THE DENTITION OF EARLY SCOTTISH RACES.

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CONTENTS.

INTRODUCTION.

The object of the present study was to examine the teeth and jaws of Scottish skulls ranging from the Neolithic to the Mediaeval period; and by a comparison of the data on the various groups, to attempt to determine whether significant differences exist between them.

The science of anthropometry (i.e. the study by measurement of the human body and skeleton) is one of long standing. Sufficient numbers of skulls of many races have been measured for basic patterns to emerge. Individual variation is too great to allow of any single skull being correctly grouped merely by measurement, but it is possible to say whether it lies within the limits of the group to which it has been tentatively assigned on the basis of archaeological or geographical evidence.

Comparatively little odontometric work has yet been done, partly perhaps because of the added difficulties involved in its study. Technical error is a more serious problem than in craniometry, since odontometric measurements are very much smaller, while the unit of measurement (.1 mm.) remains the same. At the same time, variation within racial groups appears to be great, especially when compared with the variation between racial groups.
Racial/

Racial differences are thus small, and may not fall outside the limits of technical error. In order to obtain valid results, many measurements must be made for each racial group studied.

It would seem, however, that odontometric study may be of value in assessing racial characteristics and relationships. The true value of the method can only be decided when more work has been done on the subject. Too few groups have as yet been studied for basic patterns to be apparent.

The study of morphological variation in the teeth has also proved to be of value. The bulk of the work in this sphere has been done on the Mongoloid races, (e.g. Pedersen 1949, Moorrees 1957, Nelson 1938, Goldstein 1948) and a basic Mongoloid pattern has been recognised. No pattern of morphological variation yet exists so far as white races are concerned.

The study of races of the past is as worthwhile as that of living man. No complete odontometric survey of prehistoric or mediaeval skulls has yet been made in Britain, and this study attempts to fill part of this gap in knowledge.

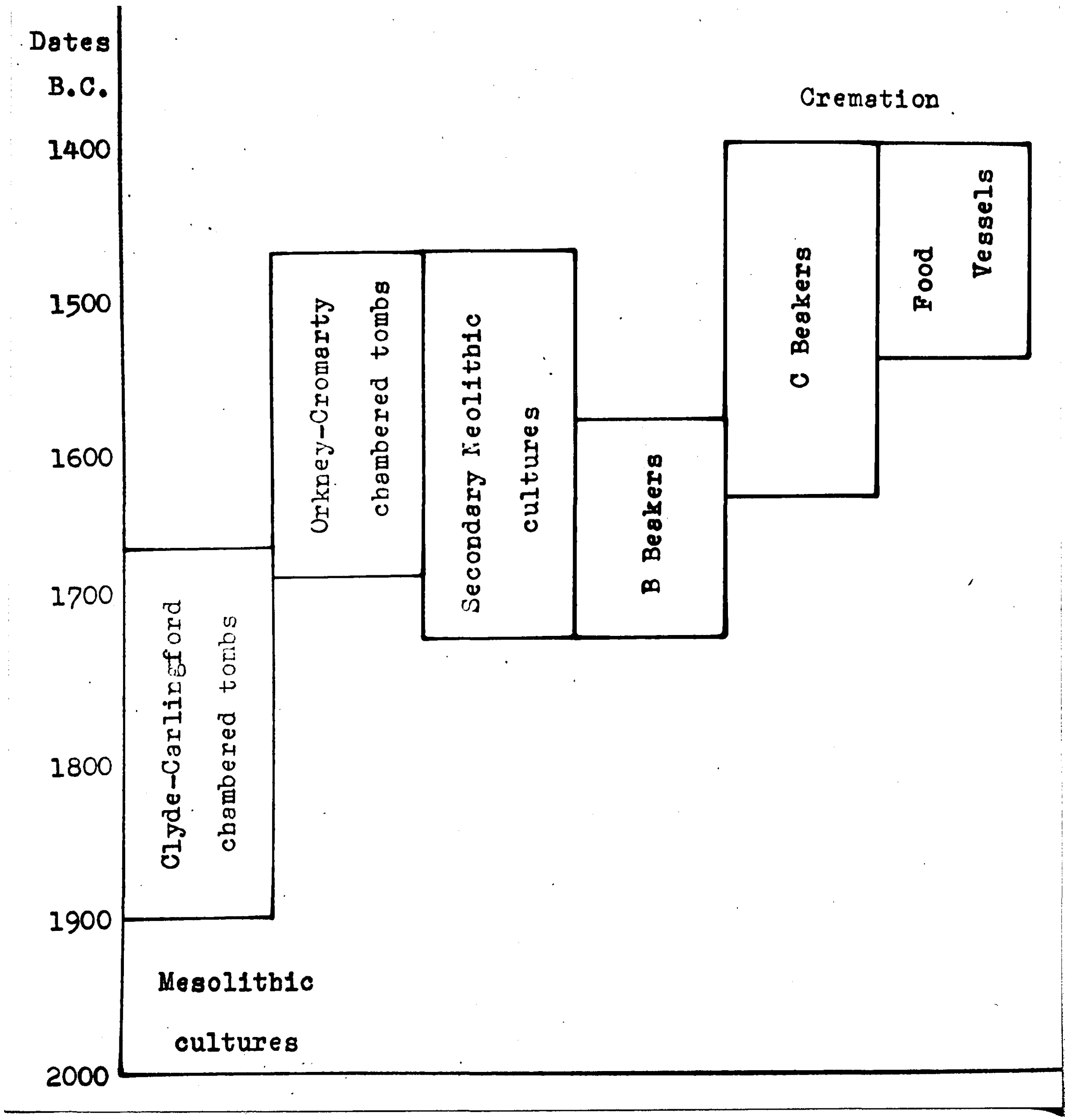


Fig. 1. Tentative chronology of the Neolithic and Bronze Age cultures in Scotland (after Piggott, 1954).

THE ARCHAEOLOGICAL BACKGROUND.

The first inhabitants of northern Britain after the retreat of the ice-sheets were the Mesolithic food-gatherers and fishers sparsely scattered on the 25 foot beaches, chiefly in the west. Their presence is known from finds of microliths (small flints) of Tardenoisian type, Azilian bone harpoons and an antler axe of the Baltic Forest Culture (Childe 1935; Lacaille, 1954). These primitive hunters had no elaborate burial customs and, since few skeletal remains have survived, they need no further consideration here.

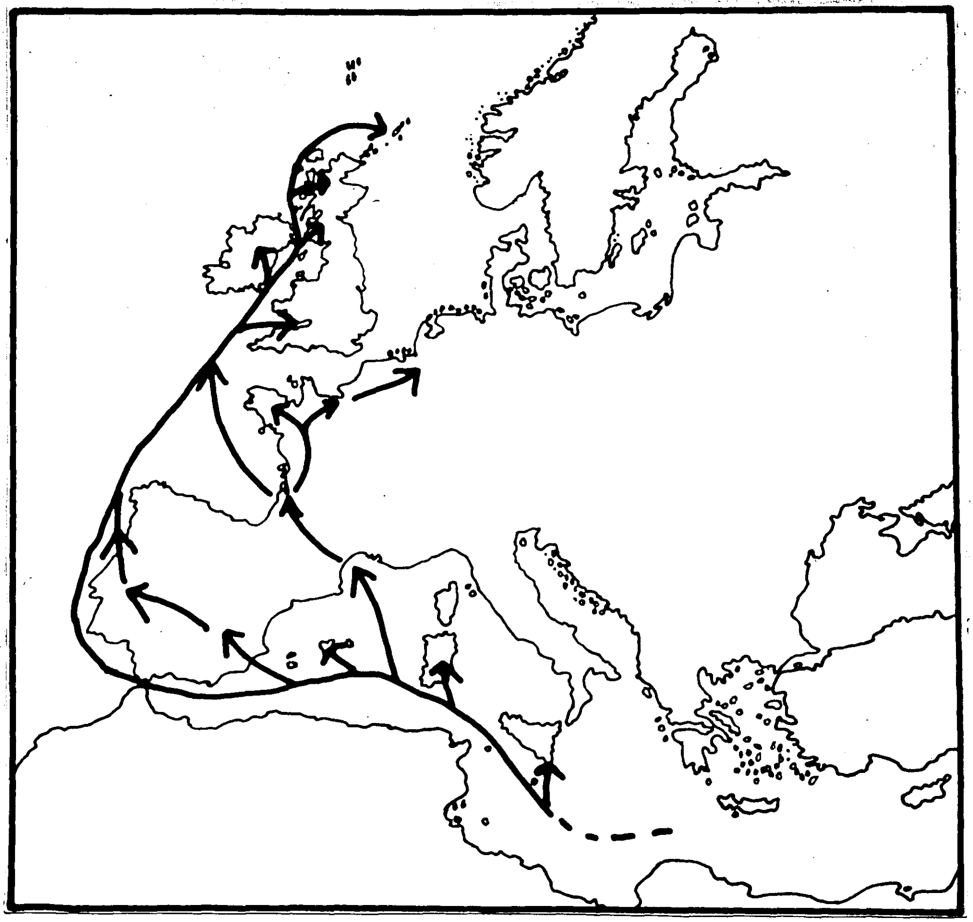
About the year 2000 B.C., there was an influx to Britain of new settlers from the Continent, bringing with them agricultural methods and elaborate burial customs. The first immigrants are known as Neolithic, since metal objects have never been found in their graves. Objects of copper, or, more usually, bronze are associated with the burials of later settlers, who are therefore assigned to a Bronze Age. Although it was formerly believed that the Bronze Age followed the Neolithic period with little or no overlap, it is now generally accepted that Bronze Age invaders had reached Britain by the Middle Neolithic, and that the two cultures existed side by side for some time (Piggott, 1954). A tentative chronology of the Neolithic and Bronze periods in Scotland/

Fig. 2. Neolithic pot of Western type from Oatslie Sandpit, Roslin. The "baggy" shape of the vessel may indicate its derivation from leather prototypes.

Scotland (after Piggott, 1954) is given in Fig. 1., though at the moment there is considerable confusion regarding the dating of the Neolithic period, as a result of the widely divergent figures obtained by the radio-carbon method (Piggott, 1959; Waterbolk, 1960; Watts, 1960). If reliance can be placed on Carbon-14 dates, then the Neolithic period may have commenced as much as a thousand years earlier than is indicated in Fig. 1., which is based upon archaeological evidence.

It is not at all certain, either that the Neolithic people were entirely unacquainted with metal, or that the earliest Bronze Age invaders used it to any great extent: the terms "Neolithic" and "Bronze Age" are now merely convenient distinguishing labels, which separate two groups of peoples between whom there were many cultural points of difference, other than the presence or absence of metal objects in their graves. The two groups were also anthropologically distinct, as will be discussed later.

The primitive Neolithic farmers were semi-nomadic, and still depended to a large extent on hunting. Their weapons and tools were made of polished stone or chipped from flint nodules. Axe-heads, leaf-shaped arrowheads and flint knives and scrapers were the characteristic forms. There is no evidence that cloth weaving was practised; instead, flint scrapers and other hide-dressing tools/



Map 1. The routes followed by the Neolithic invaders of Britain.

tools suggest that clothing was of leather or furs. The "baggy" round-based forms of primary Neolithic pottery vessels (Fig. 2) may indicate that they were copies of leather originals. Very few Neolithic settlements remain - presumably in areas where timber was available, rather flimsy wooden shelters would be erected. The Neolithic people expended a great deal more effort and care on their burial places than on their dwelling houses. Their characteristic rite was collective burial, a tomb generally being used during more than one generation (Daniel, 1950; Piggott 1954).

Bands of Neolithic colonists reached the west coast of Britain, moving northwards from Spain and France along the western sea route (Map 1). Their burial monuments were elaborate chambered cairns, built of dry-stone walling and large orthostats (i.e. upright blocks of stone), and roofed by large lintels or corbelled vaults. They can be divided into two main groups, (a) gallery graves and (b) passage graves, with different origins on the Continent, but both ultimately derived from the Western Mediterranean area. These groups can each be further subdivided into smaller classes with limited geographical distributions. Some groups can be related to similar tombs on the Continent, and it would seem that the cairns built nearest to the initial British/

Fig. 3a. General view of a Clyde-Carlingford chambered cairn at Auchindrain, Furnace, Argyll, showing the ruined state in which most of these structures are now found.

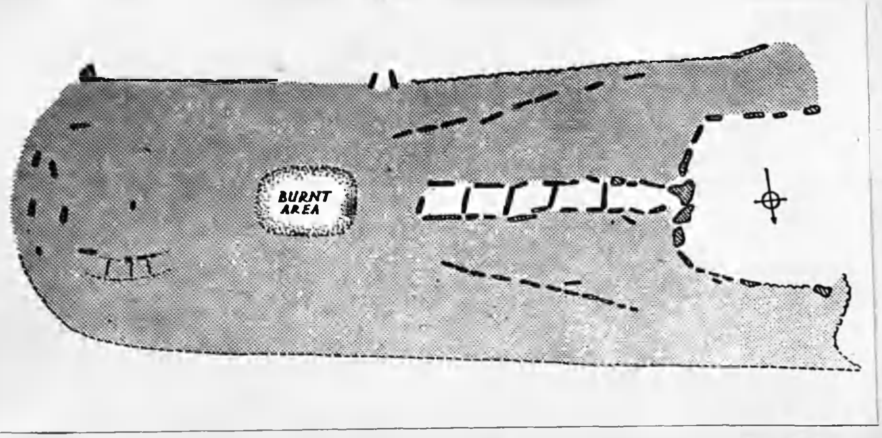


Fig. 3b. Plan of Clyde-Carlingford tomb of Carn Ban, Arran.

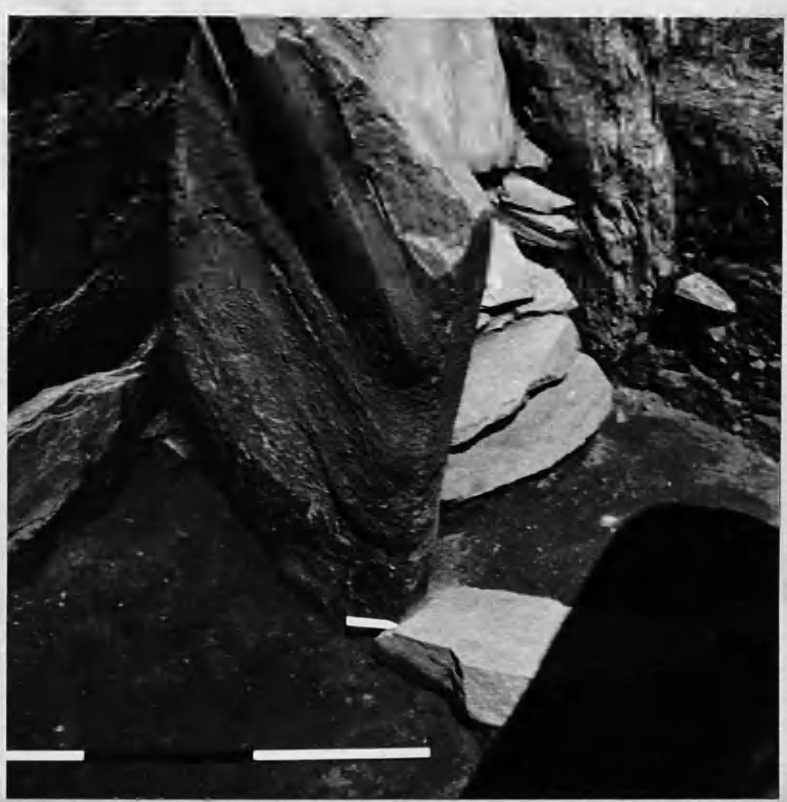


Fig. 3c. Interior of a Clyde-Carlingford cairn at Brackley, Kintyre, showing the method of construction with orthostats and dry stone walling.

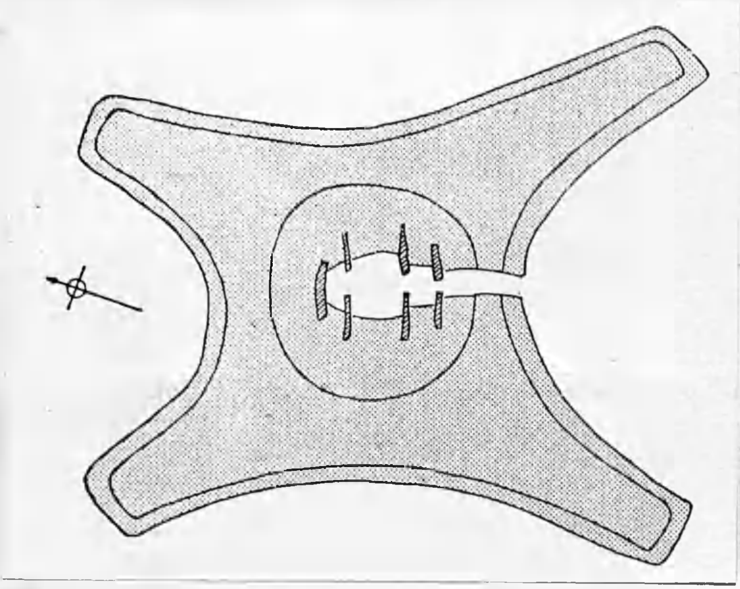


Fig. 4a. Plan of a passage grave of the Orkney-Cromarty group at Ormiegill, Caithness.

Fig. 4b. Interior of the corbelled chamber of an Orkney-Cromarty passage grave, at Kinbrace Hill, Strath of Kildonan, Sutherland.

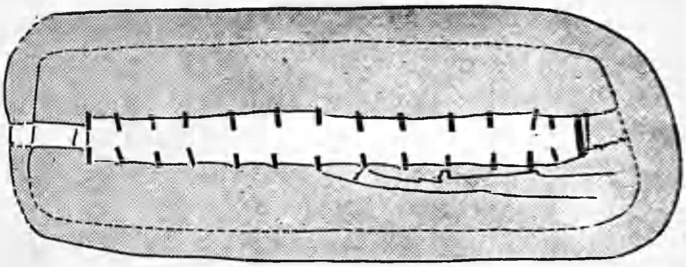
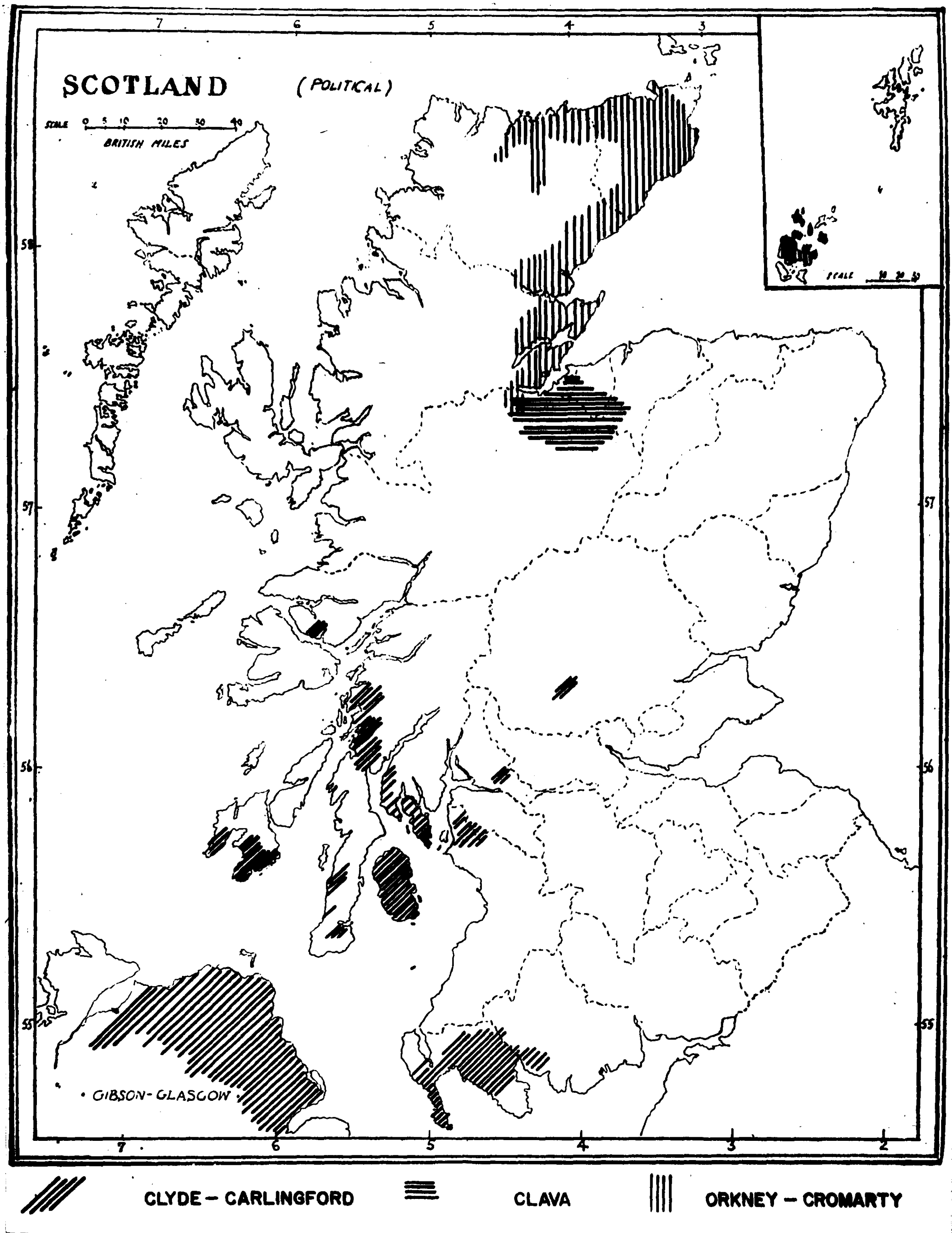


Fig. 5a. Plan of stalled cairn at Midhowe, Rousay, Orkney.

