25	0.59	3.02**
	F	29	8.36	0.58	6.94		
I^2	M	15	6.89	0.64	9.29	0.43	2.27*
	F	34	6.46	0.60	9.29		
C	M	31	7.76	0.40	5.15	0.28	3.31**
	F	43	7.48	0.33	4.41		
P^1	M	29	6.77	0.36	5.32	0.21	2.60*
	F	43	6.56	0.32	4.88		
P^2	M	22	6.66	0.35	5.26	0.27	2.76**
	F	36	6.39	0.37	5.79		
M^1	M	14	10.89	0.46	4.22	0.55	3.25**
	F	30	10.34	0.55	5.32		
M^2	M	36	9.76	0.64	6.56	0.42	3.07**
	F	47	9.34	0.60	6.42		
M^3	M	49	8.99	0.76	8.45	0.41	2.44*
	F	34	8.58	0.75	8.74		

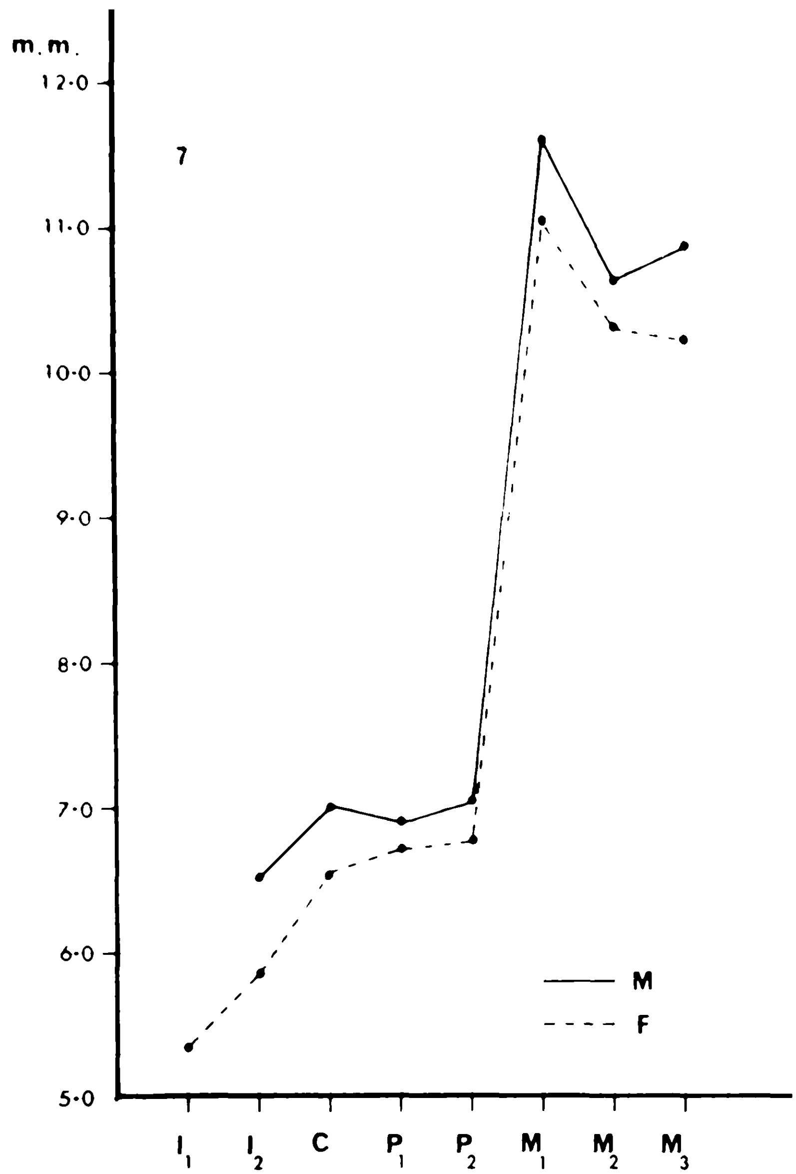

Fig. 7. Mean values of the mesiodistal diameters of the mandibular teeth in males and females of the Aebelholt group.

TABLE 3.

Mean mesiodistal diameters of mandibular teeth in the Aebelholt group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	1	-	-	-	-	-
	F	11	5.36	0.30	5.60		
I_2	M	5	6.52	0.49	7.52	0.63	3.81***
	F	20	5.89	0.28	4.75		
C	M	22	7.01	0.35	4.99	0.45	4.69***
	F	40	6.56	0.37	5.64		
P_1	M	24	6.90	0.46	6.67	0.19	1.88
	F	42	6.71	0.35	5.22		
P_2	M	24	7.04	0.45	6.39	0.25	2.41*
	F	34	6.79	0.35	5.15		
M_1	M	9	11.61	0.69	5.94	0.58	2.44*
	F	25	11.03	0.58	5.26		
M_2	M	24	10.63	0.67	6.30	0.31	2.17*
	F	40	10.32	0.48	4.65		
M_3	M	32	10.89	1.19	10.93	0.65	2.56*
	F	29	10.24	0.71	6.93		

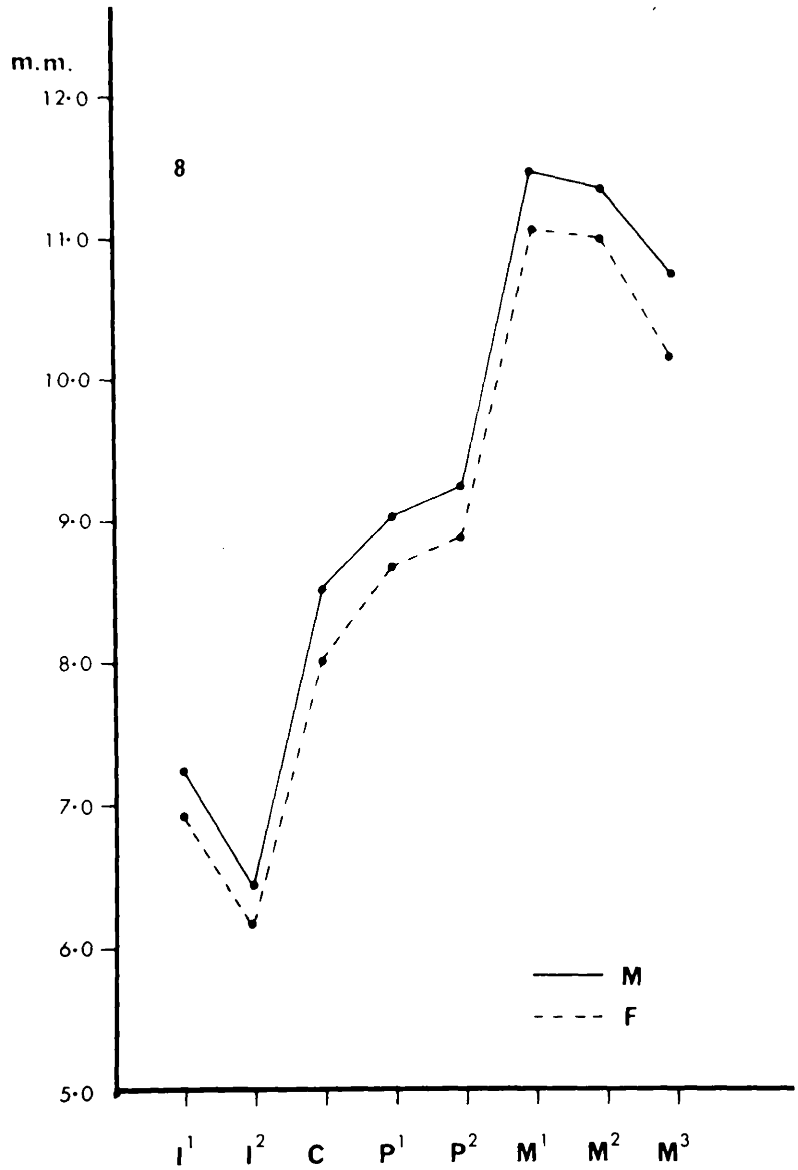

Fig. 8. Mean values of the labiolingual diameters of the maxillary teeth in males and females of the Aebelholt group.

TABLE 4.

Mean labiolingual diameters of maxillary teeth in the Aebelholt group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	22	7.24	0.45	6.22	0.33	3.06**
	F	41	6.91	0.39	5.64		
I^2	M	22	6.42	0.44	6.85	0.28	2.58*
	F	45	6.14	0.41	6.68		
C	M	34	8.51	0.54	6.35	0.51	4.42***
	F	48	8.00	0.50	6.25		
P^1	M	43	9.03	0.56	6.20	0.37	3.44***
	F	54	8.66	0.50	5.77		
P^2	M	47	9.25	0.57	6.16	0.43	3.96***
	F	49	8.82	0.49	5.56		
M^1	M	36	11.49	0.52	4.53	0.40	3.37**
	F	49	11.09	0.56	5.05		
M^2	M	53	11.38	0.76	6.68	0.37	2.56*
	F	51	11.01	0.71	6.45		
M^3	M	55	10.77	0.81	7.52	0.63	3.45***
	F	34	10.14	0.88	8.68		

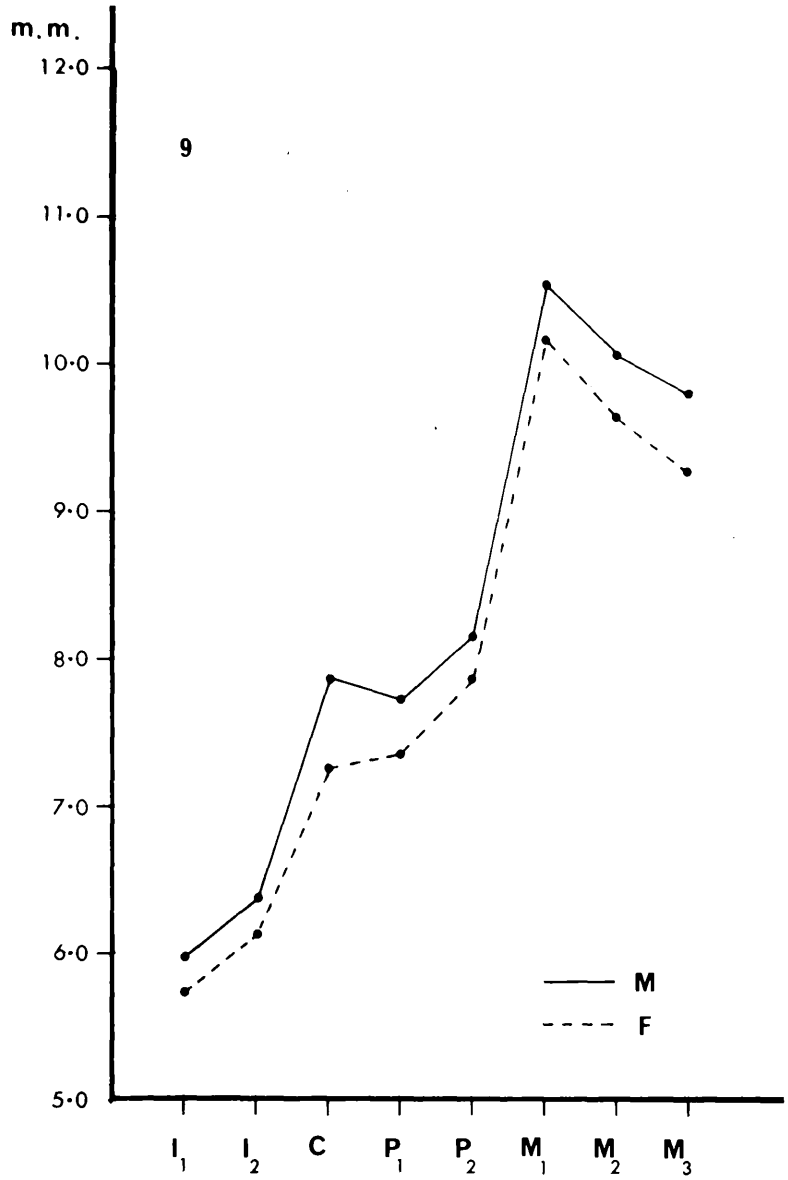

Fig. 9. Mean values of the labiolingual diameters of the mandibular teeth in males and females of the Aebelholt group.

TABLE 5.

Mean labiolingual diameters of mandibular teeth in the Aebelholt group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	6	5.98	0.38	6.35	0.26	1.71
	F	12	5.72	0.26	4.55		
I_2	M	6	6.37	0.51	8.01	0.25	1.21
	F	18	6.12	0.42	6.86		
C	M	18	7.89	0.48	6.08	0.64	4.18***
	F	33	7.25	0.55	7.59		
P_1	M	33	7.73	0.47	6.08	0.39	4.18***
	F	47	7.34	0.36	4.90		
P_2	M	37	8.16	0.54	6.62	0.29	2.69**
	F	46	7.87	0.45	5.72		
M_1	M	29	10.56	0.46	4.36	0.36	3.19**
	F	44	10.20	0.48	4.71		
M_2	M	40	10.10	0.62	6.14	0.42	3.47***
	F	47	9.68	0.51	5.27		
M_3	M	39	9.83	0.77	7.83	0.53	3.26**
	F	33	9.30	0.58	6.24		

It was found that the mean dimensions of the teeth of Aebelholt males were always greater than those of Aebelholt females. In most cases these differences in tooth size between male and female were found to be statistically significant, and some of them were very highly significant, at the level $P < 0.001$. One comparison, that concerning the mes-:iodistal diameter of the mandibular first incisor, could not be made because of lack of material. Of the remaining 31 comparisons, 9 were significant at the level $P < 0.001$, 10 at the level $P < 0.01$, and 9 at the level $P < 0.05$, giving a total of 28 signific-:ant results.

For the Aebelholt group, the only tooth measure-:ments which did not show a statistically significant sex difference were the mesiodistal diameter of the mandibular first premolar and the labiolingual dia-:meters of the mandibular incisors.

The teeth which showed the most consistently high level of significance were the canines. For both jaws, and for both tooth dimensions, the high-:est value of 't' (indicating the most highly sig-:nificant result) was that calculated for the canine. Three/

Three of the four 't' values for the canines were found to represent significance at the very high lev-:el of $P < 0.001$.

All the comparisons made for the second premolars, and first, second and third molars of both jaws were also found to show significant sex differences, but the level of significance varied considerably. The labiolingual diameters of these teeth on the whole showed more highly significant differences than did the mesiodistal diameters.

The labiolingual diameters of the first premol-:ars of both jaws also showed highly significant sex differences, though the mesiodistal diameters did not. Some of the differences in size observed for the in-:cisors were significant, others were not. Both dimensions of the maxillary central incisors appeared to show a rather higher level of significance than did those of the lateral incisors, and this was part-:ly the result of the greater variability in size of the latter teeth, as evidenced by the larger values of the coefficient of variation.

In the case of the Aebelholt material it was possible to provide some check on the degree to which measurements/

measurements may have been affected by attrition. There existed the large group of children's skulls in which the entirely unworn permanent teeth and tooth germs had been removed from the jaws for a previous study. If the children were divided fairly evenly between the sexes, and there was no *a priori* reason why they should not have been, then pooled measurements of their teeth should provide mean values lying midway between the true mean values for the teeth of the males and females. If the adult teeth had suffered from attrition to such an extent as to render the calculated values inaccurate*, then the mean values of the children's teeth might be expected to approach or even exceed those of the male adults.

The resulting mean mesiodistal and labiolingual diameters of the children's teeth are shown in Tables 6 and 7. The third molars have not been included, as very few were sufficiently developed to allow of measurement. The mean values obtained for the corresponding measurements of Aebelholt males and females have been inserted for comparison.

TABLE 6.

Dimensions of maxillary teeth in Aebelholt children.

Mesiodistal diameter.

	$\bar{x}$	n	s	$\bar{x}$ ♂	$\bar{x}$ ♀
I^1	8.48	54	0.53	8.95	8.36
I^2	6.53	45	0.46	6.89	6.46
C	7.51	47	0.33	7.76	7.48
P^1	6.71	40	0.31	6.77	6.56
P^2	6.62	37	0.35	6.66	6.39
M^1	10.36	79	0.52	10.89	10.34
M^2	9.40	43	0.52	9.76	9.34

Labiolingual diameter

	$\bar{x}$	n	s	$\bar{x}$ ♂	$\bar{x}$ ♀
I^1	6.92	35	0.42	7.24	6.91
I^2	6.04	30	0.40	6.42	6.14
C	8.00	32	0.47	8.51	8.00
P^1	8.70	30	0.53	9.03	8.66
P^2	8.80	26	0.59	9.25	8.82
M^1	11.23	67	0.55	11.49	11.09
M^2	11.15	33	0.58	11.38	11.01

TABLE 7.

Dimensions of mandibular teeth in Aebelholt children.

Mesiodistal diameter.

	$\bar{x}$	n	s	$\bar{x}$ ♂	$\bar{x}$ ♀
l_1	5.40	57	0.33	-	5.36
l_2	5.89	56	0.36	6.52	5.89
C	6.57	54	0.33	7.01	6.56
P_1	6.79	47	0.33	6.90	6.71
P_2	6.97	42	0.33	7.04	6.79
M_1	11.25	81	0.54	11.61	11.03
M_2	10.66	42	0.53	10.63	10.32

Labiolingual diameter.

	$\bar{x}$	n	s	$\bar{x}$ ♂	$\bar{x}$ ♀
l_1	5.76	38	0.37	5.98	5.72
l_2	6.16	40	0.33	6.37	6.12
C	7.44	38	0.42	7.89	7.25
P_1	7.35	35	0.44	7.73	7.34
P_2	7.83	31	0.42	8.16	7.87
M_1	10.15	65	0.50	10.56	10.20
M_2	9.63	28	0.50	10.10	9.68

Most of the mean values for mesiodistal and lab-:iolingual measurements of the children's teeth lay between the mean values recorded for adult males and females. In only one instance, that of the mesiodis-:tal diameter of the mandibular second molar, did the mean value of the children's teeth exceed that of the adult males by a very small amount. Contrary to ex-:pectations, the majority of the mean values calculat-:ed for the children's teeth fell much closer to the values recorded for the females and in some five cases even slightly below the female means.

This result is difficult to explain fully. It may be that there was a considerably higher proportion of females than males among the children, and indeed the proportions of the sexes may have varied for diff-:erent teeth, since each skull did not necessarily provide measurements of all the teeth. On the other hand, it may be that the sexing of the Aebelholt mat-:erial was not quite accurate and that some poorly marked male skulls had been included with the females, thus resulting in mean values for females which are a little too high. Although no child's tooth was meas-:ured unless its crown appeared to have been fully formed/

formed, it is possible that measurements were made of some teeth in which the full thickness of enamel had not been completed in the cervical region. This would result in low values of the labiolingual diamet-:ers but would not affect the mesiodistal diameters.

But it appears fairly clear that at any rate the measurements recorded for the adults have not been rendered inaccurate as the result of loss of tooth substance by attrition.

The mean dimensions of the teeth of Naestved males and females were next compared, and the results of these comparisons are presented in Tables 8 - 11, and Figs. 10 - 13.

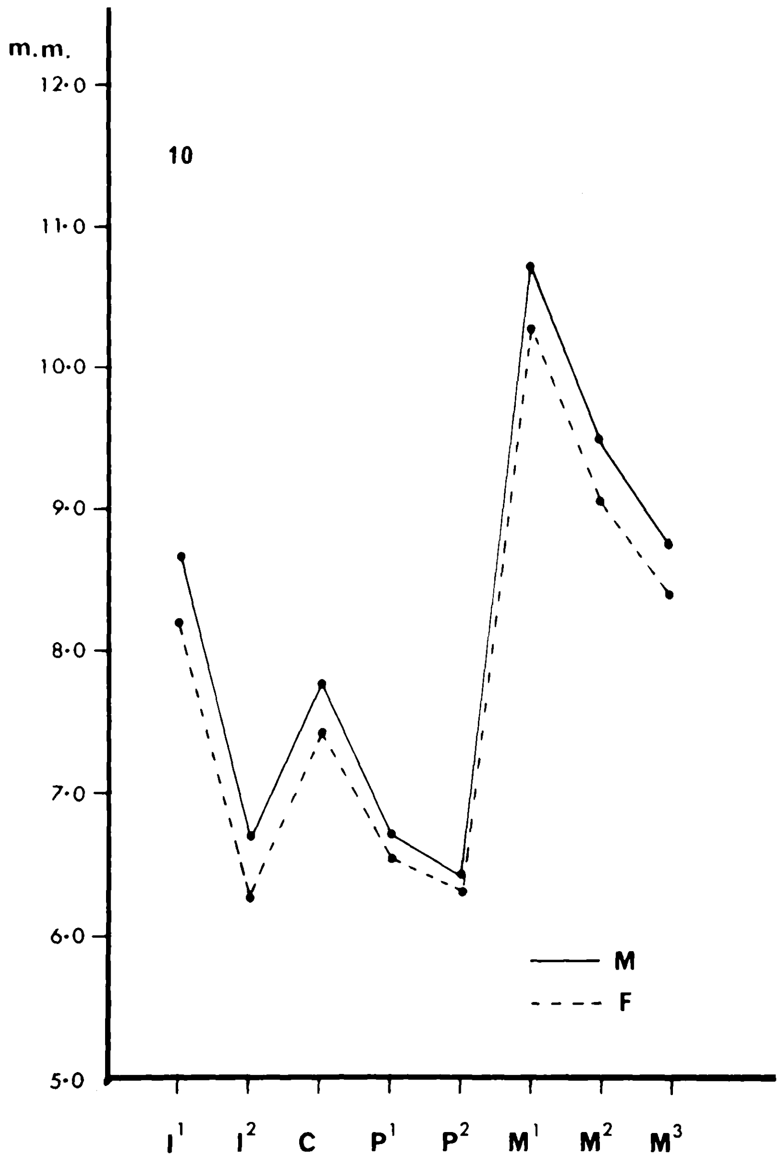

Fig. 10. Mean values of the mesiodistal diameters of the maxillary teeth in males and females of the Naestved group.

TABLE 8.

Mean mesiodistal diameters of maxillary teeth in the Naestved group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	13	8.68	0.51	5.88	0.49	3.10**
	F	25	8.19	0.44	5.37		
I^2	M	18	6.68	0.47	7.04	0.40	2.64*
	F	36	6.28	0.55	8.76		
C	M	31	7.76	0.34	4.38	0.35	4.22***
	F	54	7.41	0.36	4.86		
P^1	M	29	6.69	0.28	4.19	0.17	2.33*
	F	54	6.52	0.34	5.21		
P^2	M	27	6.41	0.34	5.30	0.11	1.31
	F	51	6.30	0.36	5.71		
M^1	M	17	10.71	0.41	3.83	0.42	3.05**
	F	46	10.29	0.51	4.96		
M^2	M	36	9.49	0.57	6.01	0.46	3.99***
	F	58	9.03	0.53	5.87		
M^3	M	39	8.73	0.84	9.62	0.34	2.11*
	F	43	8.39	0.61	7.27		

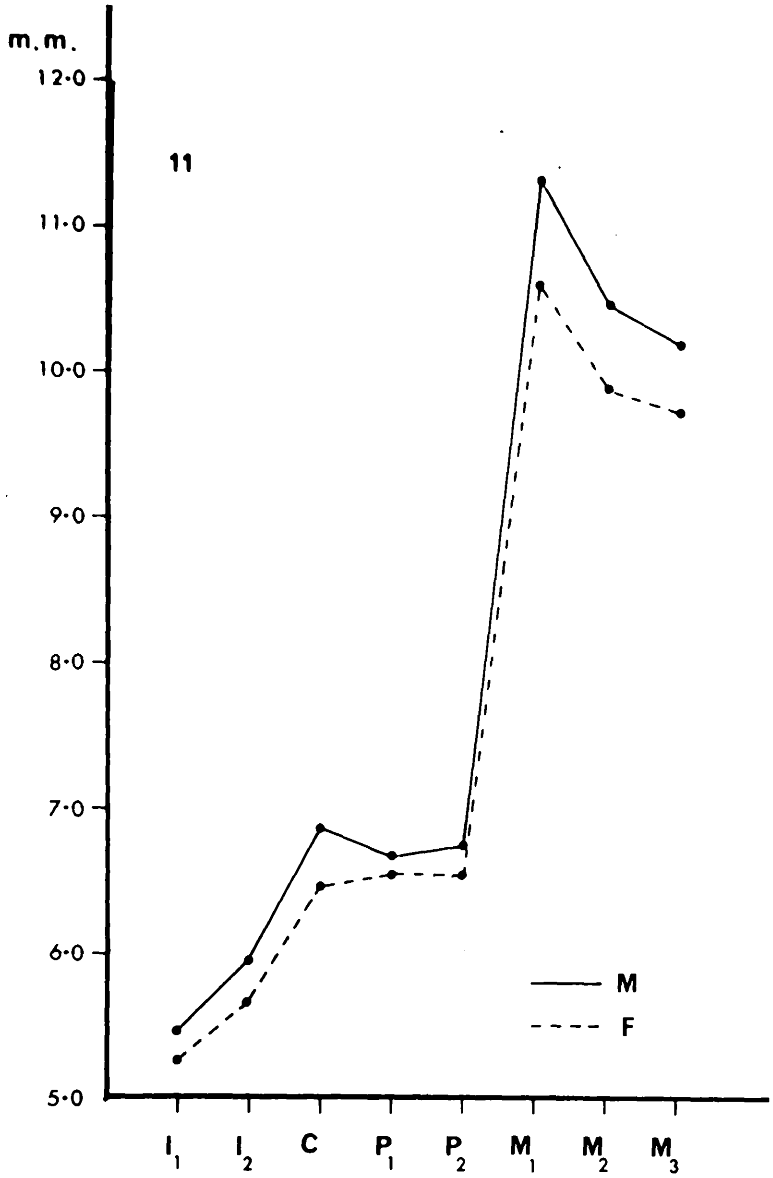

Fig. 11. Mean values of the mesiodistal diameters of the mandibular teeth in males and females of the Naestved group.

TABLE 9.

Mean mesiodistal diameters of mandibular teeth in the Naestved group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	6	5.45	0.12	2.20	0.20	2.20*
	F	17	5.25	0.21	4.00		
I_2	M	11	5.94	0.23	3.87	0.28	2.62*
	F	25	5.66	0.32	5.65		
C	M	28	6.87	0.35	5.09	0.41	4.59***
	F	42	6.46	0.38	5.88		
P_1	M	30	6.67	0.38	5.70	0.12	1.34
	F	52	6.55	0.40	6.11		
P_2	M	30	6.73	0.29	4.31	0.19	2.36*
	F	47	6.54	0.38	5.81		
M_1	M	19	11.37	0.59	5.19	0.72	4.02***
	F	33	10.65	0.64	6.01		
M_2	M	32	10.51	0.74	7.04	0.59	3.83***
	F	45	9.92	0.61	6.15		
M_3	M	34	10.24	0.83	8.11	0.45	2.70**
	F	42	9.79	0.62	6.33		

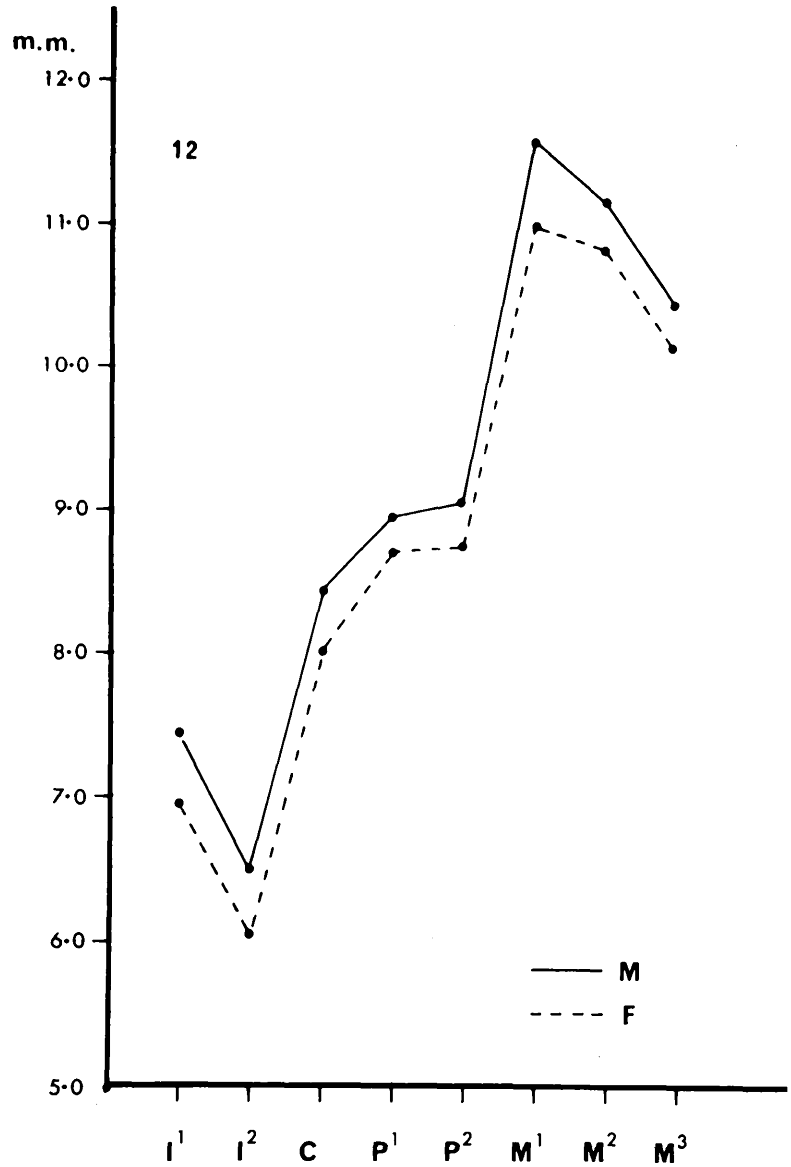

Fig. 12. Mean values of the labiolingual diameters of the maxillary teeth in males and females of the Naestved group.

TABLE 10.

Mean labiolingual diameters of maxillary teeth in the Naestved group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	18	7.43	0.37	4.98	0.50	4.70***
	F	35	6.93	0.37	5.34		
I^2	M	21	6.50	0.43	6.62	0.47	3.99***
	F	38	6.03	0.44	7.30		
C	M	28	8.43	0.51	6.05	0.42	3.71***
	F	54	8.01	0.47	5.87		
P^1	M	38	8.95	0.47	5.25	0.25	2.49*
	F	64	8.70	0.50	5.75		
P^2	M	37	9.04	0.49	5.42	0.31	2.73**
	F	62	8.73	0.58	6.64		
M^1	M	24	11.60	0.44	3.79	0.60	4.73***
	F	50	11.00	0.54	4.91		
M^2	M	41	11.18	0.65	5.81	0.34	2.69**
	F	61	10.84	0.61	5.63		
M^3	M	40	10.45	0.68	6.51	0.31	1.90
	F	45	10.14	0.81	7.99		

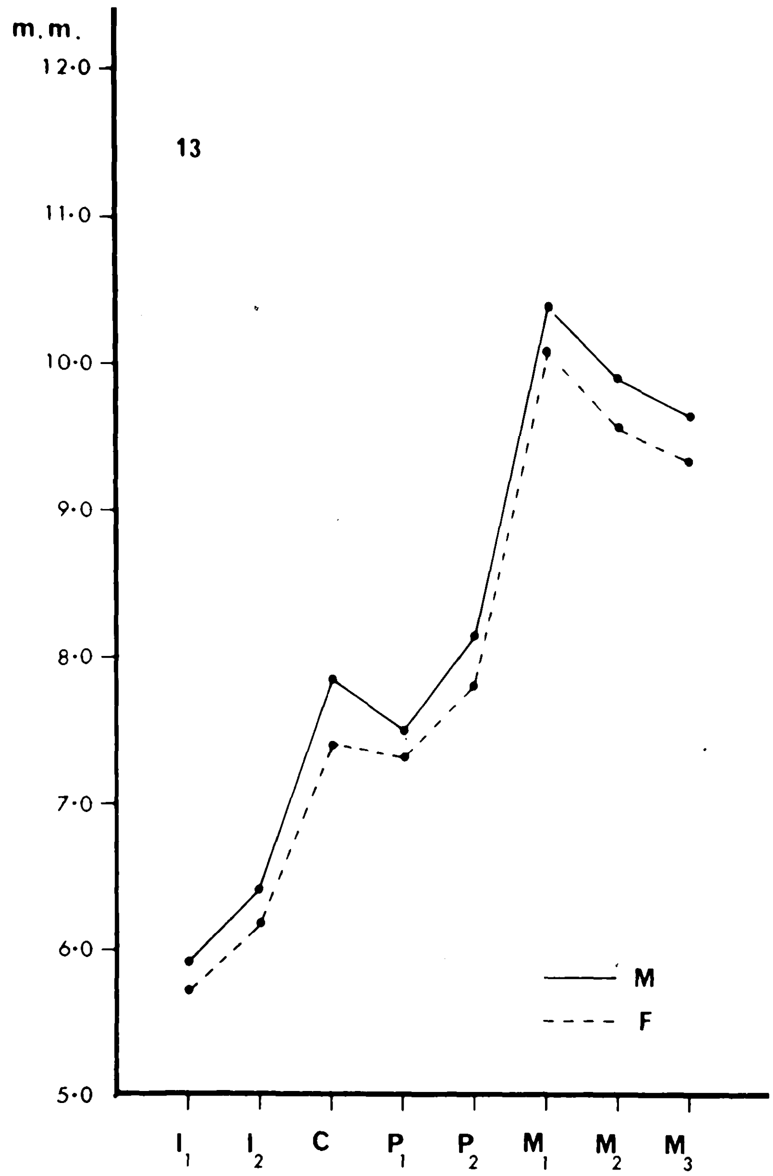

Fig. 13. Mean values of the labiolingual diameters of the mandibular teeth in males and females of the Naestved group.

TABLE 11.

Mean labiolingual diameters of mandibular teeth in the Naestved group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	2	5.90	-	-	0.20	-
	F	11	5.70	0.33	5.79		
I_2	M	3	6.40	-	-	0.23	-
	F	19	6.17	0.37	6.00		
C	M	16	7.84	0.49	6.25	0.44	3.53***
	F	41	7.40	0.39	5.27		
P_1	M	30	7.50	0.41	5.47	0.19	1.86
	F	48	7.31	0.45	6.16		
P_2	M	32	8.14	0.46	5.65	0.32	3.38***
	F	49	7.82	0.39	4.99		
M_1	M	25	10.41	0.62	5.96	0.31	2.41*
	F	42	10.10	0.43	4.26		
M_2	M	36	9.92	0.64	6.45	0.33	2.69**
	F	52	9.59	0.42	4.38		
M_3	M	35	9.68	0.68	7.02	0.33	2.45*
	F	42	9.35	0.50	5.35		

In the Naestved material, as well as in that from Aebelholt, there was a clearly marked sex difference in tooth size. In every instance the mean value re-:corded for the teeth of males was higher than the corresponding mean value for the females. Most of these sex differences could be shown to be statistic-:ally significant. Sufficient data were not avail-:able to allow comparisons to be carried out for the labiolingual diameters of the mandibular incisors. Statistical comparisons could be made for the remain-:ing 30 tooth dimensions, and of these 11 showed very highly significant sex differences ($P < 0.001$), 6 show-:ed highly significant differences ($P < 0.01$) and an-:other 9 showed differences significant at the level $P < 0.05$, giving a total of 26 significant results.

In this population, the tooth dimensions for which the sex difference could not be shown to be statistic-:ally significant were the mesiodistal diameter of the maxillary second premolar, the labiolingual dia-:meter of the maxillary third molar and both dimen-:sions of the mandibular first premolar.

As in the case of the Aebelholt group, it was the canines which showed the most consistently high level of of significance, the 't' value for each dimension of both maxillary and mandibular canines indicating very high significance, at the level $P < 0.001$. In tables 8, 9 and 11, the highest value of 't' calculated in each case was that for the canine.

Comparisons of the molar dimensions showed sig-:nificant sex differences except for the labiolingual dimension of the maxillary third molar. The level of significance varied considerably, and this finding was similar to the result recorded for the Aebelholt group.

Where sex comparisons of incisor dimensions could be made, these were found to show statistically sig-:nificant differences, but a high level of signific-:ance was reached only in the case of the labiolingual diameters of the maxillary incisors.

The premolars showed least sex difference in size and this again was in accordance with the results obtained for the Aebelholt material.

In general, therefore, it was found that sex differences in tooth size existed in the material from both Aebelholt and Naestved. The mean value of every tooth dimension was greater in the males than in the females./

females. In 61 instances, it was possible to carry out statistical tests of the significance of these ob:served differences. Of these 61 comparisons, 20 were significant at the level $P < 0.001$ (very highly signif:icant), 16 at the level $P < 0.01$ (highly significant) and 18 at the level $P < 0.05$ (significant), giving a total of 54 significant results, of which 36 were highly significant. The highest level of significance in both groups was displayed by the canines, while the premolars appeared to show least sex difference in size, and the molars and incisors occupied an inter:mediate position.

B. Comparison of crown size in Aebelholt and Naestved groups.

A comparison was next carried out to determine whether differences existed between the local popul:ations at Aebelholt and Naestved. It would at first seem unlikely that differences should exist between two groups of Danes who had lived in areas separated by a matter of only fifty-seven miles. However, Selmer-Olsen (1949) showed that quite marked differ:ences in tooth size could be demonstrated in Lapps from/

from different villages, and in view of this finding it seemed worthwhile to examine possible differences between the Danish groups.

The results of this comparison are presented in Tables 12 - 19 and in Figs. 14 - 21.

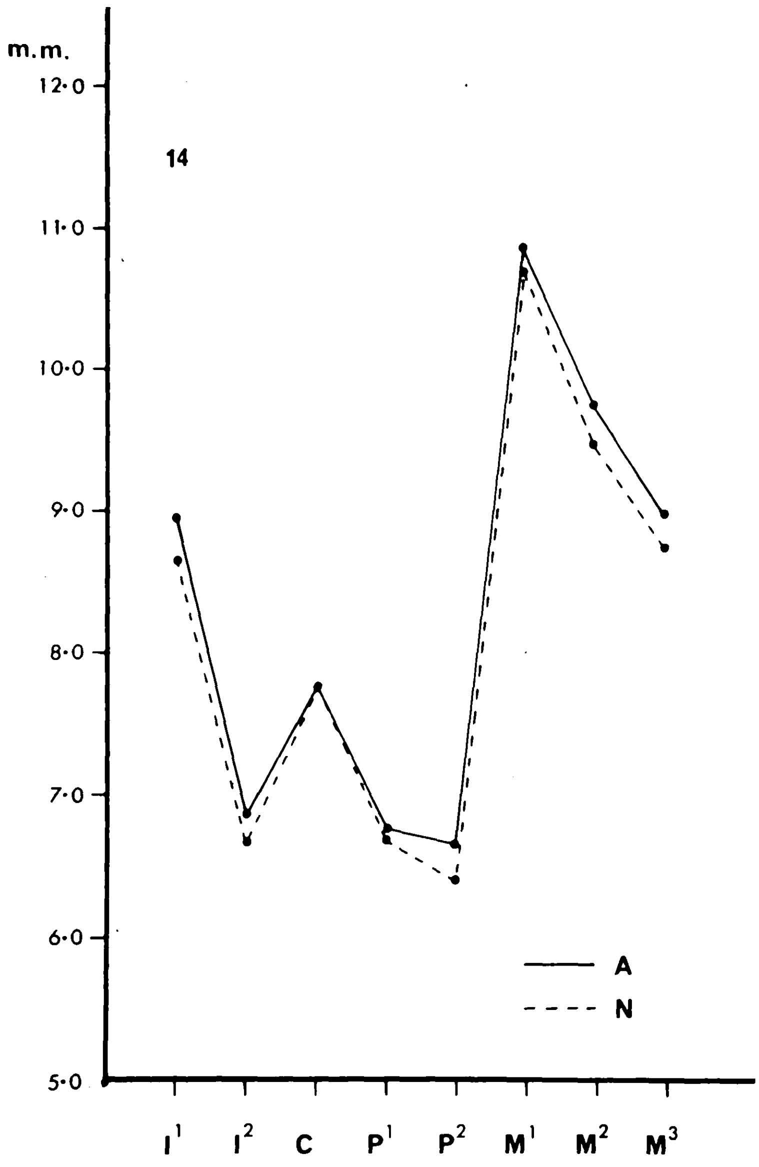

Fig. 14. Mean values of the mesiodistal diameters of the maxillary teeth in Aebelholt males and Naestved males.

TABLE 12.

Mean mesiodistal diameters of maxillary teeth in medi-:aeval Danes ; comparison of Aebelholt males and Naestved males.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I^1	A	11	8.95	0.47	5.25	0.27	1.34
	N	13	8.68	0.51	5.88		
I^2	A	15	6.89	0.64	9.29	0.21	1.09
	N	18	6.68	0.47	7.04		
C	A	31	7.76	0.40	5.15	0	0
	N	31	7.76	0.34	4.38		
P^1	A	29	6.77	0.36	5.32	0.08	0.95
	N	29	6.69	0.28	4.19		
P^2	A	22	6.66	0.35	5.26	0.25	2.51*
	N	27	6.41	0.34	5.30		
M^1	A	14	10.89	0.46	4.22	0.18	1.16
	N	17	10.71	0.41	3.83		
M^2	A	36	9.76	0.64	6.56	0.27	1.89
	N	36	9.49	0.57	6.01		
M^3	A	49	8.99	0.76	8.45	0.26	1.52
	N	39	8.73	0.84	9.62		

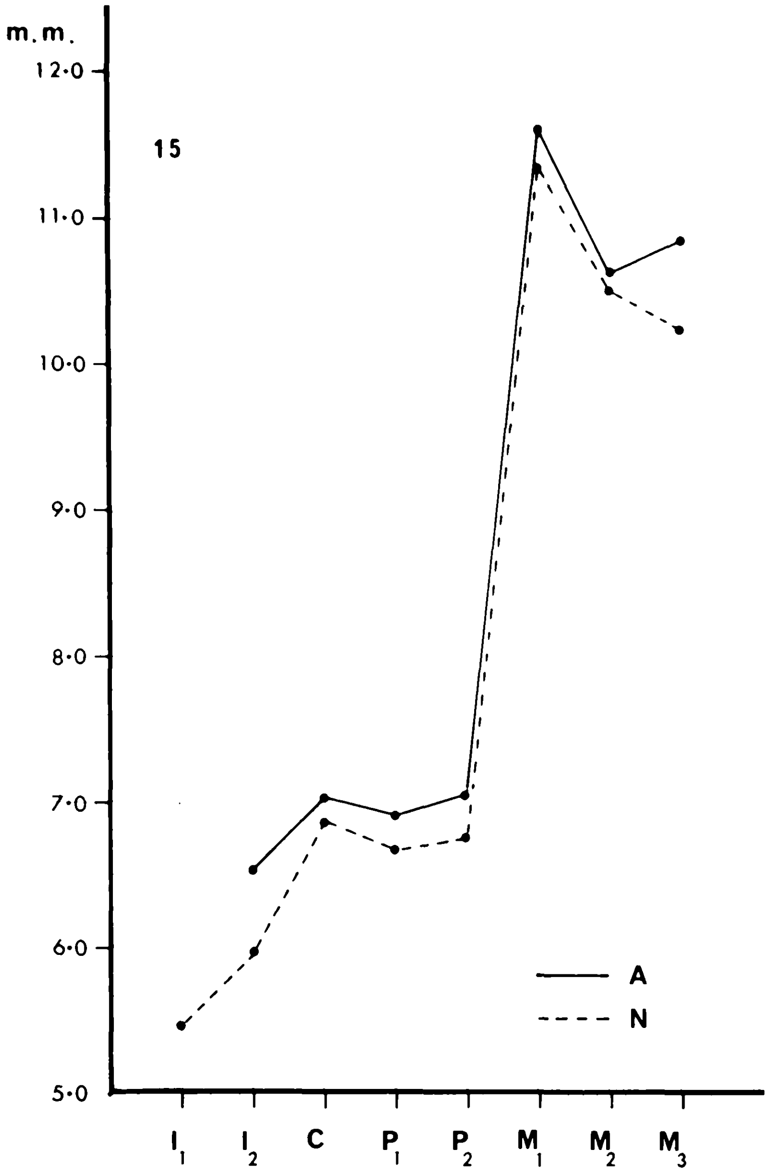

Fig. 15. Mean values of the mesiodistal diameters of the mandibular teeth in Aebelholt males and Naestved males.