Fig. 5b. Interior of Midhowe cairn, showing the dividing slabs which separate the chamber into compartments or "stalls".



Map 2. Distribution map of the most important types of chambered cairn in Scotland.

British point of entry of the settlers are most closely related to the Continental series. Later British graves tend to show gradually increasing deviation from the original type, and the development of local features.

The long segmented gallery graves of the Clyde-Carlingford area (Fig. 3) may possibly be derived from the western Pyrenean region. The Clava passage graves are closely similar to the Iberian corbelled tombs, whose influence may also be seen less directly in the large Orkney-Cromarty group of passage graves (Fig. 4) , though certain cairns of the latter series also show features probably derived from the presumably earlier Clyde-Carlingford cairns. The Hebridean chambered cairns also show evidence of a mingling of Clyde-Carlingford and passage grave elements. Highly individual local developments are seen in the stalled cairns of Orkney (Fig. 5) and the heel-shaped cairns of Shetland. The areas of distribution of the most important cairn types are shown on Map 2. The Shetland and Hebridean cairns are confined to the areas implied by their names and have not been indicated.

In part later than, and in part contemporary with, these primary Neolithic cultures, there were the Secondary Neolithic cultures, whose origins seem to go back to the indigenous Meso-lithic/

Fig. 6. Neolithic village of stone built houses at Skara Brae, Orkney.

Fig. 7a. Beaker of type B from Bathgate.

Fig. 7b. Beaker of type C from West Fenton, Drem.

lithic population, influenced by the primary Neolithic settlers (Piggott, 1954). The Secondary Neolithic cultures are known chiefly from the pottery and stone implements they produced. In the treeless areas of Orkney and Shetland, villages were built of dry-stone walling, and the ruins of some of these have survived, e.g. at Skara Brae and Rinyo (Fig. 6). Hunting and fishing, Mesolithic pursuits, played a more important part in Secondary Neolithic economies than among the primary Neolithic peoples. The chambered cairns continued to be used by the Secondary Neolithic people.

Already by the middle of the Neolithic period, <u>circa</u> 1750 B.C., further settlers, known as the Beaker people from their highly characteristic pottery style (Fig. 7), were arriving on the east coast of Britain (Map 3). They formed a totally different racial group from the Neolithic complex, and are generally regarded as being the first of the British Bronze Age peoples. Their funeral rites differed entirely from those of the Neolithic races: instead of collective tombs, individual burial was the custom.

The Beaker people appear to have been nomadic stock-breeders and hunters, and therefore permanent settlements are rare and difficult to find (Childe, 1952), though Beaker pottery has been found in hut circles at Muirkirk in Ayrshire (Baird, 1914; Fair-

bairn/

Map 3. The routes followed by the Bronze Age invaders of Britain. The dotted line indicates Coon's theory (1939) of the origin of the Bell Beaker people in Spain (see Chap. 3).

Fig. 8. Food Vessel from Corstorphine, Edinburgh.

bairn, 1927). Stone was still largely used for implements, such as barbed and tanged arrowheads, flint knives and archers' wrist-guards, but bronze was soon employed for axes and daggers, while ornaments of gold were occasionally made. These metal objects were chiefly made in Ireland and Northern Britain from native ores of copper and tin, and alluvial gold (Callander, 1923).

The main invasions of the Beaker people (Map 3) took place directly across the North Sea from the Continent (Abercromby, 1902), in contradistinction to the Neolithic approach from the French and Iberian coasts by the western sea route. Movements of Beaker folk and the starting points of their invasion of Britain have been worked out on the basis of the typology of Beaker pottery, of which there are three varieties, designated A, B and C. Degeneration of the primary types appears further away from the original points of entrance of the Beaker invaders.

Beakers of A type are found only in England. Scottish Beakers are of B and C types (Fig. 7). B Beakers are found from Aberdeenshire to East Lothian, as a result of direct invasion from the Rhine area, and the heavy concentration of C Beakers in Aberdeenshire is derived from the same region at the mouth of the Rhine (Stone (1958). In south-east Scotland, in the Tweed valley, infiltration appears to have occurred from north-east England. The scattered/

Fig. 9. Short cist burial from Skateraw, Dunbar. The body is in the typical flexed position.

scattered Beakers of the West coast of Scotland are considered to be the result of a secondary movement by sea from Wales (Mitchell, 1934).

Another type of pottery vessel which appears in the Early Bronze Age, in part at least contemporary with Beakers, is the Food Vessel (Fig. 8). It was formerly believed that this ceramic style was due to fresh invaders along the western sea route, but it now seems more probable that it resulted from an admixture of Neolithic and Beaker traditions (Childe, 1935; Stone, 1958).

Early Bronze Age burials in Scotland were usually enclosed in a short stone cist (Fig. 9), a box-like structure *circa* 3 - 4 feet long, 2 feet wide and 1½ - 2 feet deep, in which the body was placed in a contracted position with the limbs flexed. The sides of the cist were generally formed by single large flat blocks of stone, often very carefully dressed, and another large flat slab formed a cover. The floor of the cist may be paved, or covered with gravel, or covered with a layer of clay, which may also have been used to lute the seams between the upright slabs (Childe, 1935). Sometimes a round cairn marks the site of the cist. Such short cist burials may contain as grave goods either Beakers or Food Vessels, and less frequently tools or weapons of bronze. Some short cists have produced no grave goods/

Fig. 10. Cinerary Urn from Udny, Aberdeenshire.

goods at all, and these are generally assigned to the Bronze Age, though one or two short cists have been found to contain objects of Iron Age date (Childe, 1935).

Beaker burials take the form of inhumations, but cremations are found with a proportion of Food Vessels. In the Middle Bronze Age, cremation became the generally accepted rite, and Cinerary Urns (Fig. 10) superseded both Beakers and Food Vessels. Since there are no known skeletal remains of the Late Bronze Age population, the development and degeneration of bronze weapons need not be elaborated here.

With the advent of the Early Iron Age, the picture becomes very obscure. The period is chiefly known through the fortified sites built during it, and nearly all the datable objects have been random finds. It therefore becomes almost impossible to correlate any burials with any phase during the period. At some stage, extended burial in long stone cists (Fig. 11) became common practice, and these cists are usually assigned to circa 4th - 11th centuries A.D. The long stone cist differs from the short cist not only in its proportions (circa 5 - 6 feet long, 2 feet wide and $1\frac{1}{2}$ feet deep) but also in its construction, the long sides and cover each being formed of a number of small slabs instead of one large block.

Stevenson/

Fig. 11. Long cist burial from Craig's Quarry, Dirleton.
The body is in the extended position.

Stevenson (1954) pointed out that long cist burials can be dated in Germany to the pagan period, and that they are also found in Gothic and provincial Roman cemeteries of the 4th century A.D. He considered that the long cists have a pre-Christian origin. A very few of these sites contain relics of iron which serve to date them in the Early Iron Age context, others, particulaly in the north, contain objects of Viking provenance which often do no more than mark them as pagan, though sometimes a closer dating is possible. Most of the long cists contain no datable objects whatever, and their dating then becomes extremely vague. If orientated N-S, they are sometimes referred to a pagan era, while E-W orientation may be a feature of early Christian burials. A fact which further complicates the problem is that in some areas of Scotland the practice of burial in long cist continued into late mediaeval times, and in the far north, e.g. in Lewis (Stuart, 1867), it is thought to have occurred as late as the 18th century.

A few skulls of <u>circa</u> 12th - 15th centuries A.D. are included in this survey. The dating of these specimens is based on the fact that they were buried in the cemeteries of certain abbeys or monasteries which flourished in this period.

THE ANTHROPOLOGICAL BACKGROUND.

Varying cranial forms can be associated with the cultural periods described above.

Only one certainly Mesolithic skull is known from Scotland - skull B from the shell deposits in the Macarthur cave, Oban. It is dolichocephalic (long-headed), and was considered by Coon (1939) to have descended from a purely long-headed variety of Upper Palaeolithic European man, the Central European Aurignacian type.

Skeletal remains of the Neolithic period are scanty and poorly distributed in Scotland. They are also often in a fragmentary condition owing to the practice of successive burials in chambered cairns, which led to the original occupants being swept unceremoniously aside to make room for later comers. There is also evidence to suggest that ritual fracture of the bones may have been practised (Daniel 1950).

Neolithic skulls have been subdivided into four main types whose chief characteristics were described by Coon (1939) as shown in Table 1.

Table/

TABLE 1. TYPES OF NEOLITHIC MAN (AFTER COON, 1939)

Mediterranean race

	Mediterranean proper	Danubian	Megalithic	Corded
Stature	Short	Short	Tall	Tall
Skull length (means)	183-187m.m.	Same as Med. proper	Over 190 m.m.	194 m.m.
Vault height (means)	132-137	137-140 greater than breadth	Moderate less than breadth	over 140 greater than breadth
Cranial index (means)	73-75	Same as Med. proper.	68-72	
Face	Short	Same as Med. proper	Medium to long	Very long
Nose	Leptorrhine to Mesorrhine	Mesor-rhine to chamaer-rhine	Leptor-rhine	Leptorrhine often pro-minent

All known British Neolithic skulls appear to belong to the Megalithic group of the Mediterranean race, and the Neolithic peoples of England and Scotland appear to form a homogeneous population/

Fig. 12. Neolithic skull from a stalled cairn on Holm of Papa Westray, viewed from above to illustrate its dolichocephaly.

population (Morant, 1926). The skull is dolichocephalic (Fig. 12), with exaggerated glabello-occipital length and occipital bossing. The calvarial (basio-bregmatic) height is average, the facial skeleton (Fig. 13) leptoprosopic (i.e. narrow; facial index above 90), and the nasal cavity is rather narrow. Brow ridges are of moderate heaviness and muscular markings are stronger than in most other Mediterranean groups, though not so pronounced as in Upper Palaeolithic man.

The Bronze Age Beaker invasions brought a completely different cranial type to Britain. In general, Beaker skulls are brachycephalic (round-headed), due to greatly increased cranial breadth (Fig. 14).

Cranial height is similar to that of the Neolithic skull, the facial skeleton (Fig. 15) is just euryprosopic (i.e. broad; facial index below 85) and there is only a slight increase in width of the nasal aperture (Cameron, 1934). However, there is a great deal of variation in Beaker skulls, and several explanations have been put forward to account for the presence of mesocephalic and dolichocephalic skulls among the brachycephalic ones in Early Bronze Age sites.

Morant (1926) suggested that this is the result of intermingling of the Beaker and Neolithic races. As inhumation burial/

Fig. 13. Facial view of the Neolithic skull from Holm of Papa Westray.

burial was replaced by cremation in the Late Bronze Age, no skeletal remains are available for this period, and any further evidence in favour of hybridisation has been destroyed. Morant also believed from study of the coefficient of racial likeness that English and Scottish Bronze Age skulls are not racially homogeneous, but Howells (1937) was inclined to doubt this on the grounds that Morant's material might not have been sufficiently representative of the populations under discussion.

On the other hand, Wright (1904), Elgee (1933) and Childe (1952) suggested that there was a long-headed Bronze Age strain, and this idea was amplified in Coon's (1939) account of Bronze Age racial origins. According to Coon, the formation of the Beaker racial complex took place in Central Europe, where it involved indigenous peoples of Mesolithic and Neolithic ancestry, together with newcomers who were the disseminators of the art of metal-working. The new element in the mixture was a race with a Dinaric type of planoccipital brachycephalic skull. They travelled from an unknown source in Asia Minor to Spain, where they became associated with the Bell Beaker complex (a Copper Age culture of central Spain arising from local beginnings). These Dinarics, now known as the Bell Beaker people, pushed further into Central Europe (see Map 3), where they

became/

Fig. 14. Bronze Age skull from Craigglockhart, viewed from above to illustrate its brachycephaly.

became mixed with (a) the Borreby race, a mixture of Mesolithic survivors and Neolithic people, probably of the Corded and Megalithic groups, and (b) pure Corded Neolithic people. Further expansion of this racial mixture caused a migration down the Rhine, and thence across the North Sea to Britain. Coon believed that all three elements - Bell Beaker (planoccipital brachycephalic), Borreby (curvoccipital brachycephalic) and Corded (dolichocephalic) - can be recognised among English Beaker skulls, but that Scottish Beaker skulls contain more of the Bell Beaker element and less of the Borreby, resulting in smaller cranial dimensions. He also stated that the Corded element is virtually absent in Scotland, as nearly all the few dolichocephalic skulls from Scottish short cists appear to be those of Megalithic survivors.

Food Vessel skulls also appear to be pure Bell Beaker in type (Coon, 1939), though no reappraisal has been made of them since the change in archaeological opinion concerning Food Vessels.

In the succeeding Iron Age, the cranium returns towards the dolichocephalic form, but does not as a rule show such an extreme dolichocephaly as does the Neolithic skull. Further than this, there is considerable divergence of opinion concerning the/

Fig. 15. Facial view of the Bronze Age skull from Craiglockhart.

the racial origins and even the general features of the British Iron Age skull. The English and Scottish material must be dealt with separately, and the English skulls will be described first, since more work has been done on them than on the Scottish skulls.

Morant (1926) stated that the Iron Age skull is characterised by a low calvarial height, and considered this a distinguishing feature from the later Anglo-Saxon skulls. He also believed that the Iron Age peoples of England and the Lowlands of Scotland formed a homogeneous population. Howells (1937), and Goodman and Morant (1940), however, have subsequently shown that the type described by Morant (1926) does not truly represent the total Iron Age population. A series of Irish Iron Age skulls (Howells, 1937) approximates more closely to a hypothetical cross between 51% Neolithic skulls and 49% Bronze Age skulls, while the Iron Age skulls from Maiden Castle (Goodman and Morant, 1940) show a calvarial height as great as that of the Anglo-Saxons.

It appears to be undecided to what extent the Iron Age population represents an invasion of a new, Celtic, racial element, or to what extent a fusion between the existing Neolithic and Bronze Age populations, particularly in remote areas. Coon (1939) gave no help on this point, as he described only "Kelts in Britain", though in a later chapter he spoke of

the/

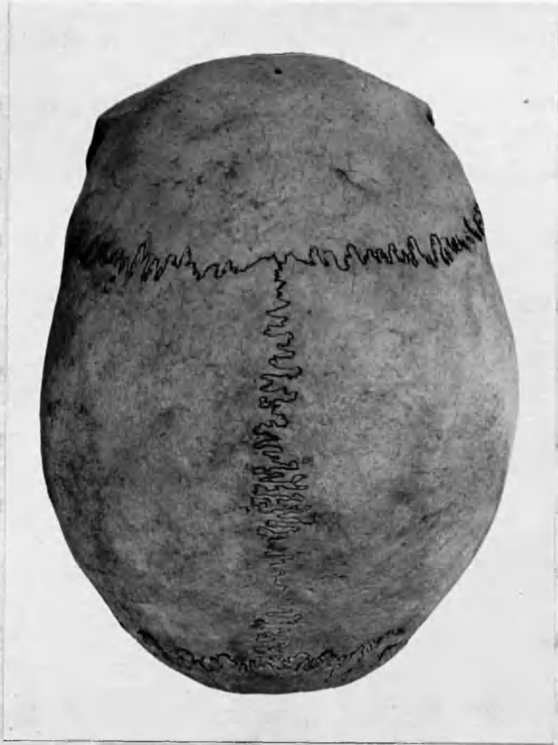


Fig. 16. Long Cist skull of dolichocephalic type from Yarrow.

the survival of the Bronze Age type in Anglo-Saxon times.

The incursions of the Anglo-Saxons in England took place within historical times, but the extent to which they replace the Iron Age population appears doubtful, since 17-18th century English skulls approximate more closely in a number of features to the Iron Age than to the Anglo-Saxon type (Morant, 1926). The latter is usually differentiated from the Iron Age skull by a greater calvarial height, steep high forehead, deep jaw, and in general, stronger muscle attachments and greater robustness.

In the case of the Scottish material, i.e. theskulls from long cist burials, the problem of racial differentiation is further complicated by the difficulty of assigning most of the material to any particular period. Only a few skulls can be accurately dated as Early Iron Age, and the rest of the long cist material may range from the 4th-11th centuries A.D., or even later. It is usually impossible to attempt a close dating, but it has been suggested (Henshall, 1958) that the most probable period of use of the Lasswade long cist cemetery in Midlothian is between the 5th and 8th centuries A.D.

Turner (1915) described the long cist skull as being dolichocephalic in type, with the height less than the breadth (Fig./

Fig. 17. Facial view of the Long Cist skull from Yarrow.

(Fig. 16). The face is long and narrow (Fig. 17), nose leptorrhine (i.e. narrow; index below 48) and palate shaped like a wide horseshoe. Morant (1926) used this series of skulls as his "Scottish Iron Age" group, which he considered as forming a homogeneous population with the English Iron Age skulls. Of the Scottish material he stated, "some were possibly of Anglo-Saxon date, but the majority were undoubtedly earlier". Turner himself, however (1915) suggested that the cemeteries of long cists with E-W orientation in S. E. Scotland were used in the early Christian period, when a considerable infiltration of Anglo-Saxons had occurred in this area. More recently, Wells (1959) has studied the long cist burials of the Lothians, and believes that the skulls from this area may be a mixture of Bronze Age, Iron Age and Anglo-Saxon races.

Anglo-Saxons penetrated only the S. E. part of Scotland, i.e. the Lothians, Fife and, for a short time, part of Angus. In the period of Northumbrian expansion in the 8th century, they also reached Galloway in the S. W. But the same type of skull (Coon, 1939) was brought by the Vikings to N. E. and N. W. Scotland and the Hebrides. Coon was of the opinion that the Vikings were of the northwestern Nordic race and did not differ from the Saxons. Turner (1915) more cautiously stated that

too/

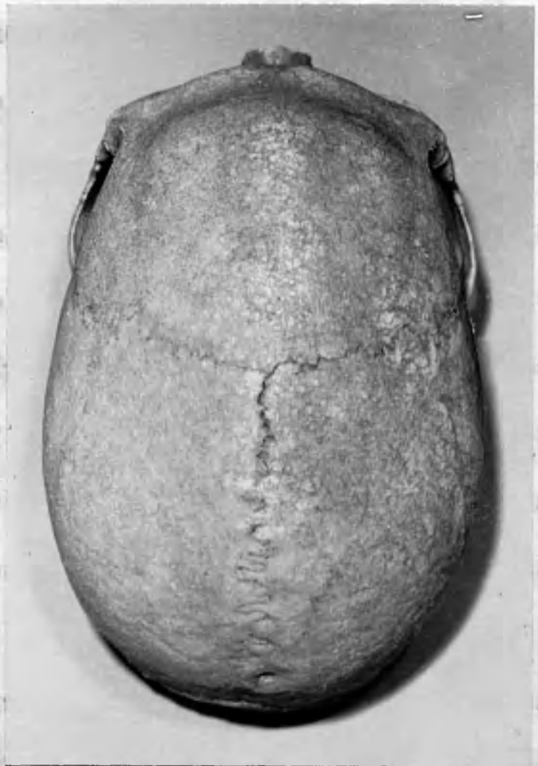


Fig. 18. Dolichocephalic Viking skull from
Huna, Caithness.

too few Viking skulls had yet been measured for a general type to emerge, but that they were probably generally dolichocephalic (Figs. 18, 19). Some of the long cists in the N. E. of Scotland can be shown to contain pagan Viking burials, and it is possible that other long cists in this area may also have belonged to these people.

No recent general survey has been made of the crania from long cists in Scotland apart from the Lothians. Wells (in Stevenson, 1954) considered that the Gairloch skull belongs to the Iron Age type, though, since it is more dolichocephalic than the average of that group, a Neolithic strain may have persisted. On the other hand, the Galson, Lewis, skeletons have broader skulls and faces than the Iron Age type, and Wells suggested that this may be the result, either of admixture of Bronze Age people, or of persistence of a broad-headed Palaeolithic stock. An isolated group of long cists has recently been excavated at Terally, Wigtownshire in the S.W. of Scotland (Livens, 1958), and the extreme dolichocephaly of one of these skulls suggests a Neolithic survival.

In the mediaeval period there is thought to have been no major incursion of new racial types. Some Flemings settled in East/

Fig. 19. Facial view of the Viking skull from Huna.