TABLE 13.

Mean mesiodistal diameters of mandibular teeth in medi-:aeval Danes ; comparison of Aebelholt males and Naestved males.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I_1	A	1	-	-	-	-	-
	N	6	5.45	0.12	2.20		
I_2	A	5	6.52	0.49	7.52	0.58	3.30**
	N	11	5.94	0.23	3.87		
C	A	22	7.01	0.35	4.99	0.14	1.41
	N	28	6.87	0.35	5.09		
P_1	A	24	6.90	0.46	6.67	0.23	2.01 *
	N	30	6.67	0.38	5.70		
P_2	A	24	7.04	0.45	6.39	0.31	3.10**
	N	30	6.73	0.29	4.31		
M_1	A	9	11.61	0.69	5.94	0.24	0.95
	N	19	11.37	0.59	5.19		
M_2	A	24	10.63	0.67	6.30	0.12	0.63
	N	32	10.51	0.74	7.04		
M_3	A	32	10.89	1.19	10.93	0.65	2.58*
	N	34	10.24	0.83	8.11		

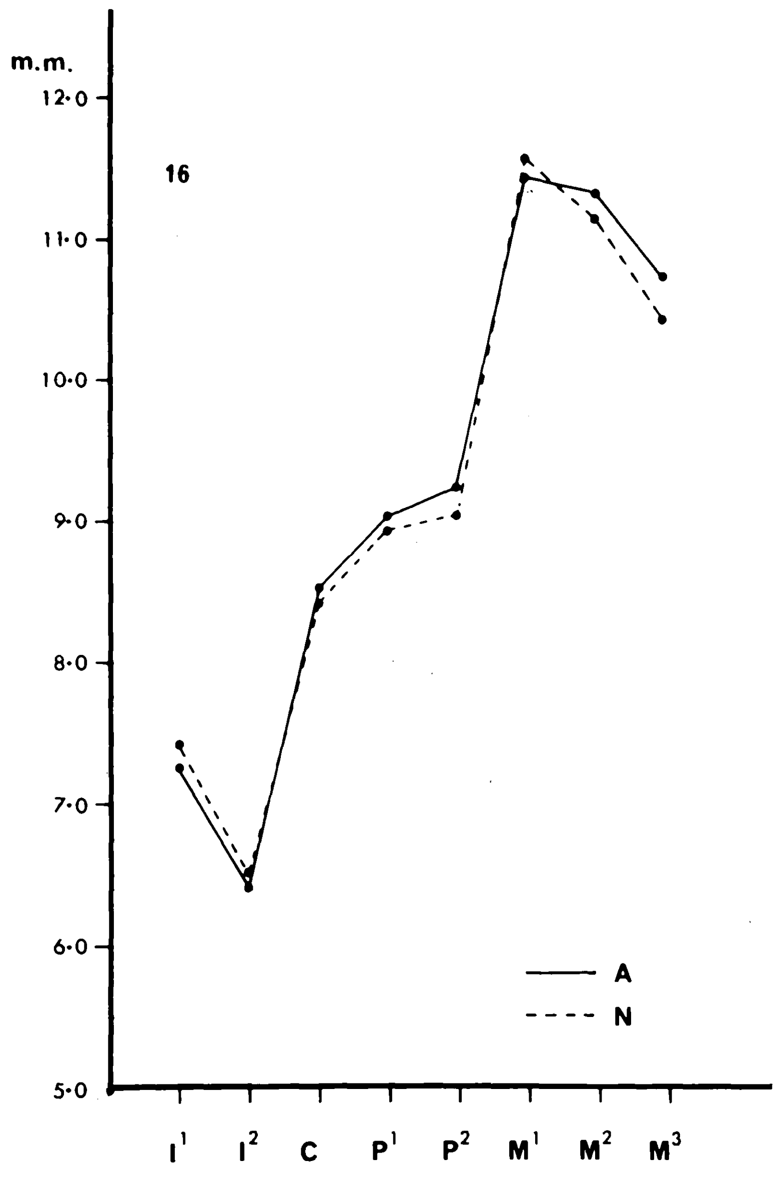

Fig. 16. Mean values of the labiolingual diameters of the maxillary teeth in Aebelholt males and Naestved males.

TABLE 14.

Mean labiolingual diameters of maxillary teeth in medi-:aeval Danes ; comparison of Aebelholt males and Naestved males.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I^1	A	22	7.24	0.45	6.22	0.19	1.45
	N	18	7.43	0.37	4.98		
I^2	A	22	6.42	0.44	6.85	0.08	0.61
	N	21	6.50	0.43	6.62		
C	A	34	8.51	0.54	6.35	0.08	0.59
	N	28	8.43	0.51	6.05		
P^1	A	43	9.03	0.56	6.20	0.08	0.69
	N	38	8.95	0.47	5.25		
P^2	A	47	9.25	0.57	6.16	0.21	1.78
	N	37	9.04	0.49	5.42		
M^1	A	36	11.49	0.52	4.53	0.11	0.85
	N	24	11.60	0.44	3.79		
M^2	A	53	11.38	0.76	6.68	0.20	1.34
	N	41	11.18	0.65	5.81		
M^3	A	55	10.77	0.81	7.52	0.32	2.04*
	N	40	10.45	0.68	6.51		

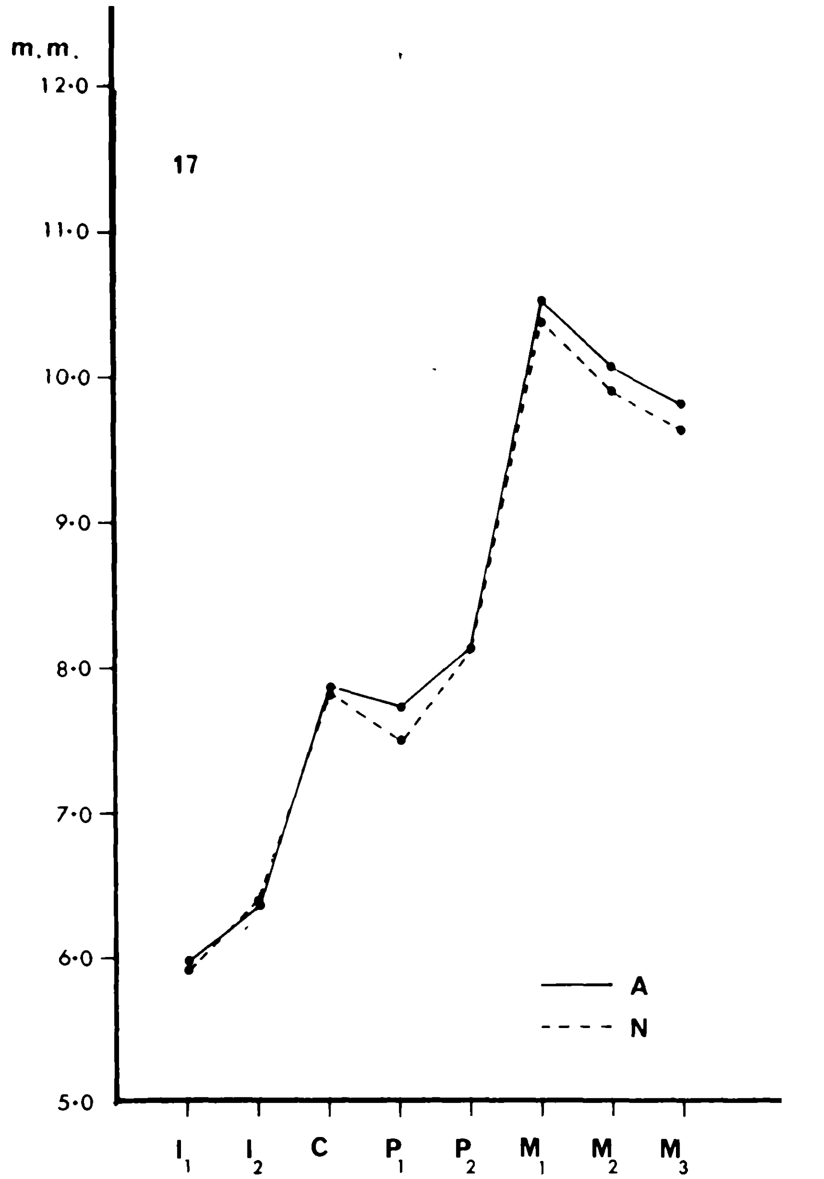

Fig. 17. Mean values of the labiolingual diameters of the mandibular teeth in Aebelholt males and Naestved males.

TABLE 15.

Mean labiolingual diameters of mandibular teeth in med-:iaeval Danes ; comparison of Aebelholt males and Naestved males.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I_1	A	6	5.98	0.38	6.35	0.08	-
	N	2	5.90	-	-		
I_2	A	6	6.37	0.51	8.01	0.03	-
	N	3	6.40	-	-		
C	A	18	7.89	0.48	6.08	0.05	0.30
	N	16	7.84	0.49	6.25		
P_1	A	33	7.73	0.47	6.08	0.23	2.06*
	N	30	7.50	0.41	5.47		
P_2	A	37	8.16	0.54	6.62	0.02	0.17
	N	32	8.14	0.46	5.65		
M_1	A	29	10.56	0.46	4.36	0.15	1.02
	N	25	10.41	0.62	5.96		
M_2	A	40	10.10	0.62	6.14	0.18	1.24
	N	36	9.92	0.64	6.45		
M_3	A	39	9.83	0.77	7.83	0.15	0.89
	N	35	9.68	0.68	7.02		

The comparison between Aebelholt males and Naestved males showed that in most cases the Aebelholt mean values were a little higher than those for the Naestved group, but in some instances this relationship was re-:versed. Many of the differences were small and only a few of them were statistically significant.

Most of the statistically significant differences were to be found in the mesiodistal dimensions of the mandibular teeth, four of which were significantly larger in the Aebelholt males than in the Naestved males. In the case of the second incisors and second premolars the significance of the results reached the level $P < 0.01$, while the differences for the first premolar and third molar were significant at the level $P < 0.05$.

The labiolingual diameters of the mandibular teeth showed less difference between the two groups than did the mesiodistal diameters, and only one of these diff-:erences was sufficiently large to give a statistically significant result. This was the labiolingual diameter of the mandibular first premolar, and the significance of the difference between the groups only reached the level $P < 0.05$.

For the maxillary teeth, only two dimensions gave results/

results which reached the lowest level of significance. These were the mesiodistal diameter of the second pre-:molar and the labiolingual diameter of the third molar.

Thus it appeared that, with the exception of the mesiodistal diameters of the mandibular teeth, there was little statistically significant difference in tooth size between males from Aebelholt and males from Naestved.

Tooth size of Aebelholt and Naestved females is compared in Tables 16 - 19 and Figs. 18 - 21.

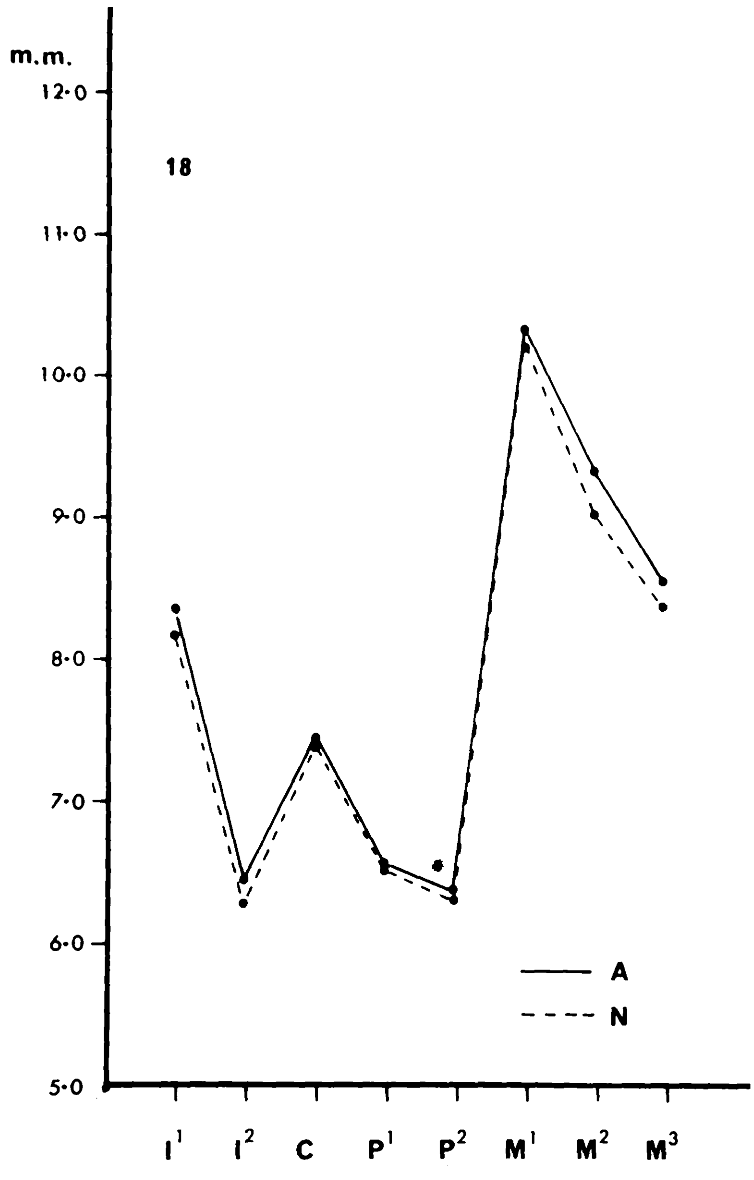

Fig. 18. Mean values of the mesiodistal diameters of the maxillary teeth in Aebelholt females and Naestved females.

TABLE 16.

Mean mesiodistal diameters of maxillary teeth in medi- :aeval Danes ; comparison of Aebelholt females and Naestved females.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I^1	A	29	8.36	0.58	6.94	0.17	1.20
	N	25	8.19	0.44	5.37		
I^2	A	34	6.46	0.60	9.29	0.18	1.31
	N	36	6.28	0.55	8.76		
C	A	43	7.48	0.33	4.41	0.07	0.99
	N	54	7.41	0.36	4.86		
P^1	A	43	6.56	0.32	4.88	0.04	0.60
	N	54	6.52	0.34	5.21		
P^2	A	36	6.39	0.37	5.79	0.09	1.15
	N	51	6.30	0.36	5.71		
M^1	A	30	10.34	0.55	5.32	0.05	0.41
	N	46	10.29	0.51	4.96		
M^2	A	47	9.34	0.60	6.42	0.31	2.82**
	N	58	9.03	0.53	5.87		
M^3	A	34	8.58	0.75	8.74	0.19	1.23
	N	43	8.39	0.61	7.27		

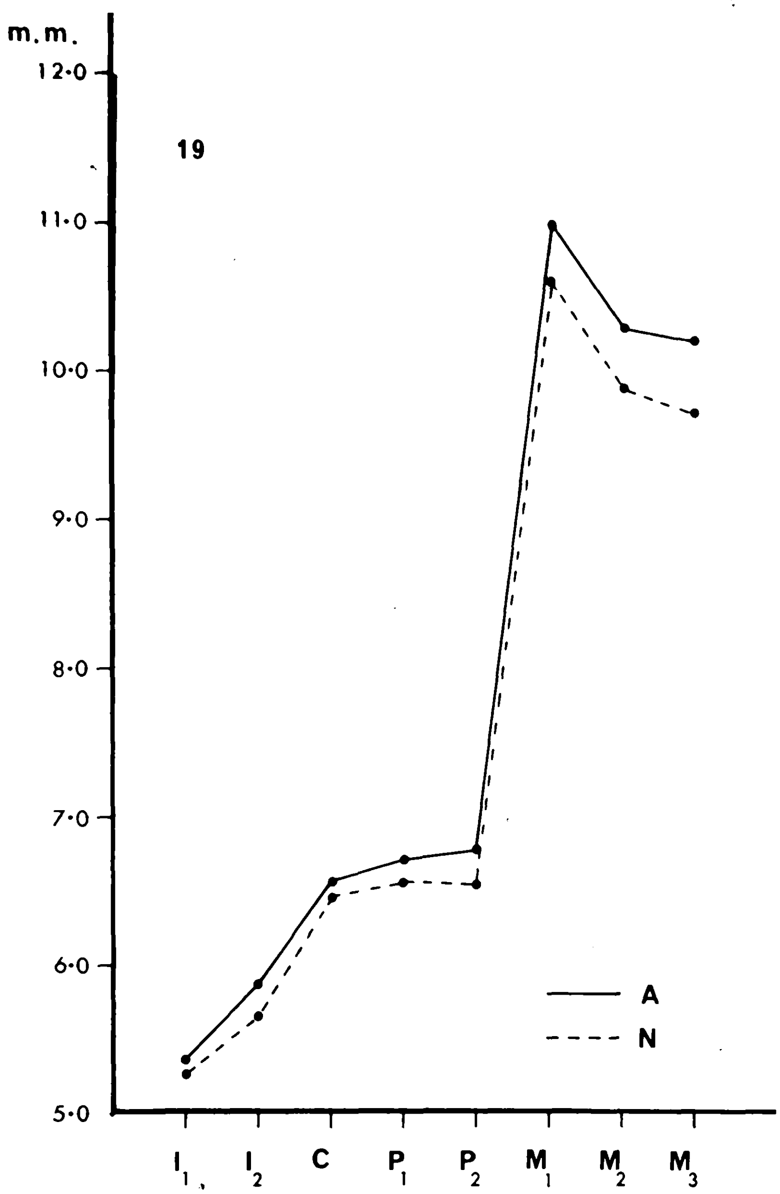

Fig. 19. Mean values of the mesiodistal diameters of the mandibular teeth in Aebelholt females and Naestved females.

TABLE 17.

Mean mesiodistal diameters of mandibular teeth in medi-:aeval Danes ; comparison of Aebelholt females and Naestved females.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I_1	A	11	5.36	0.30	5.60	0.11	1.16
	N	17	5.25	0.21	4.00		
I_2	A	20	5.89	0.28	4.75	0.23	2.51*
	N	25	5.66	0.32	5.65		
C	A	40	6.56	0.37	5.64	0.10	1.21
	N	42	6.46	0.38	5.88		
P_1	A	42	6.71	0.35	5.22	0.16	2.04*
	N	52	6.55	0.40	6.11		
P_2	A	34	6.79	0.35	5.15	0.25	3.05**
	N	47	6.54	0.38	5.81		
M_1	A	25	11.03	0.58	5.26	0.38	2.33*
	N	33	10.65	0.64	6.01		
M_2	A	40	10.32	0.48	4.65	0.40	3.33**
	N	45	9.92	0.61	6.15		
M_3	A	29	10.24	0.71	6.93	0.45	2.83**
	N	42	9.79	0.62	6.33		

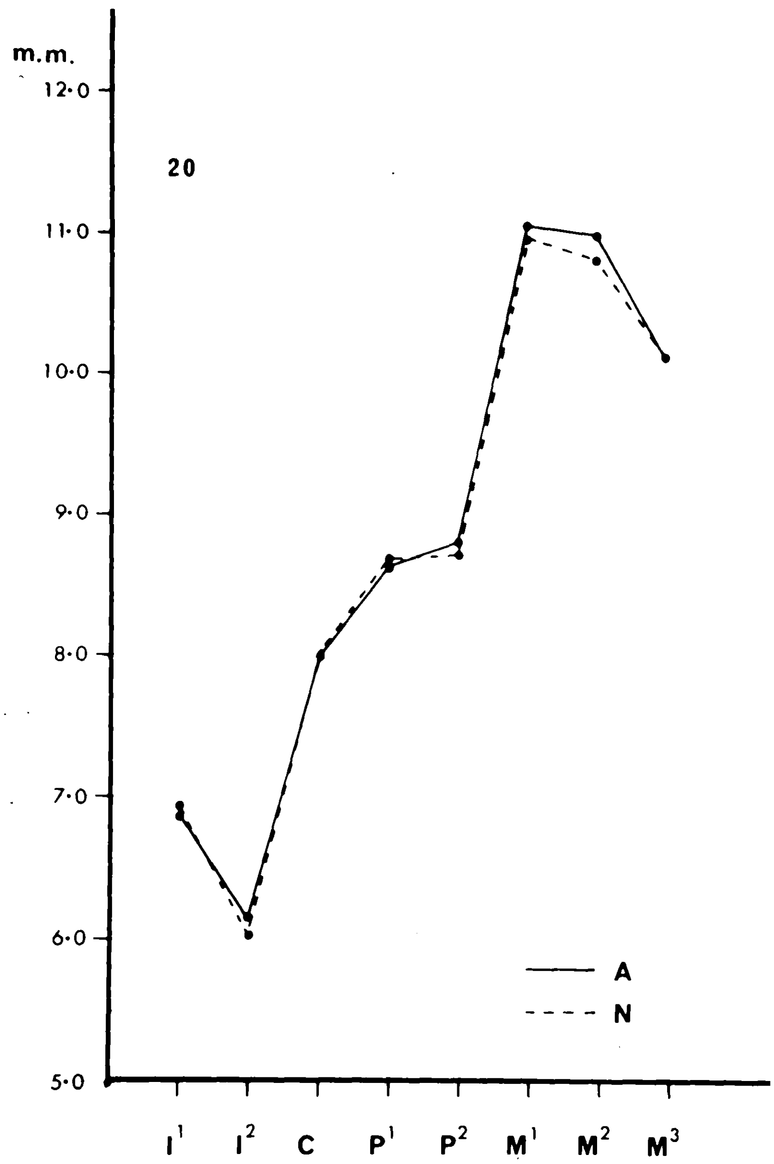

Fig. 20. Mean values of the labiolingual diameters of the maxillary teeth in Aebelholt females and Naestved females.

TABLE 18.

Mean labiolingual diameters of maxillary teeth in medi-:aeval Danes ; comparison of Aebelholt females and Naestved females.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I^1	A	41	6.91	0.39	5.64	0.02	0.23
	N	35	6.93	0.37	5.34		
I^2	A	45	6.14	0.41	6.68	0.11	1.18
	N	38	6.03	0.44	7.30		
C	A	48	8.00	0.50	6.25	0.01	0.10
	N	54	8.01	0.47	5.87		
P^1	A	54	8.66	0.50	5.77	0.04	0.43
	N	64	8.70	0.50	5.75		
P^2	A	49	8.82	0.49	5.56	0.09	0.87
	N	62	8.73	0.58	6.64		
M^1	A	49	11.09	0.56	5.05	0.09	0.82
	N	50	11.00	0.54	4.91		
M^2	A	51	11.01	0.71	6.45	0.17	1.37
	N	61	10.84	0.61	5.63		
M^3	A	34	10.14	0.88	8.68	0	0
	N	45	10.14	0.81	7.99		

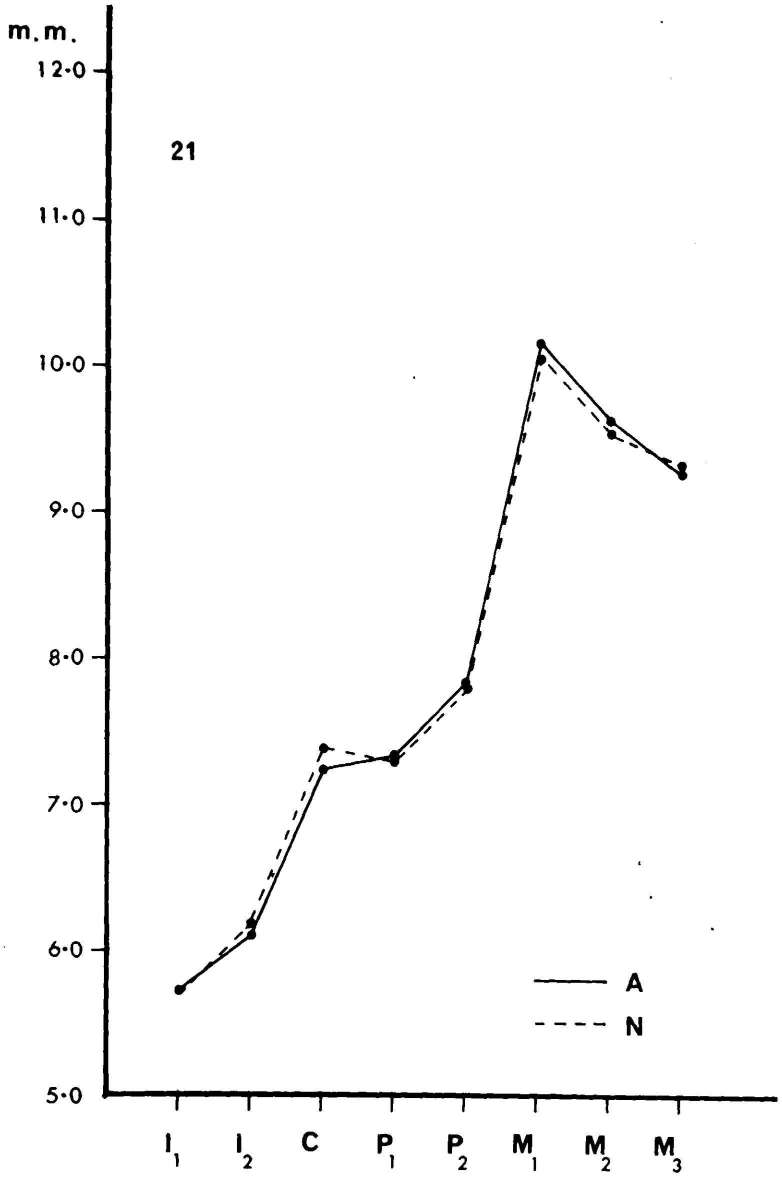

Fig. 21. Mean values of the labiolingual diameters of the mandibular teeth in Aebelholt females and Naestved females.

TABLE 19.

Mean labiolingual diameters of mandibular teeth in mediaeval Danes ; comparison of Aebelholt females and Naestved females.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I_1	A	12	5.72	0.26	4.55	0.02	0.16
	N	11	5.70	0.33	5.79		
I_2	A	18	6.12	0.42	6.86	0.05	0.39
	N	19	6.17	0.37	6.00		
C	A	33	7.25	0.55	7.59	0.15	1.37
	N	41	7.40	0.39	5.27		
P_1	A	47	7.34	0.36	4.90	0.03	0.36
	N	48	7.31	0.45	6.16		
P_2	A	46	7.87	0.45	5.72	0.05	0.58
	N	49	7.82	0.39	4.99		
M_1	A	44	10.20	0.48	4.71	0.10	1.02
	N	42	10.10	0.43	4.26		
M_2	A	47	9.68	0.51	5.27	0.09	0.97
	N	52	9.59	0.42	4.38		
M_3	A	33	9.30	0.58	6.24	0.05	0.40
	N	42	9.35	0.50	5.35		

The results of the comparison between Aebelholt and Naestved females fell into the same pattern as that already observed for the males of these groups.

Tooth dimensions were usually slightly larger in the Aebelholt females than in the Naestved females, though in some instances the Naestved mean value was the higher. Few of the observed differences were statistically significant, and the results where sig:nificance was achieved were almost entirely confined to the mesiodistal diameters of the mandibular teeth. The mandibular second premolar, second molar and third molar were significantly larger in the Aebelholt fe:males, and the results reached the level of signific:ance $P < 0.01$. The mesiodistal diameters of the sec:ond incisors, first premolars and first molars also showed significant differences between Aebelholt and Naestved females, but the level of significance was lower ($P < 0.05$).

The only other result where a significant differ:ence was found between Aebelholt and Naestved females was that for the mesiodistal diameter of the maxillary second molar. In this comparison, the level of sig:nificance reached was $P < 0.01$.

The/

The labiolingual diameters of both maxillary and mandibular teeth were almost identical in the females from Aebelholt and Naestved, and none of these comparis-:ons showed a statistically significant difference be-:tween the two populations.

There was therefore little significant difference in tooth size between Aebelholt females and Naestved females, except for the mesiodistal diameters of the mandibular teeth.

It thus appeared that in general the teeth of the Aebelholt population were slightly larger than those of the Naestved group, though for a few dimensions the reverse was true. Only a small proportion of these differences (14 of 61 comparisons) could be shown to be statistically significant, and these were found largely among the mesiodistal diameters of the mandibular teeth, and in particular in the females, whose mandibular mol-:ars appeared to have been considerably smaller in the mesiodistal diameter in the Naestved group than in the Aebelholt group. The level of significance, however, did not rise above the point $P < 0.01$. There was virt-:ually no difference between the groups in respect of the mesiodistal diameters of the maxillary teeth or in respect

respect of the labiolingual diameters of maxillary or mandibular teeth.

C. Sex comparison of crown size in the combined mediaeval Danish group.

Since it could be shown that there was much less difference in tooth size between the two Danish groups, than there was between the sexes in either group, it was decided that the two groups could reasonably be pooled to form a combined "Aebelholt + Naestved" or "mediaeval Danish" group. A comparison was then carried out between the two sexes using the pooled data, and the results of this comparison are shown in Tables 20 - 23 and Figs. 22 - 25.

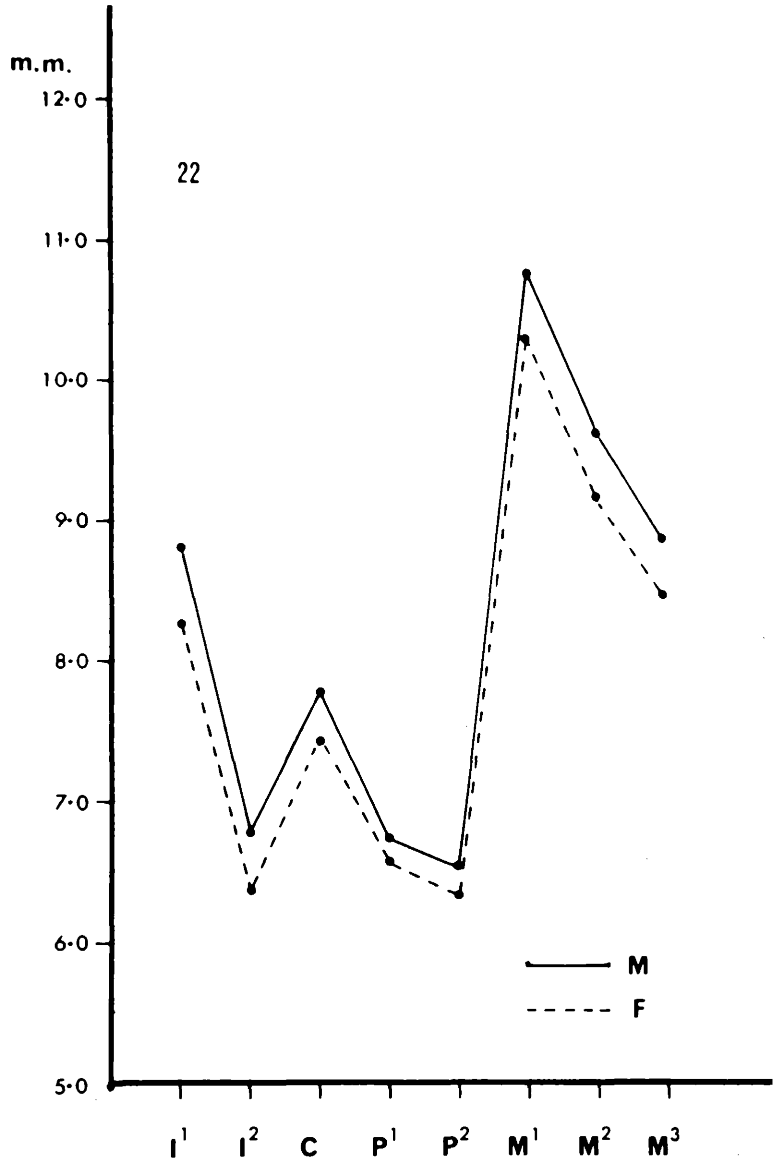

Fig. 22. Mean values of the mesiodistal diameters of the maxillary teeth in males and females of the combined mediaeval Danish group.

TABLE 20.

Mean mesiodistal diameters of maxillary teeth in med-:iaeval Danes from Aebelholt and Naestved; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	24	8.80	0.49	5.57	0.52	4.14***
	F	54	8.28	0.52	6.28		
I^2	M	33	6.78	0.55	8.11	0.41	3.42***
	F	70	6.37	0.58	9.11		
C	M	62	7.76	0.39	5.03	0.32	5.42***
	F	97	7.44	0.35	4.70		
P^1	M	58	6.73	0.32	4.75	0.19	3.52***
	F	97	6.54	0.33	5.05		
P^2	M	49	6.52	0.37	5.67	0.19	2.93**
	F	87	6.33	0.36	5.69		
M^1	M	31	10.79	0.43	3.99	0.48	4.52***
	F	76	10.31	0.52	5.04		
M^2	M	72	9.63	0.62	6.44	0.46	5.06***
	F	105	9.17	0.58	6.32		
M^3	M	88	8.87	0.80	9.02	0.40	3.43***
	F	77	8.47	0.68	8.03		

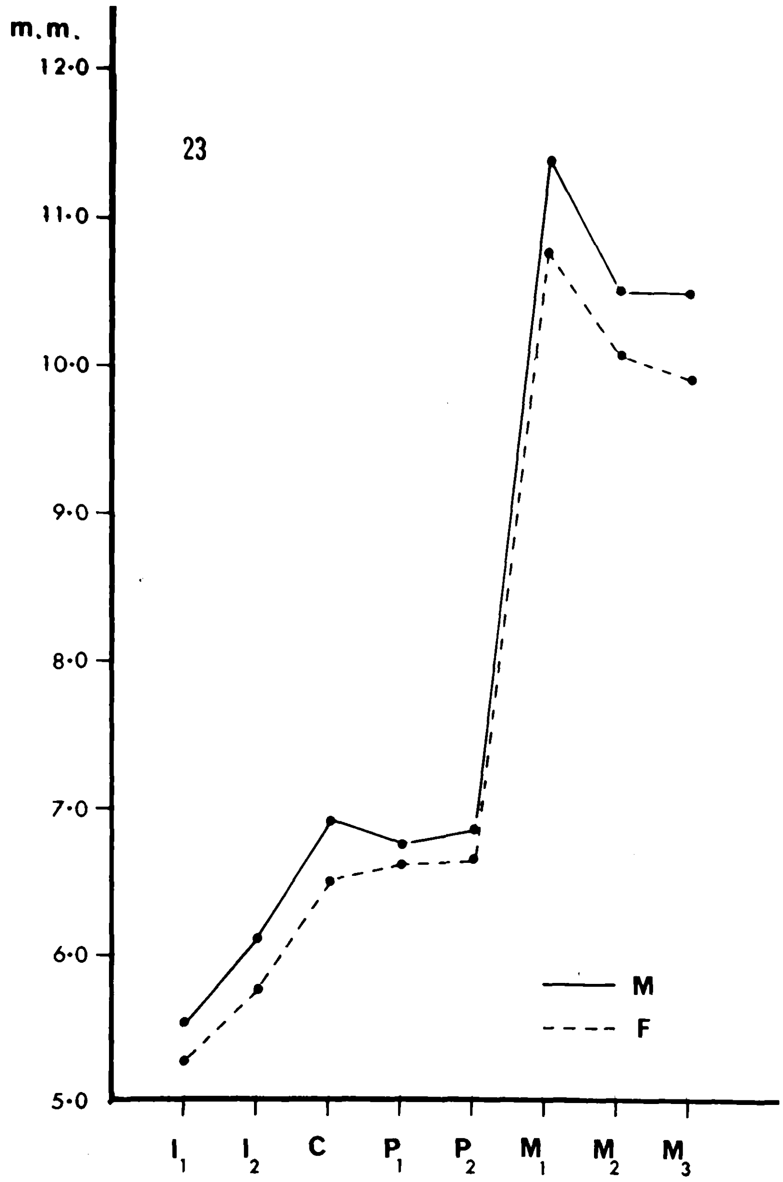

Fig. 23. Mean values of the mesiodistal diameters of the mandibular teeth in males and females of the combined mediaeval Danish group.

TABLE 21.

Mean mesiodistal diameters of mandibular teeth in med-:iaeval Danes from Aebelholt and Naestved ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	7	5.53	0.23	4.16	0.24	2.31*
	F	28	5.29	0.25	4.73		
I_2	M	16	6.12	0.42	6.86	0.36	3.55***
	F	45	5.76	0.32	5.56		
C	M	50	6.93	0.35	5.05	0.42	6.40***
	F	82	6.51	0.37	5.68		
P_1	M	54	6.77	0.43	6.35	0.15	2.19*
	F	94	6.62	0.39	5.89		
P_2	M	54	6.87	0.39	5.68	0.23	3.39***
	F	81	6.64	0.38	5.72		
M_1	M	28	11.45	0.62	5.41	0.63	4.32***
	F	58	10.82	0.64	5.91		
M_2	M	56	10.56	0.71	6.72	0.45	4.11***
	F	85	10.11	0.58	5.74		
M_3	M	66	10.56	1.07	10.13	0.59	3.87***
	F	71	9.97	0.69	6.92		

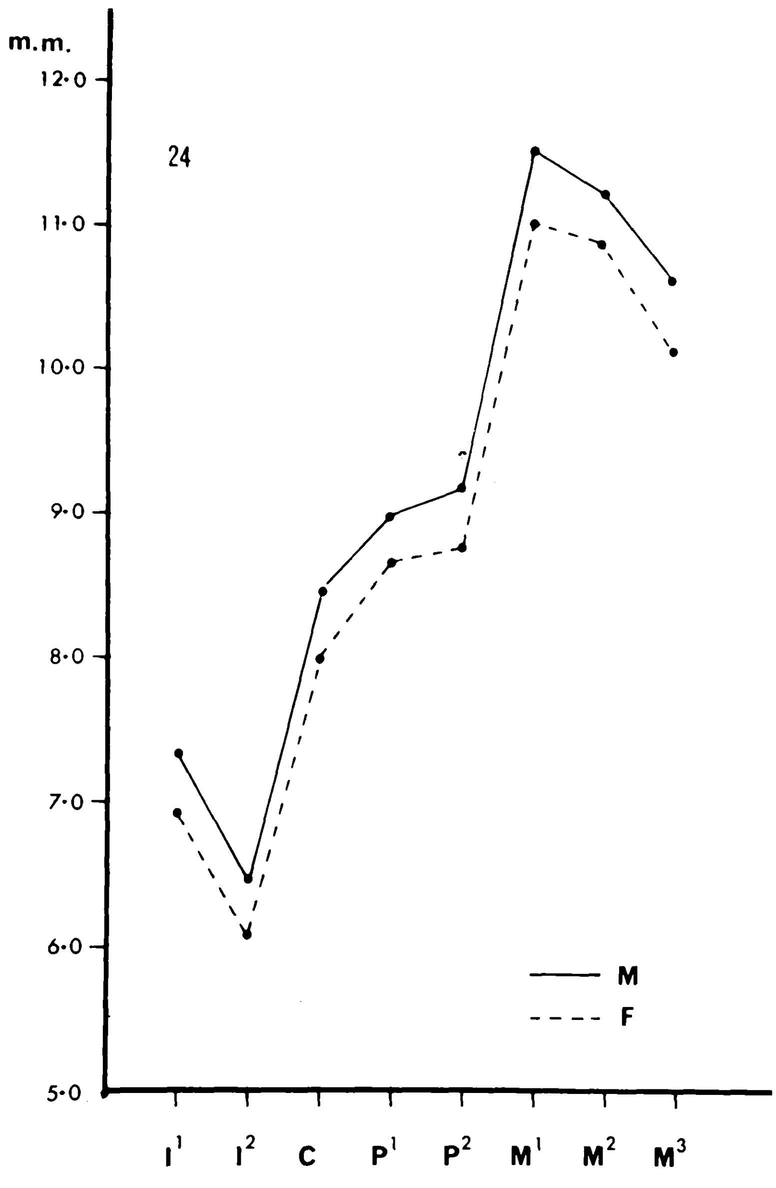

Fig. 24. Mean values of the labiolingual diameters of the maxillary teeth in males and females of the combined mediaeval Danish group.

TABLE 22.

Mean labiolingual diameters of maxillary teeth in med-:iaeval Danes from Aebelholt and Naestved ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	40	7.33	0.42	5.73	0.41	5.37***
	F	76	6.92	0.38	5.49		
I^2	M	43	6.46	0.43	6.66	0.37	4.63***
	F	83	6.09	0.42	6.90		
C	M	62	8.47	0.52	6.14	0.47	5.85***
	F	102	8.00	0.48	6.00		
P^1	M	81	8.99	0.52	5.78	0.31	4.24***
	F	118	8.68	0.50	5.76		
P^2	M	84	9.16	0.55	6.00	0.39	4.96***
	F	111	8.77	0.54	6.16		
M^1	M	60	11.54	0.49	4.25	0.50	5.81***
	F	99	11.04	0.55	4.98		
M^2	M	94	11.29	0.72	6.38	0.37	3.85***
	F	112	10.92	0.66	6.04		
M^3	M	95	10.63	0.77	7.24	0.49	4.01***
	F	79	10.14	0.84	8.28		

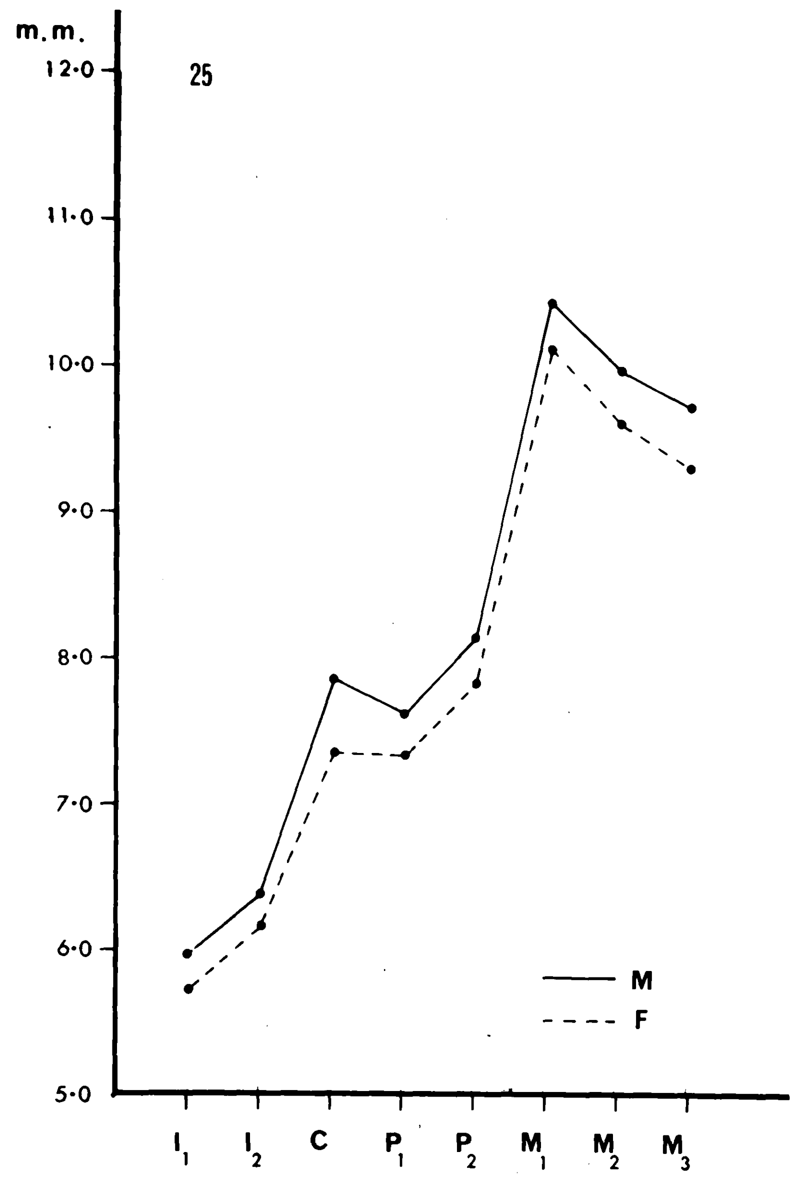

Fig. 25. Mean values of the labiolingual diameters of the mandibular teeth in males and females of the combined mediaeval Danish group.

TABLE 23.

Mean labiolingual diameters of mandibular teeth in med-:iaeval Danes from Aebelholt and Naestved ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	8	5.96	0.34	5.70	0.25	2.01
	F	23	5.71	0.29	5.08		
I_2	M	9	6.38	0.42	6.58	0.23	1.58
	F	37	6.15	0.39	6.34		
C	M	34	7.87	0.48	6.10	0.53	5.41***
	F	74	7.34	0.47	6.40		
P_1	M	63	7.62	0.45	5.91	0.29	4.20***
	F	95	7.33	0.41	5.59		
P_2	M	69	8.15	0.50	6.13	0.31	4.33***
	F	95	7.84	0.42	5.36		
M_1	M	54	10.49	0.54	5.15	0.34	3.99***
	F	86	10.15	0.46	4.53		
M_2	M	76	10.01	0.63	6.29	0.37	4.48***
	F	99	9.64	0.46	4.77		
M_3	M	74	9.76	0.73	7.48	0.43	4.12***
	F	75	9.33	0.53	5.68		

When the data from the Aebelholt and Naestved groups were pooled, sex differences in tooth size show:ed an even higher degree of statistical significance. Of 32 comparisons made, only 2 did not give a signif:icant result, those for the labiolingual diameters of mandibular incisors. Twenty-seven of the 30 statistic:ally significant results were significant at the ex:tremely high level $P < 0.001$. This was overwhelming evidence in favour of a real sex difference in tooth size, occurring in both dimensions of the crown.

An examination of the values recorded for 't' showed that the canines were the teeth in which sex difference was most marked. This was true for both mesiodistal and labiolingual dimensions of the teeth, and also for both maxillary and mandibular teeth. Values of 't' were also consistently high for first molars and second molars of both jaws, and for maxill:ary incisors. Lower values of 't' were recorded for mandibular incisors and all third molars, indicating a lesser degree of sex differentiation in the size of these teeth. For the labiolingual diameters of the premolars high values of 't' were recorded, while the significance of differences in their mesiodistal diameters/

diameters was rather lower.

D. Discussion of sex differences in crown size in mediaeval Danes.

The fact that the canines exhibited the greatest sex difference in size was in accordance with the results published by other authors. Mijsberg (1931) and Moorrees (1957) both found that sex differences in tooth size, in Javanese and Aleuts respectively, were most marked in the canines. Selmer-Olsen (1949) reported that for the Lapps, sex differences were greatest in the canines and second molars. In his work on mesiodistal diameters of Swiss incisors, canines and premolars, Ståhle (1959) found that the canines showed the most pronounced sex difference. Thomsen (1955) also noted a large sex difference in canine size in the Tristanites. The studies of Moorrees et al (1957) and Garn et al (1964) on the mesiodistal diameters of the teeth of American Whites both showed that the greatest sex difference was to be found in the canines. Barrett et al (1963, 1964) found that sex differences in the mesiodistal diameters of Australian aborigine teeth were most pronounced in the mandibular canines and all the/

the first molars, while in labiolingual dimension the maxillary canines and second incisors showed the great-:est differences.

Moorrees (1957) also remarked that for the mesio-:distal diameter of Aleut teeth, the mandibular canine showed a higher level of significance in sex difference than did the maxillary canine, while for the labiolingual diameter both canines showed almost the same degree of significance. This was found to be true also for the Danish canines in the present study.

Mijsberg (1931) found that in the Javanese the sex differences were more marked for the labiolingual dia-:meters of the teeth than for the mesiodistal diameters. Selmer-Olsen (1949), in his work on the Lapps, also reached the conclusion that sex differences were great-:er in the labiolingual than in the mesiodistal diameters. On the other hand, Moorrees (1957) found the greatest sex differences in Aleut teeth among the mesiodistal diameters, and Thomsen (1955) reported significant sex differences in a higher proportion of mesiodistal dia-:meters than of labiolingual diameters in Tristanite teeth. There was no very marked difference in the Danes in this respect, but on the average slightly higher/

higher values of 't' were found for the labiolingual diameters than for the mesiodistal diameters, thus supp-:orting the findings of Mijsberg (1931) and Selmer-Olsen (1949).

E. Variability of crown size in mediaeval Danes.

Variability in size of the teeth was studied by means of the coefficient of variation, the values for which have been included ('v') in Tables 2 - 23. The coefficients of variation in these tables ranged from 2.20 for the mean mesiodistal diamèter of mandibular first incisors in Naestved males to 10.93 for the mean mesiodistal diameter of mandibular third molars in Aebelholt males. This range was very similar to the range of coefficients of variation published by Moorrees for the Aleuts (2.62 - 10.97).

It was of interest to discover which teeth showed the greatest variability in size and which were the least variable. The two teeth with a) the highest and b) the lowest coefficient of variation for each dimen-:sion are shown in Tables 24 and 25. The results have been listed separately for males and females of the Aebelholt,/

Aebelholt, Naestved and combined Danish groups.

TABLE 24.

Teeth which showed the greatest degree of variability, as measured by the coefficient of variation.

		Maxilla				Mandible			
		M.D.		L.L.		M.D.		L.L.	
Aebelholt	♂	I^2	M^3	M^3	I^2	M_3	I_2	I_2	M_3
"	♀	I^2	M^3	M^3	I^2	M_3	C	C	I_2
Naestved	♂	M^3	I^2	I^2	M^3	M_3	M_2	M_3	M_2
"	♀	I^2	M^3	M^3	I^2	M_3	P_1	P_1	I_2
A + N	♂	M^3	I^2	M^3	I^2	M_3	I_2	M_3	I_2
"	♀	I^2	M^3	M^3	I^2	M_3	M_1	C	I_2

TABLE 25.

Teeth which showed the least degree of variability, as measured by the coefficient of variation.

		Maxilla				Mandible			
		M.D.		L.L.		M.D.		L.L.	
Aebelholt	♂	M^1	C	M^1	P^2	C	M_1	M_1	C
"	♀	C	P^1	M^1	P^2	M_2	I_2	I_1	M_1
Naestved	♂	M^1	P^1	M^1	I^1	I_1	I_2	P_1	P_2
"	♀	M^1	C	M^1	I^1	I_1	I_2	M_1	M_2
A + N	♂	M^1	P^1	M^1	I^1	I_1	C	M_1	I_1
"	♀	C	M^1	M^1	I^1	I_1	I_2	M_1	M_2

In the maxilla, the teeth which showed greatest var-:iability in both dimensions were always the third molar and second incisor. The values of the coefficient of variation for these teeth were large and stood out clear-:ly from those of the other teeth. In the mandible there was rather less consistency in the results, and less strongly marked differences between the coefficients for different teeth. Though the third molar and second incisor again appeared frequently in the table, other teeth occasionally showed high variability, such as the canine, second molar and second premolar : even the first molar occurred once. On the whole, however, the third molar and second incisor of both jaws showed the great-:est degree of variability.

There was less consistency in the teeth which show-:ed the smallest coefficients of variation, and these low coefficients did not stand out so clearly from the others. The tooth which most frequently exhibited the lowest variability in the maxilla was the first molar. In the mesiodistal dimension it was followed by the canine and first premolar, but in the labiolingual di-:mension by the first incisor and second premolar. As in the case of the greatest coefficients of variation, the/

the results were less clear-cut for the mandibular teeth. The first molar and first incisor here were the teeth which most frequently showed a low coefficient of variation, but the second incisor, canine, first and second premolars and second molar appeared occasionally in the table. In general, the first molars of both jaws were the teeth in which the lowest coefficients of variation were most frequently to be found.

These results were similar to those of other work-:ers. Selmer-Olsen (1949) found that in the Lapps the maxillary third molars and second incisors showed the greatest coefficients of variation for the mesiodistal dimension, while the coefficients were smallest for central incisors, canines and first molars. In the lower jaw the difference in variability between the teeth seemed to be less, but the third molars still showed the highest coefficient of variation, while the lowest coefficient was found in the first molar. For the labiolingual dimension, the third molars showed the highest, and the first molars the lowest coefficient in both jaws.

In the Tristanites studied by Thomsen (1955), the first molar presented the lowest coefficient of variation in/

in the molar series, while the maxillary first incisor was "definitely less labile in size than the second in:cisor".

Moorrees (1957) reported that the maxillary third molars of Aleut males were extremely variable in both dimensions, but the mandibular third molars only in the mesiodistal dimension. On the other hand, the third molars of females showed coefficients of variation in the middle range, similar to those of the other teeth. This does not seem to have been the case in any other group studied so far.

Barrett, Brown and Macdonald (1963) found that in the mesiodistal dimension, the third molars and maxill:ary second incisors of Australian aborigines showed the greatest variability, while the first molars gave the lowest values of the coefficient of variation. The maxillary second incisor and mandibular first and second incisors appeared to be most variable in labio:lingual dimension (Barrett et al, 1964), while the third molars did not show great variability.

It thus appears to be a general finding that the third molars and maxillary second incisor vary most in respect of tooth dimensions, while the first molars and maxillary/

maxillary first incisor and canine are the teeth which vary least in size. This pattern of the coefficients of variation has been correlated with the distribution of certain morphological features of the teeth in att:empts to identify the stable and labile elements of the dentition. It has usually been stated that the most mesial tooth of each group (incisors, premolars and molars) is the most stable, and that stability de:creases distally (Butler, 1939; Dahlberg, 1945; Moorrees, 1957). The exception to this rule is stated to be found in the mandibular incisors, of which the second is more stable than the first. Changes in tooth size and morphology are thus generally believed to affect first the more distal members of each tooth group, leading to a greater degree of variability in these teeth.

In the mediaeval Danes the relative variability of the maxillary incisors accorded with this view. The frequent appearance of the mandibular first incisor in the table of low coefficients of variation, and the inclusion of the mandibular second incisor in the table of high coefficients suggested that, contrary to gen:eral belief, the mandibular first incisor here was more/

more stable than the second incisor. But the numbers of observations recorded were small, and too much re:liance could not be placed upon this result.

The canine is generally regarded as a stable tooth, and in fact appeared quite frequently in Table 25 of low coefficients of variation. Though the mandibular canines were represented three times in Table 24 of high coefficients of variation, in two instances the coefficient for the canine was only marginally larger than those of the other teeth. The only instance where a really high value was recorded for the coeffic:ient of variation of the canine, in relation to those of the other teeth, was in the labiolingual diameter of the mandibular canine of Aebelholt females.

There did not appear to be any consistent relat:ionship between the coefficients of variation of the first and second premolars. Taking the results for both sexes of Aebelholt, Naestved and combined Danish groups into account, the maxillary second premolar showed a slight tendency to greater variability in both dimensions. In the mandible, the first premolar always showed greater variability in mesiodistal diameter, while the second premolar tended to be the more variable in/

in labiolingual diameter. The differences between the coefficients of variation of first and second premolars were often quite small. A similar situation was ob-:served by Thomsen in Tristanite teeth, where "the first and second premolars show no consistent difference in coefficient of variation".

The relative variability of molar size in the med-:iaeval Danes in general supported the theory of in-:creasing variation towards the distal of the molar series. In nearly every instance the coefficient of variation increased from first to second to third molar. However, as Thomsen found for the Tristanites, there were one or two exceptions to this general rule. In the mesiodistal diameter, the mandibular molars of Aebelholt females, and of females of the combined Dan-:ish group, showed a slight irregularity, in that the second molar was slightly less variable than the first molar. The third molar showed the highest coefficient of variation in every case. In the Tristanites, the labiolingual dimensions of the mandibular molars did not show a consistent increase of coefficient of vari-:ation from first to third molar. The Lapps, on the other hand, showed a consistent increase in coefficient of/

of variation from first to third molar in both dimens-:ions of maxillary and mandibular teeth, while in the Aleuts there was considerable irregularity in the molar coefficients of variation and a consistent increase in variability from first to third molar was seldom found. Mesiodistal dimensions of Australian aborigine molars and labiolingual dimensions of their maxillary molars showed a regular increase in coefficient of variation distally, though this pattern was not quite consistent in the labiolingual diameters of the mandibular molars. Stein and Epstein (1934) reported a distal increase in coefficient of variation in the labiolingual dimensions of molars of New Britain Melanesians of both sexes. In the Pecos Indians studied by Nelson (1938), the mes-:iodistal diameters of maxillary molars and the labio-:lingual diameters of mandibular molars showed a con-:sistent increase in coefficient of variation from first to third molars, while the coefficient of variation was irregularly distributed in the case of the labiolingual dimensions of maxillary molars and the mesiodistal di-:mensions of mandibular molars. In the latter instance the Pecos teeth showed the same rank order of coefficient of variation as did the mediaeval Danish females, i.e. M2/

$M2 < M1 < M3$.

Although there were instances of irregular dist-:ribution of molar coefficients of variation to be found in many races, in most cases the molar dimensions showed an increase in variability towards the distal part of the molar series, and the Danes also conformed to this pattern. These findings supported the theory that stability in size decreases towards the back of the molar series.

It is of interest to note that the teeth which show the highest coefficients of variation in the Danes and in other races, i.e. the third molars and the max-:illary second incisors, are also teeth which are comm-:only congenitally absent. This is not to say that incidence of congenitally missing teeth can be directly related to the coefficient of variation. Values of the coefficient of variation in the Danes were uniform-:ly high for maxillary second incisors and third molars, but for the mandibular third molars the coefficients of variation in the females were not very high and those for the males were not always as large as the values for the maxillary third molars.

In the literature on agenesis of the third molars in/

in races of European origin, there is no agreement of opinion concerning sex ratio or maxilla-mandible ratio of incidence of missing teeth. According to Hellman (1936), congenitally missing third molars were more frequent in females than in males, and these findings were quoted (and evidently accepted) by Garn and Lewis (1962) and Garn, Lewis and Vicinus (1963). On the other hand, Grahnén (1956) found no significant differ-:ence in frequency of missing third molars between the two sexes, while in the material studied by Goblirsch (1930) agenesis of third molars was more frequent in the males. Similarly, Nanda (1954) and Garn, Lewis and Vicinus (1963) found the third molars more often absent in the mandible than in the maxilla, whereas Goblirsch (1930) and Grahnén (1956) found a higher in-:cidence of third molar agenesis in the maxilla than in the mandible. Very recently, Gravely (1965) stated that he found neither sex difference nor maxilla/mandible difference in the number of third molars detectable by radiographs at different ages. In view of this lack of agreement in the published data, no further comments can be made concerning possible relationship between the variability in size and the frequency of agenesis in/

in these teeth.

There is also the case of the mandibular second premolar which has been stated to be congenitally absent in a fairly high proportion of individuals, (e.g. Grahnén, 1956) and which did not show a high coefficient of var-:iation for tooth dimensions. It may be that, as Selmer-Olsen (1949) has suggested, there is a different mechanism operating in agenesis of the mandibular second premolar from that which produces congenital absence of the third molars and maxillary lateral incisors, since in the case of the mandibular second premolars neither a high coefficient of variation nor atypical small var-:iants are found, while both of these occur with third molars and maxillary second incisors.

Sex differences in the coefficients of variation have been reported by some workers, and in order to discover whether any general sex difference in coeff-:icient of variation existed in the mediaeval Danes, the mean coefficients of variation were calculated for mesiodistal and labiolingual dimensions of maxillary and mandibular teeth in the two sexes. These mean coefficients of variation are shown in Table 26.

TABLE 26.

Mean coefficients of variation for tooth dimensions.

		♂	♀
Aebelholt	Max. M.D.	6.19	6.47
	Mand.M.D.	6.96	5.40
	Max. L.L.	6.31	6.26
	Mand.L.L.	6.44	5.73
Naestved	Max. M.D.	5.78	6.00
	Mand.M.D.	5.19	5.74
	Max. L.L.	5.55	6.18
	Mand.L.L.	6.13	5.28
A + N	Max. M.D.	6.07	6.28
	Mand.M.D.	6.30	5.77
	Max.L.L.	6.02	6.20
	Mand.L.L.	6.17	5.47

Among the Danish groups, the number of times that the mean coefficient of variation for males exceeded the mean coefficient of variation for females exactly equalled the number of times that the female mean co-:efficient of variation was larger than the male mean coefficient of variation. In the Aebelholt group, male teeth tended to be more variable in size than fe-:male teeth, while in the Naestved group the females varied more. When the groups were combined, the larger coefficients were divided evenly between the sexes. When the average of all the mean coefficients was taken, the final result for males was 6.09 and for females 5.89. It thus seemed unlikely that there was a real and con-:sistent sex difference in variability of the Danish teeth.

A similar procedure was carried out by Selmer-Olsen for the Lapps, and the mean coefficient of variation for the tooth dimensions of females was found to be higher than that for males. Selmer-Olsen, however, included the values for root lengths in the mean coefficient, and if these are ignored, the difference between the sexes for the mean coefficient of variation of crown dimensions in the Lapps is very slight. Thomsen also found/

found no sex difference in coefficient of variation for crown dimensions in the Tristanites. Stein and Epstein (1934) reported higher coefficients of variation in fe-:males than males, but they had studied only the labio-:lingual dimensions of the molars of their New Britain Melanesians. Barrett et al (1964) stated that varia-:bility in the labiolingual crown dimension of Australian aborigine teeth was greater in the males than in the females. In their study of the mesiodistal dimensions of aborigine teeth, Barrett, Brown and Macdonald (1963) did not discuss overall sex difference in variability, but remarked that the coefficient of variation for the maxillary canine was greater in males than in females. They believed the difference between the sexes in this respect to be significant. The mesiodistal dimension of maxillary canines was slightly more variable in Aebelholt males than in Aebelholt females, but the sit-:uation was reversed for the Naestved group and also for the combined Danish group. There was thus no con-:sistent sex difference in variability of maxillary canines in the Danish material, nor an overall differ-:ence between the sexes in variability of tooth dimen-:sions.

When/

When a comparison of variability in tooth size was made between the Aebelholt and Naestved groups, it was found that the mean coefficient of variation was slight-:ly higher for the Aebelholt group (6.22) than for the Naestved group (5.73). A further examination of the coefficients of variation showed that the mean coeff-:icients were similar for Naestved males (5.66) and Naestved females (5.80) and showed only a slight rise in Aebelholt females (5.97). The mean coefficient of variation for Aebelholt males (6.48) was rather larger. Since the Aebelholt females showed a mean coefficient of variation similar to that of the Naestved population, there did not appear to be a consistent difference be-:tween these populations in variability of tooth size, and some other factor may have caused the greater var-:iability observed in the Aebelholt males.

F. Rank order of molar size in mediaeval Danes.

The rank order of size of the molar teeth in indi-:viduals has been studied by several workers, as it throws some light on the extent to which the molars have been modified in various racial groups. Information on/

on this aspect of the mediaeval Danish dentition was limited because of the small number of complete molar series which were available for study.

In any molar series, the rank order of size may differ for mesiodistal and labiolingual dimensions, and it is therefore preferable to find some means of combin:ing these measurements to give an overall impression of the size of each tooth. Pedersen (1949) and Selmer:Olsen (1949) employed for this purpose the crown module, which is the average of the mesiodistal and labiolingual diameters. Hjelmman (1928), Thomsen (1955) and Moorrees (1957) used the "crown area", obtained by multiplying mesiodistal diameter by labiolingual diameter. This quantity is not a true representation of the actual area of the occlusal surface of the crown, since even the mol:ars and premolars are not geometrically accurate rect:angular shapes, while incisors and canines are still further from the cubical form. For this reason the term "robustness value" used by Pedersen (1949) and Goose (1963) is perhaps to be preferred. In spite of its inaccuracy as a representation of the actual area of the crown, it is quite useful as a means of indicat:ing relative size of tooth crowns.

The/

The robustness value was calculated for each molar tooth which formed part of a complete molar series in the sexed Aebelholt and Naestved material. This procedure could not be carried out with the Aebelholt children's skulls, since almost no third molars were sufficiently developed to be measured, and therefore nearly all of the molar series were incomplete.

If the molar series from both sides of the same jaw in an individual were complete, then that from the right side was chosen for study. If the right quadrant was incomplete it could sometimes be replaced by the molar series from the left. Partial series were not studied, since there was no means of knowing how the missing tooth would have affected the result, and it was felt that in:complete series were thus of little value. As the quantity of material was severely limited, results for the two Danish groups were pooled, and the distribution of the various patterns of relative molar size, for males and females separately, is presented in Tables 27 and 28.

TABLE 27.

Relative sizes of maxillary molars in mediaeval Danish males and females.

	Males	Females
$M^1 > M^2 > M^3$	20	28
$M^1 > M^3 > M^2$	0	1

TABLE 28.

Relative sizes of mandibular molars in mediaeval Danish males and females.

	Males	Females
$M_1 > M_2 > M_3$	14	14
$M_1 > M_3 > M_2$	3	10
$M_3 > M_1 > M_2$	2	0
$M_2 > M_1 > M_3$	0	1

In the maxilla a gradual decrease in size from first to third molar was found in almost every instance in both sexes. There was only one exception, in one of the fe-:males, where the second molar was smaller than the third molar. This was due to a large third molar, rather than to an exceptionally small second molar.

Gradual decrease throughout the molar series was also the most frequently recorded rank order of size in the mandible in both sexes. Other patterns were record-:ed with greater frequency than in the maxilla, especial-:ly one in which the third molar exceeded the second mol-:ar in size. This was found to occur more often in the females, and was due to a greater reduction in size of the second molar, not to lack of reduction in the third molar. Exceptionally large variants of third and second molars were found in a small minority of cases.

In order to compare the results for Danes with those for other races, the data for males and females were combined and the resulting distribution of patterns of rank order in molar size is shown in Table 29.

TABLE 29.

Relative size of molars in mediaeval Danes.

	Maxilla	Mandible
M1 > M2 > M3	48	28
M1 > M3 > M2	1	13
M3 > M1 > M2	0	2
M2 > M1 > M3	0	1

This table again showed that in both jaws the molars most frequently decreased in size from first to third, and that this was almost universal in the maxilla, while it occurred in only 63.6% of mandibles. The next most common rank order of size was that in which the first molars were the largest but the third molars exceeded the second molars in size. In one instance this was found in the maxilla, whereas in the mandible this pattern of molar size was found in 29.5% of cases. Isolated ex-:amples were found, in the mandible only, of two other patterns : one in which the second molar was the largest and one in which the third molar was the largest. In both of these patterns the first molar occupied the inter-:mediate position.

Hjelmman (1928) also used the robustness value to assess/

assess the relative size of the molars in his study of Finnish teeth. The Finnish material consisted of 195 upper molar series and 190 lower molar series : of these, 58 maxillae and 59 mandibles lacked the third molars. Thus, Hjelmman studied 137 complete series of maxillary molars and 131 complete mandibular molar series. The results of this study were very similar to those obtained for the Danes. In the Finns, the pattern $M^1 > M^2 > M^3$ occurred in 92.7% of maxillary molar series, and this pattern was found in a very large majority of the Danish maxillae. The only other rank order of maxillary molar size which occurred in the Danes was $M^1 > M^3 > M^2$, and the latter pattern was found in 5.8% of Finns. Single in-:stances of two other patterns of molar size were also found in the Finns, accounting for 1.5% of the total.

In the mandible, the commonest rank order of molar size in Finns was again $M_1 > M_2 > M_3$, occurring in 64.1% of molar series. This was very similar to the figure of 63.6% obtained for the frequency of this formula in the Danes. Other patterns of relative molar size occ-:urred in the Finns in the same order as in the Danes : $M_1 > M_3 > M_2$ in 18.3% (29.5% in Danes); $M_3 > M_1 > M_2$ in 8.4% (4.6% in Danes); and $M_2 > M_1 > M_3$ in 4.6% (2.3% in Danes/

Danes). The pattern $M_3 > M_2 > M_1$ which did not occur in Danes, accounted for 2.3% of Finnish mandibular molar series. Single instances of three other patterns were also found in the Finns, making up the remaining 2.3% of this group.

Thus there is a considerable degree of similarity between Finns and mediaeval Danes, in respect of the rel-:ative sizes of the molars. Patterns of rank order of molar size occur in the same order of frequency and to nearly the same degree of frequency in both groups.

It was difficult to compare the results obtained for the mediaeval Danes with those published by Pedersen for East Greenland Eskimos, by Thomsen for Tristanites and by Moorrees for Aleuts, since in all these studies the number of complete molar series was even smaller than in the mediaeval Danish skulls. As far as could be seen from this scanty material, the proportion of individuals in whom molar size decreased progressively from first to third molar was lower in Eskimoes, Aleuts and Tristanites than in Danes. This suggested that second and third molars had undergone greater reduction compared to the first molar in the mediaeval Danes than in these three racial groups.

Selmer-Olsen/

Selmer-Olsen had available a much larger quantity of Lapp material, but chose the crown module for the study of the size ratio of the molars instead of robustness value. However, it seems likely that the results would be fairly similar whether crown module or robustness value were used. Selmer-Olsen also found that in many cases there was progressive reduction in module from the first to the third mandibular molar (no information was given concern-:ing the maxillary molars). The figure quoted in his table for the formula $M_1 > M_2 > M_3$ was 50.2%, but Selmer-:Olsen also found 12.0% of cases with the formula $M_1 > M_2 = M_3$. Since in the Danish material a small proportion of cases had M_2 and M_3 almost equal, these two classes in Selmer-Olsen's work could be combined, giving a total of 62.2% of progressive decrease in molar size in Lapps, a figure very similar to the 63.6% recorded for mediaeval Danes. The proportion of individuals among the Lapps in whom the second mandibular molar was the smallest in the series was reported as 21.1%, which was quite close to the 29.5% found among the Danes.

Putting his results in a different way, Selmer-Olsen stated that in 83% of Lapps the mandibular first molar was larger than the second molar. The comparable proportion in/

in Danes, obtained by adding the numbers with the patterns $M_1 > M_2 > M_3$ and $M_1 > M_3 > M_2$, is 93.1%. Simil-:arly, in 63% of Lapps the second molar was larger than the third, while in the Danes the patterns $M_1 > M_2 > M_3$ and $M_2 > M_1 > M_3$ accounted for 65.9% of the total.

Mediaeval Danes and Lapps thus appear to present very similar distributions of the patterns of rank order of mandibular molar size, i.e. as far as size is concerned, Lapps and Danes have reached the same stage in the reduction of the mandibular molars rel-:ative to one another.

G. Summary.

The most important conclusions to be drawn from these results may be summarized as follows:-

1. In both Aebelholt and Naestved groups there is a sex difference in tooth size, with the males presenting larger values for tooth dimensions than the females. Many of these sex differences in tooth dimensions are statistically significant. In each group the canines are the teeth which show the high-:est level of significance for both dimensions.

2./

2. No significant differences can be demonstrated in labiolingual tooth dimensions between females of the Aebelholt and Naestved groups. Very few of the differences in this tooth diameter between Aebelholt males and Naestved males are statistically significant. In the mesiodistal diameter, the maxillary teeth show virtually no significant differences between the two groups in either sex. The mesiodistal diameters of mandibular teeth are smaller in Naestved individuals than in those from Aebelholt, and some of these diff-:erences are significant, particularly in the premol-:ars and molars of the females.

3. On the whole, the differences between the Aebelholt and Naestved groups are sufficiently slight to allow of the material being pooled to form a com-:bined mediaeval Danish group. An examination of sex differences in this pooled material shows that male teeth are still larger in every dimension than those of females. The statistical significance of the differences is even higher than that recorded for the individual groups, thus proving the existence of a real sex difference in both crown dimensions of the teeth of mediaeval Danes. The greatest sex difference/

difference is again exhibited by the canines. There is very little difference in degree of significance between mesiodistal diameters and labiolingual dia-:meters of the teeth, but on the average the labio-:lingual diameters show a slightly higher degree of significance in sex difference.

4. The greatest degree of variability in tooth dimensions is shown by third molars and second incisors of both jaws. The teeth which vary least in both dimensions are the first molars, first incisors and canines. These results support the theory that the stability of the teeth decreases from mesial to distal in each tooth group. In the molar series in partic-:ular, variability is usually found to increase pro-:gressively from first to third molar. No sex diff-:erence in variability is found in the mediaeval Danes, nor does there appear to be any difference in variabil-:ity of tooth dimensions between the Aebelholt and Naestved groups.

5. The rank order of size of the molar teeth has been studied by means of the robustness values. In the maxilla, a progressive decrease in size from first to third molar is observed in almost every instance/

instance in both sexes. A consistent decrease in molar size towards the distal is also the relation-:ship most frequently recorded in the mandible, but there is also a fairly large minority of instances where progressive decrease in size is not shown. In most of these cases the second molar has been reduced until it is smaller than the third molar, and this is observed more often in females than in males. There are also a few individuals in whom the second or third mandibular molar is the largest in the series. The first molar is never observed to be the smallest in the series.

A comparison has been made wherever possible between these findings and the results recorded by other workers, except for the statistical evaluation of racial differences in tooth size, which is con-:sidered in the following chapter.

A COMPARISON OF CROWN SIZE IN MEDIAEVAL DANES AND OTHER RACES.

Having established a series of mean values for mesiodistal and labiolingual tooth dimensions in med-:iaeval Danes from Aebelholt and Naestved, and having also established that there existed a highly signific-:ant difference in tooth size between the sexes in this population, it then remained to consider whether significant differences in tooth size could be shown to exist between the Danes and other racial groups.

Attention was first turned to tooth dimensions which had already been published for other European populations of prehistoric or mediaeval date.

A. Comparison of crown size in mediaeval Danes and prehistoric Scottish races.

Comparisons were first made between tooth dimen-:sions in the mediaeval Danes and those already re-:corded by the writer (Lunt, 1961) from Scottish Neo-:lithic, Bronze Age and Dark Age skulls. The Neo-:lithic material was derived from the chambered tombs of the western Scottish seaboard and of the northern Isles, while the Bronze Age individuals had been buried in short cists, distributed mainly near the east coast. The/

The Dark Age material had been excavated from long cists, most of which had been found in the eastern Lowlands. One or two of these long cists had been shown to belong to the early Iron Age, but the maj-:ority of them were believed to be early Christian burials, from a period ranging from the 5th century A.D. to the 11th century A.D. (Stevenson, 1954) Many of the long cists probably dated from the 6th - 8th centuries. (Henshall, 1958) Together with these long cist burials from the Low-:lands, there were included in the Dark Age group a few Viking skulls from the north-east of Scotland.

It was decided that it would be unwise to apply statistical tests in these comparisons. In dealing with the Danish material it had been possible to ex-:clude worn teeth on a much more rigorous basis than had proved feasible in the study of the scanty Scot-:tish prehistoric material. While the Scottish groups were comparable one with another, and the Danish groups were also comparable with one another, since the same criteria had been used in assessing wear within the Scottish or Danish material, the two groups as a whole had not been subjected to the same criteria and were thus not statistically comparable.

Also/

Also as a result of the small numbers of teeth avail-:able in the Scottish material, the mean values were calculated using both measurements from each individ-:ual (following Selmer-Olsen, 1949), and the standard deviations calculated may be a little too low in com-:parison with the standard deviations calculated for the Danish material.

The mean figures obtained for mesiodistal and labiolingual diameters of the teeth in mediaeval Danes and in Scottish Neolithic, Bronze Age and Dark Age skulls have therefore simply been tabulated in Tables 30 - 37. In the case of the Scottish material, 'n' here represents the number of individuals from which the teeth were obtained (as in the Danish material), not the number of teeth which were used originally in preparing the mean values. Differences where the Scottish teeth presented a larger mean value than the Danish teeth have been indicated by a + sign, those where Scottish teeth were smaller than Danish teeth by a - sign. All measurements are given in milli-:metres.

TABLE 30.

Comparison of mean mesiodistal diameters of maxillary teeth in males of mediaeval Danish and prehistoric Scottish groups.

		I^1	I^2	C	P^1
Danes	$\bar{x}$	8.80	6.78	7.76	6.73
	n	24	33	62	58
	s	0.49	0.55	0.39	0.32
Neolithic	$\bar{x}$	9.7	7.2	8.0	6.8
	n	1	5	6	6
	d	+0.90	+0.42	+0.24	+0.07
Bronze Age	$\bar{x}$	9.0	6.9	7.7	6.6
	n	5	10	15	19
	s	0.61	0.60	0.48	0.39
	d	+0.20	+0.12	-0.06	-0.13
Dark Age	$\bar{x}$	8.6	6.8	7.8	6.6
	n	9	13	19	19
	s	0.36	0.58	0.45	0.45
	d	-0.20	+0.02	+0.04	-0.13

TABLE 30 (Cont.)

		P^2	M^1	M^2	M^3
Danes	$\bar{x}$	6.52	10.79	9.63	8.87
	n	49	31	72	88
	s	0.37	0.43	0.62	0.80
Neolithic	$\bar{x}$	6.7	10.5	9.6	8.5
	n	5	5	5	4
	d	+0.18	-0.29	-0.03	-0.37
Bronze Age	$\bar{x}$	6.4	10.7	9.6	8.7
	n	19	16	18	11
	s	0.46	0.65	0.54	0.61
	d	-0.12	-0.09	-0.03	-0.17
Dark Age	$\bar{x}$	6.6	10.4	9.1	8.1
	n	18	9	17	16
	s	0.28	0.41	0.64	0.68
	d	+0.08	-0.39	-0.53	-0.77

TABLE 31.

Comparison of mean mesiodistal diameters of maxillary teeth in females of mediaeval Danish and prehistoric Scottish groups.

		I^1	I^2	C	P^1
Danes	$\bar{x}$	8.28	6.37	7.44	6.54
	n	54	70	97	97
	s	0.52	0.58	0.35	0.33
Neolithic	$\bar{x}$	8.6	6.4	7.6	6.1
	n	1	1	1	1
	d	+0.32	+0.03	+0.16	-0.44
Bronze Age	$\bar{x}$	8.1	6.6	7.8	6.7
	n	3	5	7	7
	s	0.56	0.53	0.33	0.52
	d	-0.18	+0.23	+0.36	+0.16
Dark Age	$\bar{x}$	8.4	6.4	7.3	6.2
	n	4	9	17	17
	s	0.40	0.46	0.41	0.33
	d	+0.12	+0.03	-0.14	-0.34

TABLE 31 (Cont.)

		P^2	M^1	M^2	M^3
Danes	$\bar{x}$	6.33	10.31	9.17	8.47
	n	87	76	105	77
	s	0.36	0.52	0.58	0.68
Neolithic	$\bar{x}$	6.2	9.8	9.4	6.6
	n	1	2	1	1
	d	-0.13	-0.51	+0.23	-1.87
Bronze Age	$\bar{x}$	6.6	10.3	9.6	8.6
	n	9	8	7	5
	s	0.44	0.48	0.45	0.27
	d	+0.27	-0.01	+0.43	+0.13
Dark Age	$\bar{x}$	6.3	10.1	8.8	7.9
	n	16	16	18	14
	s	0.27	0.52	0.56	0.58
	d	-0.03	-0.21	-0.37	-0.57

TABLE 32.

Comparison of mean mesiodistal diameters of mandibular teeth in males of mediaeval Danish and prehistoric Scottish groups.

		I_1	I_2	C	P_1
Danes	$\bar{x}$	5.53	6.12	6.93	6.77
	n	7	16	50	54
	s	0.23	0.42	0.35	0.43
Neolithic	$\bar{x}$	5.5	-	7.2	7.2
	n	1	0	2	1
	d	-0.03	-	+0.27	+0.43
Bronze Age	$\bar{x}$	5.5	6.1	6.8	6.8
	n	7	11	17	22
	s	0.45	0.38	0.37	0.29
	d	-0.03	-0.02	-0.13	+0.03
Dark Age	$\bar{x}$	5.1	6.0	6.9	6.8
	n	4	9	18	20
	s	0.18	0.35	0.33	0.46
	d	-0.43	-0.12	-0.03	+0.03

TABLE 32 (Cont.)

		P_2	M_1	M_2	M_3
Danes	$\bar{x}$	6.87	11.45	10.56	10.56
	n	54	28	56	66
	s	0.39	0.62	0.71	1.07
Neolithic	$\bar{x}$	7.2	10.5	10.5	10.9
	n	1	1	2	3
	d	+0.33	-0.95	-0.06	+0.34
Bronze Age	$\bar{x}$	7.0	11.1	10.6	10.4
	n	17	20	20	14
	s	0.33	0.52	0.71	0.69
	d	+0.13	-0.35	+0.04	-0.16
Dark Age	$\bar{x}$	7.0	10.9	10.3	10.3
	n	20	12	20	20
	s	0.46	0.33	0.51	0.75
	d	+0.13	-0.55	-0.26	-0.26

TABLE 33.

Comparison of mean mesiodistal diameters of mandibular teeth in females of mediaeval Danish and prehistoric Scottish groups.

		I_1	I_2	C	P_1
Danes	$\bar{x}$	5.29	5.76	6.51	6.62
	n	28	45	82	94
	s	0.25	0.32	0.37	0.39
Neolithic	$\bar{x}$	-	-	-	-
	n	0	0	0	0
	d	-	-	-	-
Bronze Age	$\bar{x}$	5.3	6.1	6.8	6.9
	n	2	6	7	6
	s	-	0.60	0.48	0.34
	d	+0.01	+0.34	+0.29	+0.28
Dark Age	$\bar{x}$	5.1	5.9	6.4	6.5
	n	2	9	14	14
	s	-	0.37	0.25	0.39
	d	-0.19	+0.14	-0.11	-0.12

TABLE 33 (Cont.)

		P_2	M_1	M_2	M_3
Danes	$\bar{x}$	6.64	10.82	10.11	9.97
	n	81	58	85	71
	s	0.38	0.64	0.58	0.69
Neolithic	$\bar{x}$	-	-	-	-
	n	0	0	0	0
	d	-	-	-	-
Bronze Age	$\bar{x}$	6.8	11.1	10.3	10.5
	n	7	6	7	5
	s	0.29	0.34	0.53	0.30
	d	+0.16	+0.28	+0.19	+0.53
Dark Age	$\bar{x}$	6.5	10.5	10.0	9.7
	n	14	16	16	13
	s	0.37	0.60	0.44	0.66
	d	-0.14	-0.32	-0.11	-0.27

TABLE 34.

Comparison of mean labiolingual diameters of maxillary teeth in males of mediaeval Danish and prehistoric Scottish groups.

		I^1	I^2	C	P^1
Danes	$\bar{x}$	7.33	6.46	8.47	8.99
	n	40	43	62	81
	s	0.42	0.43	0.52	0.52
Neolithic	$\bar{x}$	7.8	6.7	8.9	9.1
	n	2	5	6	6
	d	+0.47	+0.24	+0.43	+0.11
Bronze Age	$\bar{x}$	7.4	6.3	8.7	9.0
	n	8	11	16	18
	s	0.40	0.49	0.62	0.54
	d	+0.07	-0.16	+0.23	+0.01
Dark Age	$\bar{x}$	7.3	6.2	8.4	9.0
	n	15	16	20	19
	s	0.39	0.54	0.36	0.58
	d	-0.03	-0.26	-0.07	+0.01

TABLE 34 (Cont.)

		P^2	M^1	M^2	M^3
Danes	$\bar{x}$	9.16	11.54	11.29	10.63
	n	84	60	94	95
	s	0.55	0.49	0.72	0.77
Neolithic	$\bar{x}$	9.3	11.5	11.9	11.7
	n	4	5	6	4
	d	+0.14	-0.04	+0.61	+1.07
Bronze Age	$\bar{x}$	9.2	11.9	11.5	10.5
	n	16	13	16	11
	s	0.59	0.62	0.55	1.01
	d	+0.04	+0.36	+0.21	-0.13
Dark Age	$\bar{x}$	9.1	11.6	11.1	10.5
	n	19	12	18	16
	s	0.45	0.30	0.57	0.69
	d	-0.06	+0.06	-0.19	-0.13

TABLE 35.

Comparison of mean labiolingual diameters of maxillary teeth in females of mediaeval Danish and prehistoric Scottish groups.

		I^1	I^2	C	P^1
Danes	$\bar{x}$	6.92	6.09	8.00	8.68
	n	76	83	102	117
	s	0.38	0.42	0.48	0.50
Neolithic	$\bar{x}$	7.0	5.7	8.0	9.4
	n	1	1	1	1
	d	+0.08	-0.39	0	+0.72
Bronze Age	$\bar{x}$	7.2	6.5	8.4	8.9
	n	4	5	7	7
	s	0.30	0.27	0.37	0.38
	d	+0.28	+0.41	+0.40	+0.22
Dark Age	$\bar{x}$	7.1	6.1	7.8	8.5
	n	7	10	18	14
	s	0.36	0.50	0.45	0.36
	d	+0.18	+0.01	-0.20	-0.18

TABLE 35 (Cont.)