East Coast towns, but their numbers were probably too small to affect the existing cranial type. Very little skeletal material is available for this period, since many of the Christian cemeteries in which the mediaeval population was buried are still in use, and deliberate removal of skeletal material from any churchyard is frowned upon. Wells also points out, in notes on skulls in the National Museum of Antiquities in Edinburgh, that the few mediaeval skulls we possess are probably those of soldiers or ecclesiastics, neither of whom were likely to be buried in their place of origin, so that it would be dangerous in any case to draw conclusions from these skulls as to the skeletal type of the general population. I am not aware of any collection of measurements of skulls belonging to the period between the long cists and the 17th-19th centuries. Skulls from the latter period were described by Turner (1903), but this period does not come within the scope of the present work.

MATERIAL AND MEASURING INSTRUMENTS.

A. Material

The work was carried out on the whole of the Scottish skeletal material at present available from Neolithic, Bronze Age, Long Cist and Viking burials. A small group of mediaeval skulls was also studied.

The only Mesolithic skull from Scotland, the Macarthur cave skull, which is in the Anatomical Museum of the University of Edinburgh, was unfortunately not available for study, as a result of reconstruction being carried out in the Anatomy Department.

The chief difficulty encountered was lack of suitable material. A considerable number of skulls had to be discarded after a preliminary study of museum catalogues, since there was insufficient dating evidence on which to assign them to any particular group. Of the skulls which could be classified with reasonable accuracy, a further 64 consisted only of the calvarium or other non-tooth-bearing fragments, and were thus useless. The amount of useful material was still further reduced by ante-

and/

and post-mortem loss of teeth, particularly of the incisors, and by severe attrition and/or fracture of the enamel, both of which rendered measurements of the teeth impossible.

Tooth measurements were possible on the following -

	Skull & Mandible	Skull only	Mandible only	Fragments
Neolithic	2	22	7	27
Bronze Age	36	8	6	3
Long Cist	34	6	15	0
Viking	10	3	3	0
Mediaeval	10	4	5	0

Measurements of facial skeleton and mandible were made on a further 12 specimens, and notes on pathological conditions were possible on 9 others.

When a search was made through the volumes of the Proceedings of the Society of Antiquaries of Scotland, it was found that 36 skulls and fragments of approximately 56 others had apparently disappeared since the reports on them were published. Several of the skulls had excellent dentitions, judging from the photographs, and teeth or jaw fragments were specifically mentioned in a large number of the reports. The numbers quoted, in fact, exclude all missing specimens where the report stated that teeth or facial bones were absent. This situation is all the more regrettable/

regrettable when reference is made to the Neolithic material from the chambered cairn at Knowe of Rowiegar, Orkney, in which 18 fragments of the jaws carried 110 measurable teeth.

A fairly high proportion of the material had already been published, with anatomical reports in varying degrees of detail. Determination of sex had already been carried out for these skulls, and some at least of the anthropometric measurements and indices were readily available. Where material had not been published, cranial measurements were made, and sexing was attempted with the help of an anatomist. Sexing of fragments was usually impossible, unless other parts of the skeleton were present.

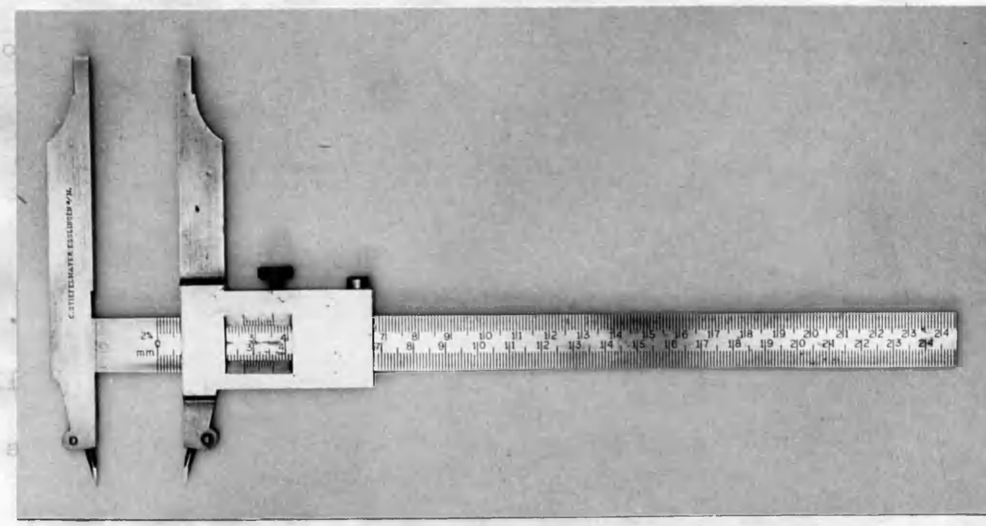


Fig. 20. Small sliding caliper.

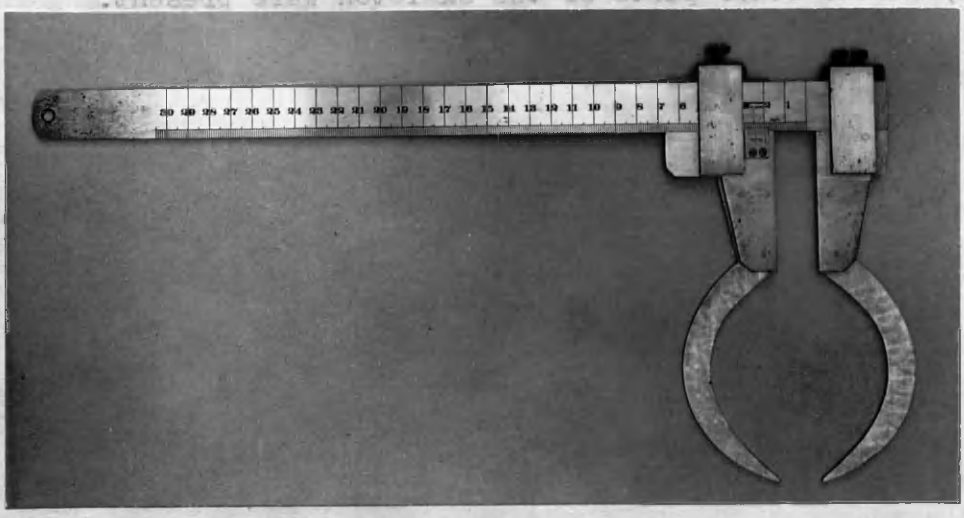


Fig. 21. Large sliding caliper with curved extensions to arms.

B. Measuring Instruments.

Tooth measurements were made with a sliding caliper reading to 0.1 mm. by means of a vernier scale (Fig. 20). The caliper points were sharpened as much as was possible without weakening them or making them flexible.

Certain of the shorter skull and mandible measurements could also be made with this instrument. Many of them, however, involved measuring the tangent to a curved surface and for this purpose a different instrument was necessary (Fig. 21). This consisted of a standard caliper with vernier scale reading to 0.1 mm., modified by the addition of curved arms. The long diameter of the space enclosed by these curved portions is 95 mm. and the short diameter 62 mm. It was found that this degree of curvature enabled all the necessary skull measurements, including basion-nasion diameter, to be taken easily. The only measurement which could not be made was auricular head height, for which a head spanner is required.

PREVIOUS STUDIES IN ODONTOMETRY.

A number of odontometric investigations has been made, ranging in time from the 1870s to the present day. The races studied have varied widely, as have also the methods used by the investigators and the manner in which their results have been presented. Some of the earliest odontometric work was carried out on European white races. Unfortunately, in many respects the results are unsuitable for a full comparison with later studies, since there is no sex differentiation, the numbers of observations are not always stated, and sometimes maximum-minimum values replace mean figures.

The earliest work appears to be that published in 1874 by Mühlreiter, who stated in this paper that he had been unable to trace any tooth measurements in the literature, except the few reported by Owen (1845) for the lower canine and first premolar of the chimpanzee. Mühlreiter measured "a very great number" of teeth from the local population of the Salzburg area, and presented the results in the form of maximum-minimum values.

Lambert (1877) made the earliest attempt to define racial differences in the teeth. He compared the broad groupings of white, yellow and black races. Although his results were not presented/

presented in an accurate form, yet Lambert was able to demonstrate certain basic differences between these three racial groups.

In 1902, Black published a series of mean values for the teeth of American whites. No sex differentiation was made, and the numbers of observations from which the means were calculated have not been provided. Nevertheless, these figures became the standard for whites with which the tooth measurements for various coloured races were compared in later works.

De Terra (1905) and Choquet (1908) gave accounts of tooth size in various racial groups, but the numbers of observations are too small to allow of further comparison, and neither author presented his results in the form of mean values. De Terra included in his work three groups of prehistoric or early historic Europeans, but gave no account of the provenance or dating of this material. Papers on individual white races include those by Hillebrand (1909) on Hungarians, Kajava (1912) on Lapps, de Jonge Cohen (1918) on Bolk's Amsterdam collection of skulls, and Hjelmman (1928) on Finlanders. There is only one paper which is entirely devoted to an early European race, that by Schwerz (1917) on the 5th-10th century Alamanni of Switzerland, and this is therefore of particular interest in connection with the present work.

Several/

Several workers have shown that there are differences in dimensions between the teeth of whites and those of coloured races: in particular, of Japanese (Miyabara, 1916), Australian aborigines (Campbell, 1925), New Pomeranians (Janzer, 1927), South African Bushmen (Drennan, 1929) and Bantus (Shaw, 1931). In none of these papers was there any attempt to determine whether the observed differences were statistically significant.

Of the papers so far mentioned, the authors of only three (Miyabara, 1916; Janzer, 1927; and Hjellman, 1928) made sex differentiation of all their material, though Hillebrand (1909) did so for the maxilla only. Sex differences were observed by these writers but their significance was not evaluated. Mijsberg (1931), however, carried out a statistical preparation of the results which he had obtained from measurement of the teeth of Javanese, with the special purpose of investigating possible sex differences.

Since 1931, all the major odontometric investigations have included a more or less complete statistical preparation of the data.

Nelson (1938) examined the teeth of the American Indians of Pecos Pueblo. The material was derived from a settlement of 12th-19th century date. No sex differentiation was made, and the statistical technique used was not entirely accurate, as a result/

result of the lack of statistical preparation of the data for the races with which Nelson compared the Pecos Indians.

In his studies of the East Greenland Eskimos, Pedersen (1949) dealt with the measurements for male and female separately, and also made distinction between right and left sides. He provided a statistical analysis of the measurements of all the permanent teeth except the incisors, but did not attempt to evaluate differences in tooth size between the Eskimos and other races.

An extremely detailed odontometric survey of the Norwegian Lapps was carried out by Selmer-Olsen (1949). In this work, sex differentiation was made, but the measurements of teeth from both sides of the jaws were combined. The large quantity of Lapp material available enabled comparisons to be made not only between the Lapps and other races, but also between Lapps from different districts. Calculation of step indices and correlations between various groups of teeth were also made. The significance of the results of all these operations was discussed.

Moorrees (1957) used odontometric methods in his study of the dentition of the Aleuts. He made a statistical evaluation of sex differences in this population, and also made a racial comparison between its Eastern and Western subdivisions. Comparisons were also made between the Aleuts and a number of other races/.

races.

In addition to these major works whose main object was in each case an anthropological one, odontometry has also been used in orthodontic studies by Lundstrom (1944) and Seipel (1946), both working on Swedish children. Neither of these papers provides a complete survey of the permanent dentition, since Lundstrom omitted second and third permanent molars, and Seipel measured only the mesiodistal diameters of the teeth.

Nearly all the authors mentioned carried out the measurements on skeletal material. Lundstrom (1944) and Moorrees (1957), however, measured the teeth from plaster casts obtained by means of hydrocolloid impressions. This method may introduce a source of error in comparisons with measurements obtained directly from the teeth.

A few authors (e.g. Jackson, 1914; Campbell, 1928; Cameron, 1934) have included measurements of the teeth in descriptions of individual British skulls of prehistoric date, but no survey has been made of any extensive series of material.

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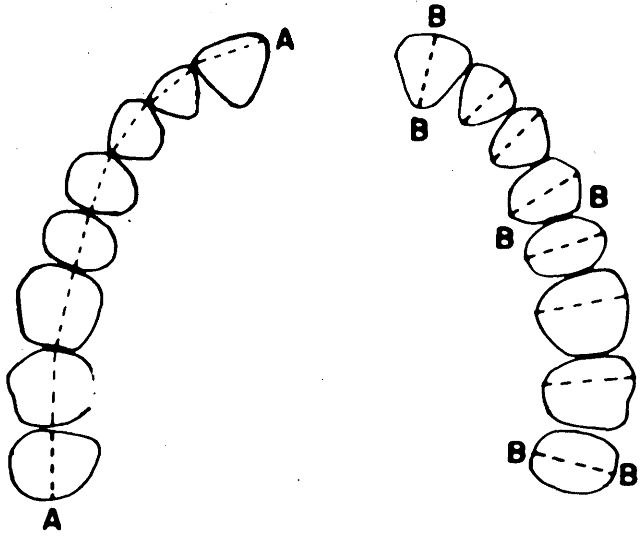

Fig. 22. The line A - A indicates the direction in which the mesiodistal diameters were measured, and the lines B - B indicate the labiolingual diameters of the teeth.

ODONTOMETRIC METHODS.

A. Measurements and Measuring Points.

The main part of this work consisted of the measurement of the crowns of the permanent teeth, in the mesiodistal and labio-lingual diameters (Fig. 22). It was originally intended to measure occlusogingival crown height and the length and degree of division of the roots but it was very soon found to be impossible to carry out these measurements. None of the teeth was free from attrition; therefore accurate crown heights could not be obtained. Root measurements were impossible, since to obtain them the specimen would have had to be partially destroyed. No deciduous teeth have been included in the present study.

There has been some considerable confusion over the nomenclature of odontometrical measurements. Martin's (1928) rule, that all sagittal cranial measurements should be termed measurements of length and coronal ones of breadth, cannot be successfully applied to tooth measurements, since the teeth are arranged in an arcade and not in a straight antero-posterior row. Whatever terms are used, length, breadth, width, or thickness, difficulties in interpretation are liable to arise. For that reason/

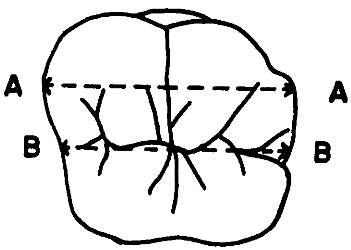

Fig. 23. Occlusal surface of a molar. The line A – A indicates the maximum mesiodistal diameter, and the line B – B the contact point diameter which was used in the present study.

reason all these terms have been discarded and, following Moorrees (1957), have been replaced by the terms "mesiodistal diameter" and "labiolingual diameter" abbreviated when necessary to M.D. and L.L. respectively.

The mesiodistal diameter (Fig. 22) is defined as the distance between mesial and distal contact points, measured in a plane parallel to the occlusal surface (Selmer-Olsen, 1949). This definition can be applied to every tooth except the third molar, where the distal measuring point had to be determined for each tooth individually. This measurement was usually but not always the greatest mesiodistal dimension of the tooth. For example, where the buccal surface of the molars was appreciably longer than the lingual surface, the measurement used was slightly less than the maximum mesiodistal diameter (Fig. 23). In some of the teeth where marked interproximal attrition had taken place, it was found that the contact points had become broadened and that it was possible to obtain several different readings. In such cases the measurement was made from the centre of the contact area if attrition had taken place evenly, or from the least damaged part of the contact area if the attrition was uneven. Difficulty was sometimes experienced in reaching the measuring points with the calipers, particularly with crowded incisors or/

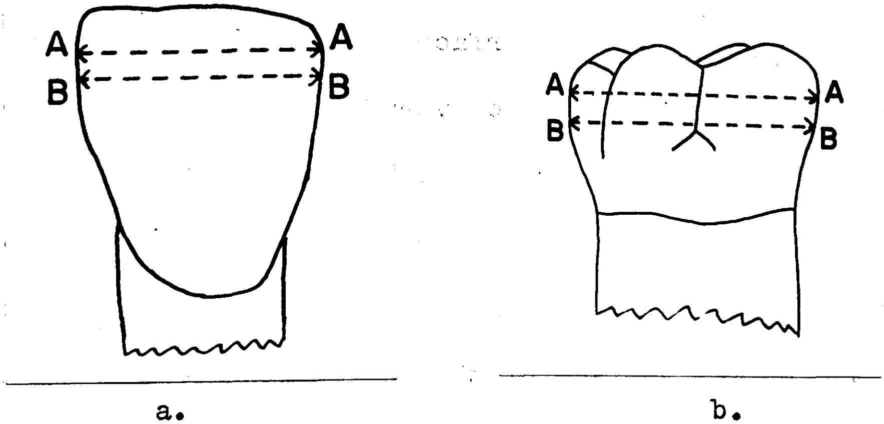

Fig 24. Illustrates the effect of attrition on the accuracy of measurement of the mesiodistal diameter of a. an incisor and b. a molar. The line A - A indicates the level at which measurement is usually made. Between the lines A - A and B - B measurements can be made with reasonable accuracy. When attrition has progressed beyond the level B - B, inaccuracy in the measurements will result.

or tilted molars and premolars. If the teeth were in a rotated position, measurement was made from the points which under normal circumstances would have been in contact with the neighbouring teeth.

The labiolingual diameter (Fig. 22) is defined as the greatest distance between labial and lingual surfaces of the tooth, measured in a plane at right angles to the mesiodistal diameter of the tooth (Selmer-Olsen, 1949; Moorrees, 1957). This diameter is situated much further gingivally than is the mesiodistal diameter. It is not usually found to lie at the centre of the mesiodistal diameter, but well to the mesial or distal side of it.

Considerable difficulty in recording measurements resulted from attrition both of the occlusal surface and of the proximal surfaces, and this affected chiefly the mesiodistal diameter. It was necessary to judge first of all whether occlusal attrition had removed tooth substance to a level beyond the original contact point, and secondly whether interproximal attrition had removed a sufficiently thick layer of enamel to render measurements inaccurate. These questions arose most frequently with the incisors and first molars (Fig. 24). Although every effort was made to exclude teeth which were so worn as to provide inaccurate measurements, yet there is no criterion apart from subjective/

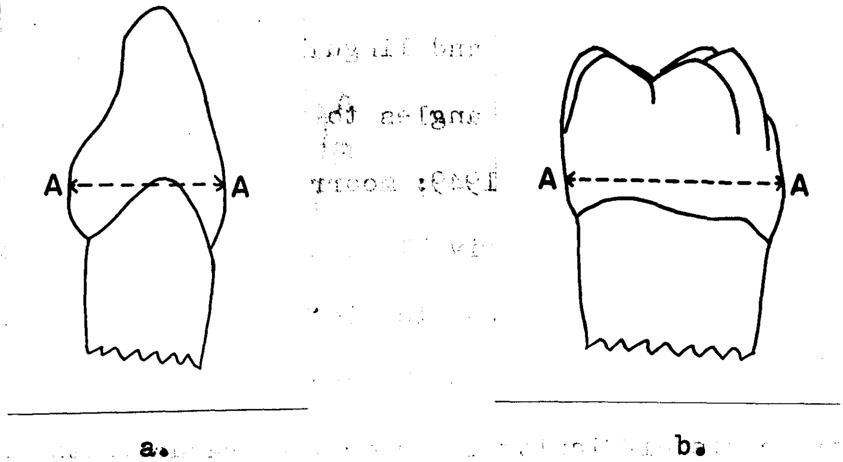

Fig. 25. Illustrates the effect of attrition on the accuracy of measurement of the labiolingual diameter of a. an incisor and b. a molar. The line A - A indicates the level at which the measurement is usually made. A very great deal of attrition must take place before the accuracy of this measurement will be affected.

subjective judgment, and it is felt that there is a probability that a number of mesiodistal measurements have been included which are too small. On the other hand, when the grouping of results was being carried out, a check was made to see whether what appeared to be abnormally small or large variants in the groups could be associated with the presence or absence of attrition, and this was not found to be the case.

Attrition caused much less doubt in the case of the labiolingual diameters, since these are situated much further gingivally than the mesiodistal diameter, and the slight amount of wear on the labial and lingual surfaces is not sufficient to affect the accuracy of the measurement (Fig. 25).

In a considerable number of teeth post-mortem fracture of the enamel rendered one or both measurements impossible. This appeared to be due to shrinkage in the dentine, the enamel retaining its original contours, and was most frequent in teeth where occlusal attrition had removed the enamel over the cusps, thereby breaking its continuity and lessening the adhesion between the tissues.

Caries did not present any problem in this connection since hardly any teeth were affected. On the other hand, thick deposits of supragingival calculus sometimes made labiolingual measurements/

measurements impossible.

When measurements were made of the teeth, they were frequently repeated several times in order to keep a check upon the accuracy with which the measuring points were determined and measurements read from the calipers. Measurements of corresponding teeth from left and right sides were also used as a check upon one another, and when a discrepancy was noted both teeth were carefully re-measured. In spite of this it is still probable that some degree of error in the measurements exists, though it has been kept to a minimum. It was not considered necessary to carry out a statistical investigation of the standard error of the method. In this context, Robinson (1956) pointed out that "the high standard of accuracy suggested by the elaborate checks and counterchecks of instrument and measurer described by some authors is fallacious".

B. Statistical methods.

As complete a statistical evaluation as possible has been made of the data obtained. The material was grouped on archaeological grounds, and each group subdivided into male and female sections. Not all of the material could be sexed: therefore in order to make use of all available data, calculations were also carried out using the "combined sex group", which included all the material in a particular racial group, whether of known male or female sex, or of unknown sex. Of the sexed skulls, nearly every group contained more male specimens than female.

The range and mean of the mesiodistal and labiolingual measurements for each tooth were calculated for all the different groups. The measurements from both sides of the same skull were included in the calculations, although this was not, strictly speaking, statistically correct since there was at least some degree of correlation between the two sides of the same skull* On the other hand, there was frequently a slight, and/

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* In this connection, it is interesting to note that Selmer-Olsen's (1949) statement - "... a peculiarity attracted attention. Where the crown breadth of a tooth on the one side was noticeably smaller than that of the other, the thickness was often shown to be nearly correspondingly larger" - was corroborated in this study.

and occasionally a marked, difference between measurements of teeth from right and left sides of the same skull. In view of this, and since the larger numbers thus obtained rendered more statistical work possible than if only one measurement had been used per skull, it was decided to use both measurements where they had been obtained.

No further statistical work was carried out on groups consisting of fewer than five measurements. This was an arbitrary limit selected by the writer, since it proved difficult to obtain any definite opinion in statistical literature on the number of observations below which statistical preparation was unreliable. Hrdlicka (1947) stated "5 subjects or specimens of the same sex, age category and normalcy, could reasonably be expected to give fair indications, though not yet solid conclusions, as to the characters of the group or parts. Ten subjects or specimens would be at least doubly as valid. But to have definite results the series should not be smaller than 20, and the larger it is the better". Pedersen (1949) also chose five as the minimum number of observations on which to make a statistical analysis. Therefore, on groups containing five or more observations further statistical preparation was done, but caution was exercised in drawing any conclusions where a group contained fewer than ten observations./

observations.

For groups of five or more observations, the standard deviation and standard error of the mean were calculated using the following formulae:-

1. Standard deviation, S.D.

$$= \sqrt{\frac{\text{Sum of squares of deviation from mean}}{\text{no. of observations, n}}}$$

Where a group contained fewer than 30 observations, n in this calculation was replaced by (n-1) (Hill, 1955).

2. Standard error of the mean, S.e.M $= \frac{\text{S.D.}}{\sqrt{n}}$

Wherever possible, an evaluation was then made of the differences between the mean figures for male and female, and between the mean figures for the different racial groups. In order to do this the standard error of the difference and critical ratio were calculated, using the following formulae:-

3. Standard error of the difference, S.e.D.

$$= \sqrt{(\text{S.e.M.}_1)^2 + (\text{S.e.M.}_2)^2}$$

4. Critical ratio, C.R.

$$= \frac{\text{Difference}}{\text{S.e.D.}}$$

It is general statistical practice to consider as being "significant"/

"significant" a C.R. of 2.5 or over. In other words, if the difference between two mean observations is more than $2\frac{1}{2}$ times as great as the standard error of this difference it is considered that the difference is likely to be a real one and not to have arisen by chance, since the likelihood of a difference of this magnitude arising by chance is in the order of 1 in 80 (Hill, 1955). This level of significance has been adopted in the present work, with reservations if the groups under comparison are particularly small.

For all the teeth from which it was possible to obtain both mesiodistal and labiolingual diameters, the crown index was calculated, using the formula:-

$$\text{Crown index, C.I.} = \frac{\text{L.L} \times 100}{\text{M.D.}}$$

A statistical preparation of the data was carried out in the manner already described for mesiodistal and labiolingual diameters.

C. Method of comparison of groups.

The skulls could be divided into four main groups: Neolithic, Bronze Age, Iron Age and Mediaeval. Of these, the first three were each subdivided into two sections, on grounds which will be discussed later in dealing with individual groups.

Whenever possible, a statistical comparison was then made between the subgroups, in respect of the mean crown diameters and index of each tooth. It would have been preferable to confine all the statistical work on racial differences to comparisons between the teeth of males and comparisons between the teeth of females, since the proportion of male and female skulls in the combined sex group is unknown, and may vary widely from one racial subgroup to another. Sex differences may thus obscure or exaggerate racial differences. In most of the subgroups, however, the amount of sexed material was small, and comparison of the combined sex groups was considered to be advisable, in spite of these disadvantages.

In dealing with the racial comparison of the main groups statistical evaluation of data has been restricted to comparisons between males and between females, since it was more important that differences between the main racial groups should be accurately evaluated, and in these groups the quantity of material was also greater. A statistical evaluation was also made of sex differences within the main groups.

The/

The relative size of the first, second and third molars in either jaw is considered to be of some importance, since it reflects the amount of reduction in the molar series, which takes place usually from behind forward (Moorrees, 1957). The number of Scottish skulls with complete molar series was so small that no comparison between groups could be made on the basis of individual molar relationships. Instead, the general tendency of groups to show reduction in one or other molar has been deduced from the mean mesiodistal diameters of the molars. This is not as accurate a method as the investigation of the relative size of the molars in individuals, and has only been used in the sex comparisons within the main groups and in the racial comparison between the main groups.

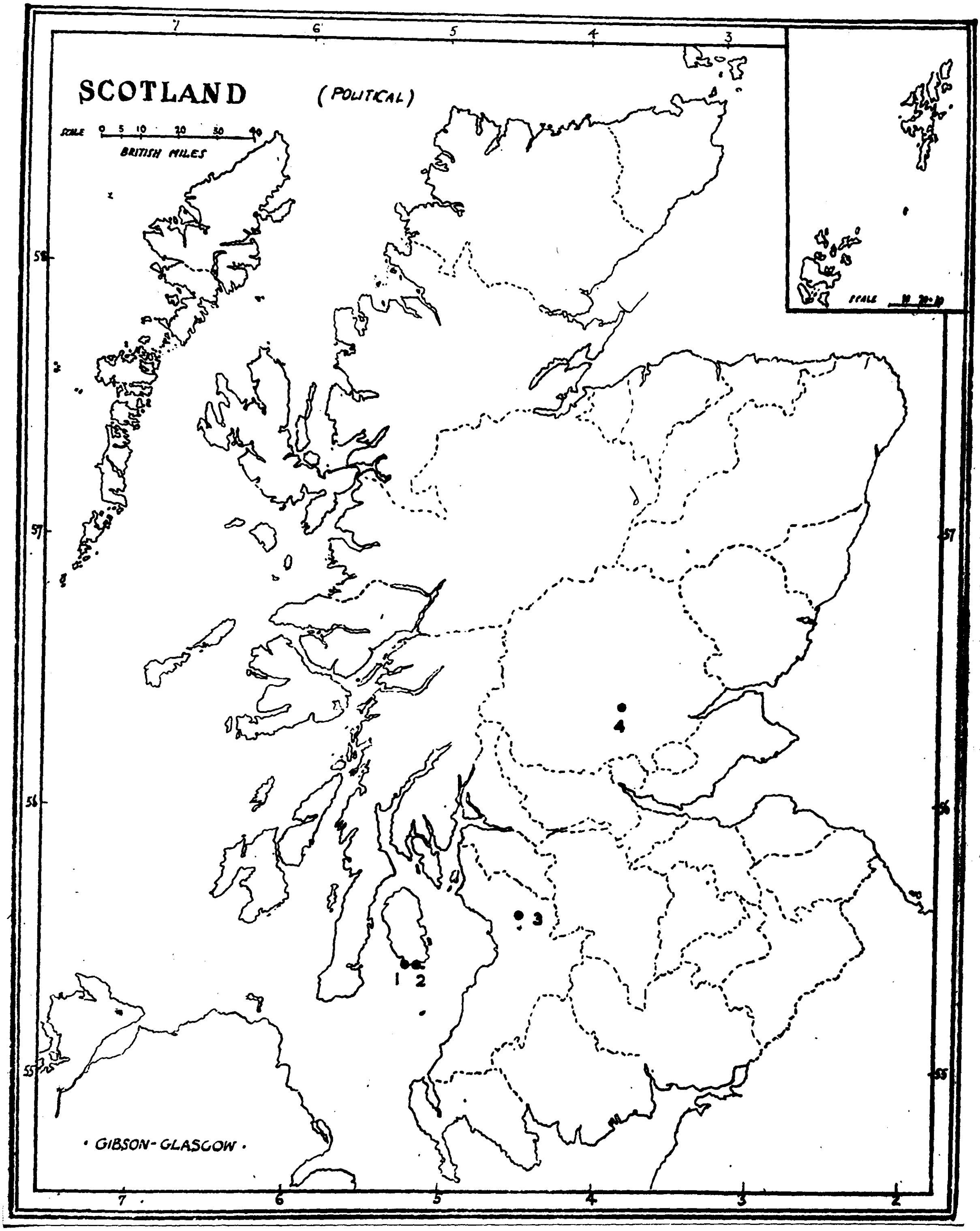
At the beginning of the discussion of each main group, a short description has been given of the provenance of the material. The skulls from which the measurements were derived have been listed, and the find spots indicated on an accompanying distribution map. A list of references has also been added. Occasionally a reference was to "Donations to, or Acquisitions of, the National Museum of Antiquities of Scotland", inserted in the "Proceedings of the Society of Antiquaries of Scotland"; or to the publications of the Royal Commission on Ancient and Historic/

Historic Monuments for Scotland; or to "Discovery and Excavation", the publication of the Scottish Regional Group of the Council for British Archaeology. In such cases, there being no individual author, the reference has been given in the form: name of publication, volume, page and year, and has not subsequently been included in the Bibliography. References given by name of author and year appear in full in the Bibliography.

In the tables, mesiodistal and labiolingual diameters have been given in tenths of a millimetre, so that the readings become a whole number. The crown indices take the form of a percentage, worked correct to the first decimal place. Graphs have been prepared to illustrate the sex comparisons and main racial comparisons.

The following standard statistical abbreviations have been used in the tables:

S.D.	-	standard deviation
S.e.M.	-	standard error of the mean
D.	-	difference (between two mean values)
S.e.D.	-	standard error of the difference
C.R.	-	critical ratio.



Map. 4. Distribution map of Western Neolithic skulls.

ODONTOMETRY RESULTS. NEOLITHIC GROUP.

The Neolithic material has been divided into two subgroups, which have been termed "Western Neolithic" and "Northern Neolithic". This division was made on the basis of archaeological differences of tomb type, the Western Neolithic skulls being those from Clyde-Carlingford gallery graves; while the Northern Neolithic group consisted of occupants of several stalled passage graves of the Orkney-Cromarty group. Neither group of skulls was truly representative of the area in which the corresponding type of cairn is found, as can be seen by comparison of Map 2 with Maps 4 and 5.

The Western Neolithic group consisted of material from the following sites:-

Site	No. Indivs.	References
1. Clachaig, Arran	2	Bryce, 1902 Turner, 1915
2. Torlin, Arran	1	Bryce, 1902 Turner, 1915
3. Darvel, Ayrshire	1	
4. Cultoquhey, Crieff	1	

The distribution of these sites is shown on Map 4 where they/

they are numbered to correspond with the above list.

In this small group, a large proportion of the material derived from two of the numerous chambered cairns of Arran (where there is the greatest concentration in Scotland of Clyde-Carlingford tombs). The mainland of Scotland was represented by two skulls only - one from Darvel, Ayrshire, and fragments of another from an outlier of the Clyde-Carlingford cairns at Cultoquhey near Crieff in Perthshire. The latter cairn must be regarded as being on the very fringe of the area occupied by Neolithic settlers. Many large and important groups of cairns were completely unrepresented - the cairns of Galloway, of the Kilmartin area and of other parts of Argyll. In many cairns, however, the excavators found only small fragments of bone or none at all; e.g. in some of the Arran cairns (Bryce, 1902), at Clach na Tiompan, Perthshire (Henshall & Stewart, 1956), at Cairnholy, Wigtownshire, (Piggott & Powell, 1951) and at Brackley, Kintyre (Scott, 1958). Material from some of the earlier excavations cannot now be traced: e.g. the bone fragments and teeth found in the Nether Largie cairn in the Kilmartin district (Greenwell, 1866).

The Northern Neolithic group of skulls was larger numerically, but was confined to material from the Orkney Islands. The/

The sites from which the material was obtained are as follows:-

	Site	No. indivs.	References
5.	Isbister, South Ronaldsay	28 approx.	Disc. & Ex., p. 38. 1958
6.	Knowe of Yarso Rousay	3	Callander & Grant, 1935 R.C.A.M. Orkney. p.213. 1946. Inventory No. 575
7.	Knowe of Rowiegar Rousay	18 approx.	R.C.A.M. Orkney. p.218. 1946. Inventory No. 578
8.	Midhowe, Rousay	3	Callander & Grant, 1934 R.C.A.M. Orkney. p.221. 1946. Inventory No. 583
9.	Holm of Papa Westray	1	Turner, 1915 R.C.A.M. Orkney. p.189. 1946. Inventory No. 545

The positions of these cairns are indicated on Map 5.

Orkney was thus the only passage grave area to be represented in the skeletal material. No skulls were available from the large mainland section of the Orkney-Cromarty group which covered an area from Caithness to the Moray Firth. Several of the Caithness cairns were excavated nearly a hundred years ago by Anderson (1866, 1868, 1871) who found a number of complete skulls and many fragments. The present whereabouts of this material, if indeed it still exists are unknown to the writer. The Clava cairns have produced only slivers of cremated bone (Piggott, 1956), and/

and no skeletal material from the Shetland heel-shaped cairns has been recorded (R.C.A.M., Shetland, 1946. Introduction and Report).

One mandible was examined from the cairn at Haugabost, Lewis, in the Hebrides. Since the Hebridean group of chambered cairns appeared to have affinities with both the gallery grave and passage grave types, it was decided that the Haugabost mandible could not easily be combined with either group, and the few measurements obtained from it have not been included in the tables which follow.

The extremely small number of skulls in the Western Neolithic group made comparison between the latter and the Northern Neolithic group of little value. The usefulness of the material was further reduced by difficulty in sexing a large proportion of it. Since the skulls from Clachaig, Torlin, Midhowe, Yarso and Holm of Papa Westray had already been published, their sex had been determined as far as possible. Unfortunately, however, the large series from Isbister had not yet been examined by an anthropologist, and the writer had insufficient experience to distinguish between the sexes with complete certainty. There appeared to be a preponderance of male skulls in the Isbister collection, and none of the skulls had definitely female characteristics/

teristics. In the absence of an authoritative report, they have all been relegated to the combined sex group.

The numbers of observations in the Western group were too small to permit of a statistical comparison of Western and Northern groups, and it was for the same reason impossible to compare male and female tooth measurements of the combined Total Neolithic group. The tables were thus restricted to range and mean of the measurements. When only one observation was available, this was inserted in the table in brackets, since it could not be regarded as a true mean value.

Mean mesiodistal diameters of the maxillary teeth of Western and Northern Neolithic groups are compared in Tables 2-4 and mean mesiodistal diameters of the mandibular teeth of the same groups in Tables 5 and 6.

TABLE 2. NEOLITHIC.

Mean mesiodistal crown diameters of maxillary teeth of Neolithic males. Comparison of Western and Northern groups. (1/10 m.m.).

Tooth	Gp.	No. indivs.	No teeth	Mean	Range
I.1.	W	1	1	(97)	-
	N	0	0	-	-
I.2.	W	2	2	71	64-78
	N	3	4	73	66-76
C.	W	2	2	83	81-84
	N	4	6	79	76-82
P.1.	W	1	1	(70)	-
	N	5	7	68	64-72
P.2.	W	0	0	-	-
	N	5	9	67	61-73
M.1.	W	0	0	-	-
	N	5	8	105	101-110
M.2.	W	2	3	99	98-102
	N	3	6	95	80-105
M.3.	W	2	3	87	86-89
	N	2	4	83	80-87

Brackets indicate results which are not true mean values since only one observation could be made.

No skull from the Northern Neolithic group could be classified with certainty as that of a female. Table 3 therefore contains observations for the Western group only.

TABLE 3. NEOLITHIC.

Mean mesiodistal crowndiameters of maxillary teeth of Neolithic females of Western group. (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	2	86	85-86
I.2.	1	1	(64)	-
C.	1	2	76	75-76
P.1.	1	2	61	60-61
P.2.	1	2	62	-
M.1.	2	2	98	93-103
M.2.	1	2	94	93-94
M.3.	1	1	(66)	-

Brackets indicate results which are not true mean values since only one observation could be made.

TABLE 4. NEOLITHIC.

Mean mesiodistal crown diameters of maxillary teeth of Neolithic males and females. Comparison of Western and Northern groups. (1/10 m.m.).

Tooth	Group	No. indivs.	No. teeth	Mean	Range
I.1.	W	2	3	89	85-97
	N	2	2	87	84-90
I.2.	W	3	3	69	64-78
	N	5	6	74	66-80
C.	W	3	4	79	75-84
	N	11	15	79	74-84
P.1.	W	2	3	64	60-70
	N	16	23	66	57-72
P.2.	W	1	2	62	-
	N	17	23	67	60-73
M.1.	W	1	2	98	93-103
	N	25	44	105	98-114
M.2.	W	3	5	97	93-102
	N	22	33	96	80-105
M.3.	W	3	4	82	66-89
	N	12	17	87	76-94

Data for the mesiodistal diameters of the mandibular teeth were even more scanty than for the maxillary teeth. The Western group consisted entirely of male mandibles, while none of the Northern mandibles could be sexed. As a result, the Northern group could appear only in the comparison of the combined sex groups. No table of measurements could be prepared for the mandibular teeth of females.

TABLE 5. NEOLITHIC.

Mean mesiodistal crown diameters of mandibular teeth of Neolithic males of Western group. (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	1	(55)	-
I.2.	0	0	-	-
C.	2	2	72	70-74
P.1.	1	2	72	70-73
P.2.	1	1	(72)	-
M.1.	1	1	(105)	-
M.2.	2	2	105	97-112
M.3.	3	3	109	96-117

Brackets indicate results which are not true mean values since only one observation could be made.

In comparing the figures for the combines sexes in Table 6, it must be noted that the Western group consists only of the male measurements in Table 5, there being no unsexed mandibles in this group.

TABLE 6. NEOLITHIC.

Mean mesiodistal crown diameters of mandibular teeth of Neolithic males and females. Comparison of Western and Northern groups. (1/10 m.m.).

Tooth	Group	No. indivs.	No. Teeth	Mean	Range
I.1.	W	1	1	(55)	-
	N	1	1	(50)	-
I.2.	W	0	0	-	-
	N	4	5	64	56-68
C.	W	2	2	72	70-74
	N	7	10	67	60-73
P.1.	W	1	2	72	70-73
	N	11	14	69	64-76
P.2.	W	1	1	(72)	-
	N	11	16	68	62-75
M.1.	W	1	1	(105)	-
	N	18	26	112	102-122
M.2.	W	2	2	105	97-112
	N	14	21	107	96-116
M.3.	W	3	3	109	96-117
	N	12	16	105	90-117

Brackets indicate results which are not true mean values since only one observation could be made.

When the very small size of the groups is taken into account, there is reasonable similarity in the mesiodistal dimensions of the maxillary teeth of Western and Northern Neolithic groups, and also in the same dimensions of the mandibular teeth of these groups. The greatest differences are found in the combined sex group in the first molars of both jaws, the mean diameter of the Northern Neolithic teeth being greater in each case by 0.7 m.m.

Unfortunately, so few Western skulls could be measured that it is quite impossible to draw any conclusions from these results, except perhaps, that it is surprising that the differences between the Western and Northern groups are not greater when the small numbers of observations and wide ranges of variation of the measurements are considered.

A comparison of mean mesiodistal diameters of the maxillary teeth of males and females of the Total Neolithic group is made in Table 7. Since it was impossible to obtain mesiodistal measurements of mandibular teeth of females in either Western or Northern group, no comparison could be made between males and females of the Total Neolithic group in respect of their mean mandibular mesiodistal tooth diameters.