		P^2	M^1	M^2	M^3
Danes	$\bar{x}$	8.77	11.04	10.92	10.14
	n	111	99	112	79
	s	0.54	0.55	0.66	0.84
Neolithic	$\bar{x}$	9.0	11.2	11.0	9.8
	n	1	2	1	1
	d	+0.23	+0.16	+0.08	-0.34
Bronze Age	$\bar{x}$	9.2	11.5	11.7	10.8
	n	7	8	7	5
	s	0.41	0.37	0.53	0.61
	d	+0.43	+0.46	+0.78	+0.66
Dark Age	$\bar{x}$	8.7	11.2	10.6	9.8
	n	15	13	17	14
	s	0.41	0.57	0.67	0.65
	d	-0.07	+0.16	-0.32	-0.34

TABLE 36.

Comparison of mean labiolingual diameters of mandibular teeth in males of mediaeval Danish and prehistoric Scottish groups.

		I_1	I_2	C	P_1
Danes	$\bar{x}$	5.96	6.38	7.87	7.62
	n	8	9	34	63
	s	0.34	0.42	0.48	0.45
Neolithic	$\bar{x}$	6.5	-	8.7	8.2
	n	1	0	1	1
	d	+0.54	-	+0.83	+0.58
Bronze Age	$\bar{x}$	5.9	6.4	7.7	7.8
	n	9	11	17	20
	s	0.31	0.35	0.58	0.39
	d	-0.06	+0.02	-0.17	+0.18
Dark Age	$\bar{x}$	5.8	6.2	7.6	7.7
	n	8	9	16	19
	s	0.45	0.45	0.54	0.48
	d	-0.16	-0.18	-0.27	+0.08

TABLE 36 (Cont.)

		P_2	M_1	M_2	M_3
Danes	$\bar{x}$	8.15	10.49	10.01	9.76
	n	69	54	76	74
	s	0.50	0.54	0.63	0.73
Neolithic	$\bar{x}$	8.6	10.5	10.2	10.2
	n	1	2	3	3
	d	+0.45	+0.01	+0.19	+0.44
Bronze Age	$\bar{x}$	8.3	10.6	10.2	10.2
	n	17	16	18	14
	s	0.37	0.55	0.73	0.69
	d	+0.15	+0.11	+0.19	+0.44
Dark Age	$\bar{x}$	8.2	10.7	10.1	9.9
	n	20	14	20	19
	s	0.49	0.29	0.47	0.59
	d	+0.05	+0.21	+0.09	+0.14

TABLE 37.

Comparison of mean labiolingual diameters of mandibular teeth in females of mediaeval Danish and prehistoric Scottish groups.

		I_1	I_2	C	P_1
Danes	$\bar{x}$	5.71	6.15	7.34	7.33
	n	23	37	74	95
	s	0.29	0.39	0.47	0.41
Neolithic	$\bar{x}$	-	-	-	-
	n	0	0	0	0
	d	-	-	-	-
Bronze Age	$\bar{x}$	6.1	6.4	7.8	7.6
	n	2	6	7	6
	s	-	0.18	0.29	0.27
	d	+0.39	+0.25	+0.46	+0.27
Dark Age	$\bar{x}$	5.7	6.1	7.0	7.2
	n	3	8	11	12
	s	0.67	0.53	0.45	0.40
	d	-0.01	-0.05	-0.34	-0.13

TABLE 37 (Cont.)

		P_2	M_1	M_2	M_3
Danes	$\bar{x}$	7.84	10.15	9.64	9.33
	n	95	86	99	75
	s	0.42	0.46	0.46	0.53
Neolithic	$\bar{x}$	-	-	-	-
	n	0	0	0	0
	d	-	-	-	-
Bronze Age	$\bar{x}$	8.2	10.8	10.4	10.2
	n	7	5	6	6
	s	0.30	0.23	0.23	0.35
	d	+0.36	+0.65	+0.76	+0.87
Dark Age	$\bar{x}$	7.8	10.0	9.6	9.2
	n	13	15	17	12
	s	0.53	0.65	0.54	0.72
	d	-0.04	-0.15	-0.04	-0.13

Great caution must be exercised in making any deductions from these tables in which tooth size in mediaeval Danish and prehistoric Scottish skulls is compared. No firm conclusions can be drawn, but it may perhaps be permissible to make a few comments on outstanding features of the tables.

In spite of the greater degree of attrition which the teeth of the Scottish skulls were known to have undergone, it was surprising how often a mean value for one or other of the Scottish groups exceed:ed the corresponding mean value for the Danish teeth.

The data from the Scottish Neolithic population were drawn from an extremely small group of individ:uals. No mandibular teeth of females were avail:able, and for maxillary teeth of females and mandib:ular teeth of males, measurements were obtained us:ually from one, or at most from three, individuals. The mean values for the Neolithic teeth in these in:stances varied considerably when compared with those for the Danish teeth, sometimes being larger and some:times smaller. Measurements of the maxillary teeth of Scottish Neolithic males were obtained from a slightly larger group of 5-6 individuals. These measurements/

measurements were much larger in the Scottish Neolithic males than in the Danish males, with the exception of the mesiodistal diameters of all three molars and the labiolingual diameter of the first molar. In these four dimensions the Scottish Neolithic teeth were the smaller, though the differences were considerable only for the mesiodistal diameter of the first and third maxillary molars, and may perhaps have been due to att:rition.

A much greater number of Bronze Age skulls was av:ailable for study, though the degree of attrition was if anything greater than that in the Neolithic skulls. Although attrition had been marked in the Scottish Bronze Age teeth, yet of a total of 64 tooth dimensions examined 47 showed a larger mean value in the Scottish Bronze Age population than in the mediaeval Danes. In some cases the difference was very large and would prob:ably have reached significance had statistical tests been applied. This greater size of Bronze Age teeth when compared with mediaeval Danish teeth was more mark:ed in the females than in the males, and was also slightly more marked in the labiolingual diameters(which would not have suffered so much from attrition) than in the/

the mesiodistal diameters of the teeth. In the 17 dimensions where the mean value for the Danish teeth exceeded that for the Scottish Bronze Age teeth, the difference was frequently very small and only in one case did it rise above 0.18m.m. This exception was the mesiodistal diameter of the male mandibular first molar, a tooth which is the first to suffer severely from attrition.

The size relationship between Scottish Bronze Age and mediaeval Danish teeth was exactly reversed in the case of the comparison between Scottish Dark Age and mediaeval Danish teeth, for of 64 tooth dimen:sions, only 17 were found to have a larger value in Dark Age teeth than in mediaeval Danish teeth. How:ever, the differences in size between Dark Age and mediaeval Danish teeth were not as great as those be:tween Bronze Age and mediaeval Danish teeth, though 17 of the differences between Dark Age and mediaeval Danish teeth were of the magnitude of 0.25m.m. or more. Many of these large differences were found in the molar dimensions where attrition is likely to have had a considerable effect on the size of Scottish Dark Age teeth.

It/

It thus appeared from a general survey of these tables that the Scottish Bronze Age dentition on the whole consisted of teeth which were rather larger than those of the mediaeval Danish population. The Scot-:tish Dark Age teeth were more closely similar in size to the mediaeval Danish teeth, or even slightly smaller, though the effects of attrition had to be taken into account here.

In studying the Scottish prehistoric skulls, the opinion was formed (Lunt, 1961), that there had been a slight but gradual decrease in tooth size from Neo-:lithic to Dark Age times. It had been expected that because of the greater attrition in the Scottish mat-:erial, the later Danish skulls might prove to possess teeth which gave greater mean values for tooth dimen-:sions than those of all the Scottish skulls and thus it would be impossible to show a continuation of this trend towards progressive decrease in tooth size. However, as the Bronze Age teeth appear to be larger than the Danish mediaeval teeth, this seems to confirm the original suggestion put forward by the writer. Brabant & Twiesselmann (1964) also mentioned a grad-:ual decrease in tooth size in European material from various/

various prehistoric and historic periods, and their findings will be discussed later.

Whether this apparent progressive reduction in tooth size is a function of time, or whether it is a racial feature, must remain undecided. The Scottish Bronze Age material was derived from inhumation bur:ials made in short cists. The first invasions of Scotland by the Bronze Age Beaker people are now be:lieved to have occurred at the beginning of the sec:ond millenium B.C., and the type of single grave in:humation burial which they introduced was practised until the 15th century B.C. (Piggott, 1962; Henshall, 1965). About this time the rite of cremation grad:ually became dominant, and remained as the usual method of disposal of the dead throughout the Middle and Late Bronze Age. The date usually accepted for the beginning of the Early Iron Age in Scotland is the second or third century B.C. (Powell, 1962; Henshall, 1965), but though one or two of the skulls included in the Scottish Dark Age group may belong to inhumation burials from this early period, most of them had been excavated from long cists, which are generally ascribed to the 5th - 9th centuries A.D. (Henshall/

(Henshall, 1958). The mediaeval Danes are known to have been buried during the period 12th - 16th cent-:uries A.D. (Chap.2). The lapse in time between the Scottish Bronze Age and the Scottish Dark Age material is thus much greater than between the Scottish Dark Age burials and those of the mediaeval Danish period. There is also a greater difference in size between Scottish Bronze Age and Scottish Dark Age teeth, than there is between Scottish Dark Age and mediaeval Dan-:ish teeth.

On the other hand, the last great incursion of a new race into our continent occurred at the begin-:ning of the Iron Age, when the Nordic races swept westwards over the whole of western Europe.(Coon,1939). The smaller tooth might well be a racial feature of the Indo-European-speaking Celtic and Germanic tribes, and as such might be expected to persist in the med-:iaeval population.

B. Comparison of crown size in mediaeval Danes and prehistoric or mediaeval European races.

Studies of tooth size in a number of prehistoric and mediaeval populations in Europe and the Near East have/

have been made by various other writers, and it is of interest to compare these results wherever possible with the results obtained for mediaeval Danes. A full statistical comparison can only be made if mean values and standard deviations have been published for males and females separately.

De Terra (1905) measured the teeth of small num:bers of prehistoric Swiss, of Alemanni and of skulls from graves of the Roman period and other early his:toric graves, but as he published the results in the form of maxima and minima, no comparison of any kind can be made between these results and the figures ob:tained for mediaeval Danes. In Hillebrand's (1909) study of Hungarian teeth, he included skulls dating to the Völkerwanderung period (i.e. 3rd - 6th cent:uries A.D.) but did not separate these from skulls of later date. Schwerz (1917) published mean values for tooth measurements in Alamanni of the 5th - 10th centuries A.D., but did not make sex differentiation of this material.

In Lysell's (1958 b) study of the mediaeval Swedish teeth from Västerhus, he dealt separately with males and females, and also provided statistical data./

data. Tooth measurements were given by Carr (1960) for skulls of Middle Minoans dated to the period 1750-1550 B.C., but sex differentiation could not be made. In 1960, Dahlberg published figures for tooth size ob-:tained from the Jarmo skulls of the Neolithic period, and compared these measurements with those of Meso-:lithic Natufian skulls.

Recently, Brabant and his co-workers recorded tooth measurements from a large number of Belgian and French population groups of prehistoric and early his-:toric periods. The earliest of these was the Meso-:lithic group (c. 3000 B.C.) from the caves at Rouffignac in the Dordogne (Sahly, Brabant and Bouyssou, 1962). The Neolithic period was represented by the skulls (c. 2500 - 1500 B.C.) from Les Matelles(Brabant, Sahly and Bouyssou, 1961). Also from Rouffignac came a number of skulls of the Iron Age, which were not earlier than 1000 B.C. (Sahly, Brabant and Bouyssou, 1962). These authors also studied some skulls dat-:ing to the Roman period (50 B.C. - c.400 A.D.) from France (Brabant, 1963). But the bulk of their mat-:erial was described as "Frankish" and they examined skulls of this period (4th and 5th centuries A.D.) from/

from Coxyde (Twiesselmann and Brabant, 1960), and from Achet, Spy, Ciply and the Musée de l'Homme in Paris (Brabant, 1963). The remaining population groups which were studied were Huns from Mözs (Brabant and Nemeskeri, 1963), Merovingian skulls of 5th - 8th cen:tury date from Gutschoven, Rosmeer and Tongres, and the Musée de l'Homme (Brabant, 1963) and Belgian skulls of mediaeval date (Brabant, 1963). In all of these studies tooth measurements were included, but in none of them was distinction made between the sexes. Re:ports were also published on the dentition of mediaeval Belgians from Nivelles (Brabant, 1960) and from Renaix (Brabant and Twiesselmann, 1960), but no measurements were included.

In only two of these reports, that by Lysell (1958b) on the mediaeval Swedish skulls from Västerhus and that by Twiesselmann and Brabant (1960) on the Frankish skulls from Coxyde, were statistical con:stants included. Since Lysell also divided his mat:erial according to sex, it was possible to carry out a statistical comparison of tooth size in mediaeval Swedes and Danes. This comparison will be presented later in this chapter.

As/

As far as all the other prehistoric and early historic groups were concerned, comparison could only be made by setting out the published figures beside those which had been calculated for the mediaeval Danes. When this was done, some general impressions could be recorded.

In the following Tables 38 - 41, the mean values of tooth measurements for as many as possible of the races mentioned above, and for mediaeval Danes, have been listed, together with the number of observations when this was available from the published reports. It should be noted that many of the groups contained very small numbers of individuals. In fact, only three groups were large enough to give satisfactory numbers of measurements, and these were the Gallo-Romans from France, the Franks from Coxyde and the Franks from Spy. In those instances where the actual number of measurements was not quoted, the number of skulls forming the group was small. Furthermore it may be remarked that Brabant and his co-workers did not state whether measurements from one or both sides of a skull were used, but it seems probable from a scrutiny of the numbers of observations and the numbers of skulls, that/

that measurements from both sides were combined. Thus while 'n' for the Danes represents the number of individuals studied, 'n' for the other prehistoric and mediaeval races is probably rather higher than the actual number of individuals in the group.

The figures for Mesolithic Natufians and Neoli:thic Jarmoites were drawn from the paper by Dahlberg (1960), those for the Minoans from Carr (1960) and for the Alamanni from Schwerz (1917). The figures for the remaining groups were from various papers by Brabant and co-workers.

In compiling these tables, it was noticed that in the published tooth dimensions of the Neolithic skulls from Les Matelles, the figures for the mesio:distal and labiolingual diameters of five teeth had been transposed. This has been corrected.

TABLE 38. Mesiodistal diameters of maxillary teeth.

	I^1		I^2	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	24	8.80	33	6.78
Mediaeval Danes (female)	54	8.28	70	6.37
Natufians - Mesolithic	9	8.92	8	6.67
Jarmo - Neolithic	2	8.8	4	6.7
Minoans - Bronze Age	-	8.5	-	6.1
Rouffignac - Mesolithic	9	8.56	7	6.70
Les Matelles - Neolithic	-	8.47	-	6.75
Rouffignac - Iron Age	6	7.90	-	-
France - Gallo-Roman	90	8.22	122	6.61
Coxyde - Franks	98	8.30	103	6.43
Achet - Franks	15	8.42	11	6.77
Spy - Franks	22	8.00	27	6.47
Ciply - Franks	9	8.32	14	6.56
Musée de l'Homme - Franks	-	8.23	-	6.83
Mosz - Huns	10	8.53	9	6.78
Alamanni	-	8.7	-	6.7
Gutschoven - Merovingian	-	8.35	-	6.84
Rosmeer etc. - Merovingian	-	8.51	-	6.83
Musée de l'Homme - Merovin.	-	8.38	-	6.72
Belgian - Mediaeval	7	8.57	7	6.61

TABLE 38.(Cont.) Mesiodistal diameters of maxillary teeth.

	C		P^1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	62	7.76	58	6.73
Mediaeval Danes (female)	97	7.44	97	6.54
Natufians - Mesolithic	10	7.72	13	7.01
Jarmo - Neolithic	5	8.3	2	7.5
Minoans - Bronze Age	-	7.5	-	6.7
Rouffignac - Mesolithic	8	7.43	11	6.91
Les Matelles - Neolithic	-	7.63	-	6.78
Rouffignac - Iron Age	3	7.46	11	6.82
France - Gallo-Roman	162	7.58	181	6.47
Coxyde - Franks	108	7.60	108	6.47
Achet - Franks	9	7.51	10	6.39
Spy - Franks	29	7.64	27	6.66
Ciply - Franks	14	7.41	15	6.53
Musée de l'Homme - Franks	-	7.42	-	6.51
Mosz - Huns	10	7.59	10	6.70
Alamanni	158	7.7	118	6.8
Gutschoven - Merovingian	-	7.70	-	6.45
Rosmeer etc. - Merovingian	-	7.80	-	6.81
Musée de l'Homme - Merov.	-	7.53	-	6.89
Belgian - Mediaeval	12	7.62	9	7.27

TABLE 38.(Cont.) Mesiodistal diameters of maxillary teeth.

	P^2		M^1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	49	6.52	31	10.79
Mediaeval Danes (female)	87	6.33	76	10.31
Natufians - Mesolithic	15	6.85	14	10.87
Jarmo - Neolithic	3	7.8	5	10.8
Minoans - Bronze Age	-	6.8	-	10.5
Rouffignac - Mesolithic	7	6.54	7	10.41
Les Matelles - Neolithic	-	6.88	-	10.35
Rouffignac - Iron Age	5	6.68	8	10.70
France - Gallo-Roman	179	6.42	171	10.66
Coxyde - Franks	106	6.33	104	10.00
Achet - Franks	11	6.30	17	10.68
Spy - Franks	24	6.43	23	10.43
Ciply - Franks	16	6.54	17	10.51
Musée de l'Homme - Franks	-	6.34	-	10.88
Mosz - Huns	9	6.31	9	10.47
Alamanni	192	6.6	-	10.6
Gutschoven - Merovingian	-	6.34	-	10.42
Rosmeer etc. - Merovingian	-	6.27	-	11.25
Musée de l'Homme - Merov.	-	6.55	-	10.83
Belgian - Mediaeval	9	6.77	10	10.79

TABLE 38.(Cont.) Mesiodistal diameters of maxillary teeth.

	M^2		M^3	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	72	9.63	88	8.87
Mediaeval Danes (female)	105	9.17	77	8.47
Natufians - Mesolithic	11	10.52	8	9.34
Jarmo - Neolithic	5	10.2	1	8.4
Minoans - Bronze Age	-	9.7	-	-
Rouffignac - Mesolithic	6	9.84	8	8.62
Les Matelles - Neolithic	-	9.61	-	-
Rouffignac - Iron Age	8	10.35	7	8.11
France - Gallo-Roman	183	9.76	101	8.71
Coxyde - Franks	102	8.86	89	8.32
Achet - Franks	10	9.69	4	8.58
Spy - Franks	21	9.83	17	8.69
Ciply - Franks	18	9.40	10	8.82
Musée de l'Homme - Franks	-	9.77	-	9.11
Mosz - Huns	11	9.75	7	8.96
Alamanni	-	9.5	-	8.8
Gutschoven - Merovingian	-	10.33	-	9.75
Rosmeer etc. - Merovingian	-	10.74	-	8.86
Musée de l'Homme - Merovin.	-	9.74	-	8.86
Belgian - Mediaeval	11	9.70	7	8.61

TABLE 39. Mesiodistal diameters of mandibular teeth.

	I_1		I_2	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	7	5.53	16	6.12
Mediaeval Danes (female)	28	5.29	45	5.76
Natufians - Mesolithic	10	5.37	13	5.95
Jarmo - Neolithic	3	5.3	3	6.0
Minoans - Bronze Age	-	5.7	-	6.5
Rouffignac - Mesolithic	11	5.22	9	5.70
Les Matelles - Neolithic	-	5.78	-	5.98
Rouffignac - Iron Age	4	5.32	7	5.91
France - Gallo-Roman	127	5.10	158	5.79
Coxyde - Franks	102	5.07	107	5.73
Achet - Franks	13	5.08	16	5.86
Spy - Franks	27	5.09	30	5.77
Ciply - Franks	12	5.24	20	5.85
Musée de l'Homme - Franks	-	5.12	-	5.93
Mosz - Huns	10	5.28	9	5.89
Alamanni	-	5.6	-	6.2
Gutschoven - Merovingian	-	4.97	-	5.63
Rosmeer etc. - Merovingian	-	5.47	-	6.06
Musée de l'Homme - Merovin.	-	5.20	-	5.62
Belgian - Mediaeval	10	5.29	6	6.28

TABLE 39.(Cont.) Mesiodistal diameters of mandibular teeth.

	C		P_1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	50	6.93	54	6.77
Mediaeval Danes (female)	82	6.51	94	6.62
Natufians - Mesolithic	13	7.03	16	7.06
Jarmo - Neolithic	4	7.1	3	8.0
Minoans - Bronze Age	-	6.9	-	6.8
Rouffignac - Mesolithic	11	6.83	6	6.90
Les Matelles - Neolithic	-	6.85	-	6.93
Rouffignac - Iron Age	20	6.79	18	6.97
France - Gallo-Roman	180	6.42	189	6.34
Coxyde - Franks	109	6.63	108	6.42
Achet - Franks	10	6.38	8	6.68
Spy - Franks	37	6.79	35	6.59
Ciply - Franks	25	6.67	23	6.67
Musée de l'Homme - Franks	-	6.29	-	6.88
Mosz - Huns	12	7.04	12	6.70
Alamanni	-	7.7	-	6.9
Gutschoven - Merovingian	-	6.48	-	6.17
Rosmeer etc. - Merovingian	-	7.00	-	6.88
Musée de l'Homme - Merovin.	-	6.61	-	6.86
Belgian - Mediaeval	7	6.94	8	6.85

TABLE 39.(Cont.) Mesiodistal diameters of mandibular teeth.

	P_2		M_1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	54	6.87	28	11.45
Mediaeval Danes (female)	81	6.64	58	10.82
Natufians - Mesolithic	14	7.18	16	11.52
Jarmo - Neolithic	3	8.3	6	11.4
Minoans - Bronze Age	-	7.1	-	11.3
Rouffignac - Mesolithic	13	6.97	12	11.28
Les Matelles - Neolithic	-	7.14	-	11.27
Rouffignac - Iron Age	10	7.04	17	11.21
France - Gallo-Roman	165	6.48	154	10.22
Coxyde - Franks	109	6.56	107	10.72
Achet - Franks	8	6.85	12	10.90
Spy - Franks	29	6.69	19	10.50
Ciply - Franks	18	6.81	18	10.80
Musée de l'Homme - Franks	-	6.98	-	11.12
Mosz - Huns	12	6.80	12	10.87
Alamanni	-	7.1	-	11.0
Gutschoven - Merovingian	-	6.32	-	10.45
Rosmeer etc. - Merovingian	-	7.02	-	10.86
Musée de l'Homme - Merovin.	-	6.88	-	11.07
Belgian - Mediaeval	8	6.84	9	11.03

TABLE 39.(Cont.) Mesiodistal diameters of mandibular teeth.

	M_2		M_3	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	56	10.56	66	10.56
Mediaeval Danes (female)	85	10.11	71	9.97
Natufians - Mesolithic	16	11.05	14	10.90
Jarmo - Neolithic	6	11.0	2	11.1
Minoans - Bronze Age	-	11.0	-	-
Rouffignac - Mesolithic	11	10.54	5	10.20
Les Matelles - Neolithic	-	10.69	-	-
Rouffignac - Iron Age	21	9.18	8	10.98
France - Gallo-Roman	163	9.89	160	9.37
Coxyde - Franks	109	9.96	99	9.97
Achet - Franks	9	10.45	5	10.22
Spy - Franks	22	10.08	25	10.18
Ciply - Franks	24	10.30	20	10.38
Musée de l'Homme - Franks	-	10.55	-	10.06
Mosz - Huns	12	10.26	7	10.17
Alamanni	-	10.7	-	10.8
Gutschoven - Merovingian	-	9.94	-	9.11
Rosmeer etc. - Merovingian	-	10.45	-	10.23
Musée de l'Homme - Merovin.	-	10.37	-	10.04
Belgian - Mediaeval	10	10.18	7	10.06

TABLE 40. Labiolingual diameters of maxillary teeth.

	I^1		I^2	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	40	7.33	43	6.46
Mediaeval Danes (female)	76	6.92	83	6.09
Natufians - Mesolithic	8	7.26	8	6.82
Jarmo - Neolithic	2	6.6	4	6.0
Minoans - Bronze Age	-	7.1	-	6.5
Rouffignac - Mesolithic	9	7.12	7	6.88
Les Matelles - Neolithic	-	7.28	-	6.51
Rouffignac - Iron Age	6	7.50	-	-
France - Gallo-Roman	90	7.24	122	6.49
Coxyde - Franks	98	7.10	103	6.21
Achet - Franks	14	7.20	11	6.35
Spy - Franks	22	7.45	27	6.69
Ciply - Franks	9	7.17	14	6.51
Musée de l'Homme - Franks	-	7.51	-	6.75
Mosz - Huns	10	7.25	9	6.51
Alamanni	-	7.5	-	6.6
Gutschoven - Merovingian	-	7.25	-	6.85
Rosmeer etc. - Merovingian	-	7.51	-	6.75
Musée de l'Homme - Merovin.	-	7.34	-	6.70
Belgian - Mediaeval	7	7.19	8	6.65

TABLE 40.(Cont.) Labiolingual diameters of maxillary teeth.

	C		P^1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	62	8.47	81	8.99
Mediaeval Danes (female)	102	8.00	118	8.68
Natufians - Mesolithic	9	8.61	13	9.44
Jarmo - Neolithic	5	8.4	2	9.5
Minoans - Bronze Age	-	8.3	-	8.6
Rouffignac - Mesolithic	8	8.31	11	9.13
Les Matelles - Neolithic	-	8.24	-	9.29
Rouffignac - Iron Age	3	8.26	11	9.48
France - Gallo-Roman	162	8.32	181	8.58
Coxyde - Franks	108	8.33	108	8.59
Achet - Franks	9	8.33	10	8.40
Spy - Franks	28	8.35	27	8.80
Ciply - Franks	14	8.30	15	9.04
Musée de l'Homme - Franks	-	8.44	-	8.35
Mosz - Huns	10	8.42	10	9.02
Alamanni	158	8.4	118	9.0
Gutschoven - Merovingian	-	9.25	-	8.36
Rosmeer etc. - Merovingian	-	8.47	-	8.95
Musée de l'Homme - Merovin.	-	8.38	-	8.34
Belgian - Mediaeval	12	8.33	9	8.83

TABLE 40. (Cont.) Labiolingual diameters of maxillary teeth.

	P^2		M^1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	84	9.16	60	11.54
Mediaeval Danes (female)	111	8.77	99	11.04
Natufians - Mesolithic	15	9.53	14	12.30
Jarmo - Neolithic	2	9.8	5	11.4
Minoans - Bronze Age	-	8.8	-	11.4
Rouffignac - Mesolithic	7	9.38	7	11.75
Les Matelles - Neolithic	-	8.20	-	12.11
Rouffignac - Iron Age	5	10.04	8	12.25
France - Gallo-Roman	179	8.87	171	11.17
Coxyde - Franks	106	8.81	104	11.22
Achet - Franks	11	8.53	17	11.22
Spy - Franks	24	9.05	23	11.11
Ciply - Franks	16	9.04	17	11.44
Musée de l'Homme - Franks	-	8.42	-	11.26
Mosz - Huns	9	9.13	9	11.50
Alamanni	192	9.3	-	11.5
Gutschoven - Merovingian	-	9.43	-	11.14
Rosmeer etc. - Merovingian	-	9.18	-	11.53
Musée de l'Homme - Merovin.	-	8.62	-	11.41
Belgian - Mediaeval	10	9.15	10	11.58

TABLE 40.(Cont.) Labiolingual diameters of maxillary teeth.

	M^2		M^3	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	94	11.29	95	10.63
Mediaeval Danes (female)	112	10.92	79	10.14
Natufians - Mesolithic	11	12.14	8	11.30
Jarmo - Neolithic	5	11.4	1	10.7
Minoans - Bronze Age	-	11.0	-	-
Rouffignac - Mesolithic	6	11.56	8	11.47
Les Matelles - Neolithic	-	11.84	-	-
Rouffignac - Iron Age	8	12.51	7	11.57
France - Gallo-Roman	183	10.93	101	10.65
Coxyde - Franks	102	10.65	89	10.13
Achet - Franks	10	11.12	4	11.18
Spy - Franks	21	10.63	17	10.15
Ciply - Franks	18	11.34	10	10.74
Musée de l'Homme - Franks	-	11.02	-	10.89
Mosz - Huns	11	11.05	7	10.77
Alamanni	-	11.4	-	11.0
Gutschoven - Merovingian	-	11.00	-	10.62
Rosmeer etc. - Merovingian	-	11.47	-	10.56
Musée de l'Homme - Merovin.	-	11.11	-	10.12
Belgian - Mediaeval	11	11.24	7	9.96

TABLE 41. Lebiolingual diameters of mandibular teeth.

	I_1		I_2	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	8	5.96	9	6.38
Mediaeval Danes (female)	23	5.71	37	6.15
Natufians - Mesolithic	10	6.21	13	6.61
Jarmo - Neolithic	3	5.8	3	6.1
Minoans - Bronze Age	-	6.0	-	6.5
Rouffignac - Mesolithic	11	6.07	9	6.48
Les Matelles - Neolithic	-	6.13	-	6.68
Rouffignac - Iron Age	4	6.02	7	6.80
France - Gallo-Roman	127	5.99	158	6.30
Coxyde - Franks	102	5.96	107	6.26
Achet - Franks	13	5.97	16	6.32
Spy - Franks	27	6.10	30	6.35
Ciply - Franks	12	6.25	20	6.39
Musée de l'Homme - Franks	-	5.98	-	6.29
Mosz - Huns	9	6.03	8	6.33
Alamanni	-	6.7	-	7.0
Gutschoven - Merovingian	-	6.46	-	6.61
Rosmeer etc. - Merovingian	-	6.14	-	6.70
Musée de l'Homme - Merovin.	-	6.19	-	6.26
Belgian - Mediaeval	10	6.39	6	6.23

TABLE 41. (Cont.) Labiolingual diameters of mandibular teeth.

	C		P_1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	34	7.87	63	7.62
Mediaeval Danes (female)	74	7.34	95	7.33
Natufians - Mesolithic	13	7.91	16	7.82
Jarmo - Neolithic	4	7.7	3	7.4
Minoans - Bronze Age	-	7.8	-	7.6
Rouffignac - Mesolithic	11	8.02	6	7.43
Les Matelles - Neolithic	-	7.89	-	7.84
Rouffignac - Iron Age	20	7.98	18	7.96
France - Gallo-Roman	180	7.76	189	7.88
Coxyde - Franks	109	7.77	108	7.32
Achet - Franks	10	7.53	8	7.49
Spy - Franks	37	7.87	35	8.43
Ciply - Franks	25	7.64	23	7.63
Musée de l'Homme - Franks	-	7.41	-	7.97
Mosz - Huns	11	7.85	11	7.67
Alamanni	-	8.0	-	8.0
Gutschoven - Merovingian	-	7.80	-	7.57
Rosmeer etc. - Merovingian	-	8.31	-	7.97
Musée de l'Homme - Merovin.	-	7.55	-	7.95
Belgian - Mediaeval	7	7.74	8	7.96

TABLE 41. (Cont.) Labiolingual diameters of mandibular teeth.

	P_2		M_1	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	69	8.15	54	10.49
Mediaeval Danes (female)	95	7.84	86	10.15
Natufians - Mesolithic	14	8.24	16	10.76
Jarmo - Neolithic	3	8.6	6	10.5
Minoans - Bronze Age	-	8.1	-	10.4
Rouffignac - Mesolithic	13	7.87	12	10.91
Les Matelles - Neolithic	-	8.38	-	10.12
Rouffignac - Iron Age	10	8.43	17	10.52
France - Gallo-Roman	165	7.94	154	10.35
Coxyde - Franks	109	7.86	107	10.28
Achet - Franks	8	7.98	12	10.28
Spy - Franks	29	8.06	19	10.43
Ciply - Franks	18	8.10	18	10.35
Musée de l'Homme - Franks	-	8.34	-	10.90
Mosz - Huns	11	8.08	11	10.60
Alamanni	-	8.5	-	10.2
Gutschoven - Merovingian	-	7.94	-	10.59
Rosmeer etc. - Merovingian	-	8.44	-	10.90
Musée de l'Homme - Merovin.	-	8.44	-	10.76
Belgian - Mediaeval	8	8.56	9	10.63

TABLE 41. (Cont.) Labiolingual diameters of mandibular teeth.

	M_2		M_3	
	n	$\bar{x}$	n	$\bar{x}$
Mediaeval Danes (male)	76	10.01	74	9.76
Mediaeval Danes (female)	99	9.64	75	9.33
Natufians - Mesolithic	16	10.62	13	10.40
Jarmo - Neolithic	6	10.1	2	10.8
Minoans - Bronze Age	-	9.7	-	-
Rouffignac - Mesolithic	11	10.20	5	9.60
Les Matelles - Neolithic	-	9.89	-	-
Rouffignac - Iron Age	21	10.20	8	9.97
France - Gallo-Roman	163	10.03	160	9.42
Coxyde - Franks	109	9.72	99	9.46
Achet - Franks	9	10.06	5	9.36
Spy - Franks	22	9.82	25	9.51
Ciply - Franks	24	10.06	20	9.77
Musée de l'Homme - Franks	-	10.36	-	9.92
Mosz - Huns	11	10.18	7	9.70
Alamanni	-	10.4	-	10.0
Gutschoven - Merovingian	-	10.11	-	9.58
Rosmeer etc. - Merovingian	-	10.54	-	10.00
Musée de l'Homme - Merovin.	-	10.24	-	9.73
Belgian - Mediaeval	10	10.11	7	9.60

There was considerable variation in tooth meas-:urements from the different population groups. An attempt was made to assess relative tooth size in a general way. Tooth measurements were classified as being (a) greater than the mean measurement recorded for Danish males (b) falling between the mean values for Danish males and Danish females, or exactly equal to one of these figures (c) lower than the mean meas-:urement for the Danish females. The proportion of males to females in each population group was of course unknown, but if it is assumed that the sexes are fairly evenly represented, then if a mean tooth measurement for a particular group lies between the values for Danish males and Danish females, it may be postulated that the group is fairly similar to the Danes in respect of this measurement. If the mean value for a tooth measurement in a group where sexes are combined falls above that for Danish males, it is reasonable to suggest that in respect of this measurement the particular group shows a greater di-:mension than do the Danes, while if a measurement should fall below that for Danish females the con-:verse is true.

For/

For each group, the numbers of tooth measurements falling into each of these categories a, b and c have been listed in Table 42, which gives therefore a very rough guide to general tooth size relative to that of mediaeval Danes.

TABLE 42. Tooth size in various European populations, relative to tooth size in mediaeval Danes. Numbers of mean values for tooth measurements falling into cat-:egories A, B and C (see text).

	A.	B.	C.
Natufians - Mesolithic	27	5	0
Jarmo - Neolithic	18	10	4
Minoans - Bronze Age	10	16	2
Rouffignac - Mesolithic	16	13	3
Les Matelles - Neolithic	15	11	2
Rouffignac - Iron Age	20	7	3
France - Gallo-Roman	6	16	10
Coxyde - Franks	0	18	14
Achet - Franks	4	22	6
Spy - Franks	5	21	6
Ciply - Franks	10	18	4
Musée de l'Homme - Franks	15	10	7
Mosz - Huns	10	20	2
Alamanni	22	10	0
Gutschoven - Merovingian	10	12	10
Rosmeer etc. - Merovingian	20	11	1
Musée de l'Homme - Merovin.	13	14	5
Belgian - Mediaeval	13	18	1

In the first section of the table, comprising the prehistoric groups, a high proportion of the tooth mea:surements were larger than those of mediaeval Danes. Most of the remaining measurements were similar to those of the Danes, and very few were smaller.

For the first four groups of Gallo-Roman and Frankish skulls the position was quite different. The majority of measurements were similar to those of med:iaeval Danes, and in the case of the Gallo-Roman skulls and the Franks from Coxyde, quite a number of tooth dimensions were smaller. Very few measurements lay above those of the Danes. The small groups of Franks from Ciply and the Musée de l'Homme appeared to have had slightly larger teeth than the others.

The Hunnish, Alamannic, Merovingian and Belgian mediaeval skulls showed a greater variability in distribution of tooth dimensions relative to those of the Danes. This may be partly due to the fact that all these groups, except perhaps that of the Alamanni, were very small. There appeared to be a tendency for the teeth in these groups to be similar to, or rather larger than, those of the Danes. Except in the case of the Merovingian skulls from Gutschoven, few/

few tooth dimensions were smaller than those of the Danes.

In so far as any conclusions can be drawn from this type of comparison, it would seem that Mesolithic and Neolithic groups from the European continent had rather larger teeth than mediaeval Danes, while the Franks had teeth very similar in size to, or slightly smaller than, those of the mediaeval Danes. Skulls of Alamanni and of individuals from the Merovingian per-:iod in Belgium and France on the other hand appear to have had slightly larger teeth than mediaeval Danes.

Brabant and Twiesselmann (1964) in discussing tooth dimensions in the various population groups which they studied, also remarked that there was a gradual diminu-:tion in tooth size in successive periods. Brabant did not appear to attach great importance otherwise to differences in tooth size, and repeatedly in dealing with the Frankish and mediaeval skulls he made the statement that tooth dimensions were found to be sim-:ilar to those of groups previously studied. This is so in some cases, but even a cursory examination of the figures shows that it is by no means universally true. If for instance the mean values for the mesio-:distal/

distal diameter of the maxillary first molar are ex-:amined, the figures recorded for the various groups of Franks are : 10.00, 10.43, 10.51, 10.68 and 10.88m.m. and those for the Merovingians 10.42, 10.83 and 11.25m.m. That is, between the largest and smallest mean value for this tooth dimension in Franks there is a differ-:ence of 0.88 m.m., and in the case of Merovingian skulls the difference is 0.83 m.m. Between Coxyde Franks and Rosmeer/Tongres Merovingians there is a difference of 1.25 m.m. In terms of variation in tooth size, these differences are very large, and it is hardly accurate to describe the tooth dimensions recorded for these different groups as "similar". It is probable, however, that these differences are part-:ly due to the small numbers of skulls in some of the groups.

From the evidence available it would seem that tooth size tended to diminish during Neolithic, Bronze Age and Dark Age periods, but then increased slightly in mediaeval times. It has been suggested that traits of earlier populations may reappear in later periods under certain circumstances, e.g. Coon (1939) spoke of the "Neolithic re-emergence" in industrial Britain/

Britain in the 19th century, and there is the possib-:ility that the slight increase in tooth size in med-:iaeval times might be due to some such phenomenon.

C. Comparison of crown size in mediaeval Danes and modern races.

Consideration must also be given to comparison of tooth size in the mediaeval Danes and in various modern races, both white and coloured.

In order to carry out such comparisons, it was necessary to make use of statistical data published by other workers in this field. The question of possible errors introduced in this procedure was important. Not all authors carried out tooth measurements on the nat-:ural teeth : instead, several of them used plaster casts of the dentition. This could give rise to err-:ors, due to distortion in the impression material dur-:ing taking of the impression, to dimensional changes in the impression material during setting, and to di-:mensional changes in the material of the cast. Hunter and Priest (1960) found that measurements on casts were on an average 0.1 m.m. larger than those of the actual teeth. Since differences of as little as 0.2 m.m. in the/

the Danish material proved to be significant, a consis-:tent error of this amount could exert a considerable influence on the results of comparisons made with di-:mensions of natural teeth.

Those workers who employed casts of the dentition of living individuals, on the other hand, had no diff-:iculty in sexing their material, and there can be no error involved from this cause. Many of them also used casts of the teeth in children, and attrition would not be expected to cause any error in tooth mea-:surements. Thus the measurements of teeth made on casts may on several counts be expected to be rather larger than those made on the natural teeth.

When comparing results obtained by different work-:ers who measured natural teeth, sources of error still existed. Teeth which had undergone a slight amount of attrition were used by every worker, and the diff-:iculty lay in the fact that one could not know to what extent the criteria used by different workers for accep-:tance or rejection of slightly worn teeth had varied.

Measuring points also varied particularly in re-:spect of the mesiodistal diameter, as has already been noted in Chap. 4. A further point which may be remarked/

remarked upon is that measurements of extracted teeth are liable to show discrepancies from measurements of teeth still in position in the jaw, especially as far as the mesiodistal diameter is concerned, as the mea-:suring points are more easily reached in the extract-:ed tooth. Keene (1964) made a similar point when he drew attention to the possibility that varying age might have an effect on the accuracy of tooth measure-:ments in children, since a different measurement might well be recorded when the teeth were spaced and readily accessible, from that obtainable later when the teeth were closely packed together. In tests made on a plastic dentoform, measurements of spaced teeth were consistently larger and were also repeatable with greater constancy than measurements of teeth in con-:tact.

It is obvious that the results of any statistical comparison between measurements obtained under circum-:stances which admit of so many possible sources of discrepancy, must be accepted only with caution. For this reason, only those comparisons which gave a sig-:nificant result at the level $P < 0.001$ have been con-:sidered as acceptable. A further safeguard was employed/

employed in omitting any calculation involving a group of fewer than 10 observations.

The following criteria were adopted in selecting published results for statistical comparison with the Danish material. The material must have been differ:entiated into male and female, with results published separately for the two sexes. The published data must also include the standard deviations calculated for each tooth dimension by the particular author, and this condition at once eliminated all studies published be:fore 1931. It was essential that the standard devi:ation should be available, since in order to carry out the 't' test for significance, the function $S(x-\bar{x})^2$ had to be calculated, using the formula

$$S(x-\bar{x})^2 = s^2(n-1),$$

where s is the standard deviation and n the number of observations.

Some authors quoted the standard error of the mean instead of the standard deviation, and in these cases no statistical comparison could be carried out. Although it would be possible to calculate an approx:imation of the standard deviation from the standard error, this calculation could not be made with sufficient/

sufficient accuracy to allow of the resulting figure being used in further statistical work.

It has already been stated that no results pub-:lished prior to 1931 were suitable for statistical comparison with those obtained for the mediaeval Danes, since before that date statistical constants were not calculated in odontometric studies. Such works as those of Hillebrand (1909) on Hungarians, Miyabara (1916) on Japanese, Campbell (1925) on Australian aborigines, Janzer (1927) on New Pomeranians, Drennan (1929) on Bushmen and Middleton Shaw (1931) on Bantu thus could not be used in comparison.

Mijsberg (1931) stated in his study of Javanese teeth that he had calculated standard deviations of the measurements he obtained, but the figures which were quoted were clearly not the standard deviations but the standard errors of the means, and were accept-:ed as such by Moorrees, who included them in the tables in his book "The Aleut Dentition" (1957).