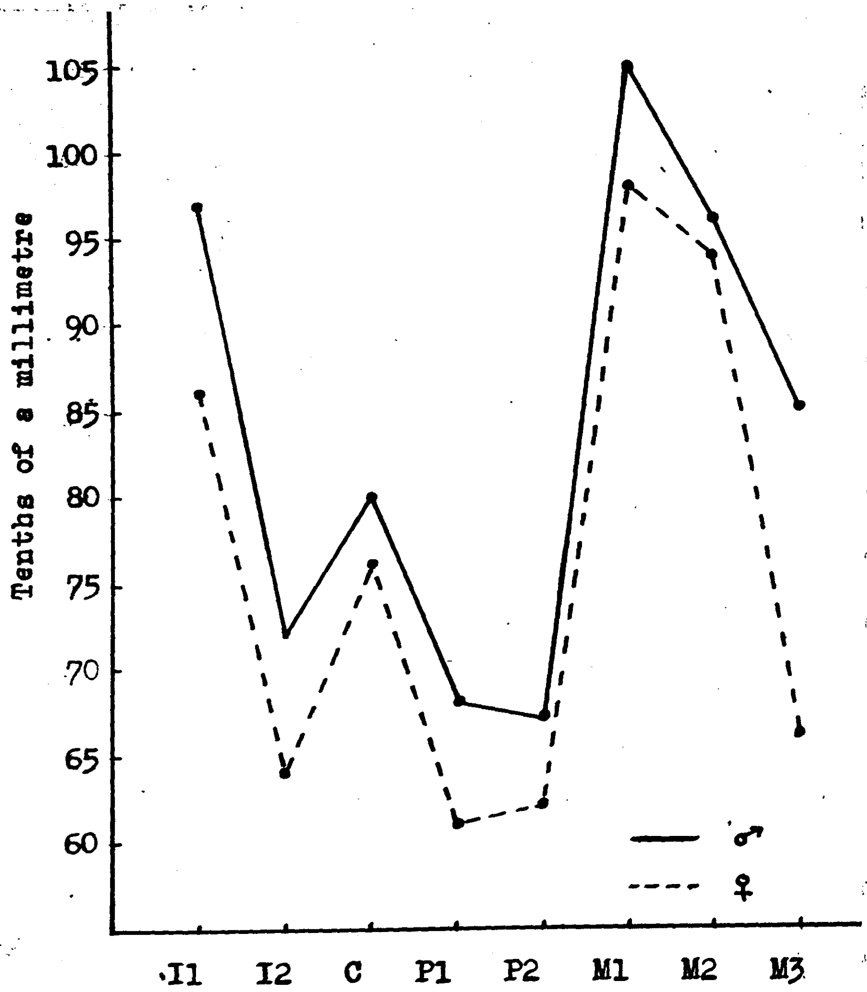


Fig. 26. The mean values of the mesiodistal diameters of the maxillary teeth in the Neolithic group.

TABLE 7. NEOLITHIC.

Mean mesiodistal crown diameters of maxillary teeth of total Neolithic group; comparison of males and females. (1/10 m.m.).

Tooth	Sex	No. indivs.	No. teeth	Mean	Range
I.1.	M	1	1	(97)	-
	F	1	2	86	85-86
I.2.	M	5	6	72	64-78
	F	1	1	(64)	-
C.	M	6	8	80	76-84
	F	1	2	76	75-76
P.1.	M	6	8	68	64-72
	F	1	2	61	60-61
P.2.	M	5	9	67	61-73
	F	1	2	62	-
M.1.	M	5	8	105	101-110
	F	2	2	98	93-103
M.2.	M	5	9	96	80-105
	F	1	2	94	93-94
M.3.	M	4	7	85	80-89
	F	1	1	(66)	-

Brackets indicate results which are not true mean values since only one observation could be made.

The numbers of observations are so small that it would be unwise to attempt to draw from them any conclusions concerning differences between mesiodistal tooth diameters of male and female Neolithic skulls. The only available female Neolithic skull gives, for the mesiodistal tooth diameters, readings which are in every case smaller than the mean figures obtained for the same diameters in Neolithic males, but which are in some cases quite well within the ranges of measurement obtained for the male teeth.

The impression given by Table 7, that the teeth of Neolithic males are larger in the mesiodistal diameter than the teeth of Neolithic females, may be correct. The point could only be proved by study of a much greater quantity of material.

Relative size of molars.

In both sexes, there is a progressive diminution in the mesiodistal diameter from the first molar to the third molar. There is thus no sex difference in the pattern of molar reduction in the maxilla. (Fig. 26).

Mean labiolingual diameters of the maxillary teeth of Western and Northern Neolithic groups are given in Tables 8 - 10, and mean labiolingual diameters of the mandibular teeth of the same groups in Tables 11 and 12.

TABLE 8. NEOLITHIC.

Mean labiolingual crown diameters of maxillary teeth of Neolithic males. Comparison of Western and Northern groups. (1/10 m.m.).

Tooth	Group	No. indivs.	No. teeth	Mean	Range
I.1.	W	1	1	(80)	-
	N	1	1	(75)	-
I.2.	W	2	2	67	64-69
	N	3	4	67	60-73
C.	W	2	2	94	91-96
	N	4	6	88	87-90
P.1.	W	1	2	89	87-90
	N	5	7	91	87-95
P.2.	W	0	0	-	-
	N	4	7	93	85-96
M.1.	W	0	0	-	-
	N	5	8	115	110-120
M.2.	W	2	3	120	117-123
	N	4	7	118	111-127
M.3.	W	2	3	126	108-135
	N	2	4	111	108-114

Brackets indicate results which are not true mean values since only one observation could be made.

As in the case of the mesiodistal measurements, Table 9 consists of measurements from female skulls of the Western group only.

TABLE 9. NEOLITHIC.

Mean labiolingual crown diameters of maxillary teeth of Neolithic females of Western group. (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	2	70	-
I.2.	1	1	(57)	-
C.	1	1	(80)	-
P.1.	1	1	(94)	-
P.2.	1	1	(90)	-
M.1.	2	2	112	111-112
M.2.	1	2	110	-
M.3.	1	1	(98)	-

Brackets indicate results which are not true mean values since only one observation could be made.

TABLE 10. NEOLITHIC.

Mean labiolingual crown diameters of maxillary teeth of Neolithic males and females. Comparison of Western and Northern groups. (1/10 m.m.).

Tooth	Group	No. indivs.	No. teeth	Mean	Range
I.1.	W	2	3	73	70-80
	N	3	3	73	70-75
I.2.	W	3	3	63	57-69
	N	5	6	67	60-73
C.	W	3	3	89	80-96
	N	12	16	90	83-97
P.1.	W	2	3	90	87-94
	N	16	23	88	71-98
P.2.	W	1	1	(90)	-
	N	17	23	93	81-102
M.1.	W	2	2	112	111-112
	N	27	47	116	105-132
M.2.	W	3	5	116	110-123
	N	23	34	118	102-130
M.3.	W	3	4	119	98-135
	N	13	19	113	104-130

Brackets indicate results which are not true mean values since only one observation could be made.

No observations of labiolingual diameter could be obtained for mandibular teeth of females in the Western group. Since the Northern mandibles could not be sexed, all measurements for this group are in the combined sex category.

TABLE 11. NEOLITHIC.

Mean labiolingual crown diameters of mandibular teeth of Neolithic males of Western group. (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	1	(65)	-
I.2.	0	0	-	-
C.	1	1	(87)	-
P.1.	1	2	82	80-83
P.2.	1	2	86	85-87
M.1.	2	2	105	104-105
M.2.	3	3	102	99-105
M.3.	3	3	102	95-107

Brackets indicate results which are not true mean values since only one observation could be made.

In comparing the figures for the combined sexes in Table 12, it must be noted that the Western group consists only of the male measurements given in Table 11, there being no unsexed mandibles in this group.

TABLE 12. NEOLITHIC.

Mean labiolingual crown diameters of mandibular teeth of Neolithic males and females. Comparison of Western and Northern groups. (1/10 m.m.).

Tooth	Group	No. indivs.	No. teeth	Mean	Range
I.1.	W	1	1	(65)	-
	N	2	3	66	65-67
I.2.	W	0	0	-	-
	N	4	5	67	63-69
C.	W	1	1	(87)	-
	N	5	7	78	68-87
P.1.	W	1	2	82	80-83
	N	12	15	74	60-81
P.2.	W	1	2	86	85-87
	N	11	17	79	70-91
M.1.	W	2	2	105	104-105
	N	16	25	106	98-116
M.2.	W	3	3	102	99-105
	N	15	23	102	92-111
M.3.	W	3	3	102	95-107
	N	12	16	101	90-116

Brackets indicate results which are not true mean values since only one observation could be made.

The differences between the mean labiolingual diameters of the teeth of Western and Northern Neolithic skulls are slightly greater than those between the mesiodistal diameters. Among the maxillary teeth, the greatest difference between the groups is in the third molars of the males, the Western mean value being greater than the Northern mean value by the relatively large amount of 1.4 m.m. This is chiefly due to the presence, in the male Clachaig skull, of third molars which were exceptionally wide buccolingually, and somewhat compressed mesiodistally. In the combined sex group, the difference in the third molar measurements is reduced to 0.6 m.m., and it should be noted that the range for the Northern measurements in this group reaches an upper limit only 0.5 m.m. short of the measurements of the Clachaig teeth. The other teeth do not show any marked differences between Western and Northern groups.

In the mandible, on the other hand, the differences are very small for incisor and molars, but are in the range 0.7-0.9 m.m. for the canine and premolars.

Insufficient material is present to allow any conclusions to be drawn from these figures. In general, there is reasonable similarity between Western and Northern groups.

A comparison of mean labiolingual diameters of the maxillary teeth/

teeth of males and females of the Total Neolithic group is made in Table 13. Since it was impossible to obtain labiolingual measurements of mandibular teeth of females in either Western or Northern group, no comparison could be made between males and females of the Total Neolithic group in respect of their mean mandibular labiolingual tooth diameters.

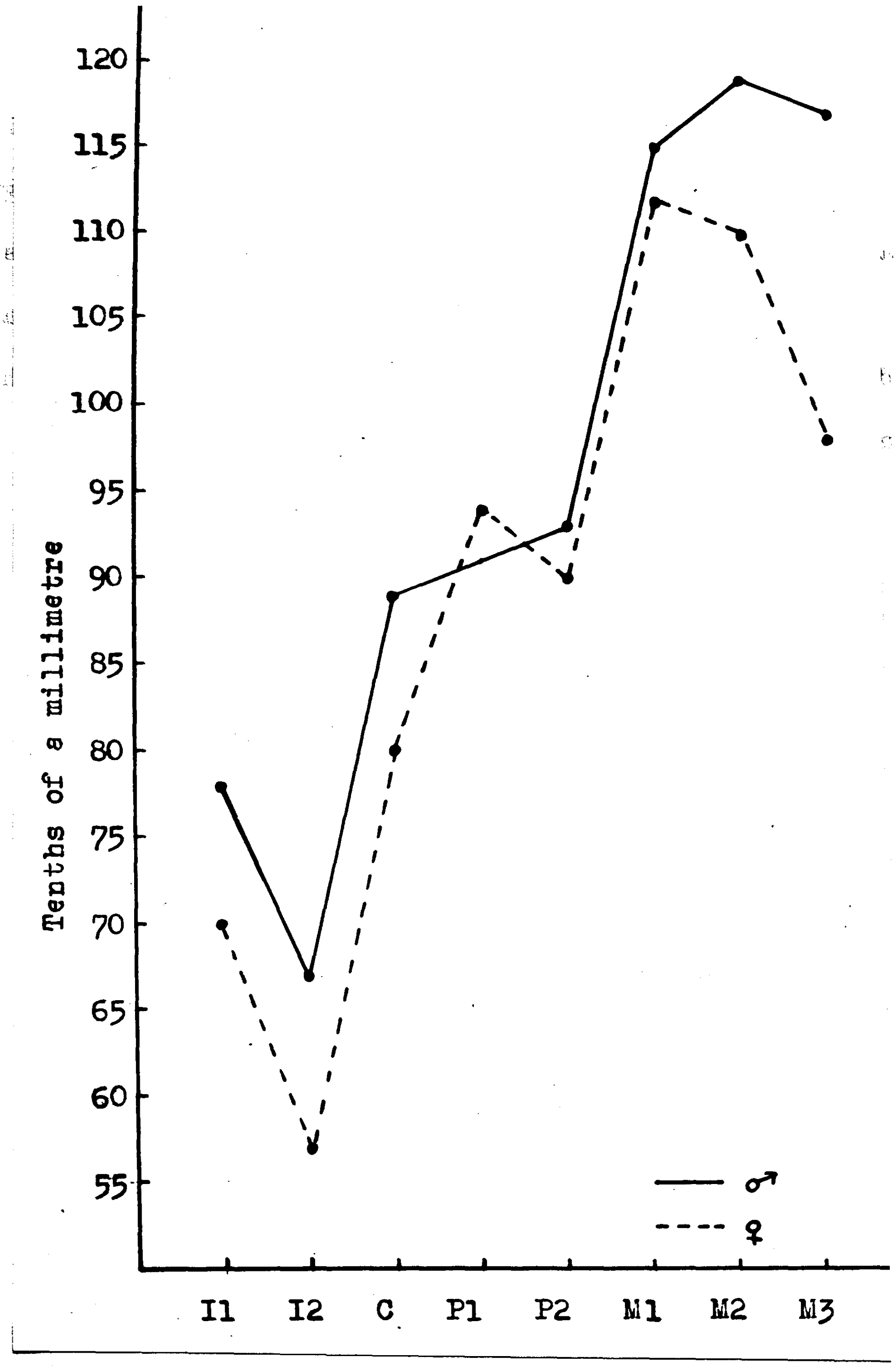


Fig. 27. The mean values of the labiolingual diameters of the maxillary teeth in the Neolithic group.

TABLE 13. NEOLITHIC.

Mean labiolingual crown diameters of maxillary teeth of total Neolithic group. Comparison of males and females. (1/10 m.m.).

Tooth	Sex	No. indivs.	No. teeth	Mean	Range
I.1.	M	2	2	78	75-80
	F	1	2	70	-
I.2.	M	5	6	67	60-73
	F	1	1	(57)	-
C.	M	6	8	89	87-96
	F	1	1	(80)	-
P.1.	M	6	9	91	87-95
	F	1	1	(94)	-
P.2.	M	4	7	93	85-96
	F	1	1	(90)	-
M.1.	M	5	8	115	110-120
	F	2	2	112	111-112
M.2.	M	6	10	119	111-127
	F	1	2	110	-
M.3.	M	4	7	117	108-135
	F	1	1	(98)	-

Brackets indicate results which are not true mean values since only one observation could be made.

The statements which have been made concerning the relationship between mean mesiodistal diameters of the teeth of Neolithic males and females are also true of the mean labiolingual diameters. The labiolingual diameters of the few available female teeth are (with the exception of the diameter of the first maxillary premolar) smaller than the corresponding mean diameters of the teeth of the males.

It is not possible however, on account of the small quantity of material, to decide whether these results represent a genuine sex difference in tooth size.

The numbers of crown indices which could be calculated were even smaller than the numbers of mesiodistal and labiolingual diameters, since it quite frequently happened that only one of these measurements could be made on any particular tooth. The tables have been given for the sake of completeness.

Mean crown indices of the maxillary teeth of Western and Northern Neolithic groups are given in Tables 14-16, and mean crown indices of the mandibular teeth of the same groups in Tables 17 and 18.

TABLE 14. NEOLITHIC.

Mean crown indices of maxillary teeth of Neolithic males.

Comparison of Western and Northern groups.

Tooth	Group	No. indivs.	No. teeth	Mean	Range
I.1.	W	1	1	(82.5)	-
	N	0	0	-	-
I.2.	W	2	2	94.3	88.5-100.0
	N	3	4	92.2	80.0-106.1
C.	W	2	2	113.3	112.3-114.3
	N	4	4	113.3	110.1-118.4
P.1.	W	1	1	(128.6)	-
	N	5	6	133.2	128.2-139.1
P.2.	W	0	0	-	-
	N	4	7	136.7	130.8-146.2
M.1.	W	0	0	-	-
	N	5	7	111.3	109.1-115.4
M.2.	W	2	2	120.0	119.4-120.6
	N	3	6	126.0	114.3-138.8
M.3.	W	2	3	144.1	121.3-155.8
	N	2	4	133.4	129.4-138.3

Brackets indicate results which are not true mean values since only one calculation could be made.

Crown indices could be calculated for maxillary teeth of females of the Western Neolithic group only.

TABLE 15. NEOLITHIC.

Mean crown indices of maxillary teeth of Neolithic females of Western group.

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	2	81.9	81.4-82.4
I.2.	1	1	(89.1)	-
C.	1	1	(106.7)	-
P.1.	1	1	(154.1)	-
P.2.	1	1	(145.2)	-
M.1.	2	2	114.1	107.8-120.4
M.2.	1	2	117.7	117.0-118.3
M.3.	1	1	(148.5)	-

Brackets indicate results which are not true mean values since only one calculation could be made.

TABLE 16. NEOLITHIC.

Mean crown indices of maxillary teeth of Neolithic males and females. Comparison of Western and Northern groups.

Tooth	Group	No. indivs.	No. teeth	Mean	Range
I.1	W	2	3	82.1	81.4-82.5
	N	2	2	83.0	77.8-88.1
I.2.	W	3	3	92.5	88.5-100.0
	N	5	6	91.4	80.0-106.1
C.	W	3	3	111.1	106.7-114.3
	N	11	13	115.0	106.4-127.6
P.1.	W	2	2	141.4	128.6-154.1
	N	16	22	132.3	120.0-145.0
P.2.	W	1	1	(145.2)	-
	N	15	20	139.4	130.4-153.2
M.1	W	2	2	114.1	107.8-120.4
	N	25	42	111.1	102.8-117.5
M.2.	W	3	4	118.8	117.0-120.6
	N	22	33	122.6	109.0-145.8
M.3.	W	3	4	145.2	121.3-155.8
	N	12	17	131.1	117.8-150.0

Brackets indicate results which are not true mean values since only one calculation could be made.

No mandibular crown indices could be calculated for females in either Western or Northern group, and none for males in the Northern group, since all the mandibles in the latter group were in the unsexed category.

TABLE 17. NEOLITHIC.

Mean crown indices of mandibular teeth of Neolithic males of Western group.

Tooth	No. indivs.	No. teeth	Mean	Range
I.1	1	1	(118.2)	-
I.2.	0	0	-	-
C.	1	1	(124.3)	-
P.1.	1	2	114.0	113.7-114.3
P.2.	1	1	(120.8)	-
M.1.	1	1	(99.0)	-
M.2.	2	2	98.0	93.8-102.1
M.3.	3	3	93.9	91.2-99.0

Brackets indicate results which are not true mean values since only one calculation could be made.

In comparing the figures for the combined sexes in Table 18, it must be noted that the Western group consists only of the male indices given in Table 17, there being no unsexed mandibles in this group.

TABLE 18. NEOLITHIC.

Mean crown indices of mandibular teeth of Neolithic males and females. Comparison of Western and Northern groups.

Tooth	Group.	No. indivs.	No. teeth	Mean	Range
I.1.	W	1	1	(118.2)	-
	N	1	1	(134.0)	-
I.2.	W	0	0	-	-
	N	4	5	105.5	96.9-121.4
C	W	1	1	(124.3)	-
	N	5	7	116.5	104.6-125.0
P.1.	W	1	2	114.0	113.7-114.3
	N	11	14	107.3	92.3-115.2
P.2.	W	1	1	(120.8)	-
	N	11	16	116.8	106.0-130.0
M.1.	W	1	1	(99.0)	-
	N	16	24	95.1	89.9-101.9
M.2.	W	2	2	98.0	93.8-102.1
	N	14	21	96.0	91.8-104.8
M.3.	W	3	3	93.9	91.2-99.0
	N	12	16	96.3	89.7-111.1

Brackets indicate results which are not true mean values since only one calculation could be made.

Little information can be gained from study of the crown indices of Neolithic teeth. The greatest difference between the Western and Northern groups occurs in the maxillary third molars. This is again due to inclusion in the Western group of the male Clachaig skull, whose maxillary third molars show an exaggerated mesiodistal compression. There are no other striking differences between the Western and Northern groups. The ranges of variation appear to be very wide.

A comparison of mean crown indices of the maxillary teeth of males and females of the Total Neolithic group is made in Table 19. Since no crown indices could be calculated for the mandibular teeth of females in either Western or Northern group, it was not possible to compare males and females of the Total Neolithic group in respect of the mean mandibular crown indices.

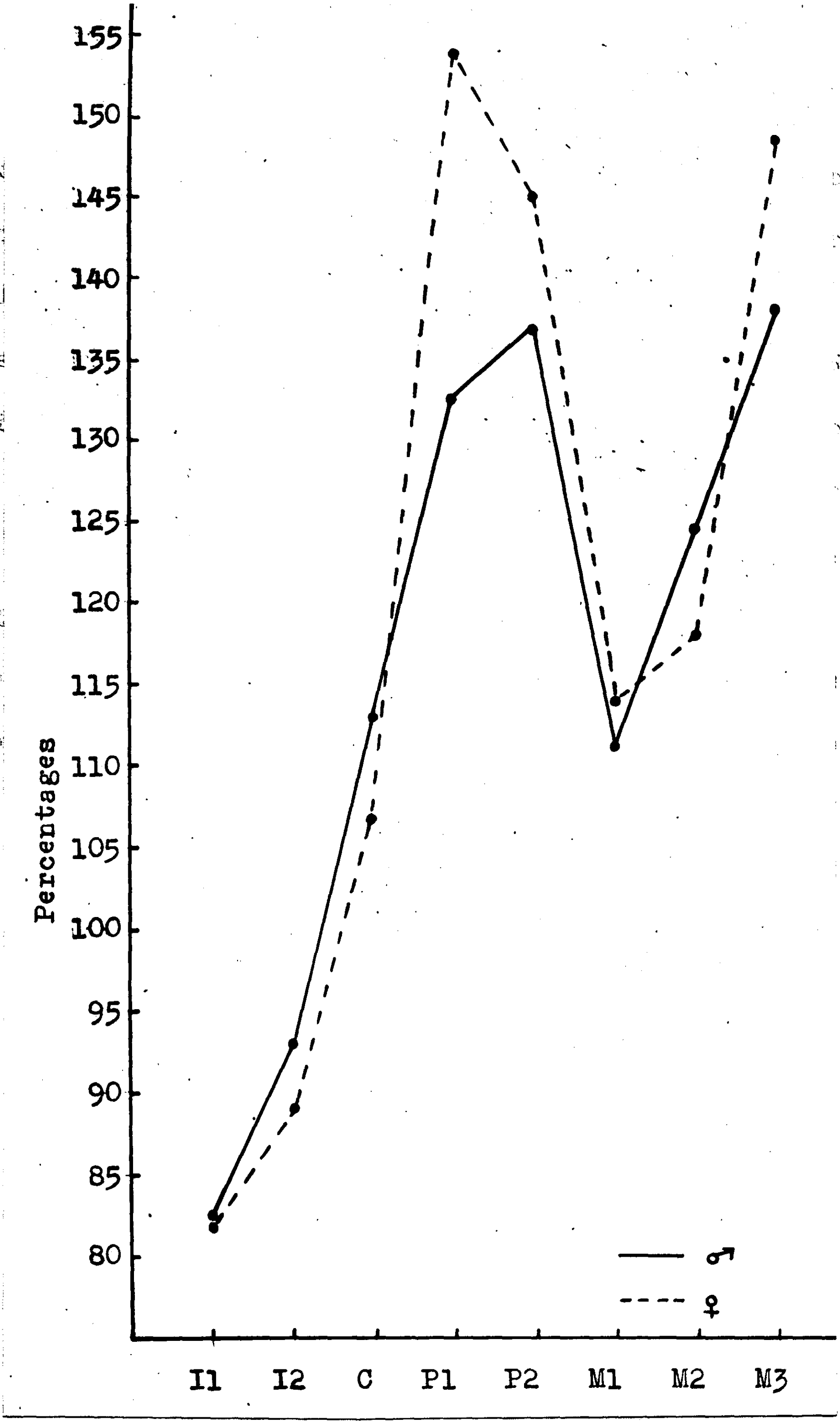


Fig. 28. The mean values of the crown indices of the maxillary teeth in the Neolithic group.

TABLE 19. NEOLITHIC.

Mean crown indices of maxillary teeth of total Neolithic group. Comparison of males and females.

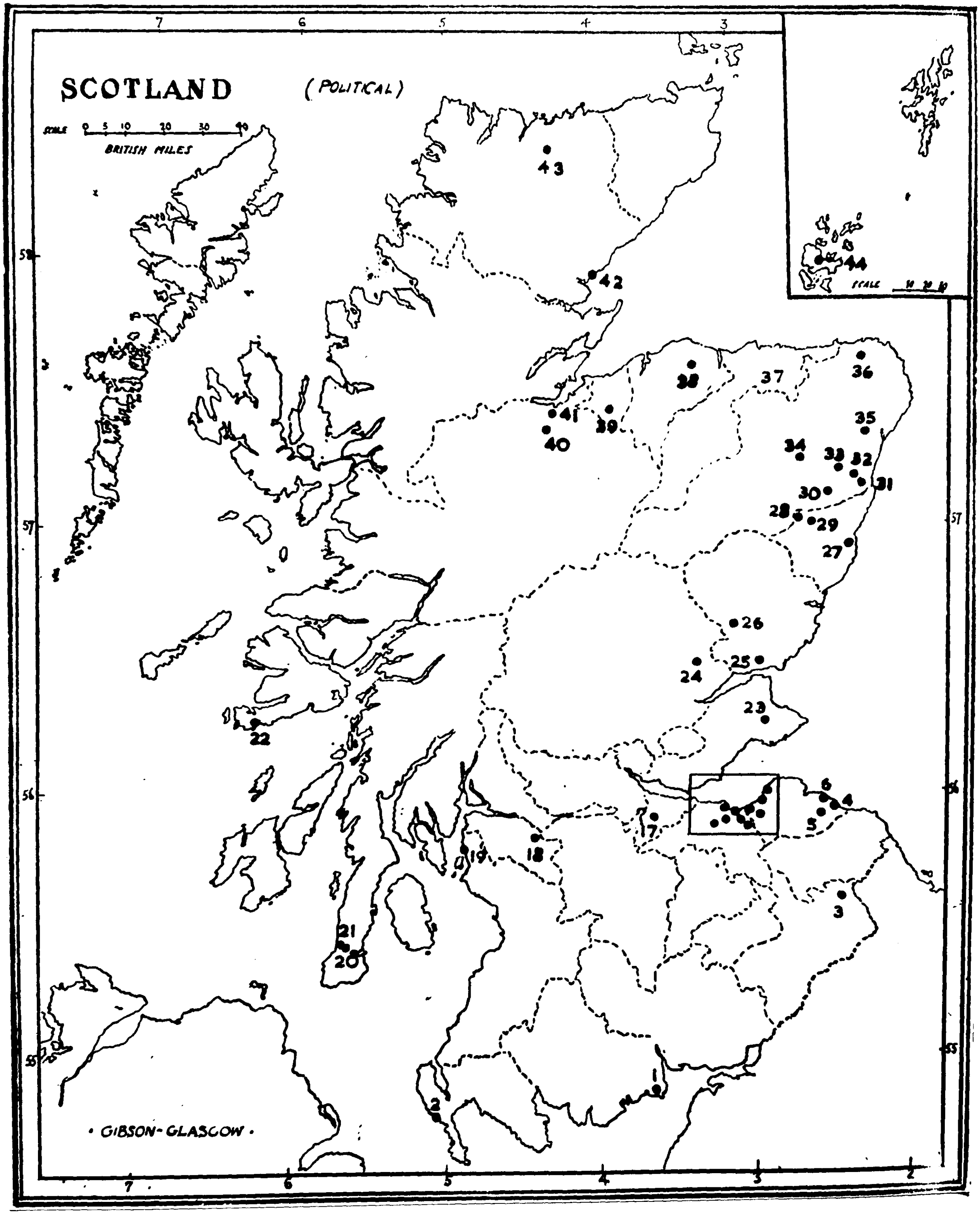
Tooth	Sex	No. indivs.	No. teeth	Mean	Range
I.1.	M	1	1	(82.5)	-
	F	1	2	81.9	81.4-82.4
I.2.	M	5	6	92.9	80.0-106.1
	F	1	1	(89.1)	-
C.	M	6	6	113.3	110.1-118.4
	F	1	1	(106.7)	-
P.1.	M	6	7	132.5	128.2-139.1
	F	1	1	(154.1)	-
P.2.	M	4	7	136.7	130.8-146.2
	F	1	1	(145.2)	-
M.1.	M	5	7	111.3	109.1-115.4
	F	2	2	114.1	107.8-120.4
M.2.	M	5	8	124.5	114.3-138.8
	F	1	2	117.7	117.0-118.3
M.3.	M	4	7	138.0	121.3-155.8
	F	1	1	(148.5)	-

Brackets indicate results which are not true mean values since only one calculation could be made.

The crown indices of the teeth of Neolithic males are sometimes higher and sometimes lower than the crown indices of the corresponding teeth of Neolithic females, and there is no evidence of any consistent variation in tooth proportion between the sexes. In view of the extremely small numbers involved, further discussion of the crown indices is not warranted.

In general, there seems to be little difference between the teeth of Western and Northern Neolithic skulls. When these groups are combined, and mean diameters of male teeth compared with those of female teeth, the mesiodistal and labiolingual diameters of the male maxillary teeth are found to be greater than those of the female teeth, with the sole exception of the labiolingual diameter of the first maxillary premolar. Since no female Neolithic mandibles were available, no comparison between male and female could be made for mesiodistal and labiolingual diameters of the mandibular teeth. The numbers of crown indices which could be calculated are so small that comparisons of them provide no useful information concerning sex differences.

In further discussion the Scottish Neolithic material will be treated as a homogeneous group.

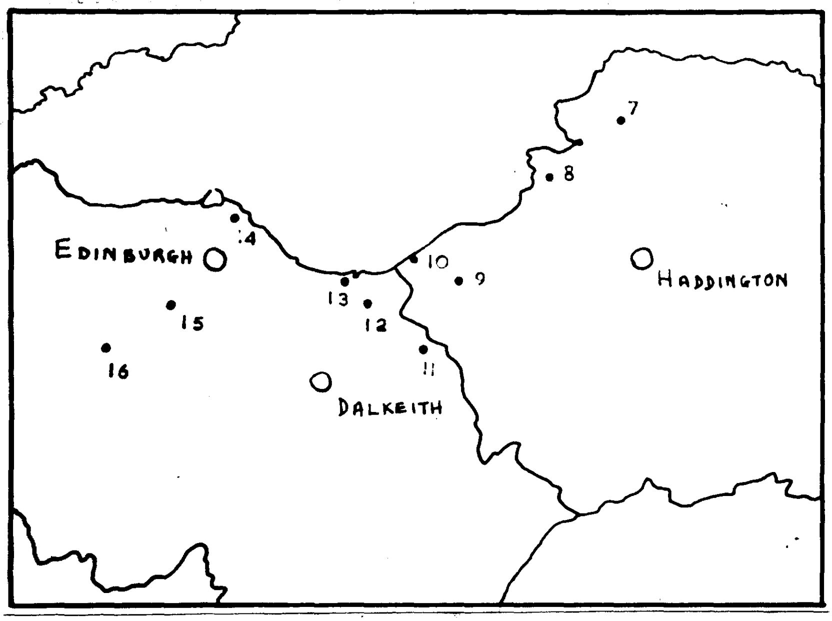


Map 6. Distribution map of Bronze Age skulls. The inset area appears in more detail in Map 7.

ODONTOMETRY RESULTS. BRONZE AGE GROUP.

Scottish Bronze Age material is not usually subdivided. Since, however, Mitchell (1934) suggested, on the basis of Beaker typology, that several separate points of entry may have been used in the Bronze Age colonization of Scotland, it was decided to split the Bronze Age group on a geographical basis into Southern and Northern subgroups, the dividing line running from the Tay estuary to the island of Mull. By comparing these subgroups an attempt was made to determine whether there was any difference between the Bronze Age populations of these two areas in so far as the teeth were concerned. In both areas the skulls were fairly evenly scattered over the corresponding short cist distribution (Map 6). There were noticeable concentrations of sites in the Aberdeen and Edinburgh areas, and in the latter district the find spots were so crowded together that a larger scale map (Map 7) was drawn so that they could be numbered.

It would have been interesting to divide the material on the basis of grave goods, and to compare the teeth of Bronze Age individuals from Beaker burials with the teeth of those accompanied by Food Vessels. The number of Food Vessel burials however,/



Map 7. Distribution map of Bronze Age skulls in the Edinburgh area.

however, was too small for this to be practicable.

The Southern Bronze Age group consisted of the material listed below. Where grave goods were present, their nature has been noted.

Site	No. indivs.	Grave goods	References
1. Mainsriddle, Dumfries	1	Beaker	Truckell, 1958
2. Port of Spittal, Portpatrick	1	Food Vessel	Coles, 1900
3. Sprouston, Roxburgh	1		Craw, 1933
4. Skateraw, Dunbar	1	Beaker	Disc. & Ex. p. 39. 1958
5. Thurston Mains, Innerwick	2	Beaker & flint	Stevenson, 1940
6. East Barns, Dunbar	1	Beaker	P.S.A.S. 35. 277. 1901. Mitchell, 1934
7. West Fenton, Drem	1	Beaker	Edwards, 1944
8. Gosford	1		
9. Birsley Quarry, Tranent	1		Turner, 1915.
10. Morrison's Haven, Prestongrange	1		Turner, 1915
11. Cousland, Cranston	1		Turner, 1915

Site	No. indivs.	Grave goods	References
12. Kirk Park, Inveresk	1		Lowe, 1894 Turner, 1915
13. Belfield, Musselburgh	1	Beaker & Stone axe	P.S.A.S. 32. 8. 1897. Turner, 1915
14. Leith	1		Turner, 1915
15. Craiglockhart	1		
16. Juniper Green	1	Beaker	Bryce, 1905 Turner, 1915
17. West Lothian	1		
18. Newlands	1		
19. Largs, Ayrshire	1	Beaker	Munro, 1906 Turner, 1915 Mitchell, 1934
20. Kilmaho, Campbeltown	2	Food Vessel bronze dagger & awl, flint knives	Disc. & Ex. p.3. 1959
21. Ballivain	2		
22. Ardachy, Bunessan, Mull	3	2 Food Vessels	Mitchell, 1897 Turner, 1915
23. Rumgally, Kemback, Fife	1	Food Vessel & flints	Gordon, 1931

The Northern Bronze Age group comprised the following:-

Site	No. indivs.	Grave goods	References
24. Bridge Farm, Meikleour	1		Ritchie, 1935
25. Tealing, Angus	2		Neish, 1870 Turner, 1915
26. Meikle Kenny, Angus	1		
27. Nether Criggie, Dunnottar	1	3 Beakers Flints	Kirk & McKenzie, 1956
28. Clashfarquhar, Banchory	1	Beaker Food Vessel	Anderson & Black, 1888 Mitchell, 1934
29. Balbridie, Durris	1	Beaker	Coles, 1906 Mitchell, 1934
30. Whitehouse, Skene	1	2 Beakers Flints	Callander, 1905 Turner, 1915 Mitchell, 1934
31. Stoneywood, Newhills	1	Beaker	Turner, 1915 Mitchell, 1934
32. Kinaldie, Kintore	1	Beaker	Stuart, 1856 Turner, 1915 Mitchell, 1934
33. Broomend, Inverurie	2	2 Beakers Flints	Chalmers, 1867 Turner, 1915 Mitchell, 1934
34. Newlands, Oyne	2	2 Beakers Bracer Flints	Callander, 1933 Mitchell, 1934 Low, 1936

Site	No. indivs.	Grave goods	References
35. Hillhead, Ellon	1	Beaker	Mitchell, 1934
36. West Castle Hill, Boyndlie, Tyrie	1	Stone hammer	Turner, 1915 Low, 1933 Mitchell, 1934
37. Lesmurdie, Banff	1	Beaker	P.S.A.S. 1. 67. 1852. Turner, 1915. Mitchell, 1934
38. Threapland, Llanbryd	1	Flint knife	Anderson & Black, 1888. Turner, 1915.
39. Carnach, Nairn	1		Edwards, 1931
40. Lochend, Inverness	1	Beaker	MacDougall, 1944
41. Culduthel, Inverness	1	Jet beads Bronze awl	Low, 1929
42. Golspie	2		Woodham & McKenzie, 1959*
43. Holding No. 9, Strathnaver	1		Edwards, 1933
44. West Puldrite, Evie, Orkney	1		Corrie, 1929

* This paper was unfortunately published after the statistical work was well under way. The authors made the suggestion that though/

though the burials were contracted ones in short cists, certain features of the cists and grave goods made an Early Iron Age date more probable. This dating was tentative, and for the moment the skulls have been left in the Bronze Age group.

There was a greater quantity of material in the Bronze Age groups than in the Neolithic, and sex determination had been carried out on a considerable number of the skulls. It was thus possible to make a statistical evaluation of the results.

Mean mesiodistal diameters of the maxillary teeth of Southern and Northern Bronze Age groups are given in Tables 20-22, and mean mesiodistal diameters of the mandibular teeth of the same groups in Tables 23-25.

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M.1.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
M.2.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	M	11	15	96	84-105	5.0	[illegible]
M.3.	S	5	7	86	77-95	6.0	2.3
	M	6	9	87	75-96	6.5	2.2

x N.I. — Number of Individuals
x N.T. — Number of Teeth

Table 20. BRONZE AGE.

Mean mesiodistal crown diameters of maxillary teeth of Bronze Age males; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	1	2	96	96–97	–	–	9	–	–
	N	4	5	87	80–93	5.0	2.2			
I.2	S	4	5	68	65–72	3.4	1.5	1	2.6	0.4
	N	6	11	69	55–78	7.0	2.1			
C.	S	6	9	77	68–83	6.5	2.2	0	–	–
	N	9	15	77	70–86	3.8	1.0			
P.1.	S	8	12	65	59–71	3.5	1.0	2	1.4	1.4
	N	11	17	67	63–75	4.0	1.0			
P.2.	S	8	11	64	55–70	5.3	1.6	0	–	–
	N	11	20	64	56–72	4.4	1.0			
M.1.	S.	4	7	109	102–116	5.5	2.1	3	2.6	1.2
	N	12	20	106	96–122	6.7	1.5			
M.2.	S	7	11	97	84–106	6.4	1.9	1	2.2	0.5
	N	11	18	96	86–105	5.0	1.2			
M.3.	S	5	7	86	77–95	6.0	2.3	1	3.2	0.3
	N	6	9	87	75–96	6.5	2.2			

x N.I. – Number of Individuals
x N.T. – Number of Teeth

Table 21. BRONZE AGE.

Mean mesiodistal crown diameters of maxillary teeth of Bronze Age females; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	2	4	77	76-78	-	-	11	-	-
	N	1	2	88	86-89	-	-			
1.2	S	4	6	67	60-74	6.0	2.4	2	-	-
	N	1	2	65	62-67	-	-			
C.	S	4	6	78	74-85	3.9	1.6	1	2.0	0.5
	N	3	5	79	76-82	2.7	1.2			
P.1.	S	4	7	67	63-72	4.4	1.7	1	-	-
	N	3	4	68	61-76	-	-			
P.2.	S	5	8	67	61-70	5.1	1.8	1	2.3	0.4
	N	4	6	66	60-70	3.7	1.5			
M.1.	S	5	8	103	97-114	5.6	2.0	2	-	-
	N	3	4	101	100-105	-	-			
M.2.	S	4	7	94	90-100	3.7	1.4	5	-	-
	N	3	4	99	96-106	-	-			
M.3.	S	2	4	87	84-89	-	-	2	-	-
	N	3	3	85	82-89	-	-			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 22. BRONZE AGE.

Mean mesiodistal crown diameters of maxillary teeth of Bronze Age males and females; comparison of Southern and Northern groups.
(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	5	10	84	76-97	8.2	2.5	6	3.1	1.9
	N	7	10	90	80-100	6.1	1.9			
I.2.	S	11	16	67	58-76	5.8	1.5	3	2.1	1.4
	N	9	17	70	55-78	6.3	1.5			
C.	S	15	23	77	68-83	4.9	1.0	1	1.3	0.8
	N	14	24	78	70-86	4.1	0.8			
P.1.	S	16	24	66	59-72	3.6	0.7	1	1.1	0.9
	N	16	25	67	61-76	4.3	0.9			
P.2.	S	19	27	66	55-73	5.1	1.0	1	1.3	0.8
	N	17	29	65	56-72	4.1	0.8			
M.1.	S	17	28	103	93-116	7.2	1.4	3	1.8	1.7
	N	16	26	106	96-112	6.3	1.2			
M.2.	S	18	28	96	84-106	5.3	1.0	2	1.5	1.3
	N	16	25	98	86-107	5.4	1.1			
M.3.	S	9	14	86	77-95	4.3	1.2	1	2.0	0.5
	N	10	13	87	75-96	5.6	1.6			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 23. BRONZE AGE.

Mean mesiodistal crown diameters of mandibular teeth of Bronze Age males; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	3	6	56	50–60	4.5	1.9	2	2.8	0.7
	N	4	6	54	47–58	4.9	2.0			
I.2.	S	3	5	61	57–65	4.0	1.8	1	2.2	0.5
	N	8	11	62	54–68	3.8	1.2			
C.	S	8	11	67	61–73	4.1	1.2	1	1.5	0.7
	N	9	14	68	62–75	3.5	0.9			
P.1.	S	10	16	67	62–72	3.0	0.8	2	1.1	1.8
	N	12	16	69	64–73	2.7	0.7			
P.2.	S	6	12	70	66–75	2.9	0.8	0	-	-
	N	11	17	70	65–76	3.7	0.9			
M.1.	S	8	12	112	105–118	4.1	1.2	1	1.8	0.6
	N	12	18	111	99–120	6.0	1.4			
M.2.	S	9	13	105	90–116	8.0	2.2	1	2.8	0.4
	N	11	17	106	95–119	6.8	1.7			
M.3.	S	7	10	105	89–117	9.1	2.8	2	3.1	0.6
	N	7	12	103	94–109	4.8	1.4			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 24. BRONZE AGE.

Mean mesiodistal crown diameters of mandibular teeth of Bronze Age females; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1	S	2	4	53	48–57	–	–	–	–	–
	N	0	0	–	–	–	–			
I.2	S	4	6	61	53–66	6.1	2.5	1	–	–
	N	2	2	62	56–67	–	–			
C.	S	4	7	70	62–74	5.3	2.0	3	2.5	1.2
	N	3	6	67	63–73	3.9	1.6			
P.1.	S	4	7	69	65–73	2.7	1.0	1	–	–
	N	2	4	70	64–74	–	–			
P.2.	S	4	8	68	65–71	1.9	0.7	1	2.1	0.5
	N	3	5	69	64–75	4.4	2.0			
M.1.	S	4	8	112	109–115	2.5	0.9	5	–	–
	N	2	3	107	105–110	–	–			
M.2.	S	5	9	104	96–110	5.0	1.7	6	–	–
	N	2	3	98	93–101	–	–			
M.3.	S	3	5	106	101–109	3.2	1.5	3	–	–
	N	2	3	103	102–103	–	–			

x N.I. – Number of Individuals
x N.T. – Number of teeth

Table 25. BRONZE AGE.