Though many studies have since been published in which tooth dimensions have been used for one purpose or another, most of these were unsuitable for statis-:tical comparisons. In 16 studies of modern dentitions in/

in which tooth dimensions were stated to have been measured, the actual mean values obtained were not quoted in the published paper (Ritter, 1933; Arai,1939; Lundström, 1942, 1943; Nance, 1947; Ballard and Wylie, 1947; Neff, 1949; Moorrees and Reed, 1954; Bolton, 1958; Lysell, 1960; Moorrees and Chadha,1962; Moorrees & Reed, 1964; Lundström, 1964; Garn, Lewis and Kerewsky, 1965 a and b; Garn, Lewis, Kerewsky and Jegart, 1965). However, in the papers by Lundström, Moorrees et al. and Garn et al., the population studied was stated or implied to be one for which tooth measurements had been published by the same authors in another paper.

De Jonge Cohen (1940), Begg (1954) and Brabant (1965) neither made sex differentiation of their mat:erial, nor provided statistical data in their publish:ed papers. Nelson (1938), Ballard (1944), Gabriel (1955) and Dahlberg (1961) published the standard dev:iations of the mean tooth dimensions of the Pecos Indian, American white, Australian aboriginal and Melanesian teeth which they examined, but did not make sex differentiation of their material. On the other hand, while Stein and Epstein (1934) and Garn, Lewis and Kerewsky (1964) divided their subjects according to/

to sex and in fact made a comparison of the mesiodistal diameters of the teeth in males and females, they did not publish standard deviations in their reports. In the papers by Smyth and Young (1932) and Filipsson and Goldson (1963) sex differentiation was made and stan:dard deviations were quoted, but in each case the mes:iodistal diameters of only two teeth were studied, and these results have not been used in the present comparisons. Beyron (1964) measured only the incisors of Australian aborigines and published no statistical constants. The results obtained by Yamada (1932) for the Japanese might have been suitable for purposes of comparison, but the original papers were unfortunately unobtainable and the tables published by Moorrees (1957) included only mean values and standard errors of the means for this material. Goose (1963) also published standard errors of the means instead of stan:dard deviations for his measurements of English 17th - 19th century teeth, and therefore a statistical com:parison could not be made between his results and those obtained for mediaeval Danes.

When those studies were eliminated, in which sex differentiation had not been made and/or statistical data/

data had not been supplied, there remained a small group of odontometrical publications, which provided results suitable for statistical comparison with those for mediaeval Danes. These were the papers by Hosaka (1936) on Chinese, Lundström (1944) and Seipel (1946) on Swedes, Pedersen (1949) on East Greenland Eskimos, Selmer-Olsen (1949) on Lapps, Thomsen (1955) on Tristanites, Moorrees (1957) on Aleuts, Moorrees et al (1957) on American Whites, Stähle (1959) on Swiss and Barrett et al (1963, 1964) on Australian aborigines.

A statistical comparison was carried out between each of these races and the mediaeval Danes in respect of tooth dimensions. At the same time a similar com:parison was made between the figures for mediaeval Danes and those published for mediaeval Swedes by Lysell (1958b).

In order to avoid constant repetition of the re:sults for mediaeval Danes, separate tables have not been constructed for each racial group. Instead, all the results for comparison of a dimension of a particular tooth have been collected in the same table. Separate tables have been compiled for the results in males and in females. Since these Tables 43 - 50 are/

are still somewhat cumbersome, they have been relegat-:ed to an Appendix.

The first of these comparisons to be considered was that between the Danes and the mediaeval Swedish skulls from Västerhus. This skeletal material was excavated in 1951 from a graveyard in Northern Sweden. The probable period of use of this cemetery was from the 11th to the 13th century A.D. (Lysell, 1958 a). Lysell pointed out that the material may not have been truly representative of the local population, since there were communications from the area both eastwards to the Bothnian Sea and westwards into Norway. Prob-:ably there were also some Lapps in the district.

Lysell's main aim in measuring the mesiodistal diameters of the permanent teeth in this mediaeval material was to demonstrate the rapid progress of attrition. He therefore measured the teeth of skulls belonging to three age groups - juvenile, adult and mature. The measurements obtained from the juvenile group were used for purposes of comparison in the present study, as it seemed that the teeth of these skulls would at least show no more attrition than those of mediaeval Danes, and probably less.

No/

No measurements were made of the labiolingual dimensions of the Västerhus teeth.

In almost every instance, the mean value recorded for the mesiodistal dimensions of the teeth of both males and females from Västerhus was quite considerably smaller than the corresponding mean values of the medi-:aeval Danish teeth. The single exception was the mesiodistal diameter of the maxillary third molar in the females, which was slightly larger in the Västerhus group.

No statistical comparisons could be made in the case of the females, since in no instance did the num-:ber of observations for a particular dimension exceed 8. The numbers of teeth measured in Västerhus males were also small, but were just sufficiently large to permit a statistical evaluation of the differences be-:tween the groups. In the case of the mandibular first molar this difference was significant at the level $P < 0.001$, and in the case of the maxillary first incisor and first premolar and the mandibular second incisor, canine, and first premolar the differences were significant at the level $P < 0.01$.

Thus in spite of the small numbers of measurements, some/

some of the teeth in Västerhus males could be shown to be significantly smaller in mesiodistal dimension than those of mediaeval Danes.

Tooth size in modern Swedes was examined first by Lundström (1944), who measured the mesiodistal diameters of all the permanent teeth except the second and third molars, in children attending the Eastman Institute in Stockholm. The measurements of incisors and canines were made directly in the mouth, while premolars and first molars were measured on models cast from hydrocolloid impressions. No labiolingual diameters were measured.

The mesiodistal measurements were published for right and left sides separately and those from the right side were chosen for comparison with the medi:aeval Danes.

The mesiodistal diameters of the teeth of males in Lundström's Swedish group were sometimes larger and sometimes smaller than those of mediaeval Danes. The incisors and first molars of both jaws were smaller in the Swedes, but none of the differences was sufficiently large to be significant. The upper canines were very slightly larger and the lower canines/

canines very slightly smaller in the Swedes. The only teeth which showed a marked difference in mesio:distal dimension in the two groups were the premol:ars of both jaws and these teeth were significantly larger in the Swedes than in the Danes.

All the teeth of the Swedish females were larger in mesiodistal diameter than those of the Danes, but the differences were in many instances very small and the only ones which were significant were those for the four premolars.

The Swedes studied by Seipel (1946) consisted of children of 4 who were patients at the Eastman Dental Institute in Stockholm, children of 13 from the municipal schools of Stockholm, and persons of 21 of whom the male section were conscripts to the Swedish Navy while the females were Post Office em:ployees, nurses and students. Approximately 500 individuals of each age group were examined and the sexes were almost equally represented.

Mesiodistal diameters of all the permanent teeth were measured, and these measurements were made dir:ectly on the teeth in the mouth. Since Seipel's main object was the study of spacing and crowding of the/

the dentition, no measurements were made of the lab:iolingual diameters of the teeth.

The mesiodistal diameters of the maxillary first molar, mandibular first incisor and mandibular first molar were smaller in Seipel's Swedish males than in mediaeval Danish males, but none of these differences could be shown to be significant. All the other teeth showed larger dimensions in the Swedes than in the Danes, and in the case of the maxillary canine, first premolar, second premolar, second molar and third molar, and the mandibular canine, first premol:ar, second premolar, second molar and third molar, the Swedish teeth were significantly larger than those of the Danes. Some of the differences were quite considerable.

In the females, only the maxillary third molar of the Danes presented a mesiodistal dimension which was larger than that of the Swedish females. No calculation of significance could be made for the third molar of either jaw in the females, since the numbers of observations were small and Seipel did not publish the standard deviations for these teeth. The mesiodistal diameters of all the other teeth except/

except the maxillary first molar, mandibular first molar and mandibular first incisor were significant-:ly larger in the mesiodistal dimension in the Swedish females.

It thus seemed that in the mesiodistal dimension, the teeth of mediaeval Danes were smaller, and some-:times considerably smaller, than the teeth of Seipel's group of Swedes.

Lysell (1958 b, 1960) stated that he measured both mesiodistal and labiolingual tooth diameters of modern Swedish children, on plaster models. With reference to the mesiodistal diameters, he remarked that these were similar to the results published by Lundström and Seipel. He did not quote the actual results he obtained and therefore the degree of sim-:ilarity could not be examined, but it should be noted that there were some quite considerable diff-:erences between Lundström's and Seipel's results - differences of a magnitude that would very probably give significant results were statistical tests app-:lied.

Apart from this, Lysell did not make any comment upon the very large difference between the mesiodistal diameters/

diameters of the teeth from the juvenile Västerhus material and of the teeth from the modern Swedish population as studied by Lundström and Seipel.

Stähle (1959) studied tooth size in Swiss children, probably from the Zürich area, in connection with the prediction of tooth size in orthodontic cases. The mesiodistal measurements of only the incisors, canines and premolars were made.

The maxillary central incisors and mandibular central and lateral incisors of Swiss males proved to be slightly smaller in mesiodistal diameter than those of the Danes. The maxillary lateral incisors and mandibular canines were slightly larger in the Swiss, while the maxillary canines and all the premolars were considerably larger in the Swiss, with differences which produced highly significant values of 't'.

For the females, all the mesiodistal dimensions were larger in the Swiss than in the Danes, and the differences were significant for all the teeth compared except the mandibular first incisor.

The general tendency was thus for the incisors, canines and premolars of modern Swiss to show rather larger/

larger mesiodistal diameters than did those of med-:iaeval Danes. This tendency was more marked in the females than in the males.

Mesiodistal diameters of the teeth of North American children of European stock were studied by Moorrees et al. (1957). All the teeth except the third permanent molars were measured, and in calcul-:ating mean values the average of the measurements from left and right sides of each individual was used. Measurements were made upon plaster casts. Labio-:lingual diameters were not measured.

The values of tooth dimensions in American Whites were sometimes larger and sometimes smaller than those for mediaeval Danes. The differences were often very small, and in relatively few instances was a signif-:icant difference recorded.

The teeth whose mesiodistal dimensions did show a significant difference between American Whites and mediaeval Danes were the same for both sexes - all the premolars and the second maxillary molar. In each case the American teeth showed a higher mean value than the Danish.

There appeared to be little difference in mesio-:distal/

:distal dimension between the teeth of American whites and mediaeval Danes, except in the case of the maxillary and mandibular premolars and the max-:illary second molar.

Selmer-Olsen (1949) carried out a detailed odon-:tometric study of the Lapp dentition. His material consisted of skulls excavated from six sites in the Finnmark district of northern Norway. They were believed to have become mixed to some extent with the Nordic population of Norway.

Both mesiodistal and labiolingual diameters of all the permanent teeth were measured, and in the statistical tables, measurements from both sides of the jaw were pooled in order to increase the amount of data available.

In a few instances the mean mesiodistal diameter of Lapp teeth was slightly larger than that of med-:iaeval Danes, but in general the Lapp teeth were smaller. In the males they were significantly smaller in several instances - the maxillary first incisor, first, second and third molars, and the man-:dibular first and third molars. In the females, a few more of the teeth showed a higher mean in Lapps. Only/

Only the three maxillary molars and the mandibular third molar were significantly smaller in the Lapp females, while the maxillary second incisor was sig-:nificantly larger in mesiodistal dimension in Lapps than in Danes.

With one exception (the mandibular second molar in the males) the labiolingual dimensions of Lapp teeth were smaller than those of Danish teeth. Significant differences were found for the maxillary canines, second premolars, first, second and third molars of both sexes, and for the mandibular canines, first and second premolars of both sexes.

Lapp teeth were therefore generally smaller in both dimensions than Danish teeth, and this was more consistent for labiolingual than for mesiodistal dia-:meters. A greater number of significant differen-:ces was found in males than in females for the mes-:iodistal dimension, but the teeth which gave sig-:nificant differences in labiolingual dimension were exactly the same in males and females.

In a general comparison of the teeth of mediae-:val Danes from Aebelholt and Naestved with those of other white groups, it may be stated that in mesiodistal/

mesiodistal dimension the Danes have larger teeth than mediaeval Swedes or Lapps, slightly smaller teeth than Lundström's Swedes or the American Whites, and distinctly smaller teeth than Seipel's Swedes and the Swiss.

It is difficult to judge to what extent these results represent the true relative sizes of the teeth in the various populations, or to what degree the measurements may have been affected by attrition or other distorting factors. Selmer-Olsen (1949) had already stated that the Lapps possessed small teeth compared to those of other races, and it is therefore not surprising to find that the Danish teeth are larger. On the other hand, the small di-:mensions of the Västerhus teeth compared to those of the Danes are unexpected. The difference cannot be accounted for solely on the basis of attrition, since the Västerhus skulls from which the measure-:ments were obtained are those of juveniles. The Danish skulls are mostly those of young adults, and their teeth would therefore have been expected to show slightly more attrition. It is possible that there was an even higher proportion of Lapp blood in/

in the Västerhus population than Lysell (1958 a) suggested.

There is a considerable degree of variation in the mesiodistal dimensions recorded for the teeth of the four modern White populations. The figures reported by Seipel for Swedes and by Stähle for Swiss children are almost all higher than those recorded by Lundström for Swedish children and Moorrees for American white children. Perhaps the most surpris-:ing difference is that between the two groups of Swedish children, both of which derived from Stockholm. These differences appear to be rather more pronounced in the males than in the females.

For labiolingual tooth dimensions, the Danes can only be compared with the Lapps, whose teeth are found to be smaller in this dimension than those of the Danes. It is unfortunate that no statistical data are available concerning the labiolingual dia-:meters of the teeth of any modern white group other than the Lapps, since attrition affects the labio-:lingual dimensions less than the mesiodistal dimen-:sions.

Since there were some fairly large differences in/

in mesiodistal diameter between the teeth of mediae-:val Danes and those of modern Swedes, Swiss and American Whites, and especially since the Danish teeth tended to be smaller than the teeth of these modern white groups, it was considered worthwhile to examine the results obtained by Goose (1963) from "modern" (i.e. 17th - 19th century) English skulls. Mesiodistal and labiolingual measurements had been recorded in this material from all the maxillary teeth except the first incisors, and sex differen-:tiation was made. No results were published for mandibular teeth. It has already been stated that no statistical comparisons could be made using this English material, since the standard deviations of the tooth measurements had not been published.

Mean values and numbers of observations for the Danish and English populations have been listed in Tables 51 and 52.

TABLE 51.

Mesiodistal dimensions of maxillary teeth in mediaeval Danes and 17th - 19th century English.

Males

	Danes		English	
	n	$\bar{x}$	n	$\bar{x}$
I^2	33	6.78	10	6.35
C	62	7.76	17	7.70
P^1	58	6.73	38	6.54
P^2	49	6.52	43	6.49
M^1	31	10.79	65	10.49
M^2	72	9.63	57	9.51
M^3	88	8.87	35	8.82

Females

	Danes		English	
	n	$\bar{x}$	n	$\bar{x}$
I^2	70	6.37	4	6.12
C	97	7.44	8	7.42
P^1	97	6.54	16	6.40
P^2	87	6.33	15	6.30
M^1	76	10.31	31	10.22
M^2	105	9.17	26	9.23
M^3	77	8.47	14	8.45

TABLE 52.

Labiolingual dimensions of maxillary teeth in med-:iaeval Danes and 17th - 19th century English.

Males

	Danes		English	
	n	$\bar{x}$	n	$\bar{x}$
I^2	43	6.46	10	6.38
C	62	8.47	17	8.46
P^1	81	8.99	38	8.82
P^2	84	9.16	42	9.26
M^1	60	11.54	65	11.46
M^2	94	11.29	61	11.48
M^3	95	10.63	27	11.04

Females

	Danes		English	
	n	$\bar{x}$	n	$\bar{x}$
I^2	83	6.09	3	5.97
C	102	8.00	7	7.97
P^1	118	8.68	14	8.62
P^2	111	8.77	14	8.91
M^1	99	11.04	32	11.02
M^2	112	10.92	24	10.90
M^3	79	10.14	7	10.80

Of the 28 mean measurements recorded for the modern English teeth, 22 were smaller than the corr:esponding diameter of mediaeval Danish teeth, though in most instances the difference was not very great. Only 3 tooth dimensions in the modern English group gave a mean value which was markedly larger than that of mediaeval Danes.

In contrast to the teeth of modern Swedes, Swiss and American Whites, the teeth of 17th - 19th century English skulls appear to be slightly smaller than those of mediaeval Danes.

The remaining population groups for which odonto:metric data was available were all of coloured or mixed coloured and white origin.

In 1955 Thomsen's odontological survey of the population of Tristan da Cunha was published. This study was made on dental casts of the entire popul:ation of 188 individuals who were living on Tristan da Cunha in 1937. The inhabitants of this remote island are of mixed white, negroid and Malayan stock, and as a result of their isolation have undergone very considerable inbreeding. Mesiodistal diameters of all the permanent teeth were measured, and

labiolingual/

labiolingual diameters were also recorded for all but the permanent incisors.

A few of the mesiodistal diameters in male Tristanites were slightly smaller than the values for Danes, but most of them were larger, and those for the maxillary first premolar and second molar and for the mandibular second premolar were signif:icantly larger in Tristanites. The mesiodistal diameters in female Tristanites were consistently larger than in Danes, and the differences were sig:nificant in the case of the maxillary first incisor, canine, first and second premolars and second molars, and of the mandibular second incisor, canine, first and second premolars and second molar.

No results were available for incisors, but the labiolingual diameters of all the other teeth in Tristanites of both sexes were larger than the corr:esponding diameters of Danish teeth. The differ:ences were very great, in the order of 1-2 m.m., and were all significant, with very high values of 't'.

The teeth of Tristanites were in general larger than those of mediaeval Danes and this was particularly marked/

marked in the labiolingual dimension. In the mesio-:distal dimension the difference between the two racial groups was more marked in the females than in the males.

The Chinese teeth, whose measurements were pub-:lished by Hosaka in 1936, were obtained from Man-:churia, and were said by Moorrees (1957) to be de-:rived from males only. Measurements of all the permanent teeth were made in both mesiodistal and labiolingual dimensions. These measurements appear to have been taken on the teeth themselves, but the material and methods were only briefly mentioned in the short German summary, while the text of the paper was in Japanese.

Some of these Chinese teeth were larger in the mesiodistal dimension than those of the Danes, while others were smaller. The canines, first and second premolars of both jaws were significantly larger in the Chinese, while the first maxillary molar of this group was significantly smaller in mesiodistal dia-:meter than the corresponding tooth in the Danish males.

In the labiolingual dimension also, the Chinese teeth

teeth were sometimes larger and sometimes smaller than those of the Danes. Significant differences were recorded for the first premolar of both jaws and for the mandibular second molar. In each case the Chinese teeth were larger.

There did not appear to be any obvious and con:sistent size relationship between Chinese and med:iaeval Danish teeth. For both mesiodistal and lab:iolingual dimensions, now one group and now the other showed the larger value. The first premolar in both jaws was larger in both dimensions in the Chinese, and the second premolars and canines were significantly larger in the mesiodistal dimension only. Otherwise there seemed to be no consistent difference in tooth size between the groups.

The Aleuts examined by Moorrees (1957) formed the total population (156 individuals) of the Aleutian Islands in 1948. These people are a Mongoloid race, in whom two different Eskimoid strains can be detect:ed. There is a slight white admixture, mostly due to the advent of Russian fur traders in the latter part of the 18th century.

Measurements were made on plaster casts from impressions/

impressions taken in the field. The study was an anthropological one, and the teeth were measured in both mesiodistal and labiolingual dimensions. Since the available material was rather small, teeth from both sides were measured and the measurements were pooled.

Some of the Aleut teeth were smaller in the mesiodistal dimension, but the majority were larger than in the Danes, and in a number of these the differences were significant. The following teeth were significantly larger in mesiodistal dimension in male Aleuts than in Danes : maxillary second incisor, canine, first premolar; mandibular canine, second premolar and second molar. The number of significantly larger teeth increased in the female Aleuts to ten, with the addition to the above list of the maxillary second premolar and second molar and of the mandibular first premolar and third molar.

All but two of the labiolingual dimensions of the teeth of Aleut males were larger than the corresponding diameters of Danish teeth. Only two of these showed significant differences - the maxillary first premolar and the mandibular second molar.

The/

The teeth of female Aleuts all had larger labiolingual diameters than those of Danish females, and the diff:erences were significant in the case of the maxillary first premolar, and of the mandibular first premolar, second premolar, second molar and third molar.

Aleut teeth tended to be rather larger in both dimensions than those of mediaeval Danes. This diff:erence was more pronounced in females than in males, and was also rather more marked in mandibular than in maxillary teeth.

The Eskimos studied by Pedersen (1949) derived from East Greenland, and had received no admixture of white blood. Tooth measurements were made upon 52 skulls, and both mesiodistal and labiolingual dia:meters were measured in all the permanent teeth ex:cept the incisors. Measurements were given separ:ately for the two sides, and those from the right side were used for comparison in the present study. Since the amount of material was small, the numbers of measurements in many instances were too few to permit of a full statistical comparison.

The mesiodistal dimensions of all the teeth studied in the Eskimos were larger than those of the mediaeval/

mediaeval Danes. Statistical tests of significance could be carried out only for the three maxillary molars and three mandibular molars of males, and for the maxillary first molar of females. Of these seven calculations, three provided statistically sig-:nificant results - for the maxillary second and third molars and the mandibular second molar of males.

Most of the labiolingual diameters of the Eskimo teeth were also larger than those of Danes. Five teeth in the females, the maxillary canine, first premolar and second premolar, and the mandibular can-:ine and second premolar, were exceptions, being smaller in Eskimos than in Danes. The numbers of observations recorded in these cases were extremely small.

Calculations could be carried out for the same teeth as with the mesiodistal dimensions. Signif-:icant differences in labiolingual dimension were recorded for the maxillary third molar and the man-:dibular first, second and third molars of males.

The evidence suggested that most Eskimo teeth were considerably larger than those of Danes. The differences would probably have shown greater statistical/

statistical significance had the numbers of obser-:vations been larger.

Barrett and his colleagues (1963, 1964) recent-:ly published studies of tooth dimensions in the Wailbri tribe of Australian aborigines, who live in Central Australia. Measurements were made on casts of the dentition, and were reported separately for mesiodistal (1963) and labiolingual (1964) dimensions. In the statistical preparation of the data, the aver-:age of the measurements from left and right sides was used.

All the teeth of Australian aborigines of both sexes were considerably larger in mesiodistal dimen-:sion than were the corresponding teeth of the medi-:aeval Danish population. Apart from the mandibular first incisor of males, where lack of data in the Danish group precluded statistical comparison, the differences for all teeth were shown to be statistic-:ally significant, and the values of 't' were ex-:tremely large.

The labiolingual diameters of the teeth of both sexes were also consistently larger in the Australian aborigines than in mediaeval Danes. All the differences/

differences proved to be significant, with very high values of 't'.

Australian aborigines have long been said to possess very large teeth (e.g. Campbell, 1925), and it is therefore to be expected that there should be a considerable difference in size when compared to the mediaeval Danes.

As well as comparing the dimensions of the Dan-:ish dentition with those of each race in turn, the position of each tooth dimension of the Danes, in comparison with the values recorded for the other races, may be briefly examined.

The relative positions of the different groups studied, varied with each tooth dimension. With one or two exceptions, the Danish teeth occupied positions fairly low in the rank order of size. Only mediaeval Swedes and Lapps were consistently placed lower.

In the mesiodistal dimension, the maxillary central incisors and first molars and the mandibular first incisors, second incisors and first molars of mediaeval Danish males were relatively large in com-:parison with those of other groups, while in the females/

females the same teeth occupied intermediate positions in the rank order of size. All other mesiodistal dimensions were small compared with those of other groups, and this was particularly marked in the case of the premolars.

For labiolingual dimensions, the comparisons were mainly with coloured groups, and the Danish teeth were generally low in the rank order of size, except for the first maxillary molar, where the Danish males took up an intermediate position.

D. Discussion.

It is hardly surprising that mediaeval Danish tooth dimensions should be small in comparison with those of coloured races, since various workers have already reached similar conclusions concerning the relative size of teeth in white and coloured races (Campbell, 1925; Drennan, 1929; Shaw, 1931; Goose, 1963; Barrett et al 1963, 1964). But it is unexpected to find that mediaeval Danish teeth also tend, in general, to be smaller than the teeth of modern white races, particularly Seipel's Swedes and Stähle's Swiss. To what extent the differences may/

may be due to variations in measuring technique, or to attrition in the Danish material, cannot be determined. In view of the results obtained by measuring the teeth of the Danish children from Aebelholt, it seems unlikely that attrition can account for the entire difference in tooth dimensions.

If possible inaccuracies in the measurements are disregarded, an examination of the results in the present study and of the results of other workers suggests that the teeth of European races gradually diminished in size from Mesolithic times to the early centuries of the Christian era, and then increased slightly from mediaeval times to the present. There are some inconsistencies in the results : for instance, mediaeval Swedish teeth are smaller, and Belgian Merovingian and mediaeval teeth appear to be larger, than those of mediaeval Danes. Also, 17th - 19th century English teeth seem to be slightly smaller than those of mediaeval Danes. Nevertheless, the fact that mediaeval Swedish, mediaeval Danish and 17th - 19th century English teeth are all smaller than the teeth of four 20th century white groups does suggest a gradual increase in tooth dimensions/

dimensions, at least over the last few centuries. If this apparent increase in tooth size is real, then an explanation must be sought.

Such processes of increase or decrease in the size of organisms or organs are generally ascribed to genetic changes. Tooth size has been consider-:ed to be genetically determined (e.g. Goose, 1962, 1963), but Møller (1965) has recently pointed out that changes in nutrition or in trace elements in the diet may also affect tooth size in humans. Similar results have been obtained from experimental animals by several workers, including Paynter and Grainger (1956, 1962), Holloway, Shaw and Sweeney (1961) and Kruger (1962).

It is a well-established fact that the average height of adult individuals of European origin has been increasing, at least since 1880, by about 1 c.m. per decade, and this increase in body size is usually attributed to improved nutrition and environment (Tanner, 1962). Though Filipsson and Goldson (1963) could not demonstrate any correlation between tooth size and stature, it does not seem unreasonable to suggest that a general increase in body size in a population/

population might be accompanied by an increase in tooth size, if the factors involved were those that affected the determination of tooth size.

Goose (1962) observed a reduction in the size of the palate in modern individuals, when compared with palate size in Romano-Britons and Anglo-Saxons, and attributed this decrease in palate size to dim-:inished function of the jaws subsequent to the in-:troduction of a softer diet in 17th century Britain. Goose also pointed out that this reduction of the size of the palate reduced the size of the alveolar pro-:cess of the jaw and led to crowding of the teeth. If the teeth are becoming slightly larger due to im-:proved diet, while the dental arches are diminishing as a result of decreasing function, then the problem of crowding of the dentition will be increased still further.

CROWN PROPORTION IN MEDIAEVAL DANES

As well as studying the individual tooth dimen-:sions, some workers have used combinations of these measurements in an attempt to express overall crown size or crown shape. Three of these calculated fun-:ctions have been used by different authors. Two of them, the crown area or robustness value, and the crown module, have already been described in Chapter 5. The robustness value has been used in the study of rank order of molar size, where a general express-:ion of crown size was required. Apart from this, the use of the robustness value and the crown module did not seem necessary in the present study, since the size of the tooth crowns had been examined in detail by means of a study of the mesiodistal and labiolingual diameters separately, a procedure which seemed to the writer to be preferable on account of its greater accuracy.

The third quantity calculated from mesiodistal and labiolingual diameters is the crown index, ob-:tained by the formula :

$$\text{Crown index} = \frac{\text{labiolingual diameter} \times 100}{\text{mesiodistal diameter}}$$

The/

The crown index attempts to express numerically the proportions or shape of the tooth crown. Its con:struction and use are similar to those of the anth:ropological indices commonly used in the study of shape and proportion in the skull, face and other parts of the skeleton.

Previous work with the crown index had not pro:vided any clear-cut results. Thomsen (1955) and Moorrees (1957) both found that the crown indices gave less evidence of sex and racial differences than did the mesiodistal and labiolingual diameters themselves. Selmer-Olsen (1949) and Pedersen (1949) observed racial differences in crown indices in dealing with Lapp and East Greenland Eskimo material, but Selmer-Olsen found no marked sex differences in the Lapps. In other words, teeth appeared to differ more in actual size than they did in shape. Similar results had been obtained by the writer in studying the prehistoric Scottish material. Nevertheless, it was decided that for the sake of completeness an examination of the crown indices should be included in the present study of the mediaeval Danish dentit:ion, particularly since no data had been published concerning/

concerning crown indices in any recent Indo-European racial group.

The numbers of crown indices calculated were rather lower than the numbers of mesiodistal and lab-:iolingual diameters available, since frequently only one of these measurements could be recorded from a particular tooth. The same procedure was used as in dealing with the absolute measurements : the indices were calculated only for the teeth from the right side of each individual, with substitution from the left where the index from the right side could not be calculated.

A. Sex comparison of crown proportions in Aebelholt and Naestved groups.

Comparisons were made between the mean crown indices calculated for the males and females of each Danish population, and between Aebelholt males and Naestved males, Aebelholt females and Naestved fe-:males.

The comparison between mean crown indices of the teeth of Aebelholt males and Aebelholt females is presented in Tables 53 and 54 and Figs. 26 and 27.

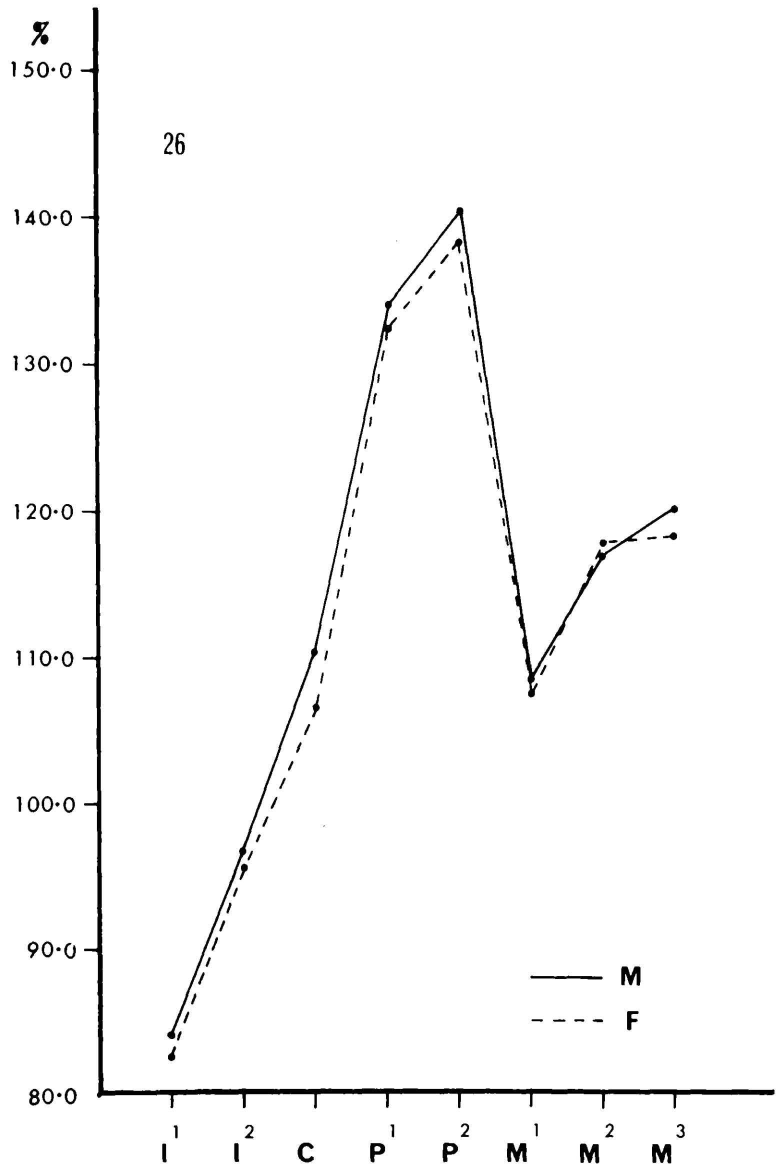

Fig. 26. Mean values of the crown indices of the maxillary teeth in males and females of the Aebelholt group.

TABLE 53.

Mean crown indices of maxillary teeth in the Aebelholt group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	8	84.1	4.5	5.4	1.5	0.63
	F	27	82.6	6.3	7.6		
I^2	M	10	96.9	11.3	11.7	1.4	0.44
	F	30	95.5	7.7	8.1		
C	M	22	110.4	5.1	4.6	4.0	2.92**
	F	39	106.4	5.1	4.8		
P^1	M	24	134.2	6.8	5.1	1.9	1.22
	F	39	132.3	5.5	4.2		
P^2	M	20	140.5	8.1	5.8	1.9	1.04
	F	32	138.6	5.1	3.7		
M^1	M	14	108.5	5.2	4.8	1.0	0.65
	F	30	107.5	4.5	4.2		
M^2	M	36	117.1	6.4	5.5	0.8	0.44
	F	46	117.9	9.2	7.8		
M^3	M	49	120.3	9.5	7.9	2.0	0.97
	F	33	118.3	8.7	7.4		

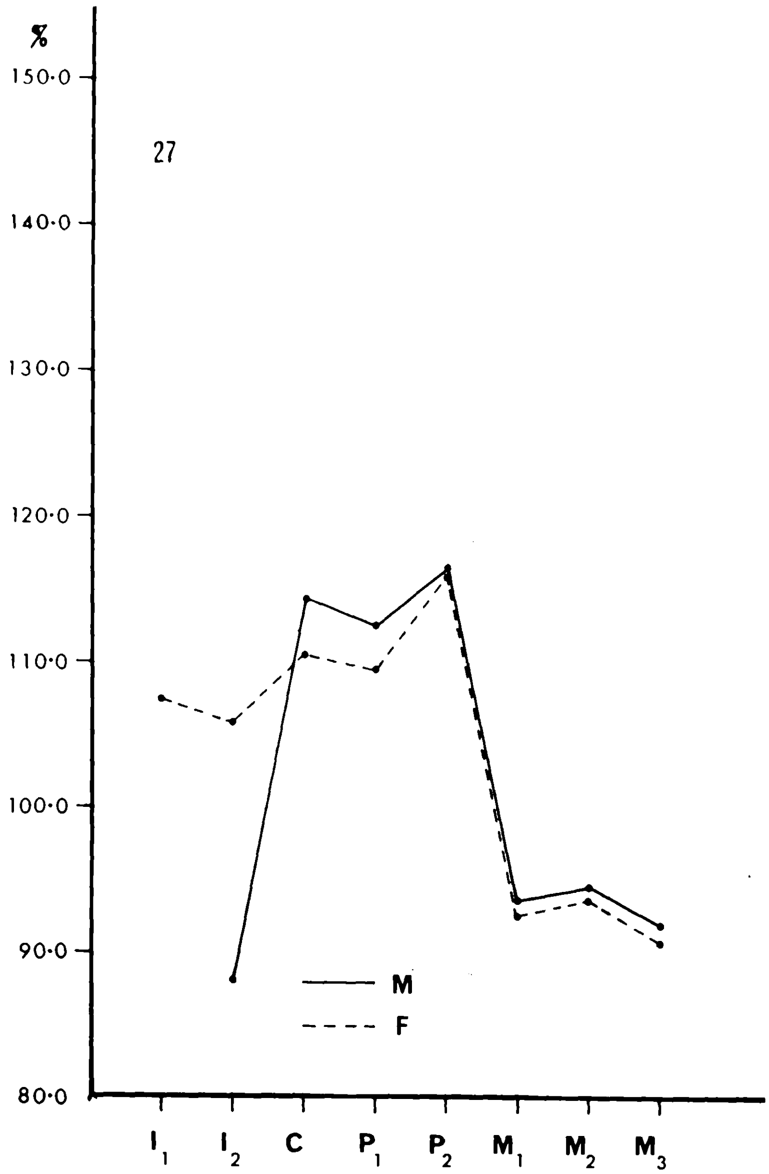

Fig. 27. Mean values of the crown indices of the mandibular teeth in males and females of the Aebelholt group.

TABLE 54.

Mean crown indices of mandibular teeth in the Aebelholt group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	1	-	-	-	-	-
	F	5	107.6	2.9	2.7		
I_2	M	2	88.2	-	-	-	-
	F	12	105.9	4.6	4.3		
C	M	12	114.5	5.3	4.6	3.9	2.32*
	F	30	110.6	4.8	4.3		
P_1	M	19	112.8	5.2	4.6	3.2	2.29*
	F	40	109.6	4.9	4.5		
P_2	M	22	116.6	6.7	5.7	0.6	0.38
	F	34	116.0	5.0	4.3		
M_1	M	9	93.6	2.7	2.9	0.9	0.61
	F	25	92.7	4.1	4.4		
M_2	M	23	94.7	3.4	3.6	0.9	0.88
	F	40	93.8	4.2	4.5		
M_3	M	32	92.1	6.1	6.6	1.3	1.02
	F	28	90.8	3.2	3.5		

The comparison of crown indices of the teeth of Aebelholt males and females showed that there was little sex difference in tooth shape in this popul-:ation, though the crown indices were almost always slightly higher in the males than in the females.

The canines were the teeth in which sex differ-:ence appeared to be most pronounced. Maxillary and mandibular canines both showed significant diff-:erences in crown index between males and females, though the level of significance was not very high. The only other tooth for which a significant sex difference in crown proportions could be demonstrated was the mandibular first premolar.

In each of these three comparisons, the crown index of the teeth of males was rather higher than that of the females, indicating that in the males the teeth were proportionately, as well as actually, greater in the labiolingual diameter than they were in the females.

The crown indices for the Aebelholt children's teeth have been listed in Table 55.

TABLE 55.

Crown indices in Aebelholt children.

Maxilla.

Tooth	n	$\bar{x}$	s
I^1	34	82.1	5.14
I^2	30	92.4	5.76
C	32	106.8	5.56
P^1	29	129.8	4.73
P^2	26	132.7	5.60
M^1	66	108.5	3.95
M^2	31	118.9	7.52

Mandible

Tooth	n	$\bar{x}$	s
I_1	37	106.8	6.72
I_2	39	104.6	6.33
C	38	113.6	5.74
P_1	35	108.3	5.25
P_2	31	112.7	4.42
M_1	65	90.4	3.62
M_2	27	90.7	3.65

The crown indices calculated for the teeth of the Aebelholt children were fairly close to those of the adults. Sometimes the value lay between that of the males and of the females, sometimes close to that of the females, and in some cases a little below that of the females. The teeth for which the difference between crown index in the adults and crown index in the children was most noticeable were the maxillary second incisor and both premolars, and the mandibular second premolar and first and second molars. In each case this could be related to a low value for the labiolingual diameter of the tooth in the children as compared to the values recorded in adults. The possible reasons for the smaller mean values of some tooth dimensions in the Aebelholt children have been discussed in Chap. 5.

The crown indices of Naestved males and females are compared in Tables 56 and 57 and Figs. 28 and 29.

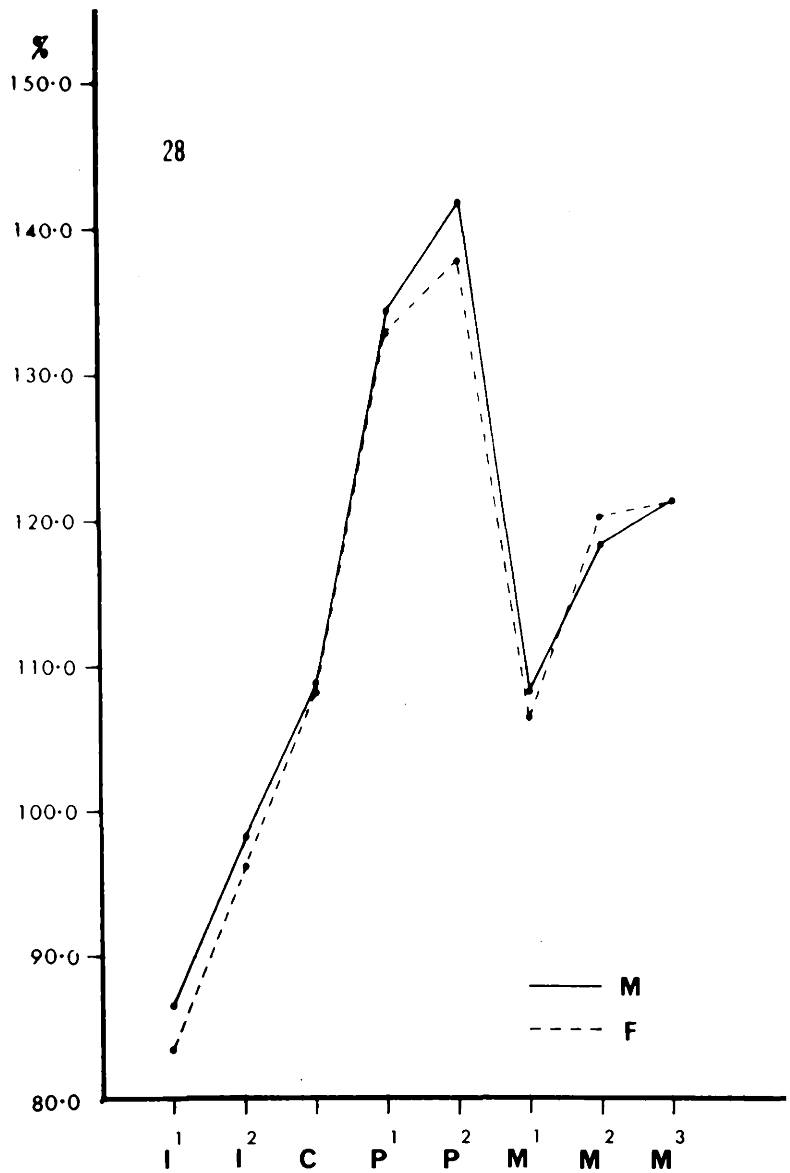

Fig. 28. Mean values of the crown indices of the maxillary teeth in males and females of the Naestved group.

TABLE 56.

Mean crown indices of maxillary teeth in the Naestved group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I^1	M	13	86.8	6.9	7.9	2.9	1.53
	F	22	83.9	4.4	5.2		
I^2	M	17	98.4	10.1	10.3	2.1	0.76
	F	30	96.3	8.5	8.8		
C	M	28	109.0	5.1	4.7	0.5	0.33
	F	48	108.5	6.9	6.4		
P^1	M	28	134.6	6.3	4.7	1.4	1.05
	F	48	133.2	5.2	3.9		
P^2	M	27	142.2	6.2	4.4	4.1	2.40*
	F	44	138.1	7.4	5.4		
M^1	M	17	108.4	4.1	3.8	1.9	1.67
	F	43	106.5	4.0	3.8		
M^2	M	33	118.4	7.3	6.2	2.0	1.23
	F	57	120.4	7.5	6.2		
M^3	M	37	121.5	8.9	7.3	0.1	0.05
	F	41	121.4	9.2	7.6		

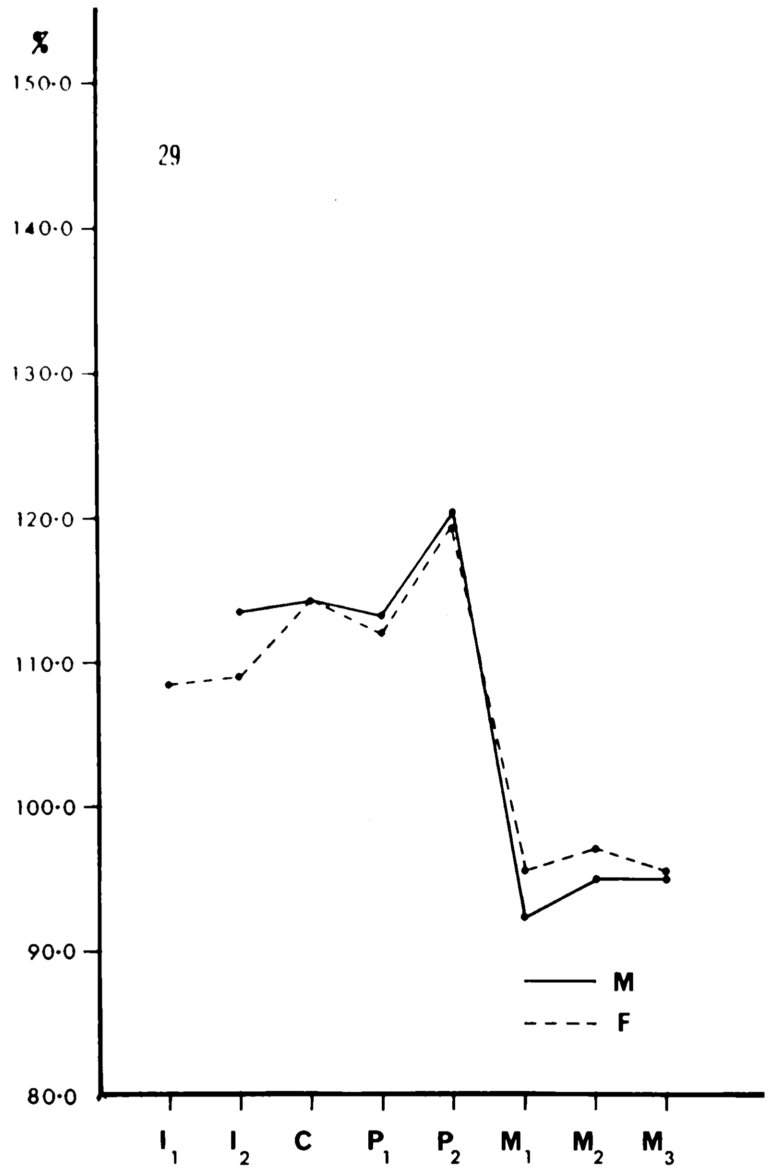

Fig. 29. Mean values of the crown indices of the mandibular teeth in males and females of the Naestved group.

TABLE 57.

Mean crown indices of mandibular teeth in the Naestved group ; comparison of males and females.

Tooth	Sex	n	$\bar{x}$	s	v	d	t
I_1	M	0	-	-	-	-	-
	F	6	108.5	5.3	4.9		
I_2	M	2	113.7	-	-	-	-
	F	14	109.0	7.3	6.7		
C	M	16	114.3	4.2	3.7	0.1	0.06
	F	34	114.2	5.9	5.2		
P_1	M	26	113.3	8.1	7.1	1.1	0.61
	F	46	112.2	6.9	6.1		
P_2	M	28	120.5	7.1	5.9	1.1	0.65
	F	45	119.4	7.0	5.9		
M_1	M	18	92.3	3.9	4.2	3.2	2.96**
	F	32	95.5	3.5	3.7		
M_2	M	30	95.0	5.1	5.4	2.1	1.88
	F	44	97.1	4.5	4.6		
M_3	M	34	95.0	5.0	5.3	0.5	0.42
	F	40	95.5	5.2	5.4		

In the Naestved group also, the crown indices in the males were usually slightly higher than the indices in the females, though sometimes the reverse was the case.

The differences between male and female proved to be statistically significant in only two teeth : the maxillary second premolar and the mandibular first molar. In the case of the maxillary second premolar, the males had teeth which were proportion:ately greater in the labiolingual dimension. The index was higher in females than males for the man:dibular first molar, and in this instance it would be more accurate to say that the female tooth was relatively smaller in the mesiodistal diameter than that in the male.

There did not appear to be any marked differen:ces in crown shape, as represented by the crown in:dex, between males and females of either Aebelholt or Naestved group.

B. Comparison of crown proportions in Aebelholt and Naestved groups.

Comparisons were next made between males of the Aebelholt/

Aebelholt and Naestved groups, and the results of these comparisons are given in Tables 58 and 59 and Figs. 30 and 31.

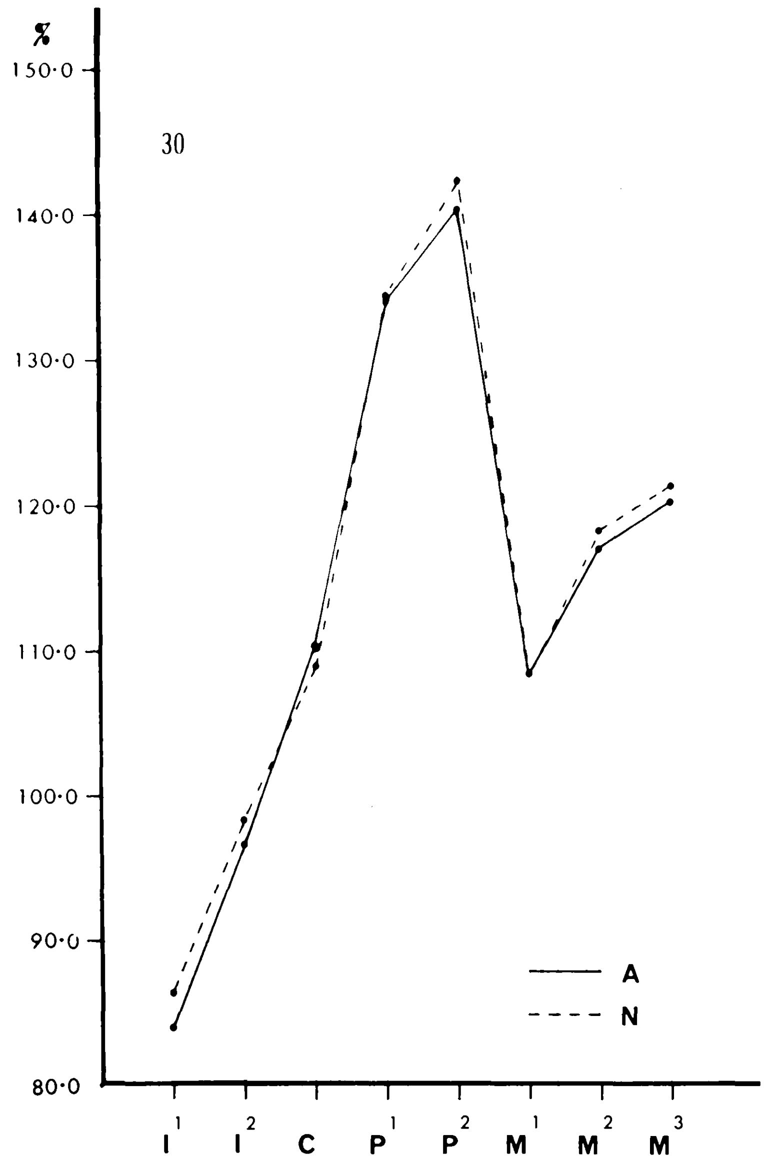

Fig. 30. Mean values of the crown indices of the maxillary teeth in Aebelholt males and Naestved males.

TABLE 58.

Mean crown indices of maxillary teeth in mediaeval Danes ; comparison of Aebelholt males and Naestved males.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I^1	A	8	84.1	4.5	5.4	2.7	0.99
	N	13	86.8	6.9	7.9		
I^2	A	10	96.9	11.3	11.7	1.5	0.36
	N	17	98.4	10.1	10.3		
C	A	22	110.4	5.1	4.6	1.4	0.96
	N	28	109.0	5.1	4.7		
P^1	A	24	134.2	6.8	5.1	0.4	0.22
	N	28	134.6	6.3	4.7		
P^2	A	20	140.5	8.1	5.8	1.7	0.82
	N	27	142.2	6.2	4.4		
M^1	A	14	108.5	5.2	4.8	0.1	0.06
	N	17	108.4	4.1	3.8		
M^2	A	36	117.1	6.4	5.5	1.3	0.79
	N	33	118.4	7.3	6.2		
M^3	A	49	120.3	9.5	7.9	1.2	0.60
	N	37	121.5	8.9	7.3		

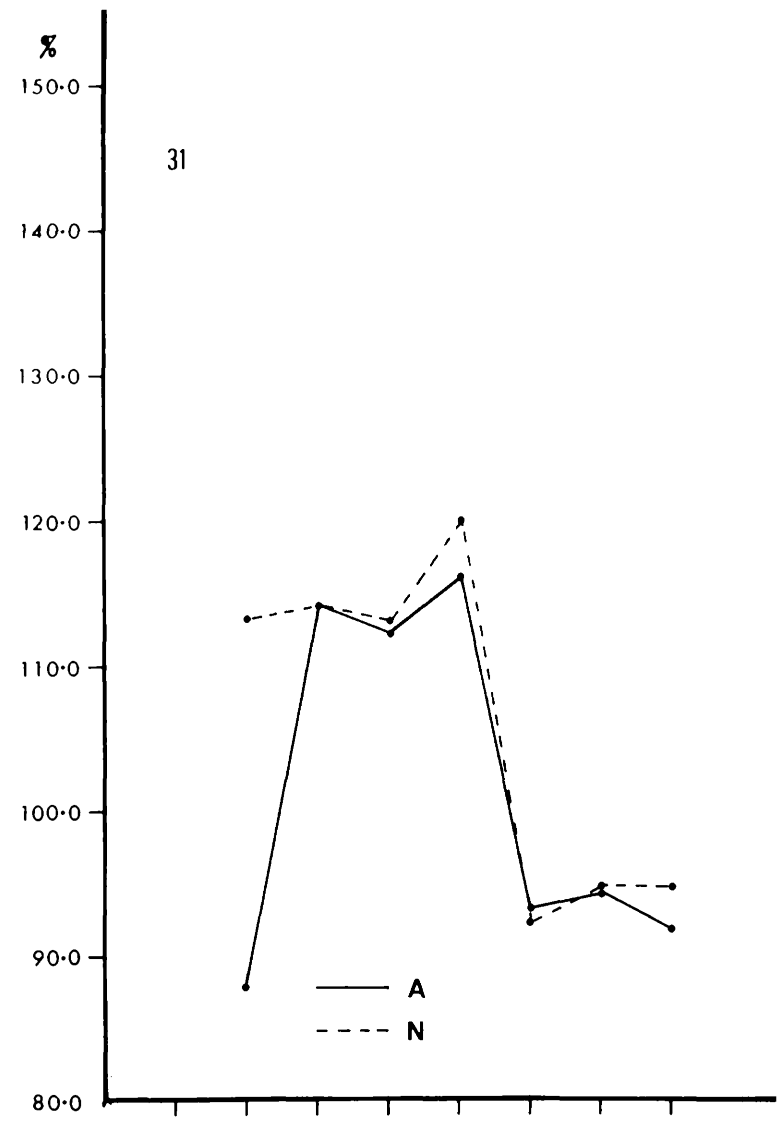

Fig. 31. Mean values of the crown indices of the mandibular teeth in Aebelholt males and Naestved males.

TABLE 59.

Mean crown indices of mandibular teeth in mediaeval Danes ; comparison of Aebelholt males and Naestved males.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I_1	A	1	-	-	-	-	-
	N	0	-	-	-		
I_2	A	2	88.2	-	-	-	-
	N	2	113.7	-	-		
C	A	12	114.5	5.3	4.6	0.2	0.11
	N	16	114.3	4.2	3.7		
P_1	A	19	112.8	5.2	4.6	0.5	0.23
	N	26	113.3	8.1	7.1		
P_2	A	22	116.6	6.7	5.7	3.9	1.99*
	N	28	120.5	7.1	5.9		
M_1	A	9	93.6	2.7	2.9	1.3	0.89
	N	18	92.3	3.9	4.2		
M_2	A	23	94.7	3.4	3.6	0.3	0.24
	N	30	95.0	5.1	5.4		
M_3	A	32	92.1	6.1	6.6	2.9	2.12*
	N	34	95.0	5.0	5.3		

No statistically significant difference in crown index could be demonstrated in the maxillary teeth of Aebelholt and Naestved males, though the indices were usually very slightly higher in the latter.

The mandibular crown indices were also in general slightly higher in the Naestved males than in the Aebelholt males, and the differences in the case of the second premolar and third molar were just sufficiently large to show significance at the lowest level $P < 0.05$.

On the whole, however, the crown indices of Aebelholt and Naestved males were very similar.

A comparison of crown indices in the females of the two groups is shown in Tables 60 and 61 and Figs. 32, 33.

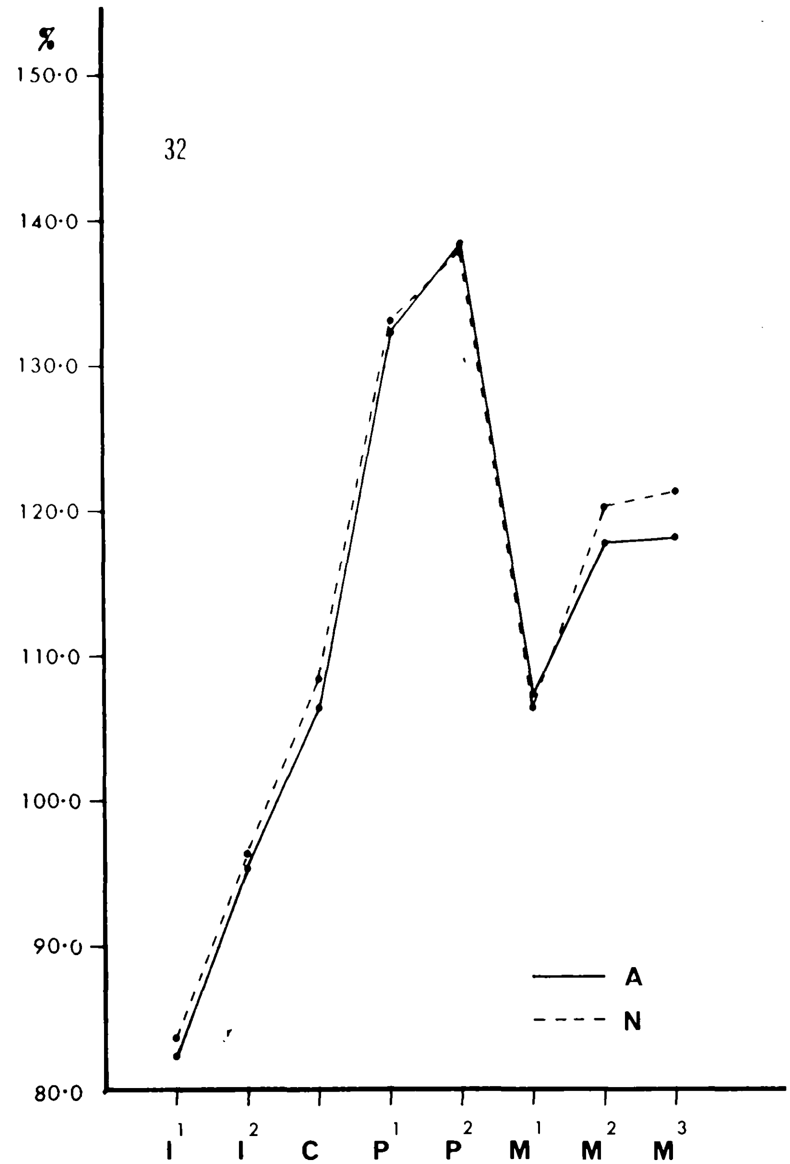

Fig. 32. Mean values of the crown indices of the maxillary teeth in Aebelholt females and Naestved females.

TABLE 60.

Mean crown indices of maxillary teeth in mediaeval Danes ; comparison of Aebelholt females and Naestved females.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I^1	A	27	82.6	6.3	7.6	1.3	0.82
	N	22	83.9	4.4	5.2		
I^2	A	30	95.5	7.7	8.1	0.8	0.38
	N	30	96.3	8.5	8.8		
C	A	39	106.4	5.1	4.8	2.1	1.58
	N	48	108.5	6.9	6.4		
P^1	A	39	132.3	5.5	4.2	0.9	0.79
	N	48	133.2	5.2	3.9		
P^2	A	32	138.6	5.1	3.7	0.5	0.33
	N	44	138.1	7.4	5.4		
M^1	A	30	107.5	4.5	4.2	1.0	1.00
	N	43	106.5	4.0	3.8		
M^2	A	46	117.9	9.2	7.8	2.5	1.52
	N	57	120.4	7.5	6.2		
M^3	A	33	118.3	8.7	7.4	3.1	1.48
	N	41	121.4	9.2	7.6		

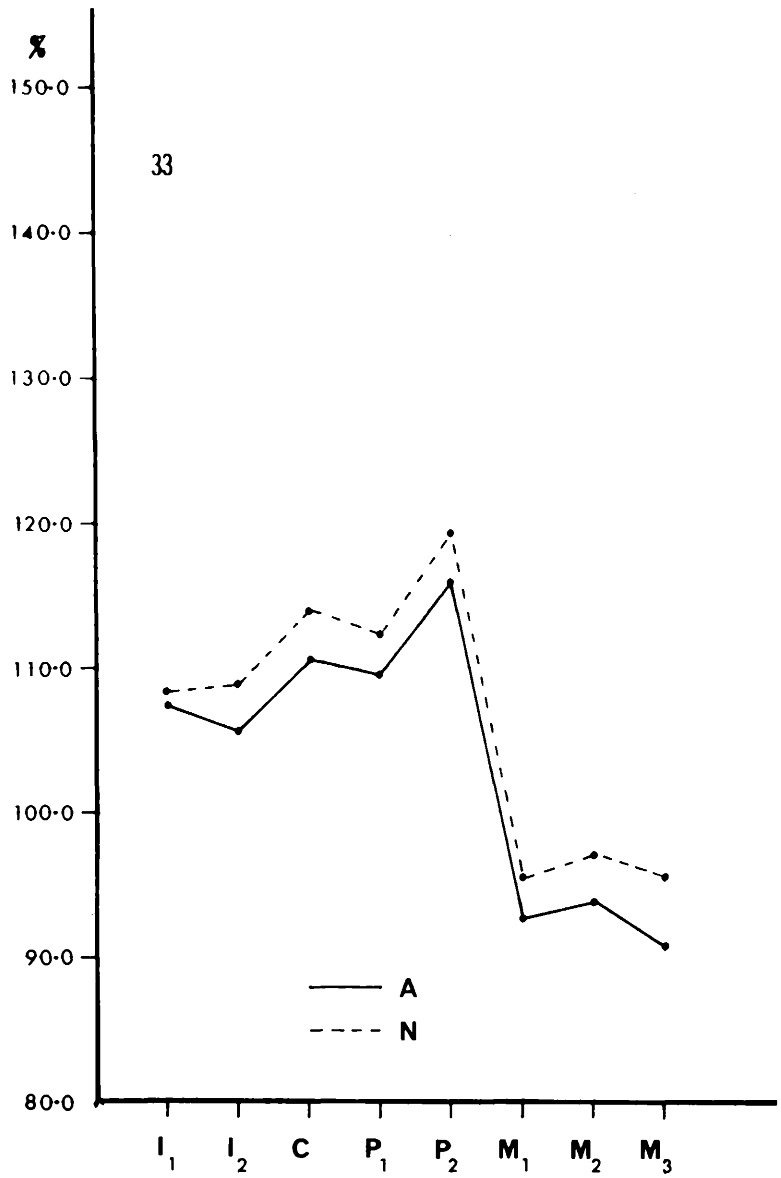

Fig. 33. Mean values of the crown indices of the mandibular teeth in Aebelholt females and Naestved females.

TABLE 61.

Mean crown indices of mandibular teeth in mediaeval Danes ; comparison of Aebelholt females and Naestved females.

Tooth	Group	n	$\bar{x}$	s	v	d	t
I_1	A	5	107.6	2.9	2.7	0.9	0.34
	N	6	108.5	5.3	4.9		
I_2	A	12	105.9	4.6	4.3	3.1	1.27
	N	14	109.0	7.3	6.7		
C	A	30	110.6	4.8	4.3	3.6	2.67**
	N	34	114.2	5.9	5.2		
P_1	A	40	109.6	4.9	4.5	2.6	1.98
	N	46	112.2	6.9	6.1		
P_2	A	34	116.0	5.0	4.3	3.4	2.39*
	N	45	119.4	7.0	5.9		
M_1	A	25	92.7	4.1	4.4	2.8	2.75**
	N	32	95.5	3.5	3.7		
M_2	A	40	93.8	4.2	4.5	3.3	3.51***
	N	44	97.1	4.5	4.6		
M_3	A	28	90.8	3.2	3.5	4.7	4.23***
	N	40	95.5	5.2	5.4		

The crown indices of maxillary teeth showed no significant differences between Aebelholt and Naestved females. The values for the Naestved teeth were us-:ually slightly larger, but the differences were small.

The crown indices of the mandibular teeth of Naestved females were all higher than those of Aebelholt females, and in five instances the differ-:ence was shown to have statistical significance. The most highly significant differences were those for the second and third molars, where significance reached the high level $P < 0.001$.

While the maxillary teeth of Aebelholt and Naestved females were similar in shape, the mandib-:ular molars in the Naestved females were relatively smaller in the mesiodistal diameter and larger in the labiolingual diameter than were the corresponding teeth in Aebelholt females. Reference to the tables of absolute measurements (Tables 17 and 19) showed that these teeth were similar in the labiolingual dimension in both groups, but showed a statistically significant difference in mesiodistal diameter. The difference in crown index was thus produced by the/

the relative shortness of the mesiodistal diameter of the mandibular molars in the Naestved females.

C. Variability of crown proportion in mediaeval Danes.

An examination of the coefficients of variation of the crown indices showed that the teeth which var:ied most in proportion in both Aebelholt and Naestved groups were the maxillary second incisors and third molars of both sexes. The values of the coefficient of variation for the crown indices of these teeth were almost identical in the Aebelholt and Naestved groups. There was little difference between the coefficients of variation of the crown indices for the other maxillary teeth and for the mandibular teeth : nearly all of these coefficients lay between 3 and 6. Thus all teeth of the mediaeval Danes showed a similar degree of variability in crown prop:ortion, except the maxillary second incisors and third molars, which appeared to vary considerably more in shape than the other teeth.

Selmer-Olsen found that in the Lapps the great:est variability of crown shape was shown by the third/

third molars, and the crown indices of the first in:cisor, canine and first molar showed the least var:iation. The indices of the maxillary second in:cisors of this population did not show exceptionally high variability.

The question of variability in crown index was not discussed by Nelson (1938), Pedersen (1949), Thomsen (1955) or Moorrees (1957).

D. Summary.

In conclusion, it may be stated that no marked sex difference can be demonstrated in crown propor:tion in either the Aebelholt or the Naestved group. Nor is there evidence of differences between the Aebelholt and Naestved groups, with the sole ex:ception that the mandibular molars appear to be relatively shorter mesiodistally in the Naestved females than in the Aebelholt females.

These findings are in accordance with the re:sults obtained by other workers (e.g. Thomsen,1955) who found little evidence of any sex or racial diff:erences in crown shape, as expressed by the crown index.

On/

On the whole, Selmer-Olsen found that the crown indices were rather higher in males than in females, while Moorrees reported that crown indices were higher in the female than in the male Aleuts. As crown indices were usually slightly higher in the Danish males than in the females, the Danish population resembles the Lapps more closely than the Aleuts in this respect.

A COMPARISON OF CROWN PROPORTION IN MEDIAEVAL DANES AND IN OTHER RACES.

In order to make comparisons more easily between the crown indices of mediaeval Danish teeth and those of other populations, the data for the Aebelholt and Naestved groups were combined. The resulting figures are shown in Tables 62 and 63, and Figs. 34 and 35.

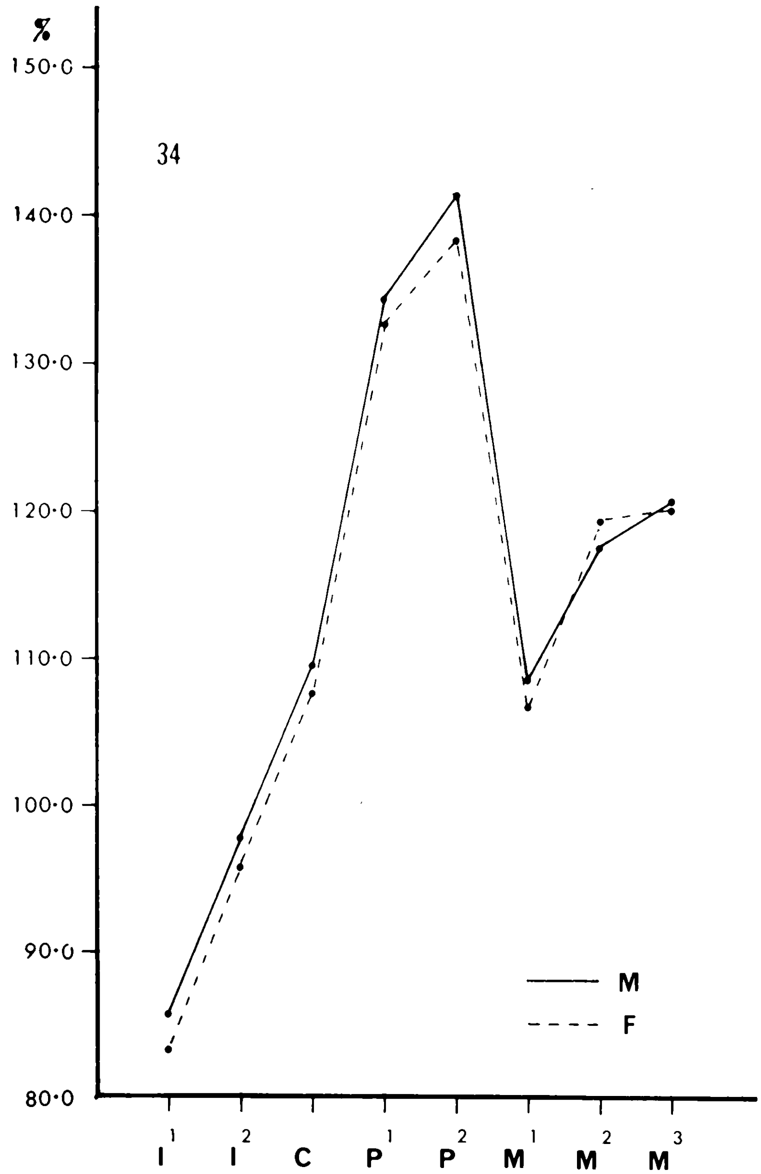

Fig. 34. Mean values of the crown indices of the maxillary teeth in males and females of the combined mediaeval Danish group.

TABLE 62.

Crown indices of maxillary teeth of combined Aebelholt and Naestved groups.

Males

	n	$\bar{x}$	s	v
I^1	21	85.8	6.1	7.1
I^2	27	97.9	10.4	10.6
C	50	109.6	5.1	4.7
P^1	52	134.4	6.5	4.8
P^2	47	141.5	7.0	4.9
M^1	31	108.4	4.5	4.2
M^2	69	117.7	6.8	5.8
M^3	86	120.8	9.2	7.6

Females

	n	$\bar{x}$	s	v
I^1	49	83.2	5.5	6.6
I^2	60	95.9	8.0	8.3
C	87	107.6	6.3	5.9
P^1	87	132.8	7.0	5.3
P^2	76	138.3	6.5	4.7
M^1	73	106.9	4.2	3.9
M^2	103	119.3	8.4	7.0
M^3	74	120.1	9.1	7.6

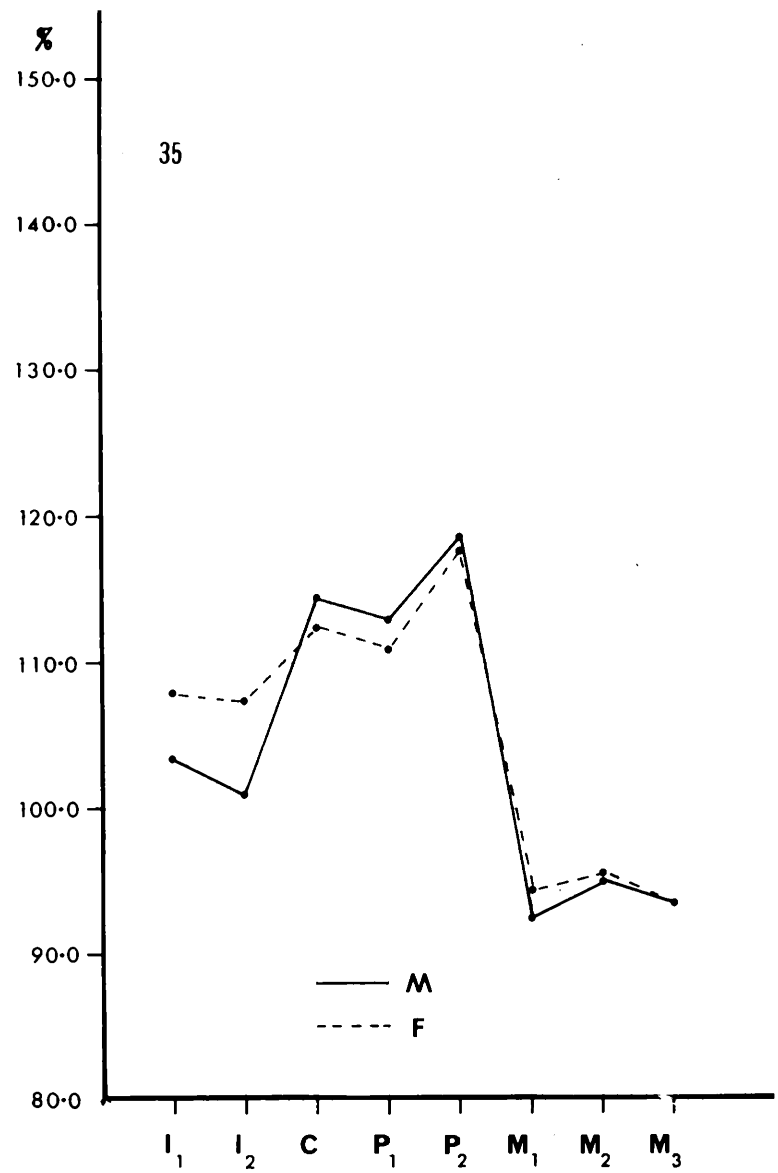

Fig. 35. Mean values of the crown indices of the mandibular teeth in males and females of the combined mediaeval Danish group.

TABLE 63.

Crown indices of mandibular teeth of combined Aebelholt and Naestved groups.

Males

	n	$\bar{x}$	s	v
I_1	1	(103.3)	-	-
I_2	4	101.0	-	-
C	28	114.4	4.6	4.0
P_1	45	113.1	7.0	6.2
P_2	50	118.8	7.1	6.0
M_1	27	92.7	3.6	3.9
M_2	53	94.9	4.4	4.6
M_3	66	93.6	5.7	6.1

Females

	n	$\bar{x}$	s	v
I_1	11	108.1	4.2	3.9
I_2	26	107.6	6.3	5.9
C	64	112.5	5.7	5.1
P_1	86	111.0	6.2	5.6
P_2	79	117.9	6.4	5.4
M_1	57	94.3	4.0	4.2
M_2	84	95.5	4.6	4.8
M_3	68	93.6	5.0	5.3

When the crown indices for the two groups of mediaeval Danes were combined in this way, there was still little difference to be observed between the sexes. The smallest difference in crown index which gave a significant value of 't' in the comparisons in Chapter 7 was one of 2.8%. Only one sex differ:ence for the combined Aebelholt/Naestved crown in:dices lay above this level, and this was the differ:ence observed between the sexes for the crown index of the maxillary second premolar. In most instances there was a difference of less than 2 % between the crown indices of males and the corresponding crown indices in females. In general, the crown indices of the males were slightly higher than those of the females.

The greatest variability in crown index (indic:ated by the coefficient of variation) was again shown by the maxillary second incisors and third mol:ars of both sexes. In the mandible there was very little difference in the coefficients of variation for different teeth in either sex.

A./

A. Comparison of crown proportions in mediaeval Danes and prehistoric Scottish races.

The crown indices of the mediaeval Danes were first compared with those calculated for the prehis-:toric Scottish groups. As has already been ex-:plained in Chapter 6, a statistical comparison of tooth dimensions in the mediaeval Danes with the tooth dimensions recorded from the prehistoric Scottish skulls was felt to be unwise. This applied also to a statistical comparison of the crown indices in these groups, since attrition in the Scottish teeth would be likely to affect the mesiodistal diameters of the crowns more severely than the labiolingual diameters, and this might result in a spurious increase in the Scottish crown indices. The indices calculated for the various groups have therefore simply been listed in Tables 64 - 67.

TABLE 64.

Comparison of mean crown indices of maxillary teeth in males of mediaeval Danish and prehistoric Scottish groups.

		I^1	I^2	C	P^1
Danes	$\bar{x}$	85.8	97.9	109.6	134.4
	n	21	27	50	52
	s	6.1	10.4	5.1	6.5
Neolithic	$\bar{x}$	82.5	92.9	113.3	132.5
	n	1	5	6	6
	d	-3.3	-5.0	+3.7	-1.9
Bronze Age	$\bar{x}$	82.2	91.9	112.5	137.3
	n	5	10	15	17
	s	3.8	8.6	8.5	7.8
	d	-3.6	-6.0	+2.9	+2.9
Dark Age	$\bar{x}$	85.4	93.4	108.4	136.6
	n	9	13	19	18
	s	4.6	10.5	5.5	7.2
	d	-0.4	-4.5	-1.2	+2.2

TABLE 64 (Cont.)

		P^2	M^1	M^2	M^3
Danes	$\bar{x}$	141.5	108.4	117.7	120.8
	n	47	31	69	86
	s	7.0	4.5	6.8	9.2
Neolithic	$\bar{x}$	136.7	111.3	124.5	138.0
	n	4	5	5	4
	d	-4.8	+2.9	+6.8	+17.2
Bronze Age	$\bar{x}$	143.0	112.5	119.5	121.2
	n	16	12	16	11
	s	8.2	3.5	6.1	9.5
	d	+1.5	+4.1	+1.8	+0.4
Dark Age	$\bar{x}$	138.4	110.9	121.3	130.4
	n	18	9	16	15
	s	6.8	3.2	7.1	11.4
	d	-3.1	+2.5	+3.6	+9.6

TABLE 65.

Comparison of mean crown indices of maxillary teeth in females of mediaeval Danish and prehistoric Scottish groups.

		I^1	I^2	C	P^1
Danes	$\bar{x}$	83.2	95.9	107.6	132.8
	n	49	60	87	87
	s	5.5	8.0	6.3	7.0
Neolithic	$\bar{x}$	81.9	89.1	106.7	154.1
	n	1	1	1	1
	d	-1.3	-6.8	-0.9	+21.3
Bronze Age	$\bar{x}$	91.4	99.0	107.3	134.5
	n	3	5	7	7
	s	8.4	10.7	5.2	9.6
	d	+8.2	+3.1	-0.3	+1.7
Dark Age	$\bar{x}$	84.8	96.9	107.5	138.4
	n	4	8	17	14
	s	4.8	5.0	7.0	7.4
	d	+1.6	+1.0	-0.1	+5.6

TABLE 65 (Cont.).

		P^2	M^1	M^2	M^3
Danes	$\bar{x}$	138.3	106.9	119.3	120.1
	n	76	73	103	74
	s	6.5	4.2	8.4	9.1
Neolithic	$\bar{x}$	145.2	114.1	117.7	148.5
	n	1	2	1	1
	d	+6.9	+7.2	-1.6	+28.4
Bronze Age	$\bar{x}$	139.7	112.6	123.9	125.3
	n	7	8	6	5
	s	6.3	3.2	4.7	7.6
	d	+1.4	+5.7	+4.6	+5.2
Dark Age	$\bar{x}$	139.4	110.4	120.4	124.6
	n	15	13	17	14
	s	4.0	4.0	5.3	7.6
	d	+1.1	+3.5	+1.1	+4.5

TABLE 66.

Comparison of mean crown indices of mandibular teeth in males of mediaeval Danish and prehistoric Scottish groups.

		I_1	I_2	C	P_1
Danes	$\bar{x}$	103.3	101.0	114.4	113.1
	n	1	4	28	45
	s	-	-	4.6	7.0
Neolithic	$\bar{x}$	118.2	-	124.3	114.0
	n	1	0	1	1
	d	+14.9	-	+9.9	+0.9
Bronze Age	$\bar{x}$	108.4	105.5	113.5	113.9
	n	7	9	17	20
	s	13.5	7.4	6.0	5.6
	d	+5.1	+4.5	-0.9	+0.8
Dark Age	$\bar{x}$	108.8	102.7	110.9	113.0
	n	4	7	16	19
	s	11.4	5.5	6.2	6.9
	d	+5.5	+1.7	+3.5	-0.1

TABLE 66. (Cont.)

		P_2	M_1	M_2	M_3
Danes	$\bar{x}$	118.8	92.7	94.9	93.6
	n	50	27	53	66
	s	7.1	3.6	4.4	5.7
Neolithic	$\bar{x}$	120.8	99.0	98.0	93.9
	n	1	1	2	3
	d	+2.0	+6.3	+3.1	+0.3
Bronze Age	$\bar{x}$	118.6	95.6	97.5	98.0
	n	16	16	17	13
	s	6.3	5.5	6.2	5.6
	d	-0.2	+2.9	+2.6	+4.4
Dark Age	$\bar{x}$	117.6	97.7	98.8	96.1
	n	20	12	19	19
	s	6.6	3.0	5.0	5.2
	d	-1.2	+5.0	+3.9	+2.5

TABLE 67.

Comparison of mean crown indices of mandibular teeth in females of mediaeval Danish and prehistoric Scott-:ish groups.

		I_1	I_2	C	P_1
Danes	$\bar{x}$	108.1	107.6	112.5	111.0
	n	11	26	64	86
	s	4.2	6.3	5.7	6.2
Neolithic	$\bar{x}$	-	-	-	-
	n	-	-	-	-
	d	-	-	-	-
Bronze Age	$\bar{x}$	115.7	104.6	113.7	111.3
	n	2	6	7	6
	s	-	10.9	6.2	6.7
	d	+7.6	-3.0	+1.2	+0.3
Dark Age	$\bar{x}$	117.2	103.8	108.2	112.2
	n	2	8	10	12
	s	-	8.8	6.9	6.9
	d	+9.1	-3.8	-4.3	+1.2

TABLE 67 (Cont.)

		P_2	M_1	M_2	M_3
Danes	$\bar{x}$	117.9	94.3	95.5	93.6
	n	79	57	84	68
	s	6.4	4.0	4.6	5.0
Neolithic	$\bar{x}$	-	-	-	-
	n	-	-	-	-
	d	-	-	-	-
Bronze Age	$\bar{x}$	121.4	97.1	101.7	98.0
	n	7	5	5	5
	s	5.4	3.8	5.3	4.4
	d	+3.5	+2.8	+6.2	+4.4
Dark Age	$\bar{x}$	119.0	95.1	95.7	95.9
	n	13	14	16	12
	s	6.6	4.1	4.7	5.9
	d	+1.1	+0.8	+0.2	+2.3

The Neolithic group consisted of very few indiv-:iduals and only in the case of the maxillary teeth of males were there sufficient observations to per-:mit discussion. Of the eight maxillary teeth, four had crown indices above those of the Danes and four had lower crown indices than the Danish teeth. In all but one of these teeth the difference in crown index was large, and on the whole the differences were greater in those instances where the Neolithic crown index was the larger.

A more satisfactory quantity of material was available for Bronze Age and Dark Age comparisons. Since no difference in crown index of less than 2.8 % had proved to be significant in comparing results within the Danish material, it seemed reasonable to suggest that indices which fell within ± 2.5% of one another were fairly similar and indicated almost id-:entical shape of the particular tooth in the two groups concerned. In the 32 comparisons between Scottish Bronze Age and Danish crown indices, 11 of the differences fell within this margin of ± 2.5 %. The remaining 21 comparisons showed a greater diff-:erence in crown index between the groups, and in

18 of these the index for the Bronze Age tooth was higher than that of the Danes.

In the case of the Scottish Dark Age teeth, a rather larger proportion of the teeth (18 of 32 comparisons) showed similarity in shape to the mediaeval Danish teeth. Fourteen comparisons gave results differing by more than 2.5 %, and of these 10 showed a higher value in the Dark Age teeth.

While a number of teeth from the Bronze Age group and a rather larger number of Dark Age teeth appeared fairly similar in crown proportions to those of mediaeval Danes, there remained a considerable number of the teeth in each Scottish group where the crown index was markedly higher than in the corresponding Danish teeth. This may have been due largely to the effect of attrition in the Scottish material, but it was not possible to discover to what extent attrition may have contributed to the differences in crown proportions between the groups, and thus any real differences which may exist have been obscured.

B./

B. Comparison of crown proportions in mediaeval Danes and modern races.

No crown indices have been published for any other prehistoric or early historic European population, and few authors included crown indices in studies of other races. The only exceptions were the reports of Selmer-Olsen (1949) on the Lapps, Thomsen (1955) on the Tristanites and Moorrees (1957) on the Aleuts. Pedersen (1949) and Nelson (1938) published crown indices for the East Greenland Eskimos and Pecos Indians respectively, but without sex differentiation. Crown indices, of the first and second mandibular molars only, were published by Hrdlicka (1923 a, 1923 b) for several groups of North American Indians and for five other races. These results were given separately for the two sexes, and for left and right sides, but no statistical data were published.

Crown indices of the mediaeval Danish teeth were compared statistically with those of Lapps, Tristanites and Aleuts. The results of this comparison are presented in Tables 68 - 71, which will be found in the Appendix.

Crown/

Crown indices in the Lapps appeared in general to be rather lower than those in the mediaeval Danes, in particular in so far as incisors, canines and pre:molars were concerned. In a few instances the in:dices were higher in the Lapps, especially for the upper first molar and all the lower molars of both sexes.

Some of these differences could be shown to be significant at the level $P < 0.001$. The indices of the maxillary second incisor, canine and second pre:molar, and of the mandibular second premolar were significantly smaller in Lapps of both sexes. In addition, in the female the maxillary second molar and mandibular canine had significantly smaller in:dices in the Lapps and the mandibular third molar had a significantly larger index in the Lapps.

The smaller indices indicated that the teeth were proportionately larger in the mesiodistal di:mension and smaller in the labiolingual dimension.