Mean mesiodistal crown diameters of mandibular teeth of Bronze Age males and females; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	8	13	54	44–60	5.0	1.4	0	–	–
	N	5	7	54	47–58	4.5	1.7			
I.2.	S	13	19	60	49–66	5.3	1.2	2	1.6	1.3
	N	11	14	62	54–68	4.0	1.1			
C.	S	18	26	68	61–74	4.4	0.9	0	–	–
	N	15	25	68	62–75	3.6	0.7			
P.1.	S	19	29	69	62–79	3.7	0.7	0	–	–
	N	18	26	69	64–74	3.1	0.6			
P.2.	S	14	25	69	65–76	3.1	0.6	1	1.0	1.0
	N	18	29	70	64–79	4.1	0.8			
M.1.	S	19	31	110	94–124	6.7	1.2	1	1.6	0.6
	N	16	24	111	99–120	5.6	1.1			
M.2.	S	21	30	105	90–124	7.2	1.3	1	1.8	0.6
	N	16	25	106	93–119	6.6	1.3			
M.3.	S	12	18	106	89–117	7.1	1.7	2	2.0	1.0
	N	12	20	104	94–112	4.4	1.0			

x N.I. – Number of individuals
x N.T. – Number of teeth

From these tables it can be seen that there are no significant differences between the Southern and Northern groups of Scottish Bronze Age skulls in respect of the mesiodistal diameters, either of the maxillary or of the mandibular teeth. On the contrary, the critical ratios are in general so low as to indicate a considerable similarity between the groups. The only tooth in which a consistently large difference appears between Southern and Northern groups is the first maxillary incisor. On account of small numbers of observations, it was not possible to carry out a statistical comparison for this tooth in the male and female groups separately, and the difference between the mean values for the combined sex groups is not significant. It is possible that there is a real difference between Southern and Northern Bronze Age groups in respect of the maxillary first incisors: the significance of this difference being obscured by the small number of observations. It must be borne in mind, however, that measurements of the first incisor tend to be unreliable as a result of attrition, and the observed differences may be due solely to this cause.

As far as the mesiodistal diameters of both maxillary and mandibular teeth of Scottish Bronze Age skulls are concerned, it would seem that no racial distinction can be made between Southern/

Southern and Northern groups.

A comparison of mean mesiodistal diameters of the maxillary teeth of males and females of the Total Bronze Age group is made in Table 26, and a similar comparison for the mandibular teeth in Table 27.

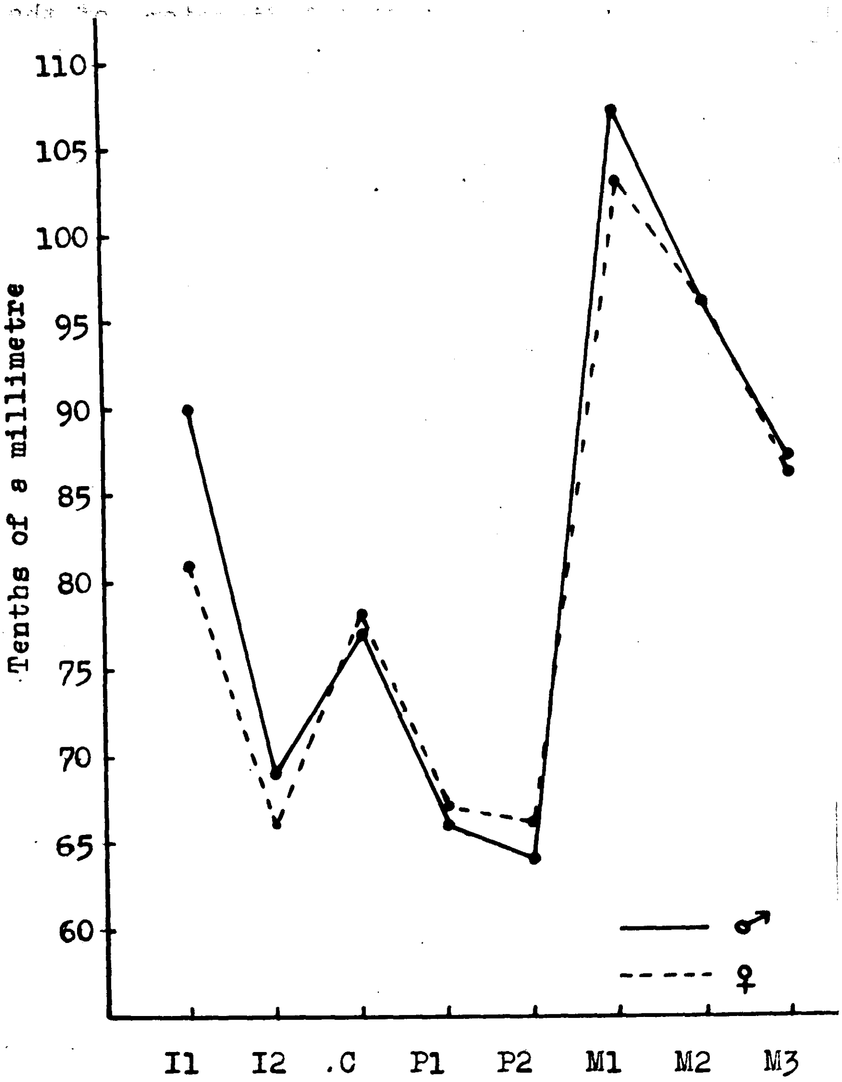


Fig. 29. The mean values of the mesiodistal diameters of the maxillary teeth in the Bronze Age group.

Table 26. BRONZE AGE.

Mean mesiodistal crown diameters of maxillary teeth of total Bronze Age group; comparison of males and females. (1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	5	7	90	80–97	6.1	2.3	9	3.3	2.7
	F	3	6	81	76–89	5.6	2.3			
I.2.	M	10	16	69	55–78	6.0	1.5	3	2.4	1.3
	F	5	8	66	60–74	5.3	1.9			
C.	M	15	24	77	68–86	4.8	1.0	1	1.4	0.7
	F	7	11	78	74–85	3.3	1.0			
P.1.	M	19	29	66	59–75	3.9	0.7	1	1.7	0.6
	F	7	11	67	61–76	5.2	1.6			
P.2.	M	19	31	64	55–72	4.6	0.8	2	1.4	1.4
	F	9	14	66	60–70	4.4	1.2			
M.1.	M	16	27	107	96–122	6.5	1.3	4	1.9	2.1
	F	8	12	103	97–114	4.8	1.4			
M.2.	M	18	29	96	84–106	5.4	1.0	0	–	–
	F	7	11	96	90–106	4.5	1.4			
M.3.	M	11	16	87	75–96	6.1	1.5	1	1.8	0.6
	F	5	7	86	82–89	2.7	1.0			

x N.I. – Number of individuals
x N.T. – Number of teeth

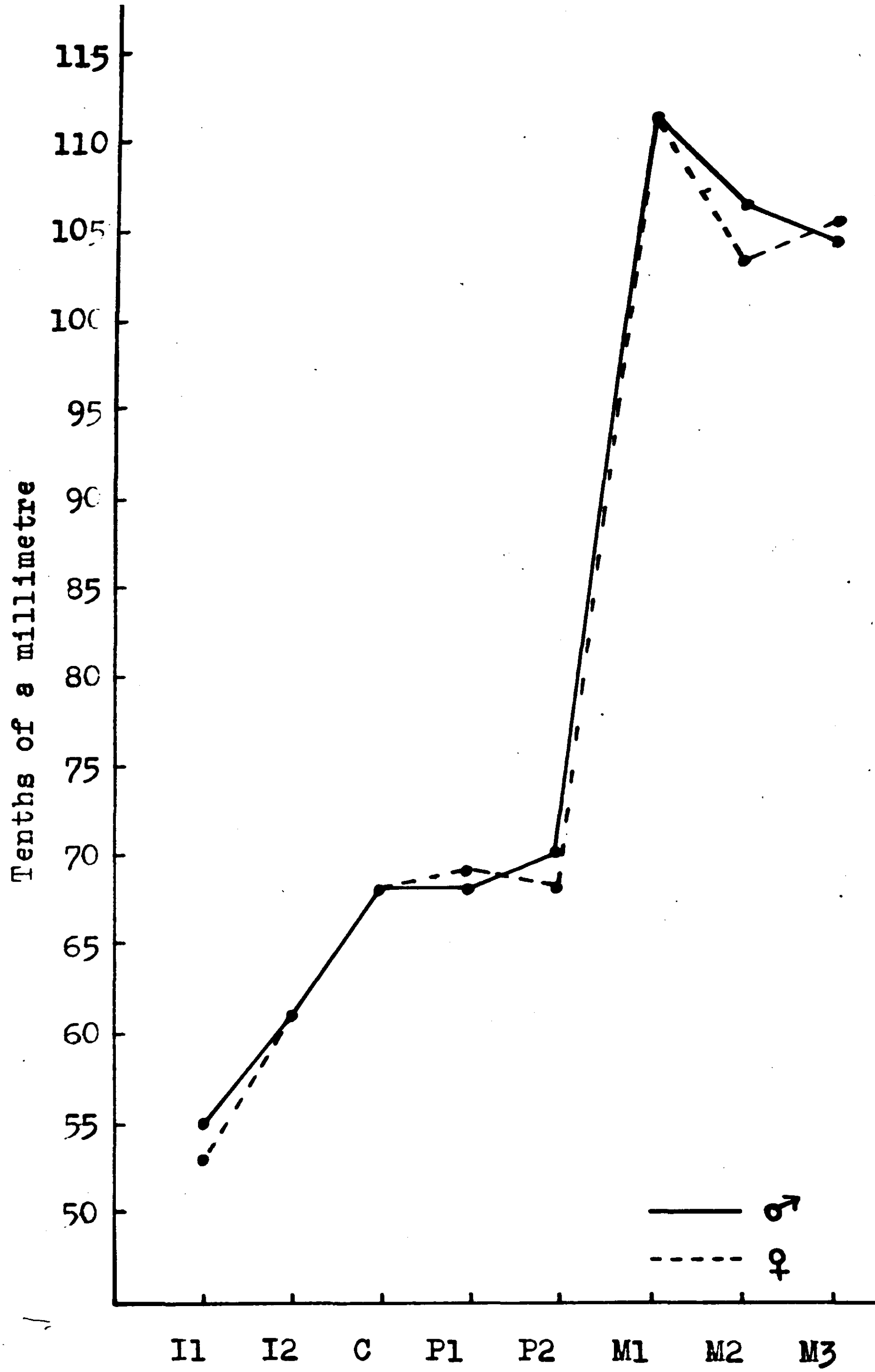


Fig. 30. The mean values of the mesiodistal diameters of the mandibular teeth in the Bronze Age group.

Table 27. BRONZE AGE.

Mean mesiodistal crown diameters of mandibular teeth of total Bronze Age group; comparison of males and females.(1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	7	12	55	47-60	4.5	1.3	2	-	-
	F	2	4	53	48-57	-	-			
I.2.	M	11	16	61	54-68	3.8	1.0	0	-	-
	F	6	8	61	53-67	6.0	2.1			
C.	M	17	25	68	61-75	3.7	0.7	0	-	-
	F	7	13	68	62-74	4.8	1.3			
P.1.	M	22	32	68	62-73	2.9	0.5	1	1.1	0.9
	F	6	11	69	64-74	3.4	1.0			
P.2.	M	17	29	70	65-76	3.3	0.6	2	1.0	2.0
	F	7	13	68	64-75	2.9	0.8			
M.1.	M	20	30	111	99-120	5.2	0.9	0	-	-
	F	6	11	111	105-115	3.4	1.0			
M.2.	M	20	30	106	90-119	7.1	1.3	3	2.0	1.5
	F	7	12	103	93-110	5.3	1.5			
M.3.	M	14	22	104	89-117	6.9	1.5	1	1.9	0.5
	F	5	8	105	101-109	3.0	1.1			

x N.I. - Number of individuals
x N.T. - Number of teeth

The differences between mean mesiodistal diameters of the teeth of Bronze Age males and the same diameters of the teeth of Bronze Age females are in general very small or non-existent. The only tooth in which sex difference in mesiodistal diameter can be shown to be statistically significant is the first maxillary incisor. For this tooth, the mesiodistal diameter is greater in Bronze Age males than in Bronze Age females. This result must be treated cautiously, since in the first place the critical ratio of the calculation (2.7) is very little above the level of significance (2.5), and in the second place the groups concerned each contain fewer than ten observations.

For all the remaining maxillary teeth and all the mandibular teeth there are no significant differences between male and female.

In contrast to the Neolithic group, the mean mesiodistal diameters of the teeth of the males are not always greater than those of the females. The teeth in which the mean mesiodistal diameters are greater in the female are the maxillary canines, first premolars and second premolars, and the mandibular first premolar and third molar. This result was unexpected, since teeth are usually smaller in the female (e.g. Moorrees, 1957).

It seems that with the amount of material available, no clear/

clear sex differentiation can be made between mean mesiodistal diameters of male and female Bronze Age teeth, except rather doubtfully for the maxillary first incisor.

Relative size of molars.

In the maxilla, both males and females show the same pattern of gradual decrease in mesiodistal diameter from first molar to third molar (Fig. 29).

The males also show a gradual decrease in mesiodistal diameter from the first molar to the third molar in the mandible. In the females, the first mandibular molar is still the largest of the three molars, but the third molar is greater in mesiodistal diameter than the second molar. Two factors combine to produce this sex difference: a greater reduction of the second molar in the female than in the male, and a slightly greater reduction of the third molar in the male than in the female. (Fig. 30).

Mean labiolingual diameters of the maxillary teeth of Southern and Northern Bronze Age groups are given in Tables 28-30, and mean labiolingual diameters of the mandibular teeth of the same groups in Tables 31-33.

Table 28. BRONZE AGE.

Mean labiolingual crown diameters of maxillary teeth of Bronze Age males; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	4	7	74	68–79	4.5	1.7	0	–	–
	N	4	4	74	70–77	–	–			
I.2.	S	5	7	62	55–70	4.9	1.9	1	2.5	0.4
	N	6	9	63	58–74	5.1	1.7			
C.	S	7	10	87	77–92	5.4	1.4	1	2.4	0.4
	N	9	14	86	71–99	7.0	1.9			
P.1.	S	8	12	91	83–98	5.2	1.5	1	2.0	0.5
	N	10	16	90	83–102	5.7	1.4			
P.2.	S	7	10	92	85–102	6.9	2.2	1	2.6	0.4
	N	9	16	91	84–102	5.4	1.4			
M.1.	S	4	6	122	117–128	4.8	2.0	4	2.7	1.5
	N	9	13	118	110–128	6.4	1.8			
M.2.	S	7	11	115	105–123	5.7	1.7	0	–	–
	N	9	16	115	107–122	5.6	1.4			
M.3.	S	5	7	103	95–130	12.2	4.7	3	5.6	0.5
	N	6	8	106	94–117	8.4	3.0			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 29. BRONZE AGE.

Mean labiolingual crown diameters of maxillary teeth of Bronze Age females; comparison of Southern and Northern groups.(1/10 m.m.)

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	2	4	74	72–76	–	–	4	–	–
	N	2	3	70	68–72	–	–			
I.2	S	4	6	66	60–69	3.2	1.3	1	–	–
	N	1	2	65	64–65	–	–			
C.	S	4	6	84	80–90	3.9	1.6	1	2.3	0.4
	N	3	5	83	79–87	3.6	1.6			
P.1.	S	4	7	91	87–96	3.5	1.4	4	2.1	1.9
	N	3	5	87	83–91	3.6	1.6			
P.2.	S	4	7	93	89–96	3.0	1.2	3	2.6	1.2
	N	3	5	90	83–94	5.1	2.3			
M.1.	S	5	8	116	112–122	3.8	1.4	2	–	–
	N	3	4	114	109–116	–	–			
M.2.	S	4	7	119	113–126	4.9	1.9	6	2.4	2.5
	N	3	5	113	109–116	3.1	1.4			
M.3.	S	2	4	111	109–112	–	–	6	–	–
	N	3	4	105	97–112	–	–			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 30. BRONZE AGE.

Mean labiolingual crown diameters of maxillary teeth of Bronze Age males and females; comparison of Southern and Northern groups.
(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	8	15	73	67-79	4.0	1.0	1	1.3	0.8
	N	8	10	72	68-77	2.8	0.9			
I.2.	S	12	18	63	55-70	4.0	1.0	1	1.5	0.7
	N	9	14	64	58-74	4.1	1.1			
C.	S	16	24	84	71-92	5.7	1.2	1	1.7	0.6
	N	14	23	85	71-99	5.9	1.2			
P.1.	S	16	25	90	83-98	4.3	0.9	0	-	-
	N	15	25	90	83-102	5.4	1.1			
P.2.	S	16	24	92	83-102	5.2	1.1	0	-	-
	N	14	24	92	83-102	5.1	1.0			
M.1.	S	17	27	116	104-125	6.4	1.2	1	1.8	0.6
	N	13	19	117	109-128	5.7	1.3			
M.2.	S	18	28	115	102-126	6.3	1.2	0	-	-
	N	14	25	115	107-122	4.7	0.9			
M.3.	S	9	14	105	95-130	9.3	2.5	1	3.3	0.3
	N	10	13	106	94-117	7.6	2.1			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 31. BRONZE AGE.

Mean labiolingual crown diameter of mandibular teeth of Bronze Age males; comparison of Southern and Northern groups.(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	5	9	59	57-62	1.7	0.6	1	1.8	0.6
	N	4	7	60	53-64	4.5	1.7			
I.2	S	5	8	62	61-66	2.1	0.8	4	1.5	2.7
	N	6	9	66	58-70	3.9	1.3			
C.	S	8	12	77	64-88	5.9	1.7	0	-	-
	N	9	13	77	68-88	6.0	1.7			
P.1.	S	10	15	76	69-82	4.8	1.2	3	1.4	2.1
	N	10	14	79	75-85	3.0	0.8			
P.2.	S	7	12	82	77-89	3.7	1.1	2	1.4	1.4
	N	10	15	84	77-90	3.6	0.9			
M.1.	S	8	12	106	94-114	7.1	2.0	1	2.2	0.5
	N	8	12	107	100-113	3.5	1.0			
M.2.	S	9	12	101	83-112	9.8	2.8	2	3.0	0.7
	N	9	13	103	95-110	4.1	1.1			
M.3.	S	7	10	103	87-110	7.6	2.4	2	3.1	0.6
	N	7	11	101	90-109	6.4	1.9			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 32. BRONZE AGE.

Mean labiolingual crown diameter of mandibular teeth of Bronze Age females; comparison of Southern and Northern groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	2	4	61	60-62	-	-	-	-	-
	N	0	0	-	-	-	-			
I.2	S	4	6	64	64-65	0.6	0.3	3	-	-
	N	2	2	61	60-62	-	-			
C.	S	4	7	78	75-80	1.8	0.7	1	2.1	0.5
	N	3	5	77	73-82	4.3	2.0			
P.1.	S	4	7	76	73-80	2.9	1.1	0	-	-
	N	2	4	76	73-79	-	-			
P.2.	S	4	8	82	78-85	2.3	0.8	1	-	-
	N	3	4	81	76-86	-	-			
M.1.	S	4	7	108	105-111	2.6	1.0	0	-	-
	N	1	2	108	-	-	-			
M.2.	S	5	9	104	98-106	2.5	0.8	1	-	-
	N	1	2	105	-	-	-			
M.3.	S	3	5	101	99-103	1.7	0.8	2	-	-
	N	3	4	103	95-106	-	-			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 33. BRONZE AGE.

Mean labiolingual crown diameters of mandibular teeth of Bronze Age males and females; comparison of Southern and Northern groups.
(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	10	16	59	52-62	2.9	0.7	1	1.4	0.7
	N	6	10	60	53-64	3.7	1.2			
I.2.	S	15	22	63	56-70	3.0	0.6	2	1.2	1.7
	N	10	14	65	58-70	3.6	1.0			
C.	S	18	27	77	64-89	5.1	1.0	0	-	-
	N	15	23	77	68-88	5.0	1.0			
P.1.	S	19	28	77	69-85	4.2	0.8	1	1.1	0.9
	N	16	24	78	72-85	3.2	0.7			
P.2.	S	15	25	82	76-89	3.4	0.7	2	1.0	2.0
	N	17	26	84	76-90	3.7	0.7			
M.1.	S	18	29	105	94-114	5.5	1.0	3	1.2	<u>2.5</u>
	N	11	18	108	100-113	2.9	0.7			
M.2.	S	20	28	102	83-112	7.0	1.3	2	1.6	1.3
	N	13	18	104	95-110	3.7	0.9			
M.3.	S	11	17	102	87-110	6.2	1.5	1	1.9	0.5
	N	13	20	101	90-109	5.3	1.2			

x N.I. - Number of individuals
x N.T. - Number of teeth

Only three comparisons in these tables show critical ratios which are above the level of significance. These are for the maxillary second molars of the females, the mandibular second incisors of the males and the mandibular first molars of the combined sex group. The former two results are of dubious value, since all the groups concerned contain fewer than ten observations. The result for the mandibular first molars of the combined sex group carries more weight, since there are 29 observations in the Southern group and in the Northern. The critical ratio for this comparison is, however, 2.5 whichis on the very borderline of significance, and thus does not provide an entirely satisfactory result.