Crown indices were not available for the inci:sors of the Tristanites. The crown indices of all the other teeth in both sexes of this population were significantly larger than those of mediaeval Danes./

Danes. This result was to be expected in view of the fact that Tristanite teeth were only slightly larger in mesiodistal diameter than those of Danes, but were very much larger in labiolingual diameter than the Danish teeth.

The very high values of the crown index in Tristanites suggested teeth which were proportionate:ly as well as absolutely very large in the labio:lingual diameter.

No crown indices were available for the incisors of Aleuts. Crown indices of the remaining teeth in the males were nearly all smaller in Aleuts than in mediaeval Danes, the only exception being the maxill:ary first molar which had a higher index in Aleuts than in Danes. Only the indices for maxillary can:ines and first premolars showed a significant diff:erence between Aleuts and Danes.

There was less difference in crown index as far as the females were concerned. Most of the indices were slightly smaller in the Aleuts, but in the case of the maxillary first premolar, first molar and third molar, and the mandibular first premolar, the mediaeval Danes had the lower indices. A significant difference/

difference in crown index between females of the two races could be demonstrated only for the mandibular second molar.

It would thus appear that crown indices in the mediaeval Danes tend to be slightly higher than those in either Lapps or Aleuts, and considerably lower than those in Tristanites.

For ease of expression when dealing with varia:tions in crown proportion, differences in mesiodist:al diameter may be referred to by using the words "longer" and "shorter", and differences in labiolin:gual diameter by using the terms "broader" and "narrower". It can then be stated that the teeth of mediaeval Danes are relatively shorter and broader than those of Aleuts and Lapps, and relatively longer and narrower than those of Tristanites.

The important factor influencing this relation:ship in the Tristanites is the extreme size of the labiolingual dimensions of the teeth. In the case of the Lapps, all the teeth tended to be smaller in both dimensions than those of the Danes, but the differences were more pronounced for the labiolingual diameter. The teeth of Aleuts tended to be larger than/

than those of Danes, and the differences were more marked in the mesiodistal diameters.

Crown indices have also been published by a few other workers, but usually without sex differentiation of the material or statistical preparation of the data. Hrdlicka (1923 a, 1923 b) published crown indices, for the first and second mandibular molars only, in U.S. Whites, Egyptians of the XII Dynasty period, U.S. Indians, Eskimos, Negroes and Melanesians. The results were reported separately for males and females. Most of the mean crown indices obtained in this study were between 97.0 and 99.0, and thus were rather larger than the mean crown indices cal:culated for these teeth in the mediaeval Danes. It is perhaps interesting to note that the mean crown indices of the first and second mandibular molars of U.S. White females, at 94.0 and 95.1, were very similar to those of mediaeval Danish females, while the crown indices of these teeth in U.S. White males (99.7 and 98.6) were higher than the crown indices of the corresponding teeth in Danish males. Apart from the U.S. Whites, Hrdlicka's results show:ed little difference in crown index between males and/

and females.

In the mediaeval Danes, as in other races, there is a progressive increase in crown index from first to third maxillary molar. Nelson (1938) suggested that there might be racial variations in the degree of this difference in crown index. In the Pecos Indians he found a difference of only 5.5 units be:tween the crown indices of first and third maxillary molars, while in other races the third molar crown index was 10 - 18 units larger than the crown index of the first molar.

Examination of the mean crown indices of the maxillary molars in the Danes showed a difference between the first molar crown index and the third molar crown index of 12.4 in males and 13.2 in fe:males. These figures are very similar to the diff:erence of 13.0 in the group of Whites used by Nelson in his comparisons.

Nelson pointed out that these variations were due to differences in the extent to which the mesio:distal and labiolingual diameters of the maxillary molars were reduced in the distal part of the molar series. In the Pecos Indians, both diameters of the

the molars were reduced to almost the same extent, and thus the crown proportions of first and third molars were fairly similar. In most other races, the mesiodistal diameters were reduced more than the labiolingual diameters, and the crown proportions of the third molar were different from those of the first molar.

Insufficient racial groups have as yet been studied, to show whether this feature might prove to be anthropologically useful. Since only the Pecos Indians have so far shown any marked difference from other racial groups, it is perhaps of rather doubt-:ful value.

In the present study, as in the reports prev-:iously published, crown indices have proved to be disappointing, in that they have provided little clear evidence of racial differences in crown propor-:tions.

CONCLUSIONS.

The aims of the present investigation were stated in Chap. 3 to be:- 1. to examine sex differences in the teeth of mediaeval Danes from Aebelholt and Naestved. 2. to examine differences between these population groups. 3. to compare the results obtained for mediaeval Danes with data previously published for other prehistoric, early historic and modern populations.

1. Sex differences.

There are sex differences in the size of the tooth crowns in mediaeval Danes. The mean mesiodistal and labiolingual diameters of the teeth of the Aebelholt males and of the Naestved males are invariably larger than the corresponding tooth diameters of Aebelholt and of Naestved females, and most of these sex differences are statistically significant. When the data for the two groups are combined, almost all the sex differences can be shown to be highly significant ($P < 0.001$). The teeth in which the sex differences in size are most marked are the canines.

Statistically significant sex differences in both crown dimensions have previously been demonstrated in/

in non-European races by Mijsberg (1931), Thomsen (1955), Moorrees (1957) and Barrett et al. (1963, 1964). Only the mesiodistal dimensions of the teeth have been studied in modern European races, and sig:nificant sex differences in this dimension have been shown by Seipel (1946), Moorrees et al. (1957), Stähle (1959) and Garn et al. (1964). The only previous study of European races in which the labio:lingual diameters of the teeth were examined, and were found to exhibit significant sex differences, was that carried out by the writer on prehistoric Scottish skulls (Lunt, 1961). In every instance, the teeth of males were larger than the teeth of females. In all previous investigations the canines showed the greatest sex difference in crown size. Thus the findings in the mediaeval Danes, of statis:tically significant sex differences which are most marked in the canines, conform to the general patt:ern which is gradually emerging.

There is a slight tendency in the Danish mater:ial for the labiolingual diameters of the teeth to show a more highly significant sex difference than the mesiodistal diameters. There is no general agreement/

agreement upon this point in previous work : in two of the four studies in which this point was consider-:ed, the labiolingual diameters were found to show more highly significant sex differences, while in the other two reports the differences in the mesio-:distal diameters appeared to attain a higher degree of statistical significance. It seems probable that there is little if any real difference between mesio-:distal and labiolingual diameters in the degree to which they exhibit sex difference.

No marked sex difference in the variability of tooth dimensions can be demonstrated in the mediaeval Danes. Such sex differences in variability have been reported by Selmer-Olsen (1949) and Barrett et al. (1963, 1964), and in both these studies the males were found to show greater variability in tooth size. On the other hand, Stein and Epstein (1934) recorded higher coefficients of variation in the females in their limited study of molar size. The mean coeff-:icient of variation for all tooth dimensions of Danish males is only 0.2% greater than the mean co-:efficient of variation for all tooth dimensions of Danish females. It does not seem likely that this small/

small discrepancy can represent any real sex differ-:ence in variability of tooth dimensions.

With regard to the rank order of size of the molars, there appears to be some sex variation in the frequency of patterns found in the mandible. Reduction of the second molar until it is smaller than the third molar is more frequently encountered in the females than in the males. The quantity of data is not sufficient to allow any assessment of the significance of this difference to be made.

The crown indices give little evidence of a marked sex difference in crown proportions. On the whole, these indices have slightly higher values in the males, which indicates that the male teeth are relatively broader in the labiolingual dimension. This can perhaps be correlated with the slightly greater significance of sex differences in the lab-:iolingual dimensions than in the mesiodistal dimen-:sions. The sex differences in crown index,however, are seldom sufficiently great to be statistically significant.

Thus, while there is a marked sex difference in tooth size in mediaeval Danes displayed by both mesiodistal/

mesiodistal and labiolingual diameters, there does not appear to be any significant sex difference in crown proportions, as represented mathematically by the crown index. This result supports the findings of other workers such as Selmer-Olsen (1949), Thomsen (1955) and Moorrees (1957), all of whom reported that the crown indices gave less evidence of sex differ:ence than did the actual mesiodistal and labiolin:gual diameters of the crown.

2. Local group differences.

A comparison of tooth dimensions in the Aebelholt group with the corresponding dimensions in the Naestved group shows that in general the Aebelholt teeth are slightly larger than those from Naestved. Most of the differences in tooth size between the two groups are small and are not statistically signific:ant. An exception occurs in the case of the mesio:distal diameters of the mandibular teeth. In a few of these diameters the males of the two groups show significant differences, and an even greater number of significant differences is found in the females.

Thus the conclusion is drawn that the mediaeval populations/

populations of Aebelholt and Naestved differ very little in respect of tooth size, with the exception of the mandibular premolars and molars which are smaller in the mesiodistal dimension in the Naestved group. A relatively greater mesiodistal shortening of the mandibular post-canine teeth seems to have occurred in the Naestved population.

In the mandible therefore, a greater difference between the groups is shown by the mesiodistal than by the labiolingual diameters. In the maxilla no such difference is obvious.

Variability of tooth dimensions is very similar in the females of the two groups, and the mean coeff-:icient of variation for Naestved males corresponds fairly closely to those of the females. The mean coefficient for Aebelholt males, however, is a little higher. It is tempting to see, in this greater var-:iability of tooth size, some evidence of admixture of other racial groups in the male population of the monastery at Aebelholt.

So few complete molar series are available that a study of differences between the Aebelholt and Naestved populations, in respect of rank order of molar/

molar size, has not been attempted.

There are few significant differences in crown index between the Danes from Aebelholt and those from Naestved. In the maxilla, no significant differences can be shown in males or in females between the Aebelholt and Naestved groups. The mandibular teeth of males show two barely significant differences between the groups, but the canines and molars of the Naestved females show a significant difference in proportion from the Aebelholt females, in that they are relatively shorter in the mesiodistal dimension and broader in the labiolingual dimension.

3. Racial differences.

Comparisons of tooth size have been made between mediaeval Danes and various other populations, both of earlier date and modern.

In comparing Danish teeth with those of three prehistoric Scottish populations, it is found that Scottish Bronze Age teeth appear to be larger than those of the Danes. The teeth of the Dark Age people of Scotland are similar in size to, or rather smaller than, the mediaeval Danish teeth. There is so little sexed Neolithic material from Scotland that/

that comparison is difficult. In the original study of the Scottish material (Lunt, 1961), use was made of some unsexed skulls, and when measurements of all Neolithic teeth were compared with those of all Bronze Age teeth it was found that the Neolithic teeth tended to be slightly larger. In the present instance, only the maxillary teeth of Neolithic males could be compared with those of the Danes, and these Neolithic teeth are much larger than the mediaeval Danish teeth. The present study seems to confirm a gradual decrease in tooth size from Neolithic and Bronze Age times to the Dark Ages and the mediaeval period. The smaller values of some tooth measurements recorded for the Scottish Dark Age material, as compared to the mediaeval Danes, may be due to the greater degree of attrition noted in the former population. It has already been stated that no decision can be reached as to whether this decrease in tooth size is a function of time or whether it represents racial traits in successive populations.

Comparison of the material studied by the writer with that published by other workers shows a similar trend in Continental European populations. Tooth measurements/

measurements of several prehistoric groups are gen:erally larger than those of the mediaeval Danes. Frankish teeth from a period beginning about two centuries earlier than the bulk of the Scottish long cists, seem to be very similar in size to those of mediaeval Danes, or slightly smaller. On the other hand, some small groups of Merovingian and mediaeval skulls, and the Alamanni studied by Schwerz (1917), possess teeth which are generally larger than those of the mediaeval Danes.

Thus it appears that there is a general tendency in European populations to show a reduction in tooth size from the Mesolithic to the Dark Age or early mediaeval period.

The only early population group for which a statistical comparison of tooth size could be carried out was the group of mediaeval Swedish skulls from Västerhus. This material is a little earlier in date than the Danish skulls from Aebelholt and Naestved. The tooth measurements used in the com:parison had been obtained from juvenile individuals and therefore should not have been affected by att:rition more severely than those of the Danes. Nevertheless/

Nevertheless, the Vässterhus teeth are smaller than those of the Danes, and some of the differences are statistically significant. The only factor which may have influenced this result is the possible pre-:sence in this area of northern Sweden of a fairly large population of Lapps, who have been shown by Selmer-Olsen (1949) to possess small teeth.

When comparisons are made between mediaeval Danes and modern Swedes, Swiss and American Whites, there is a tendency for the Danes to show smaller tooth dimensions than the modern races. This is much more marked in the case of Seipel's Swedes and the Swiss than it is with Lundström's Swedes and the American Whites. The teeth in which this difference in size is most pronounced are the premolars. It is very difficult to assess the role of attrition and of different techniques of measurement in producing these results. But it does seem unlikely that the largest differences can be entirely due to attrition or variations in technique. If some of these diff-:erences are real, then the tendency to reduction in tooth size, which was noted from Mesolithic to early mediaeval times, has not been continued in the mediaeval to/

to modern period. In view of these results, the figures obtained by Goose (1963) for 17th - 19th cen:tury English skulls were examined. The English teeth appear to be slightly smaller than those of mediaeval Danes, and thus are also smaller than the teeth of the four modern white groups. Thus there seems to be some evidence in favour of a slight in:crease in tooth size in recent centuries.

The Lapps have smaller teeth than the mediaeval Danes, and the difference in size is more clearly marked in the labiolingual than in the mesiodistal diameters.

Comparisons of tooth size have been made between the mediaeval Danes and several non-European races. There appears to be little difference in size between Chinese teeth and those of Danes, though in a few dimensions the Chinese teeth are significantly larger. Aleut teeth tend to be larger than those of Danes, though not all of the differences in tooth size are statistically significant. The teeth of Tristanites are generally larger than those of the Danes, and the differences are very much greater in the labiolingual than in the mesiodistal diameters. Eskimo teeth

are/

are also larger than those of Danes, though the very small quantity of data available for the Eskimos re:duces the significance of the differences. Tooth dimensions of Australian aborigines are considerably larger than those of mediaeval Danes, and the diff:erences between the two groups are all statistically significant. Thus it can be shown that the teeth of some Mongoloid and Australoid populations are in general larger than those of the mediaeval Danes. No suitable data are available for a comparison to be carried out with any Negroid population.

On the whole it appears that differences in tooth dimensions between populations are more clearly mar:ked in the labiolingual dimensions than in the mesio:distal dimensions.

No major differences are observed between coeff:icients of variation in Danes and in other populations. The ranges of coefficients of variation published by other workers are very similar to the range for the Danes. Also, the teeth which show the greatest and least variability in size in the Danes are the same as the teeth which display these properties in other races.

The/

The distribution of patterns of rank order of molar size is similar in Danes to those observed in Lapps and Finns. Fewer data are available for Aleuts, Tristanites and East Greenland Eskimos, but these races appear to differ in distribution of the patterns from the Danes, and the results suggest that the second and third molars have undergone less re-:duction in size relative to the first molar than is the case in Danes, Lapps and Finns.

Crown indices of the three prehistoric Scottish populations are similar to, or rather higher than, those of mediaeval Danes. This indicates a tendency for tooth crowns in the Scottish groups to be rela-:tively shorter mesiodistally and broader labiolin-:gually than those of the Danes. The difference may be largely due to the greater degree of attrition in the Scottish material, since attrition has a more serious effect on the mesiodistal diameters of the teeth.

Crown indices published for Lapps, Tristanites and Aleuts have been compared statistically with those calculated for the Danes. The crown indices of Danish teeth are slightly higher than those in Lapps/

Lapps and Aleuts, and very much lower than those of Tristanites. Thus the teeth of mediaeval Danes are relatively shorter mesiodistally and broader labio:lingually than those of Lapps or Aleuts. Tristanite teeth are much broader labiolingually than those of any other population.

Thus racial differences as well as sex differ:ences are less clearly marked in the crown indices than in the individual mesiodistal and labiolingual dimensions of the crown.

The main results of this study are :-

1. that there are statistically significant sex diff:erences in crown size of the teeth, but not in crown proportions, in mediaeval Danes;
2. that there are few significant differences, in either crown size or crown proportions, between the groups from Aebelholt and Naestved, and therefore the individuals from these localities may be regard:ed as forming a reasonably homogeneous population;
3. that the mediaeval Danes have relatively small teeth when compared with various other racial groups. The Danish dentition, in general, exhibits smaller crown dimensions than are found in modern Australoid or/

or Mongoloid races, in modern White races, and in most prehistoric European populations. Mediaeval Danish teeth are larger than those of a few popul-:ation groups:- the Scottish Dark Age people, the Dark Age Franks of Belgium, the mediaeval Swedes, the 17th - 19th century English and the modern Lapps. In crown proportions, the mediaeval Danes differ markedly from only one group, the Tristanites.

A P P E N D I X.

Statistical comparisons between Danes and other races.

Tables 43 - 50. Comparisons of mesiodistal and labiolingual tooth diameters.

Tables 68 - 71. Comparisons of crown indices.

Table 43. Mesiodistal dimensions of maxillary teeth of males.

First incisor.

Race	n	$\bar{x}$	s	d	t
Danes	24	8.80	0.49		
Mediaeval Swedes (Västerhus)	14	8.27	0.41	-0.53	3.40**
Swedes (L)	170	8.66	0.53	-0.14	1.23
Swedes (S)	483	8.84	0.55	+0.04	0.35
Swiss	209	8.73	0.49	-0.07	0.66
American Whites	87	8.78	0.46	-0.02	0.19
Lapps	73	8.37	0.42	-0.43	4.22***
Tristanites	152	8.78	0.61	-0.02	0.15
Chinese	267	8.68	0.74	-0.12	0.78
Aleuts	97	8.45	0.48	-0.35	3.18**
Australian Aborigines	130	9.35	0.58	+0.55	4.37***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

Second incisor.

Race	n	$\bar{x}$	s	d	t
Danes	33	6.78	0.55		
Mediaeval Swedes (Västerhus)	14	6.33	0.55	-0.45	2.56*
Swedes (L)	175	6.64	0.58	-0.14	1.28
Swedes (S)	469	6.81	0.60	+0.03	0.28
Swiss	205	6.87	0.59	+0.09	0.82
American Whites	84	6.64	0.63	-0.14	1.12
Lapps	95	6.84	0.55	+0.06	0.54
Tristanites	146	6.74	0.64	-0.04	0.33
Chinese	219	6.98	0.66	+0.20	1.65
Aleuts	88	7.29	0.45	+0.51	5.20***
Australian Aborigines	115	7.65	0.63	+0.87	7.19***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

Canine.

Race	n	$\bar{x}$	s	d	t
Danes	62	7.76	0.39		
Mediaeval Swedes (Västerhus)	16	7.54	0.50	-0.22	1.91
Swedes (L)	173	7.80	0.43	+0.04	0.65
Swedes (S)	463	8.10	0.46	+0.34	5.57***
Swiss	202	7.99	0.38	+0.23	4.18***
American Whites	87	7.95	0.42	+0.19	2.79**
Lapps	194	7.74	0.43	-0.02	0.32
Tristanites	132	7.93	0.49	+0.17	2.39*
Chinese	210	8.06	0.55	+0.30	4.00***
Aleuts	81	8.03	0.36	+0.27	4.29***
East Greenland Eskimos	5	8.16	0.18	+0.40	-
Australian Aborigines	80	8.31	0.57	+0.55	6.55***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

First premolar.

Race	n	$\bar{x}$	s	d	t
Danes	58	6.73	0.32		
Mediaeval Swedes (Västerhus)	16	6.48	0.29	-0.25	2.81**
Swedes (L)	111	7.15	0.36	+0.42	7.50***
Swedes (S)	135	7.18	0.38	+0.45	7.89***
Swiss	128	7.11	0.47	+0.38	5.59***
American Whites	87	7.01	0.38	+0.28	4.59***
Lapps	221	6.75	0.47	+0.02	0.30
Tristanites	132	6.96	0.45	+0.23	3.54***
Chinese	209	7.21	0.52	+0.48	6.67***
Aleuts	77	7.15	0.35	+0.42	7.12***
East Greenland Eskimos	5	7.70	0.70	+0.97	-
Australian Aborigines	98	7.69	0.46	+0.96	13.91***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

Second premolar.

Race	n	$\bar{x}$	s	d	t
Danes	49	6.52	0.37		
Mediaeval Swedes (Västerhus)	16	6.35	0.48	-0.17	1.49
Swedes (L)	86	6.78	0.41	+0.26	3.66***
Swedes (S)	125	6.97	0.39	+0.45	6.92***
Swiss	122	6.84	0.37	+0.32	5.16***
American Whites	86	6.82	0.37	+0.30	4.55***
Lapps	237	6.45	0.44	-0.07	1.04
Tristanites	128	6.64	0.46	+0.12	1.64
Chinese	143	6.86	0.58	+0.34	3.86***
Aleuts	62	6.65	0.45	+0.13	1.65
East Greenland Eskimos	5	6.88	0.34	+0.36	-
Australian Aborigines	96	7.19	0.43	+0.67	9.31***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

First molar.

Race	n	$\bar{x}$	s	d	t
Danes	31	10.79	0.43		
Mediaeval Swedes (Västerhus)	16	10.42	0.70	-0.37	2.24*
Swedes (L)	72	10.63	0.53	-0.16	1.48
Swedes (S)	164	10.69	0.48	-0.10	1.08
American Whites	83	10.81	0.56	+0.02	0.18
Lapps	256	10.23	0.61	-0.56	4.96***
Tristanites	145	10.69	0.58	-0.10	0.91
Chinese	88	10.02	0.83	-0.77	4.94***
Aleuts	53	10.37	0.71	-0.42	2.98**
East Greenland Eskimos	13	10.85	0.46	+0.06	0.41
Australian Aborigines	115	11.34	0.52	+0.55	5.39***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

Second molar.

Race	n	$\bar{x}$	s	d	t
Danes	72	9.63	0.62		
Mediaeval Swedes (Västerhus)	15	9.37	0.62	-0.26	1.48
Swedes (S)	151	10.47	0.65	+0.84	9.13***
American Whites	65	10.35	0.63	+0.72	6.73***
Lapps	267	9.34	0.61	-0.29	3.58***
Tristanites	109	10.03	0.81	+0.40	3.57***
Chinese	70	9.36	0.86	-0.27	2.16*
Aleuts	51	10.00	0.68	+0.37	3.14**
East Greenland Eskimos	19	10.27	0.51	+0.64	4.16***
Australian Aborigines	82	10.70	0.71	+1.07	9.91***

Table 43 (cont.) Mesiodistal dimensions of maxillary teeth of males.

Third molar.

Race	n	$\bar{x}$	s	d	t
Danes	88	8.87	0.80		
Mediaeval Swedes (Västerhus)	10	8.46	0.89	-0.41	1.51
Swedes (S)	33	9.48	0.98	+0.61	3.51***
Lapps	196	8.03	0.75	-0.84	8.57***
Tristanites	63	8.89	0.77	+0.02	0.15
Chinese	50	8.60	1.13	-0.27	1.64
Aleuts	27	9.16	0.89	+0.29	1.60
East Greenland Eskimos	12	9.83	0.93	+0.96	3.82***
Australian Aborigines	36	9.87	0.82	+1.00	6.25***

Table 44. Mesiodistal dimensions of mandibular teeth of males.

First incisor

Race	n	$\bar{x}$	s	d	t
Danes	7	5.53	0.23		
Mediaeval Swedes (Västerhus)	16	4.86	0.31	-0.67	-
Swedes (L)	178	5.33	0.32	-0.20	-
Swedes (S)	507	5.51	0.36	-0.02	-
Swiss	217	5.43	0.31	-0.10	-
American Whites	85	5.42	0.31	-0.11	-
Lapps	76	5.36	0.25	-0.17	-
Tristanites	154	5.54	0.54	+0.01	-
Chinese	216	5.56	0.64	+0.03	-
Aleuts	98	5.23	0.41	-0.30	-
Australian Aborigines	136	5.87	0.40	+0.34	-

Table 44 (cont.) Mesiodistal dimensions of mandibular teeth of males.

Second incisor.

Race	n	$\bar{x}$	s	d	t
Danes	16	6.12	0.42		
Mediaeval Swedes (Västerhus)	14	5.48	0.56	-0.64	3.58**
Swedes (L)	179	5.93	0.37	-0.19	1.94
Swedes (S)	507	6.13	0.40	+0.01	0.10
Swiss	217	6.05	0.37	-0.07	0.72
American Whites	85	5.95	0.38	-0.17	1.62
Lapps	123	5.98	0.38	-0.14	1.37
Tristanites	152	6.08	0.57	-0.04	0.27
Chinese	187	6.15	0.54	+0.03	0.22
Aleuts	100	6.09	0.30	-0.03	0.34
Australian Aborigines	130	6.60	0.42	+0.48	4.32***

Table 44 (cont.) Mesiodistal dimensions of mandibular teeth of males.

Canine.

Race	n	$\bar{x}$	s	d	t
Danes	50	6.93	0.35		
Mediaeval Swedes (Västerhus)	16	6.57	0.47	-0.36	3.27**
Swedes (L)	184	6.91	0.38	-0.02	0.33
Swedes (S)	503	7.12	0.39	+0.19	3.33***
Swiss	214	7.05	0.42	+0.12	1.88
American Whites	84	6.96	0.36	+0.03	0.47
Lapps	219	6.82	0.41	-0.11	1.75
Tristanites	136	7.15	0.49	+0.22	2.89**
Chinese	209	7.31	0.52	+0.38	4.87***
Aleuts	91	7.20	0.37	+0.27	4.22***
East Greenland Eskimos	2	7.20	-	+0.27	-
Australian Aborigines	98	7.49	0.46	+0.56	7.57***

Table 44 (cont.) Mesiodistal dimensions of mandibular teeth of males.

First premolar.

Race	n	$\bar{x}$	s	d	t
Danes	54	6.77	0.43		
Mediaeval Swedes (Västerhus)	16	6.46	0.34	-0.31	2.65**
Swedes (L)	128	7.21	0.38	+0.44	6.88***
Swedes (S)	160	7.27	0.37	+0.50	8.20***
Swiss	100	7.26	0.39	+0.49	7.21***
American Whites	85	7.07	0.35	+0.30	4.48***
Lapps	226	6.72	0.43	-0.05	0.76
Tristanites	135	7.07	0.70	+0.30	2.94**
Chinese	232	7.18	0.56	+0.41	5.06***
Aleuts	94	7.01	0.57	+0.24	2.70**
East Greenland Eskimos	4	7.18	-	+0.41	-
Australian Aborigines	95	7.49	0.54	+0.72	8.37***

Table 44 (cont.) Mesiodistal dimensions of mandibular teeth of males.

Second premolar.

Race	n	$\bar{x}$	s	d	t
Danes	54	6.87	0.39		
Mediaeval Swedes (Västerhus)	15	6.58	0.36	-0.29	2.57*
Swedes (L)	88	7.36	0.45	+0.49	6.62***
Swedes (S)	103	7.41	0.41	+0.54	7.94***
Swiss	106	7.31	0.45	+0.44	6.11***
American Whites	82	7.29	0.52	+0.42	5.06***
Lapps	232	6.74	0.41	-0.13	2.13*
Tristanites	121	7.21	0.53	+0.34	4.20***
Chinese	160	7.29	0.48	+0.42	5.83***
Aleuts	81	7.17	0.42	+0.30	4.17***
East Greenland Eskimos	6	7.07	0.42	+0.20	-
Australian Aborigines	89	7.56	0.51	+0.69	8.52***

Table 44 (cont.) Mesiodistal dimensions of mandibular teeth of males.

First molar.

Race	n	$\bar{x}$	s	d	t
Danes	28	11.45	0.62		
Mediaeval Swedes (Västerhus)	16	10.41	0.57	-1.04	5.50***
Swedes (L)	65	11.37	0.68	-0.08	0.53
Swedes (S)	145	11.24	0.57	-0.21	1.76
American Whites	76	11.18	0.47	-0.27	2.37*
Lapps	228	10.95	0.65	-0.50	3.88***
Tristanites	143	11.22	0.59	-0.23	1.87
Chinese	95	11.33	0.89	-0.12	0.67
Aleuts	47	11.56	0.52	+0.11	0.83
East Greenland Eskimos	10	11.96	0.44	+0.51	2.38*
Australian Aborigines	119	12.04	0.61	+0.59	4.61***

Table 44. (cont.) Mesiodistal dimensions of mandibular teeth of males.

Second molar.

Race	n	$\bar{x}$	s	d	t
Danes	56	10.56	0.71		
Mediaeval Swedes (Västerhus)	16	10.10	0.33	-0.46	2.51*
Swedes (S)	241	11.15	0.69	+0.59	5.73***
American Whites	53	10.76	0.71	+0.20	1.47
Lapps	254	10.51	0.65	-0.05	0.52
Tristanites	108	10.77	0.72	+0.21	1.78
Chinese	82	10.73	1.18	+0.17	0.97
Aleuts	43	11.19	0.89	+0.63	3.94***
East Greenland Eskimos	12	11.42	0.53	+0.86	3.98***
Australian Aborigines	82	11.45	0.68	+0.89	7.42***

Table 44. (cont.) Mesiodistal dimensions of mandibular teeth of males.

Third molar.

Race	n	$\bar{x}$	s	d	t
Danes	66	10.56	1.07		
Mediaeval Swedes (Västerhus)	8	9.96	0.53	-0.60	-
Swedes (S)	52	11.32	0.84	+0.76	4.20***
Lapps	172	9.90	0.90	-0.66	4.82***
Tristanites	45	10.78	0.92	+0.22	1.13
Chinese	26	10.60	1.50	+0.04	0.14
Aleuts	15	11.13	0.96	+0.57	1.90
East Greenland Eskimos	12	11.32	0.66	+0.76	2.38*
Australian Aborigines	33	11.61	0.93	+1.05	4.82***

Table 45. Mesiodistal dimensions of maxillary teeth of females.

First incisor.

Race	n	$\bar{x}$	s	d	t
Danes	54	8.28	0.52		
Mediaeval Swedes (Västerhus)	6	7.86	0.36	-0.42	-
Swedes (L)	106	8.54	0.47	+0.26	3.17**
Swedes (S)	490	8.62	0.53	+0.34	4.47***
Swiss	210	8.64	0.47	+0.36	4.93***
American Whites	87	8.40	0.53	+0.12	1.32
Lapps	85	8.34	0.42	+0.06	0.74
Tristanites	131	8.60	0.57	+0.32	3.56***
Aleuts	65	8.07	0.44	-0.21	2.39*
Australian Aborigines	111	9.00	0.58	+0.72	7.74***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

Second incisor.

Race	n	$\bar{x}$	s	d	t
Danes	70	6.37	0.58		
Mediaeval Swedes (Västerhus)	6	6.18	0.41	-0.19	-
Swedes (L)	93	6.46	0.58	+0.09	0.98
Swedes (S)	476	6.64	0.57	+0.27	3.70***
Swiss	190	6.83	0.49	+0.46	6.39***
American Whites	86	6.47	0.62	+0.10	1.03
Lapps	105	6.70	0.51	+0.33	3.98***
Tristanites	131	6.68	0.78	+0.31	2.92**
Aleuts	59	7.08	0.41	+0.71	7.89***
Australian Aborigines	104	7.34	0.63	+0.97	10.32***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

Canine.

Race	n	$\bar{x}$	s	d	t
Danes	97	7.44	0.35		
Mediaeval Swedes (Västerhus)	7	6.87	0.23	-0.57	-
Swedes (L)	107	7.56	0.37	+0.12	2.40*
Swedes (S)	473	7.73	0.41	+0.29	6.44***
Swiss	210	7.80	0.37	+0.36	8.00***
American Whites	85	7.53	0.37	+0.09	1.70
Lapps	177	7.47	0.37	+0.03	0.67
Tristanites	112	7.74	0.41	+0.30	5.66***
Aleuts	57	7.67	0.37	+0.23	3.90***
East Greenland Eskimos	3	7.73	-	+0.29	-
Australian Aborigines	84	7.95	0.41	+0.51	9.11***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

First premolar.

Race	n	$\bar{x}$	s	d	t
Danes	97	6.54	0.33		
Mediaeval Swedes (Västerhus)	7	6.31	0.18	-0.23	-
Swedes (L)	62	6.95	0.36	+0.41	7.45***
Swedes (S)	124	7.04	0.39	+0.50	10.20***
Swiss	122	7.03	0.40	+0.49	9.80***
American Whites	84	6.85	0.42	+0.31	5.54***
Lapps	205	6.55	0.40	+0.01	0.21
Tristanites	112	7.02	0.75	+0.48	5.85***
Aleuts	37	6.96	0.33	+0.42	6.67***
East Greenland Eskimos	2	7.15	-	+0.61	-
Australian Aborigines	86	7.53	0.41	+0.99	18.00***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

Second premolar.

Race	n	$\bar{x}$	s	d	t
Danes	87	6.33	0.36		
Mediaeval Swedes (Västerhus)	6	6.17	0.51	-0.16	-
Swedes (L)	54	6.71	0.37	+0.38	6.03***
Swedes (S)	115	6.85	0.43	+0.52	9.12***
Swiss	119	6.83	0.44	+0.50	8.62***
American Whites	81	6.62	0.43	+0.29	4.75***
Lapps	208	6.32	0.43	-0.01	0.19
Tristanites	102	6.59	0.33	+0.26	5.20***
Aleuts	37	6.61	0.41	+0.28	3.78***
East Greenland Eskimos	3	6.40	-	+0.07	-
Australian Aborigines	83	7.01	0.44	+0.68	10.97***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

First molar.

Race	n	$\bar{x}$	s	d	t
Danes	76	10.31	0.52		
Mediaeval Swedes (Västerhus)	8	9.90	0.80	-0.41	-
Swedes (L)	36	10.54	0.60	+0.23	2.07*
Swedes (S)	135	10.47	0.52	+0.16	2.13*
American Whites	85	10.52	0.51	+0.21	2.59**
Lapps	223	9.93	0.51	-0.38	5.59***
Tristanites	122	10.45	0.39	+0.14	2.15*
Aleuts	36	10.05	0.42	-0.26	2.60*
East Greenland Eskimos	18	10.54	0.58	+0.23	1.64
Australian Aborigines	109	10.92	0.50	+0.61	8.03***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

Second molar.

Race	n	$\bar{x}$	s	d	t
Danes	105	9.17	0.58		
Mediaeval Swedes (Västerhus)	8	8.91	0.46	-0.26	-
Swedes (S)	176	10.05	0.58	+0.88	12.39***
American Whites	50	9.81	0.49	+0.64	6.74***
Lapps	225	8.93	0.56	-0.24	3.58***
Tristanites	96	9.78	0.66	+0.61	7.01***
Aleuts	41	9.84	0.60	+0.67	6.20***
East Greenland Eskimos	8	10.03	0.67	+0.86	-
Australian Aborigines	79	10.31	0.61	+1.14	12.95***

Table 45. (cont.) Mesiodistal dimensions of maxillary teeth of females.

Third molar.

Race	n	$\bar{x}$	s	d	t
Danes	77	8.47	0.68		
Mediaeval Swedes (Västerhus)	4	8.53	0.65	+0.06	-
Swedes (S)	7	8.33	-	-0.14	-
Lapps	154	7.85	0.78	-0.62	5.96***
Tristanites	56	8.87	0.76	+0.40	3.20**
Aleuts	15	8.99	0.50	+0.52	2.83**
East Greenland Eskimos	4	9.38	-	+0.91	-
Australian Aborigines	35	9.76	0.75	+1.29	9.02***

Table 46. Mesiodistal dimensions of mandibular teeth of females.

First incisor.

Race	n	$\bar{x}$	s	d	t
Danes	28	5.29	0.25		
Mediaeval Swedes (Västerhus)	4	4.53	0.21	-0.76	-
Swedes (L)	117	5.34	0.32	+0.05	0.77
Swedes (S)	491	5.42	0.37	+0.13	1.83
Swiss	213	5.39	0.30	+0.10	1.69
American Whites	87	5.25	0.36	-0.04	0.55
Lapps	83	5.22	0.29	-0.07	1.13
Tristanites	132	5.49	0.46	+0.20	2.22*
Aleuts	73	5.08	0.44	-0.21	2.39*
Australian Aborigines	117	5.68	0.43	+0.39	4.59***

Table 46 (cont.) Mesiodistal dimensions of mandibular teeth of females.

Second incisor.

Race	n	$\bar{x}$	s	d	t
Danes	45	5.76	0.32		
Mediaeval Swedes (Västerhus)	6	5.18	0.27	-0.58	-
Swedes (L)	112	5.84	0.32	+0.08	1.40
Swedes (S)	493	5.94	0.37	+0.18	3.16**
Swiss	213	5.95	0.34	+0.19	3.45***
American Whites	87	5.78	0.38	+0.02	0.30
Lapps	124	5.85	0.39	+0.09	1.38
Tristanites	135	6.08	0.49	+0.32	4.10***
Aleuts	72	5.90	0.35	+0.14	2.15*
Australian Aborigines	112	6.36	0.41	+0.60	8.82***

Table 46. (cont.) Mesiodistal dimensions of mandibular teeth of females.

Canine.

Race	n	$\bar{x}$	s	d	t
Danes	82	6.51	0.37		
Mediaeval Swedes (Västerhus)	6	5.77	0.46	-0.74	-
Swedes (L)	118	6.54	0.32	+0.03	0.61
Swedes (S)	493	6.69	0.38	+0.18	4.00***
Swiss	213	6.73	0.34	+0.22	4.89***
American Whites	87	6.47	0.32	-0.04	0.75
Lapps	186	6.50	0.36	-0.01	0.21
Tristanites	120	6.87	0.39	+0.36	6.55***
Aleuts	74	6.71	0.32	+0.20	3.57***
East Greenland Eskimos	1	6.90	-	+0.41	-
Australian Aborigines	95	7.01	0.38	+0.50	8.77***

Table 46 (cont.) Mesiodistal dimensions of mandibular teeth of females.

First premolar

Race	n	$\bar{x}$	s	d	t
Danes	94	6.62	0.39		
Mediaeval Swedes (Västerhus)	6	6.23	0.27	-0.39	-
Swedes (L)	75	7.08	0.38	+0.46	7.80***
Swedes (S)	146	7.16	0.40	+0.54	10.38***
Swiss	108	7.13	0.43	+0.51	8.79***
American Whites	87	6.87	0.38	+0.25	4.39***
Lapps	191	6.59	0.43	-0.03	0.58
Tristanites	120	7.10	0.53	+0.48	7.38***
Aleuts	64	6.85	0.28	+0.23	4.11***
East Greenland Eskimos	2	7.00	-	+0.38	-
Australian Aborigines	85	7.36	0.41	+0.74	12.54***

Table 46 (cont.) Mesiodistal dimensions of mandibular teeth of females.

Second premolar.

Race	n	$\bar{x}$	s	d	t
Danes	81	6.64	0.38		
Mediaeval Swedes (Västerhus)	8	6.35	0.40	-0.29	-
Swedes (L)	47	7.16	0.41	+0.52	7.22***
Swedes (S)	117	7.21	0.39	+0.57	10.18***
Swiss	132	7.25	0.45	+0.61	10.17***
American Whites	83	7.02	0.40	+0.38	6.23***
Lapps	191	6.59	0.39	-0.05	0.98
Tristanites	107	7.13	0.39	+0.49	8.60***
Aleuts	56	7.02	0.49	+0.38	5.07***
East Greenland Eskimos	5	7.04	0.25	+0.40	-
Australian Aborigines	82	7.31	0.44	+0.67	10.31***

Table 46 (cont.) Mesiodistal dimensions of mandibular teeth of females.

First molar.

Race	n	$\bar{x}$	s	d	t
Danes	58	10.82	0.64		
Mediaeval Swedes (Västerhus)	8	10.13	0.47	-0.69	-
Swedes (L)	38	11.01	0.51	+0.19	1.53
Swedes (S)	123	10.98	0.61	+0.16	1.62
American Whites	84	10.74	0.56	-0.08	0.79
Lapps	192	10.64	0.55	-0.18	2.12*
Tristanites	112	11.01	0.50	+0.19	2.13*
Aleuts	20	11.20	0.50	+0.38	2.42*
East Greenland Eskimos	5	11.44	0.51	+0.62	-
Australian Aborigines	101	11.62	0.55	+0.80	8.33***

Table 46 (cont.) Mesiodistal dimensions of mandibular teeth of females.

Second molar.

Race	n	$\bar{x}$	s	d	t
Danes	85	10.11	0.58		
Mediaeval Swedes (Västerhus)	8	9.66	0.57	-0.45	-
Swedes (S)	275	10.70	0.64	+0.59	7.56***
American Whites	53	10.34	0.62	+0.23	2.19*
Lapps	203	10.06	0.61	-0.05	0.65
Tristanites	92	10.51	0.66	+0.40	4.26***
Aleuts	36	11.16	0.57	+1.05	9.13***
East Greenland Eskimos	6	11.37	0.56	+1.26	-
Australian Aborigines	80	11.07	0.65	+0.96	10.00***

Table 46 (cont.) Mesiodistal dimensions of mandibular teeth of females.

Third molar.

Race	n	$\bar{x}$	s	d	t
Danes	71	9.97	0.69		
Mediaeval Swedes (Västerhus)	6	9.63	1.41	-0.34	-
Swedes (S)	11	10.30	-	+0.33	-
Lapps	152	9.57	0.69	-0.40	4.04***
Tristanites	43	10.40	0.85	+0.43	2.95**
Aleuts	20	11.30	0.60	+1.33	7.82***
East Greenland Eskimos	3	11.27	-	+1.30	-
Australian Aborigines	33	11.32	0.68	+1.35	9.31***

Table 47. Labiolingual dimensions of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
First incisor.					
Danes	40	7.33	0.42		
Lapps	114	7.08	0.43	-0.25	3.21**
Chinese	267	7.33	0.66	0	0
Australian Aborigines	41	7.95	0.56	+0.62	5.64***
Second incisor.					
Danes	43	6.46	0.43		
Lapps	129	6.25	0.42	-0.21	2.84**
Chinese	219	6.56	0.58	+0.10	1.08
Australian Aborigines	41	7.03	0.51	+0.57	5.59***

Table 47 (cont.) Labiolingual dimensions of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
Canine.					
Danes	62	8.47	0.52		
Lapps	197	8.18	0.52	-0.29	3.82***
Tristanites	82	9.38	0.53	+0.91	10.22***
Chinese	210	8.31	0.65	-0.16	1.78
Aleuts	65	8.47	0.43	0	0
East Greenland Eskimos	7	8.63	0.18	+0.16	-
Australian Aborigines	41	9.12	0.56	+0.65	5.96***
First premolar.					
Danes	81	8.99	0.52		
Lapps	203	8.91	0.61	-0.08	1.04
Tristanites	75	9.81	0.51	+0.82	9.88***
Chinese	209	9.39	0.70	+0.40	4.65***
Aleuts	81	9.31	0.61	+0.32	3.60***
East Greenland Eskimos	7	9.76	0.53	+0.77	-
Australian Aborigines	85	10.38	0.61	+1.39	15.80***

Table 47 (cont.) Labiolingual dimensions of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
<u>Second premolar</u>.					
Danes	84	9.16	0.55		
Lapps	208	8.72	0.56	-0.44	6.11***
Tristanites	65	9.96	0.66	+0.80	8.08***
Chinese	143	9.17	0.67	+0.01	0.12
Aleuts	69	9.13	0.60	-0.03	0.32
East Greenland Eskimos	7	9.43	0.68	+0.27	-
Australian Aborigines	85	10.29	0.56	+1.13	13.29***
<u>First molar</u>.					
Danes	60	11.54	0.49		
Lapps	231	11.24	0.59	-0.30	3.66***
Tristanites	104	12.14	0.61	+0.60	6.52***
Chinese	88	11.19	0.78	-0.35	3.07**
Aleuts	45	11.34	0.64	-0.20	1.82
East Greenland Eskimos	15	11.79	0.29	+0.25	1.89
Australian Aborigines	85	12.63	0.54	+1.09	12.39***

Table 47 (cont.) Labiolingual dimensions of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
<u>Second molar.</u>					
Danes	94	11.29	0.72		
Lapps	258	10.96	0.66	-0.33	4.02***
Tristanites	84	12.33	0.85	+1.04	8.81***
Chinese	70	11.00	0.73	-0.29	2.54*
Aleuts	42	11.36	0.83	+0.07	0.50
East Greenland Eskimos	19	11.59	0.53	+0.30	1.72
Australian Aborigines	41	12.83	0.73	+1.54	11.41***
<u>Third molar.</u>					
Danes	95	10.63	0.77		
Lapps	187	9.93	0.83	-0.70	6.86***
Tristanites	29	11.82	1.13	+1.19	6.47***
Chinese	50	10.33	0.96	-0.30	2.04*
Aleuts	22	10.76	1.18	+0.13	0.64
East Greenland Eskimos	12	11.58	0.72	+0.95	4.06***
Australian Aborigines	32	12.09	0.82	+1.46	9.13***

Table 48. Labiolingual dimensions of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
<u>First incisor</u>.					
Danes	8	5.96	0.34		
Lapps	149	5.89	0.33	-0.07	-
Chinese	216	5.89	0.55	-0.07	-
Australian Aborigines	41	6.87	0.57	+0.91	-
<u>Second incisor</u>.					
Danes	9	6.38	0.42		
Lapps	163	6.28	0.35	-0.10	-
Chinese	187	6.30	0.53	-0.08	-
Australian Aborigines	41	7.01	0.53	+0.63	-

Table 48 (cont.) Labiolingual dimensions of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
Canine.					
Danes	34	7.87	0.48		
Lapps	211	7.55	0.48	-0.32	3.64***
Tristanites	54	8.97	0.66	+1.10	8.40***
Chinese	209	7.89	0.67	+0.02	0.17
Aleuts	74	7.93	0.62	+0.06	0.50
East Greenland Eskimos	6	7.97	0.37	+0.10	-
Australian Aborigines	41	8.39	0.48	+0.52	4.68***
First premolar.					
Danes	63	7.62	0.45		
Lapps	226	7.39	0.49	-0.23	3.33***
Tristanites	64	8.81	0.51	+1.19	13.84***
Chinese	232	8.07	0.70	+0.45	4.84***
Aleuts	86	7.82	0.52	+0.20	2.44*
East Greenland Eskimos	5	8.00	0.56	+0.38	-
Australian Aborigines	85	8.83	0.59	+1.21	13.60***

Table 48 (cont.) Labiolingual dimensions of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
Second premolar.					
Danes	69	8.15	0.50		
Lapps	217	7.75	0.47	-0.40	6.06***
Tristanites	83	9.21	0.48	+1.06	13.25***
Chinese	160	8.13	0.67	-0.02	0.22
Aleuts	79	8.40	0.62	+0.25	2.69**
East Greenland Eskimos	7	8.50	0.38	+0.35	-
Australian Aborigines	85	9.15	0.60	+1.00	11.11***
First molar.					
Danes	54	10.49	0.54		
Lapps	246	10.40	0.54	-0.09	1.10
Tristanites	110	11.22	0.51	+0.73	8.49***
Chinese	95	10.67	0.56	+0.18	1.91
Aleuts	49	10.56	0.54	+0.07	0.65
East Greenland Eskimos	10	11.63	0.60	+1.14	6.03***
Australian Aborigines	83	11.85	0.61	+1.36	13.33***

Table 48 (cont.) Labiolingual dimensions of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
Second molar.					
Danes	76	10.01	0.63		
Lapps	259	10.07	0.56	+0.06	0.80
Tristanites	80	11.16	0.65	+1.15	11.27***
Chinese	82	10.37	0.57	+0.36	3.75***
Aleuts	45	10.58	0.65	+0.57	4.75***
East Greenland Eskimos	12	10.93	0.88	+0.92	4.42***
Australian Aborigines	41	11.60	0.66	+1.59	12.72***
Third molar.					
Danes	74	9.76	0.73		
Lapps	168	9.52	0.73	-0.24	2.38*
Tristanites	14	11.53	0.61	+1.77	8.55***
Chinese	26	10.35	1.03	+0.59	3.17**
Aleuts	13	10.15	0.56	+0.39	1.84
East Greenland Eskimos	12	10.89	0.80	+1.13	4.93***
Australian Aborigines	29	11.41	0.71	+1.65	10.44***

Table 49. Labiolingual dimensions of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
First incisor.					
Danes	76	6.92	0.38		
Lapps	125	6.75	0.49	-0.17	2.62**
Australian Aborigines	36	7.50	0.36	+0.58	7.73***
Second incisor.					
Danes	83	6.09	0.42		
Lapps	129	6.08	0.42	-0.01	0.17
Australian Aborigines	36	6.69	0.49	+0.60	6.74***

Table 49 (cont.) Labiolingual dimensions of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
Canine.					
Danes	102	8.00	0.48		
Lapps	167	7.67	0.51	-0.33	5.24***
Tristanites	47	8.87	0.55	+0.87	9.78***
Aleuts	44	8.15	0.41	+0.15	1.81
East Greenland Eskimos	4	7.98	-	-0.02	-
Australian Aborigines	36	8.67	0.38	+0.67	7.53***
First premolar.					
Danes	118	8.68	0.50		
Lapps	189	8.64	0.49	-0.04	0.69
Tristanites	49	9.64	0.62	+0.96	10.55***
Aleuts	29	9.18	0.24	+0.50	5.26***
East Greenland Eskimos	2	8.40	-	-0.28	-
Australian Aborigines	81	10.10	0.56	+1.42	18.68***

Table 49 (cont.) Labiolingual dimensions of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
<u>Second premolar</u>.					
Danes	111	8.77	0.54		
Lapps	199	8.47	0.60	-0.30	4.35***
Tristanites	41	9.83	0.47	+1.06	11.04***
Aleuts	30	9.03	0.73	+0.26	2.17*
East Greenland Eskimos	3	8.47	-	-0.30	-
Australian Aborigines	81	10.05	0.60	+1.28	15.42***
<u>First molar</u>.					
Danes	99	11.04	0.55		
Lapps	208	10.74	0.53	-0.30	4.62***
Tristanites	70	11.77	0.53	+0.73	8.69***
Aleuts	20	11.21	0.47	+0.17	1.29
East Greenland Eskimos	18	11.48	0.64	+0.44	3.06**
Australian Aborigines	81	12.21	0.57	+1.17	13.93***

Table 49 (cont.) Labiolingual dimensions of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
Second molar.					
Danes	112	10.92	0.66		
Lapps	198	10.26	0.64	-0.66	8.68***
Tristanites	47	11.97	0.60	+1.05	9.46***
Aleuts	27	11.28	0.65	+0.36	2.55*
East Greenland Eskimos	8	11.45	0.70	+0.53	-
Australian Aborigines	36	12.42	0.67	+1.50	11.81***
Third molar.					
Danes	79	10.14	0.84		
Lapps	152	9.41	1.00	-0.73	5.57***
Tristanites	23	12.12	0.95	+1.98	9.66***
Aleuts	9	10.70	0.28	+0.56	1.99*
East Greenland Eskimos	4	10.23	-	+0.09	-
Australian Aborigines	30	11.93	0.83	+1.79	10.00***

Table 50. Labiolingual dimensions of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
First incisor.					
Danes	23	5.71	0.29		
Lapps	119	5.64	0.40	-0.07	0.80
Australian Aborigines	36	6.44	0.32	+0.73	8.90***
Second incisor.					
Danes	37	6.15	0.39		
Lapps	147	6.00	0.35	-0.15	2.27*
Australian Aborigines	36	6.63	0.40	+0.48	5.22***

Table 50 (cont.) Labiolingual dimensions of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
Canine.					
Danes	74	7.34	0.47		
Lapps	190	6.95	0.46	-0.39	6.19***
Tristanites	43	8.45	0.66	+1.11	10.57***
Aleuts	57	7.58	0.43	+0.24	3.00**
East Greenland Eskimos	1	7.10	-	-0.24	-
Australian Aborigines	36	8.03	0.38	+0.69	7.67***
First premolar.					
Danes	95	7.33	0.41		
Lapps	197	7.13	0.47	-0.20	3.57***
Tristanites	61	8.69	0.57	+1.36	17.44***
Aleuts	49	7.58	0.46	+0.25	3.33***
East Greenland Eskimos	3	7.47	-	+0.14	-
Australian Aborigines	81	8.69	0.55	+1.36	18.89***

Table 50 (cont.) Labiolingual dimensions of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
Second premolar.					
Danes	95	7.84	0.42		
Lapps	203	7.51	0.46	-0.33	5.89***
Tristanites	55	9.16	0.52	+1.32	17.14***
Aleuts	42	8.14	0.59	+0.30	3.41***
East Greenland Eskimos	6	7.75	0.55	-0.09	-
Australian Aborigines	81	8.94	0.51	+1.10	15.71***
First molar.					
Danes	86	10.15	0.46		
Lapps	207	10.05	0.51	-0.10	1.56
Tristanites	100	11.08	0.66	+0.93	10.94***
Aleuts	16	10.29	0.41	+0.14	1.15
East Greenland Eskimos	6	10.85	0.52	+0.70	-
Australian Aborigines	80	11.44	0.51	+1.29	17.20***

Table 50 (cont.) Labiolingual dimensions of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
Second molar.					
Danes	99	9.64	0.46		
Lapps	218	9.62	0.54	-0.02	0.32
Tristanites	72	10.94	0.61	+1.30	15.85***
Aleuts	37	10.29	0.65	+0.65	6.50***
East Greenland Eskimos	6	10.78	0.65	+1.14	-
Australian Aborigines	36	11.29	0.42	+1.65	18.75***
Third molar.					
Danes	75	9.33	0.53		
Lapps	152	9.20	0.67	-0.13	1.46
Tristanites	13	11.05	0.62	+1.72	10.49***
Aleuts	17	10.42	0.50	+1.09	7.68***
East Greenland Eskimos	3	10.40	-	+1.07	-
Australian Aborigines	30	11.16	0.57	+1.83	15.64***

Table 68. Crown indices of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
<u>First incisor</u>.					
Danes	21	85.8	6.1		
Lapps	59	84.6	4.87	1.2	0.91
<u>Second incisor</u>.					
Danes	27	97.9	10.4		
Lapps	79	91.9	6.46	6.0	3.53***
<u>Canine</u>.					
Danes	50	109.6	5.1		
Lapps	160	105.6	5.33	4.0	4.65***
Tristanites	82	118.8	7.9	9.2	7.36***
Aleuts	65	105.6	6.4	4.0	3.64***

Table 68. (cont.) Crown indices of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
<u>First premolar</u>.					
Danes	52	134.4	6.5		
Lapps	186	131.5	6.63	2.9	2.82**
Tristanites	75	140.7	10.9	6.3	3.73***
Aleuts	79	130.4	5.7	4.0	3.74***
<u>Second premolar</u>.					
Danes	47	141.5	7.0		
Lapps	195	135.4	6.91	6.1	5.40***
Tristanites	65	151.6	11.7	10.1	5.26***
Aleuts	65	136.4	8.6	5.1	3.33**
<u>First molar</u>.					
Danes	31	108.4	4.5		
Lapps	217	109.5	4.96	1.1	1.17
Tristanites	99	114.3	5.8	5.9	5.18***
Aleuts	42	109.3	4.2	0.9	0.87

Table 68 (cont.) Crown indices of maxillary teeth of males.

Race	n	$\bar{x}$	s	d	t
Second molar.					
Danes	69	117.7	6.8		
Lapps	253	117.4	6.91	0.3	0.32
Tristanites	77	125.8	9.4	8.1	5.91***
Aleuts	41	114.6	6.9	3.1	2.30*
Third molar.					
Danes	86	120.8	9.2		
Lapps	184	124.3	10.60	3.5	2.63**
Tristanites	29	134.1	9.8	13.3	6.62***
Aleuts	21	114.9	7.9	5.9	2.71**

Table 69. Crown indices of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
First incisor.					
Danes	1	(103.3)	-		
Lapps	56	108.6	6.22	5.3	-
Second incisor.					
Danes	4	101.0	-		
Lapps	90	105.6	6.69	4.6	-
Canine.					
Danes	28	114.4	4.6		
Lapps	181	110.4	6.32	4.0	3.23**
Tristanites	51	125.7	11.8	11.3	4.85***
Aleuts	72	110.1	8.9	4.3	2.43*

Table 69 (cont.) Crown indices of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
First premolar.					
Danes	45	113.1	7.0		
Lapps	203	110.1	6.29	3.0	2.83**
Tristanites	63	126.5	6.4	13.4	10.31***
Aleuts	82	111.3	7.9	1.8	1.28
Second premolar.					
Danes	50	118.8	7.1		
Lapps	198	115.2	6.33	3.6	3.50***
Tristanites	82	127.8	7.1	9.0	7.09***
Aleuts	72	117.3	6.6	1.5	1.20
First molar.					
Danes	27	92.7	3.6		
Lapps	215	94.7	4.55	2.0	2.20*
Tristanites	113	99.3	5.7	6.6	5.74***
Aleuts	47	91.5	4.2	1.2	1.25

Table 69 (cont.) Crown indices of mandibular teeth of males.

Race	n	$\bar{x}$	s	d	t
Second molar.					
Danes	53	94.9	4.4		
Lapps	245	95.8	4.38	0.9	1.36
Tristanites	78	103.9	6.9	9.0	8.41***
Aleuts	44	93.7	5.3	1.2	1.21
Third molar.					
Danes	66	93.6	5.7		
Lapps	158	96.3	6.80	2.7	2.84**
Tristanites	12	104.8	8.1	11.2	5.83***
Aleuts	13	92.8	5.9	0.8	0.46

Table 70. Crown indices of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
First incisor.					
Danes	49	83.2	5.5		
Lapps	73	80.8	5.26	2.4	2.42*
Second incisor.					
Danes	60	95.9	8.0		
Lapps	96	91.3	6.78	4.6	3.83***
Canine.					
Danes	87	107.6	6.3		
Lapps	153	102.6	4.80	5.0	6.94***
Tristanites	46	116.0	10.8	8.4	5.68***
Aleuts	44	105.9	4.4	1.7	1.62

Table 70 (cont.) Crown indices of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
First premolar.					
Danes	87	132.8	7.0		
Lapps	180	132.1	5.64	0.7	0.88
Tristanites	47	139.3	9.3	6.5	4.58***
Aleuts	27	133.4	6.9	0.6	0.39
Second premolar.					
Danes	76	138.3	6.5		
Lapps	184	133.9	7.27	4.4	4.58***
Tristanites	42	149.5	8.5	11.2	8.00***
Aleuts	25	137.8	10.9	0.5	0.28
First molar.					
Danes	73	106.9	4.2		
Lapps	191	108.4	4.82	1.5	2.34*
Tristanites	59	113.9	6.1	7.0	7.78***
Aleuts	18	110.2	5.6	3.3	2.80**

Table 70 (cont.) Crown indices of maxillary teeth of females.

Race	n	$\bar{x}$	s	d	t
<u>Second molar</u>.					
Danes	103	119.3	8.4		
Lapps	194	115.2	6.87	4.1	4.56***
Tristanites	43	124.3	8.2	5.0	3.31***
Aleuts	26	115.0	4.9	4.3	2.51*
<u>Third molar</u>.					
Danes	74	120.1	9.1		
Lapps	150	119.8	11.19	0.3	0.20
Tristanites	22	136.1	13.9	16.0	6.37***
Aleuts	9	121.3	10.2	1.2	-

Table 71. Crown indices of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
<u>First incisor</u>.					
Danes	11	108.1	4.2		
Lapps	64	109.3	6.56	1.2	0.59
<u>Second incisor</u>.					
Danes	26	107.6	6.3		
Lapps	99	102.8	8.04	4.8	2.82**
<u>Canine</u>.					
Danes	64	112.5	5.7		
Lapps	156	107.3	6.66	5.2	5.47***
Tristanites	43	123.0	6.6	10.5	8.82***
Aleuts	57	112.4	5.4	0.1	0.10

Table 71 (cont.) Crown indices of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
<u>First premolar</u>.					
Danes	86	111.0	6.2		
Lapps	177	108.7	6.41	2.3	2.77**
Tristanites	59	122.3	9.4	11.3	8.76***
Aleuts	45	111.4	5.9	0.4	0.36
<u>Second premolar</u>.					
Danes	79	117.9	6.4		
Lapps	181	114.0	6.04	3.9	4.70***
Tristanites	55	128.1	8.0	10.2	8.16***
Aleuts	41	116.6	2.9	1.3	1.23
<u>First molar</u>.					
Danes	57	94.3	4.0		
Lapps	185	94.5	3.88	0.2	0.34
Tristanites	90	100.1	5.5	5.8	6.90***
Aleuts	16	92.0	4.6	2.3	1.97

Table 71 (cont.) Crown indices of mandibular teeth of females.

Race	n	$\bar{x}$	s	d	t
Second molar.					
Danes	84	95.5	4.6		
Lapps	195	95.8	4.55	0.3	0.50
Tristanites	71	104.4	6.1	8.9	10.35***
Aleuts	36	91.9	2.3	3.6	4.44***
Third molar.					
Danes	68	93.6	5.0		
Lapps	146	96.3	5.42	2.7	3.46***
Tristanites	15	103.1	5.9	9.5	6.42***
Aleuts	16	91.6	4.8	2.0	1.44

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BIBLIOGRAPHY.

Alexandersen, V. (1962 a). Rodforholdene hos menn-:eskets underkaebehjørnetaender med saerligt henblik på torodede hjørnetaender. 1. Den mor-:fologiske variation. Tandlaegebladet. 66. 53.

Alexandersen, V. (1962 b). Rodforholdene hos menn-:eskets underkaebehjørnetaender med saerligt henblik på torodede hjørnetaender. 2. Forekomst af torodede hjørnetaender i underkaeben hos Homo sapiens og hos andre primater. Tandlaegebladet. 66. 729.

Alexandersen, V. (1963). Double-rooted human lower canine teeth. In Symposia of the Society for the Study of Human Biology, Vol. V, Dental An-:thropology. Edited by D.R. Brothwell. Oxford.

Arai, H. (1939). Über die Wechselbeziehungen zwischen dem mediodistalen und dem bukkolingualen Durchmesser der Zahnkrone. Zentralbl. f. Zahn-, Mund- u. Kieferhlk. 4. 220. (Abstract of paper in Nihon Shika Gk.Z. 30. 176. 1937).

Ashton, E.H., Healy, M.J.R. & Lipton, S. (1957).
The/

The descriptive use of discriminant functions in physical anthropology. Proc. Roy. Soc. B. 146. 552.

Azoulay, L. & Regnault, F. (1893). Des diverses formes des dents incisives superieures. Bull.Soc. Anthrop. Paris. 4. 266.

Ballard, M.L. (1944). Asymmetry in tooth size - a factor in the etiology, diagnosis and treatment of malocclusion. Angle Ortho. 14. 67.

Ballard, M.L. & Wylie, W.L. (1947). Mixed dentition case analysis - estimating size of unerupted permanent teeth. Amer. J. Ortho. & Oral Surg. 33. 754.

Barrett, M.J., Brown, T. & Macdonald, M.R. (1963). Dental observations on Australian aborigines : mesiodistal crown diameters of permanent teeth. Aust. Dent. J. 8. 150.

Barrett, M.J., Brown, T., Arato, G. & Ozols, I.V. (1964). Dental observations on Australian abor-:igines : buccolingual crown diameters of decid-:uous and permanent teeth. Aust. Dent. J.9. 280.

Begg, P.R. (1954). Stone Age man's dentition. Amer. J. Ortho. 40. 298.

Beyron, H. (1964). Occlusal relations and mastication in Australian aborigines. Acta Odont. Scand. 22. 597.

Black, G.V. (1902). Descriptive Anatomy of the Human Teeth. 4th ed. Philadelphia.

Bolton, W.A. (1958). Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. Angle Ortho. 28. 113.

Brabant, H. (1960). Observations odontologiques et anthropologiques sur les ossements provenant des fouilles executées dans la cathedrale Sainte-Gertrude à Nivelles. Acta Stomatol. Belgica. 57. 17.

Brabant, H. & Twiesselmann, F. (1960). Étude de la denture de 159 squelettes provenant d'un cimetière du XIe siècle à Renaix (Belgique). Rev. Belge de Sc. Dent. 15. 561.

Brabant, H., Sahly, A. & Bouyssou, M. (1961). Etude/

Étude des dents préhistoriques de la station archéologique des Matelles (Département de l'Hérault, France). Bull. du G.I.R.S. 4. 382.

Brabant, H. & Sahly, A. (1962). La palaeostomatol-:ogie en Belgique et en France. Acta Stomat. Belgica. 59. 285.

Brabant, H. (1963). Observations sur la denture humaine en France et en Belgique à l'époque gallo-romaine et au moyen âge. Bull. du G.I.R.S. 6. 169.

Brabant, H. & Nemeskeri, J. (1963). Étude anthrop-:ologique et stomatologique d'une série de crânes d'âge hunnique découverts à Mözs (Hongrie). Bull. du G.I.R.S. 6. 317.

Brabant, H. & Twiesselmann, F. (1964). Observations sur l'évolution de la denture permanente humaine en Europe occidentale. Bull. du G.I.R.S. 7. 11.

Brabant, H. & Sahly, A. (1964). Étude des dents néanderthaliennes découvertes dans la Grotte du Portel en Ariège (France). Bull.du G.I.R.S. 7. 237.

Brabant/

Brabant, H. (1965). Observations sur la denture des Pygmées de l'Afrique centrale. Bull. du G.I.R.S. 8. 27.

Brinch, O. & Møller-Christensen, V. (1949). On comparative investigations into the occurrence of dental caries in archaeological skulls. Odont. Tidskr. 57. 357.

Brinch, O. (1952). Investigations into the occurr:ence of dental caries in Denmark in the Middle Ages. Brit. Dent. J. 93. 88.

Broca, P. (1879). Instructions relatives à l'étude anthropologique du système dentaire. Bull. Soc. Anthrop. Paris. 2. 128.

Bronowski, J. & Long, W.M. (1951). Statistical methods in anthropology. Nature. 168. 794.

Bronowski, J. & Long, W.M. (1953). The Austral:opithecine milk canines. Nature. 172. 251.

Buffon. see Leclerc.

Butler, P.M. (1939). Studies of the mammalian den:tition. Differentiation of the post-canine dentition/

dentition. Proc. Zool. Soc. Lond. B. 109. 1.

Campbell, T.D. (1925). Dentition and palate of the Australian aboriginal. Keith Sheridan Foundation publications no.1. Adelaide.

Carbonell, V.M. (1963). Significance of Carabelli's cusp in upper molars of different populations. I.A.D.R. abstract. no.39.

Carette-Pillot, Mme. (1947). La denture des hommes du Paléolithique. L'Odontologie. 68. 3 & 75.

Carr, H.G. (1960). Some dental characteristics of the Middle Minoans. Man. 60. 119.

Choquet, I. (1908). Étude comparative des dents humaines dans les differentes races. L'Odontologie. 39.

Clark, B., Zimmerman, S. & Carbonell, V.M. (1964). Analysis of tooth size in marmosets. J. Dent. Res. 43. 834.

Coon, C.S. (1939). The Races of Europe. New York.

Dahlberg, A.A. (1945). The changing dentition of man/

man. J. Amer. Dent. Assn. 32. 676.

Dahlberg, A.A. (1960). The dentition of the first agriculturists (Jarmo, Iraq). Am. J. Phys. Anthrop. N.S. 18. 243.

Dahlberg, A.A. (1961). Relationship of tooth size to cusp number and groove conformation of occ-:lusal surface patterns of lower molar teeth. J. Dent. Res. 40. 34.

Davis, J.B. & Thurnam, J. (1865). Crania Britannica. London.

De Jonge-Cohen, Th.E. (1918). Maximal-, Minimal- und Mittelwerte der mesiodistalen Dimensionen der Zähne des menschlichen Gebisses. Öster-:reichische Zeitschrift für Stomatologie. 16. 1.

De Jonge-Cohen, Th.E. (1940). Maximal-, Minimal- und Mittelwerte der mesiodistalen Dimensionen der postkaninen Zähne des menschlichen Gebisses. Zeitschrift für Zahnärztliche Orthopädie. 32. 1.

De Terra, M. (1905). Beiträge zu einer Odontographie der Menschenrassen. Inaugural Dissertation, University/

University of Zürich.

De Vecchis, C.E. (1958). Anatomical and comparative studies of the mandibles found among remains of Palaeolithic man. Dent. Abstr. 3. 588.

Drennan, M.R. (1929). The dentition of a Bushman tribe. Annals of the South African Museum. 24. 61.

Filipsson, R. & Goldson, L. (1963). Correlation be-:tween tooth width, width of the head, length of the head and stature. Acta Odont. Scand. 21. 359.

Fisher, R.A. & Yates, F. (1943). Statistical Tables for Biological, Agricultural and Medical Research. London/Edinburgh.

Gabriel, A. (1955). The correlation of the size of human teeth with one another and with certain jaw measurements. Dent. J. Aust. 27. 174.

Garn, S.M. & Lewis, A.B. (1958). Tooth size, body size and "giant" fossil man. Amer. Anthropol. 60. 874.

Garn, S.M. & Lewis, A.B. (1962). The relationship between third molar agenesis and reduction in tooth number. Angle Ortho. 32. 14.

Garn, S.M., Lewis, A.B. & Vicinus, J.H. (1962). Third molar agenesis and reduction in the number of other teeth. J. Dent. Res. 41. 717.

Garn, S.M., Lewis, A.B. & Vicinus, J.H. (1963). Third molar polymorphism and its significance to dental genetics. J. Dent. Res. 42. 1344.

Garn, S.M., Lewis, A.B. & Kerewsky, R.S. (1964). Sex difference in tooth size. J. Dent. Res. 43. 306.

Garn, S.M., Lewis, A.B. & Kerewsky, R.S. (1965 a). Size interrelationships of the mesial and distal teeth. J. Dent. Res. 44. 350.

Garn, S.M., Lewis, A.B. & Kerewsky, R.S. (1965 b). X-linked inheritance of tooth size. J. Dent. Res. 44. 439.

Garn, S.M., Lewis, A.B., Kerewsky, R.S. & Jegart, K. (1965). Sex differences in intra-individual tooth/

tooth-size communalities. J. Dent. Res. 44. 476.

Goblirsch, A.W. (1930). A study of third molar teeth. J. Amer. Dent. Assn. 17. 1849.

Goose, D.H. (1962). Reduction of palate size in modern populations. Arch. oral Biol. 7. 343.

Goose, D.H. (1963). Dental measurement : an assess-:ment of its value in anthropological studies. In Symposia of the Society for the Study of Human Biology, Vol V : Dental Anthropology, edited by D.R. Brothwell. Oxford.

Grahnén, H. (1956). Hypodontia in the permanent dentition. A clinical and genetical investig-:ation. Odont. Revy. 7. Suppl. 3.

Gravely, J.F. (1965). A radiographic survey of third molar development. Brit. Dent. J. 119. 397.

Hellman, M. (1936). Our third molar teeth, their eruption, presence and absence. Dental Cosmos. 78. 750.

Henshall/

Henshall, A.S. (1958). A long cist cemetery at Parkburn sand pit, Lasswade. Proc. Soc. Ant. Scot. (1955-56). 89. 252.

Henshall, A.S. (1965). Personal communication.

Hillebrand, E. (1909). Beiträge zur Morphologie der menschlichen Zähne. Pester medicinisch-chirurgische Presse. 45. 200.

Hjelmman, G. (1928). Morphologische Beobachtungen an den Zähnen der Finnen. Acta Societatis Medicorum Fennicae "Duodecim". Tom.11. Fasc. 1. Helsinki.

Holloway, P.J., Shaw, J.H. & Sweeney, E.A. (1961). Effects of various sucrose: casein ratios in purified diets on the teeth and supporting structures of rats. Arch. oral Biol. 3. 185.

Hosaka, T. (1936). Statistische Untersuchungen über die Zähne bei Chinesen mit besonderer Berücksichtigung der Rassenunterschiede. J. Oriental Med. 24. 1065 & 1230; and 25. 41 & 348.

Hrdlicka, A. (1923 a). Dimensions of the first and second lower molars with their bearing on the Piltdown/

Piltdown jaw and on Man's phylogeny. Am. J. Phys. Anthrop. 6. 195.

Hrdlicka, A. (1923 b). Variation in the dimensions of lower molars in man and anthropoid apes. Am. J. Phys. Anthrop. 6. 423.

Hrdlicka, A. (1924). New data on the teeth of early man and certain fossil European apes. Am. J. Phys. Anthrop. 7. 109.

Hrdlicka, A. (1930). The skeletal remains of early man. Smithsonian Miscellaneous Collections. 83.

Hrdlicka, A. (1935). Normal variation of teeth and jaws, and orthodonty. Internat. J. Ortho. 21. 1099.

Hrdlicka, A. (1952). Practical Anthropometry. 4th ed., edited by T.D. Stewart. Philadelphia.

Hunter, W.S. & Priest, W.R. (1960). Errors and dis:crepancies in measurement of tooth size. J. Dent. Res. 39. 405.

Janzer, O. (1927). Die Zähne der Neu-Pommern. Vierteljahrsschrift für Zahnheilkunde. 43. 289/

289 & 401.

Jepsen, A. (1963). Root surface measurement and a method for X-ray determination of root surface area. Acta Odont. Scand. 21. 35.

Jørgensen, K.D. (1955). The Dryopithecus pattern in recent Danes and Dutchmen. J. Dent. Res. 34. 195.

Jørgensen, K.D. (1956). The deciduous dentition; a descriptive and comparative anatomical study. Acta Odont. Scand. 14. Suppl. 20.

Kajava, Y. (1912). Suomen Hammaslääkäriseuran Toimituksia. 10. 1. Cited by Moorrees (1957).

Keene, H.J. (1964). A possible source of error re:lated to the comparison of odontometric data in different age groups. J. Dent. Res. 43. 1255.

Keith, A. (1924). Concerning certain Structural Changes which are taking place in our Jaws and Teeth. Fifth lecture from five lectures On the Growth of the Jaws, normal and abnormal, in Health and Disease. Dental Board of the U.K.

Kruger/

Kruger, B.J. (1962). Influence of boron, fluorine and molybdenum on the morphology of the rat molar. J. Dent. Res. 41. 215.

Lambert, E. (1877). Morphologie du système dentaire des races humaines. Bull. de l'Acad. Roy. des Sciences de Belgique. 43. 559.

Leclerc, G.L., Comte de Buffon. (1749). L'Histoire Naturelle de l'Homme. Paris.

Linnaeus, C. (1755). Systema Naturae. (3rd ed. Lipsiae 1788).

Lundström, A. (1942). Äro trångställningar vanligare hos fall med stora än hos fall med små tänder? Svensk Tandläkare-Tidskrift. 35. 399.

Lundström, A. (1943). Intermaxillära tandbreddsför:hållanden och tandställningen. Svensk Tandläkare-Tidskrift. 36. 575.

Lundström, A. (1944). Förtidiga mjölktandsforluster och tandställningen. Svensk Tandläkare-Tidskrift. 37. 698.

Lundström, A. & Lysell, L. (1953). An anthropological examination/

examination of a group of mediaeval Danish skulls, with particular regard to the jaws and occlusal conditions. Acta Odont. Scand. 11. 111.

Lundström, A. (1964). Size of teeth and jaws in twins. Brit. Dent. J. 117. 321.

Lunt, D.A. (1961). The dentition of early Scottish races. M.D.S. thesis, University of Glasgow.

Lysell, L. (1958 a). A biometric study of occlusion and dental arches in a series of mediaeval skulls from Northern Sweden. Acta Odont. Scand. 16. 177.

Lysell, L. (1958 b). Qualitative and quantitative determination of attrition and the ensuing tooth migration. Acta Odont. Scand. 16. 267.

Lysell, L. (1960). Relationship between mesiodistal crown diameters in the deciduous and permanent lateral teeth. Acta Odont. Scand. 18. 83.

Martin, R. (1928). Lehrbuch der Anthropologie. 2nd ed, Jena.

Mijsberg/

Mijsberg, W.A. (1931). On sexual differences in the teeth of the Javanese. Koninklijke Akademie van Wetenschappen te Amsterdam. Proc. Sect. Sciences. 34. 1111.

Miyabara, T. (1916). An anthropological study of the masticatory system in the Japanese. Dental Cosmos. 58. 739.

Møller, I.J. (1965). The influence of trace elements on the form and the size of the teeth. Con-:tribution to the International Symposium on Tooth Morphology, Fredensborg, September 1965.

Møller-Christensen, V. (1953). Ten Lepers from Naestved in Denmark. Danish Science Press. Copenhagen.

Møller-Christensen, V. (1958). Bogen om Aebelholt kloster. Copenhagen.

Møller-Christensen, V. (1963). Personal communication.

Moorrees, C.F.A. & Reed, R.B. (1954). Biometrics of crowding and spacing of the teeth in the mandible. Amer. J. Phys. Anthrop. N.S. 12. 77.

Moorrees, C.F.A. (1957). The Aleut Dentition. Cambridge, Mass.

Moorrees, C.F.A., Thomsen, S.Ø., Jensen, E. & Yen, P.K. (1957). Mesiodistal crown diameters of the deciduous and permanent teeth in individuals. J. Dent. Res. 36. 39.

Moorrees, C.F.A. & Chadha, J.M. (1962). Crown dia-:meters of corresponding tooth groups in the deciduous and permanent dentitions. J. Dent. Res. 41. 466.

Moorrees, C.F.A. & Reed, R.B. (1964). Correlations among crown diameters of human teeth. Arch. oral Biol. 9. 685.

Morton, S.G. (1839). Crania Americana. Philadelphia.

Morton, S.G. (1844). Crania Aegyptiaca. Philadelphia.

Mühlmann, W.E. (1948). Geschichte der Anthropologie. Bonn.

Mühlreiter, E. (1874). Ueber Minimal- und Maximal-:grössen der Zähne. Dtsch. vierteljahrschr. Zahnheilk/

Zahnheilk. 119.

Nance, H.N. (1947). The limitations of orthodontic treatment. I. Mixed dentition diagnosis and treatment. Amer. J. Ortho. & Oral Surg.33. 177.

Nanda, R.S. (1954). Agenesis of the third molar in man. Amer. J. Ortho. 40. 698.

Neff, C.W. (1949). Tailored occlusion with the an:terior coefficient. Amer. J. Ortho. 35. 309.

Nelson, C.T. (1938). The teeth of the Indians of Pecos Pueblo. Am. J. Phys. Anthrop. 23. 261.

Owen, R. (1845). Odontography. London.

Paynter, K.J. & Grainger, R.M. (1956). The relation of nutrition to the morphology and size of rat molar teeth. J. Canad. Dent. Assn. 22. 519.

Paynter, K.J. & Grainger, R.M. (1962). Relationship of morphology and size of teeth to caries. Int. Dent. J. 12. 147.

Pedersen, P.O. (1949). The East Greenland Eskimo Dentition. Meddelelser om Grønland. 142.

piggott/

Piggott, S. (1962). The Prehistoric Peoples of Scotland. London.

Powell, T.G.E. (1962). The Celts. London.

Regnault, F. (1894). Variations dans la forme des dents suivant les races humaines. Bull. Soc. Anthrop. Paris. 5. ser. 4. 14.

Remane, A. (1930). Zur Messtechnik der Primatenzähne. Abderhalden's Handbuch der Biologischen Arbeits-:methoden. Abt. VII. Teil 1. p. 609. Berlin/Wien.

Ritter, R. (1933). Untersuchungen über die mesio-:distalen Grossenverhältnisse der Zähne des Oberkiefers zu denen des Unterkiefers. Fortschritte der Orthodontik. 3. 261.

Robinson, J.T. (1956). The dentition of the Austral-:opithecinae. Transvaal Museum Memoir no. 9. Pretoria.

Sahly, A., Brabant, H. & Bouyssou, M. (1962). Observations sur les dents et les maxillaires, du Mésolithique et de l'Âge du Fer, trouvés dans la grotte de Rouffignac, département de la Dordogne/

Dordogne, France. Bull. du G.I.R.S. 5. 252.

Sandifort, G. (1838). Tabulae craniorum diversarum nationum. Lugduni Batavorum.

Schwerz, F. (1917). Morphologische Untersuchungen an Zähnen von Alamannen aus dem V. bis X. Jahrhundert. Archiv. für Anthrop. N.F. 15. 1.

Seipel, C.M. (1946). Variation of tooth position. Lund.

Selmer-Olsen, R. (1949). An odontometric study on the Norwegian Lapps. Norske Videnskaps-Akademi. Oslo.

Shaw, J.C. Middleton (1931). The Teeth, the Bony Palate and the Mandible in Bantu races of South Africa. London.

Smyth, K.C. & Young, M. (1932). Facial Growth in Children. Medical Research Council. Special Report Series, no. 171.

Stähle, H. (1959). The determination of mesiodistal crown width of unerupted permanent cuspids and bicuspids. Helv. Odontol. Acta. 3. 14.

Stein/

Stein, M.R. & Epstein, J.L. (1934). The molar teeth of New Britain Melanesians. J. Amer. Dent.Assn. 21. 1409.

Stevenson, R.B.K. (1954). Long cist burials, partic-:ularly those at Galson (Lewis) and Gairloch(Wester Ross), with a symbol stone at Gairloch. Proc. Soc. Ant. Scot. (1951-52). 86. 106.

Tanner, J.M. (1962). Growth at Adolescence. Oxford.

Thomsen, S. (1955). Dental morphology and occlusion in the people of Tristan da Cuñha. Results of the Norwegian Scientific Expedition to Tristan da Cunha, 1937 - 1938, No. 25. Oslo.

Topinard, P. (1878). Anthropology. London.

Twiesselmann, F. & Brabant, H. (1960). Recherches sur les dents et les maxillaires d'une population d'âge franc de Coxyde. Bull. du G.I.R.S. 3. 99 & 335.

Weidenreich, F. (1937). The dentition of Sinanthropus pekinensis. Palaeont. Sinica. Series D no. 1. 101.

Yates, F. & Healy, M.J.R. (1951). Statistical methods in/

in anthropology. Nature. 168. 1116.

Yamada, E. (1932). J. Nippon Dent. Assn. 25. 15 etc.
Cited by Moorrees (1957).

AN ODONTOMETRIC STUDY OF MEDIAEVAL DANES.

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SUMMARY.

In the present study an examination was made of tooth size in mediaeval Danish skulls excavated at two sites (Aebelholt and Naestved) on the island of Sjaelland (Sealand).

After a brief general introduction on the development of dental anthropology as a science, the history of the Danish skeletal material was discussed in some detail, and in particular, the evidence was reported on which dating of the material rested.

Previous odontometric studies from 1874 to 1965 were described, and a detailed account was given, both of the odontometric and statistical methods which had been used by other workers, and of those which were employed in the present study.

Means, standard deviations and coefficients of variation were calculated from the data collected, and statistical assessment of the significance of observed differences between the sexes or between the groups was made by means of the 't' test.

In both Aebelholt and Naestved groups there was a sex difference in tooth size. The mean values for both mesiodistal and labiolingual dimensions of all/

all the teeth were invariably larger in the males than in the females. Many of these sex differences in tooth dimensions were statistically significant.

Few significant differences in tooth dimensions existed between the Aebelholt and Naestved groups. The largest differences were found in the mesiodistal diameters of the mandibular teeth. The material was therefore pooled, and re-examination of sex differences in tooth dimensions showed a higher level of statistical significance than before. The canines were throughout the teeth which showed the most highly significant sex differences.

Variability of tooth dimensions was studied by means of the coefficients of variation. In both dimensions, third molars and second incisors were most variable, and first molars, first incisors and canines were the least variable teeth. There was little evidence of sex or group difference in variability.

Robustness values were used to study the rank order of size of the molar teeth. There was some evidence of a sex difference in this respect in the mandible.

Wherever/

Wherever possible a comparison was made between the results for the mediaeval Danes and those published by other workers.

Comparisons of tooth dimensions themselves were also made between the mediaeval Danes and other population groups. The teeth of mediaeval Danes were rather smaller than those of Scottish Neolithic, Scottish Bronze Age and several continental European Mesolithic, Neolithic, Bronze Age and Iron Age groups, but tended to be a little larger than the teeth of Scottish Dark Age individuals (from long cist burials) and of Belgian Franks. Mediaeval Danish teeth were larger than those of mediaeval Swedes, slightly larger than those of 17th - 19th century English, and smaller than those of Merovingian or mediaeval Belgians. Statistical tests of significance could be carried out only for the comparison with mediaeval Swedes.

In comparisons with various modern races, the teeth of mediaeval Danes were found to be larger than those of Lapps, slightly smaller than those of Lundstrom's Swedes, the American Whites and the Chinese, smaller than those of Seipel's Swedes, the Swiss/

Swiss and the Aleuts, and considerably smaller than those of Tristanites, East Greenland Eskimos and Australian aborigines. Statistical tests of sig-:nificance were made in each instance. Emphasis was laid on the caution which had to be exercised in comparing results obtained by different workers.

The possible interpretation of variation in tooth size in prehistoric, mediaeval and modern Eur-:opean races was discussed.

The proportions of the tooth crowns were stud-:ied by means of the crown index.

There were few statistically significant sex differences in crown index in either the Aebelholt or the Naestved group, though in general the indices were slightly higher in the males.

There were also very few significant differen-:ces in crown index between the Aebelholt and Naestved groups, except for the mandibular teeth of females. The groups were therefore combined for purposes of comparison with results recorded for other racial groups.

Crown indices were rather higher in the Scottish Neolithic, Bronze Age and Dark Age groups than in the mediaeval/

mediaeval Danes, but this result was possibly due to the greater degree of attrition in the Scottish material.

Comparisons with three modern races showed that crown indices in the mediaeval Danes were slightly higher than those of Lapps or Aleuts, and considerably lower than those of Tristanites.

The results were drawn together in a concluding chapter, under the headings of 1. sex differences 2. local group differences 3. racial differences.

A complete bibliography has been appended.