Otherwise, the differences between the groups are very small, particularly for the mean diameters of maxillary teeth in the combined sex group. As far as the labiolingual diameters of the teeth are concerned, it again appears that the Scottish Bronze Age skulls form a relatively homogeneous group.

A comparison of mean labiolingual diameters of the maxillary teeth of males and females of the Total Bronze Age group is made in Table 34, and the corresponding comparison for the mandibular teeth in Table 35.

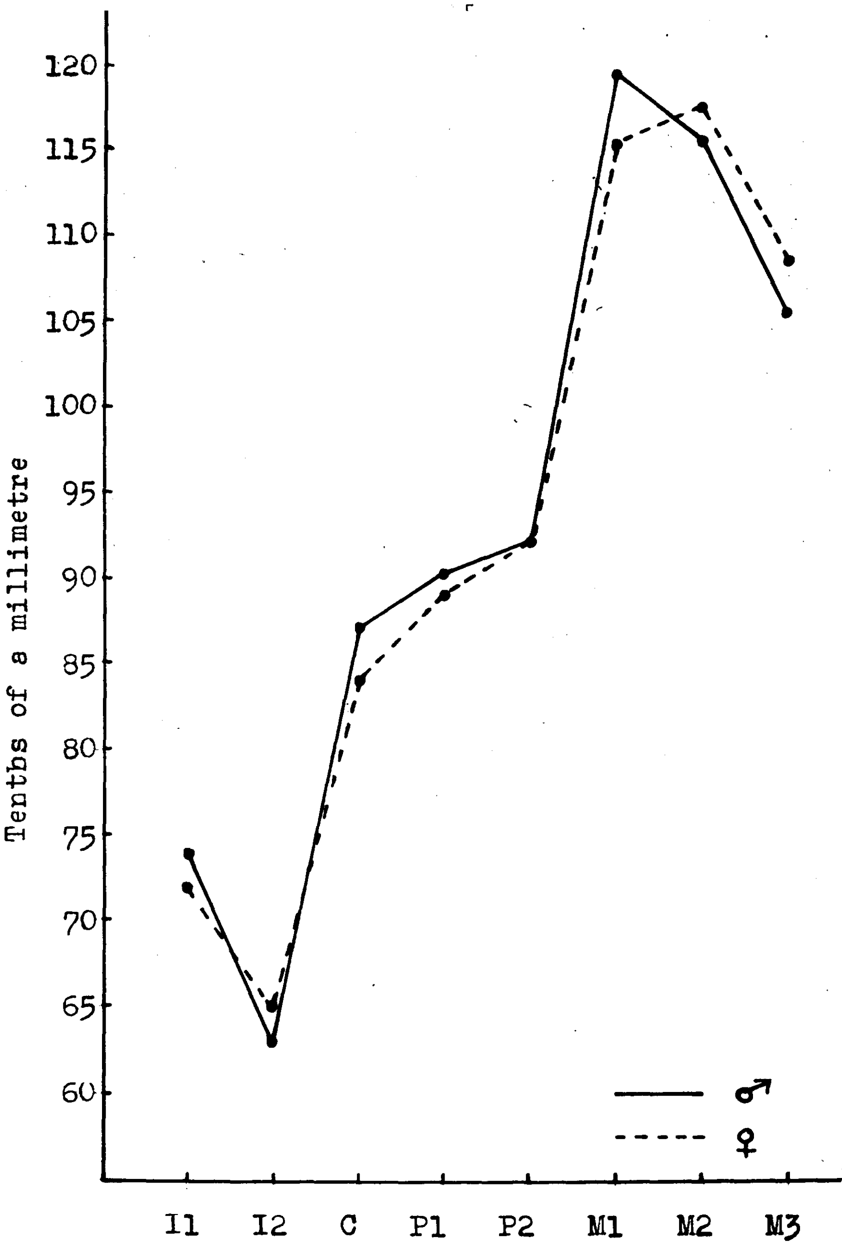


Fig. 31. The mean values of the labiolingual diameters of the maxillary teeth in the Bronze Age group.

Table 34. BRONZE AGE.

Mean labiolingual crown diameters of maxillary teeth of total **Bronze Age** group; comparison of males and females.(1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	8	11	74	68–79	4.0	1.2	2	1.7	1.2
	F	4	7	72	68–76	3.0	1.2			
I.2.	M	11	16	63	55–74	4.9	1.2	2	1.6	1.3
	F	5	8	65	60–69	2.7	1.0			
C.	M	16	24	87	71–99	6.2	1.3	3	1.7	1.8
	F	7	11	84	79–90	3.7	1.1			
P.1.	M	18	28	90	83–102	5.4	1.0	1	1.5	0.7
	F	7	12	89	83–96	3.8	1.1			
P.2.	M	16	26	92	84–102	5.9	1.2	0	–	–
	F	7	12	92	83–96	4.1	1.2			
M.1.	M	13	19	119	110–128	6.2	1.4	4	1.8	2.2
	F	8	12	115	109–122	3.7	1.1			
M.2.	M	16	27	115	105–123	5.5	1.1	2	1.9	1.1
	F	7	12	117	109–126	5.3	1.5			
M.3.	M	11	15	105	94–130	10.1	2.6	3	3.4	0.9
	F	5	8	108	97–112	6.1	2.2			

x N.I. – Number of individuals
x N.T. – Number of teeth

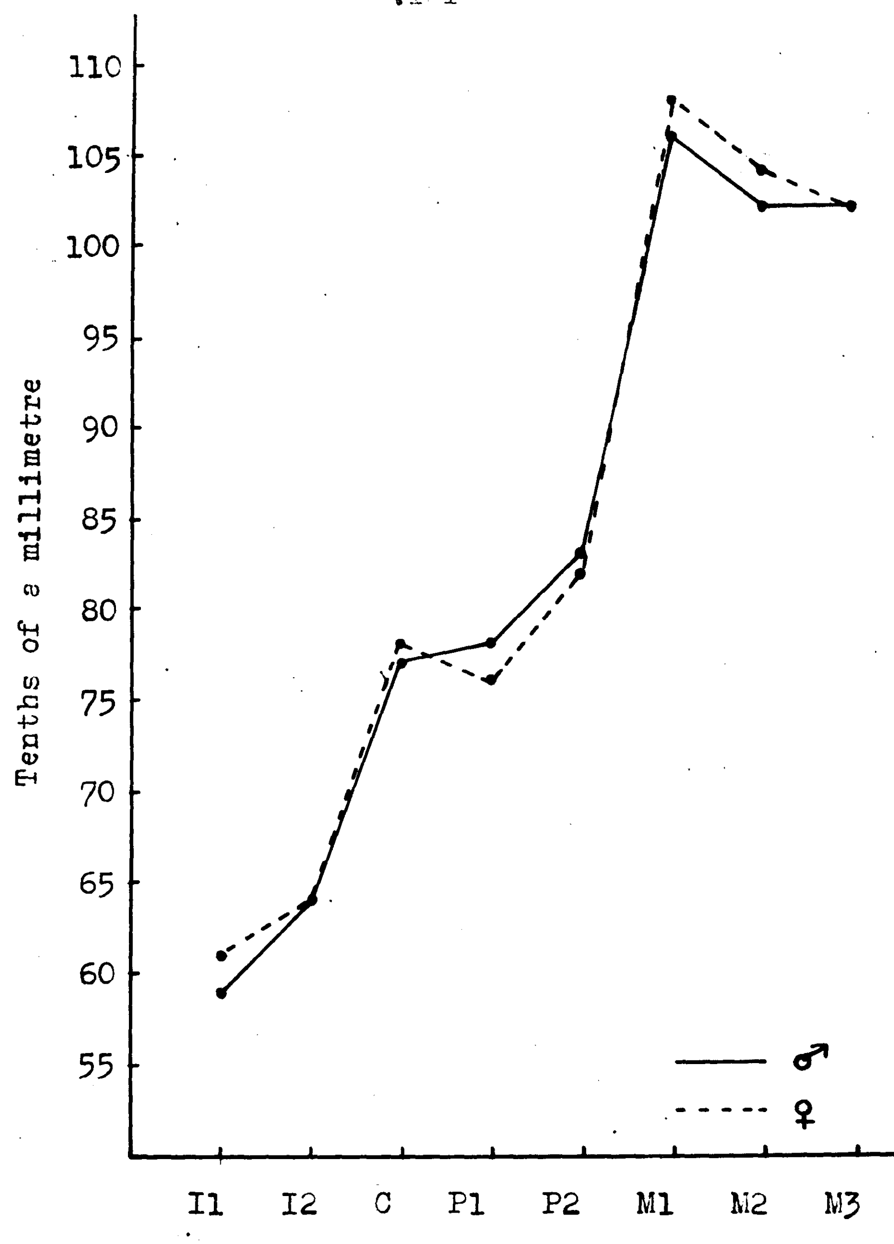


Fig. 32. The mean values of the labiolingual diameters of the mandibular teeth in the Bronze Age group.

Table 35. BRONZE AGE.

Mean labiolingual crown diameters of mandibular teeth of total Bronze Age group; comparison of males and females. (1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	9	16	59	53-64	3.1	0.8	2	-	-
	F	2	4	61	60-62	-	-			
I.2.	M	11	17	64	58-70	3.5	0.9	0	-	-
	F	6	8	64	60-65	1.8	0.6			
C.	M	17	25	77	64-88	5.8	1.2	1	1.4	0.7
	F	7	12	78	73-82	2.9	0.8			
P.1.	M	20	29	78	69-85	3.9	0.7	2	1.1	1.8
	F	6	11	76	73-80	2.7	0.8			
P.2.	M	17	27	83	77-90	3.7	0.7	1	1.1	0.9
	F	7	12	82	76-86	3.0	0.9			
M.1.	M	16	24	106	94-114	5.5	1.1	2	1.4	1.4
	F	5	9	108	105-111	2.3	0.8			
M.2.	M	18	25	102	83-112	7.3	1.5	2	1.7	1.2
	F	6	11	104	98-106	2.3	0.7			
M.3.	M	14	21	102	87-110	6.9	1.5	0	-	-
	F	6	9	102	95-106	3.5	1.2			

x N.I. - Number of individuals
x N.T. - Number of teeth

None of the differences in mean labiolingual diameter between the teeth of males and of females reached the level of significance, either in the maxilla or in the mandible.

As in the case of the mesiodistal diameters, the mean labiolingual diameters in the males are not always greater than those in the females. This crown dimension is larger in Bronze Age females for the maxillary second incisor, second molar and third molar and for the mandibular first incisor, canine, first molar and second molar. No correlation is evident between those teeth which are larger in the female in the mesiodistal diameter and those teeth which are larger in the female in the labiolingual diameter.

There is no demonstrable sex differentiation in the mean labiolingual diameters of Bronze Age teeth.

Mean crown indices of the maxillary teeth of Southern and Northern Bronze Age groups are compared in Tables 36-38, and mean crown indices of the mandibular teeth of the same groups in Tables 39-41.

Table 36 **BRONZE AGE.**

Mean crown indices of maxillary teeth of Bronze Age Males; comparison of Southern and Northern groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	1	2	79.3	77.3-81.3	-	-	4.4	-	-
	N	4	4	83.7	79.8-87.5	-	-			
I.2.	S	4	5	93.2	90.3-97.2	2.6	1.2	2.1	3.8	0.6
	N	6	9	91.1	78.4-108.8	10.7	3.6			
C.	S	6	9	114.0	106.1-135.3	9.0	3.0	2.5	3.8	0.7
	N	9	14	111.5	97.3-128.6	8.4	2.3			
P.1.	S	8	12	139.5	129.7-150.8	7.1	2.0	4.0	2.9	1.4
	N	9	15	135.5	122.7-156.3	8.2	2.1			
P.2.	S	7	10	143.9	131.4-156.3	10.5	3.3	1.5	3.7	0.4
	N	9	16	142.4	127.9-155.4	6.7	1.7			

M.1./

Table 36. (Continued).

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	S	4	6	112.7	106.9–119.6	4.6	1.9	0.3	2.1	0.1
	N	8	12	112.4	107.8–117.7	3.1	0.9			
M.2.	S	7	11	119.9	110.0–139.8	9.0	2.7	0.7	2.8	0.3
	N	9	15	119.2	114.0–124.4	3.0	0.8			
M.3.	S	5	7	120.5	109.5–149.4	13.5	5.2	1.2	5.5	0.2
	N	6	8	121.7	114.1–130.0	4.7	1.7			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 37. **BRONZE AGE.**

Mean crown indices of maxillary teeth of Bronze Age females; comparison of Southern and Northern groups.

Tooth	Gp.	N.I.ˣ	N.T.ˣ	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	2	4	96.5	92.3-100.0	-	-	15.3	-	-
	N	1	2	81.2	80.9-81.4	-	-			
I.2.	S	4	6	99.3	81.1-111.7	11.6	4.8	2.3	-	-
	N	1	1	(97.0)	-	-	-			
C.	S	4	6	109.0	103.9-118.4	6.6	2.8	3.7	3.0	1.2
	N	3	5	105.3	102.6-107.9	2.1	1.0			
P.1.	S	4	7	136.7	123.6-146.2	9.3	3.6	6.1	-	-
	N	3	4	130.6	118.4-139.7	-	-			
P.2.	S	4	7	142.2	137.1-149.2	4.5	1.7	6.0	3.7	1.6
	N	3	5	136.2	125.8-143.3	7.3	3.3			

M.1./

Bracket indicates results which are not true mean values since only one calculation could be made.

Table 37. (Continued).

Tooth	Gp.	N.I. [x]	N.T. [x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	S	5	8	112.7	105.3–116.5	3.5	1.3	0.3	-	-
	N	3	4	112.4	109.0–116.0	-	-			
M.2.	S	4	7	126.2	119.8–129.0	3.3	1.3	7.6	-	-
	N	2	3	118.6	115.5–120.8	-	-			
M.3.	S	2	4	128.1	124.7–131.8	-	-	5.5	-	-
	N	3	4	122.6	114.1–136.6	-	-			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 38. **BRONZE AGE**

Mean crown indices of maxillary teeth of Bronze Age males and females; comparison of Southern and Northern groups.

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	5	10	87.6	77.3-100.0	8.1	2.5	7.2	3.0	2.4
	N	7	9	80.4	72.0-87.5	5.2	1.7			
I.2.	S	11	16	95.8	81.1-111.7	8.4	2.1	5.1	3.3	1.5
	N	9	13	90.7	78.4-108.8	9.2	2.6			
C.	S	15	23	109.9	85.5-135.3	9.6	2.0	0.2	2.7	0.1
	N	14	23	109.7	97.3-128.6	8.6	1.8			
P.1.	S	15	23	137.5	123.6-150.8	7.5	1.6	2.6	2.3	1.1
	N	14	23	134.9	118.4-156.3	8.2	1.7			
P.2.	S	16	23	140.2	120.8-156.3	9.4	2.0	0.5	2.4	0.2
	N	14	24	140.7	125.8-155.4	7.1	1.4			

M.1./

Table 38. (Continued).

Tooth	Gp.	N.I.	N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	S	17	27	113.1	105.3-119.6	3.7	0.7	1.3	1.1	1.2
	N	12	18	111.8	106.5-117.7	3.3	0.8			
M.2.	S	18	28	120.4	110.0-139.8	7.5	1.4	2.7	1.7	1.6
	N	13	21	117.7	107.5-124.4	4.5	1.0			
M.3.	S	9	14	122.2	109.5-149.4	10.4	2.8	0.5	3.4	0.1
	N	10	13	122.7	114.1-136.6	6.7	1.9			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 39. BRONZE AGE.

Mean crown indices of mandibular teeth of Bronze Age males; comparison of Southern and Northern groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	3	6	106.9	95.0-118.0	9.3	3.9	3.0	8.3	0.4
	N	4	6	109.9	91.4-136.2	17.6	7.3			
I.2.	S	3	5	102.8	93.8-114.0	9.3	4.2	4.3	4.7	0.9
	N	6	9	107.1	98.4-117.2	6.1	2.0			
C.	S	8	11	114.0	102.7-120.6	6.2	1.9	1.0	2.5	0.4
	N	9	13	113.0	103.0-125.7	6.0	1.7			
P.1.	S	10	15	113.4	104.5-124.2	6.0	1.5	1.0	2.1	0.5
	N	10	14	114.4	105.6-123.4	5.4	1.5			
P.2.	S	6	11	117.7	109.3-130.9	5.3	1.6	1.5	2.3	0.7
	N	10	15	119.2	110.7-127.7	6.1	1.6			

M.1./

Table 39. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	S	8	11	93.9	84.7-101.9	6.5	2.0	3.4	2.3	1.5
	N	8	11	97.3	93.8-103.8	4.0	1.2			
M.2.	S	9	12	96.6	85.0-104.0	6.2	1.8	1.9	2.6	0.7
	N	8	11	98.5	88.8-106.3	6.3	1.9			
M.3.	S	7	10	98.6	90.6-114.6	7.1	2.2	1.1	2.6	0.4
	N	6	10	97.5	92.7-105.9	4.0	1.3			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 40. **BRONZE AGE.**

Mean crown indices of mandibular teeth of Bronze Age females; comparison of Southern and Northern groups.

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	2	4	115.7	107.1-125.0	-	-	-	-	-
	N	0	0	-	-	-	-			
I.2.	S	4	6	106.1	97.0-122.6	11.5	4.8	6.3	-	-
	N	2	2	99.8	92.5-107.1	-	-			
C.	S	4	7	112.6	105.4-122.2	7.4	2.8	3.0	-	-
	N	3	4	115.6	112.3-119.0	-	-			
P.1.	S	4	6	112.7	101.4-121.5	7.5	3.1	3.4	-	-
	N	2	4	109.3	104.1-117.2	-	-			
P.2.	S	4	8	122.0	109.9-127.7	6.0	2.1	1.8	-	-
	N	3	4	120.2	114.3-124.6	-	-			

M.1./

Table 40. (Continued).

Tooth	Gp.	N.I. [x]	N.T. [x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	S	4	7	95.6	91.3-98.2	2.7	1.0	6.8	-	-
	N	1	2	102.4	101.9-102.9	-	-			
M.2.	S	4	8	101.1	95.4-110.4	5.9	2.1	2.9	-	-
	N	1	2	104.0	-	-	-			
M.3.	S	3	5	95.1	92.5-99.0	2.4	1.1	7.8	-	-
	N	2	3	102.9	-	-	-			

x N.I. - Number of individuals.
x N.T. - Number of teeth

Table 41. BRONZE AGE.

Mean crown indices of mandibular teeth of Bronze Age males and females; comparison of Southern and Northern groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	S	8	14	109.4	93.1-125.0	9.6	2.6	1.2	6.7	0.2
	N	5	7	110.6	91.4-136.2	16.2	6.2			
I.2.	S	13	18	105.3	93.8-122.6	9.1	2.2	0.3	3.0	0.1
	N	9	12	105.0	92.5-117.2	7.2	2.1			
C.	S	18	26	113.8	102.7-127.1	6.3	1.2	1.9	1.8	1.1
	N	15	22	111.9	95.9-125.7	6.5	1.4			
P.1.	S	19	27	111.9	98.7-124.2	6.5	1.3	1.5	1.7	0.9
	N	16	23	113.4	104.1-123.4	5.1	1.1			
P.2.	S	14	24	118.3	109.3-130.9	6.4	1.3	0.7	1.8	0.4
	N	17	26	119.0	107.6-127.7	6.3	1.2			

M.1./

Table 41. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	S	18	28	95.9	84.7-105.2	5.5	1.0	1.4	1.5	0.9
	N	11	16	97.3	91.5-103.8	4.2	1.1			
M.2.	S	19	27	97.6	85.0-110.4	6.0	1.2	1.3	1.8	0.7
	N	12	16	98.9	88.8-106.3	5.6	1.4			
M.3.	S	11	17	96.7	88.2-114.6	6.1	1.5	1.5	1.8	0.8
	N	11	17	98.2	92.0-105.9	4.1	1.0			

x N.I. - Number of individuals
x N.T. - Number of teeth

There are no significant differences between Southern and Northern Bronze Age skulls in respect of the mean crown indices of the maxillary and mandibular teeth. The critical ratio for the crown index of the maxillary first incisor in the combined sex group is, however, only just below the level of significance. Apart from this, the critical ratio is uniformly low, In the mandible, none of the critical ratios even approaches the level of significance.

No difference can thus be detected in the crown indices between Southern and Northern Bronze Age groups.

A comparison of mean crown indices of the maxillary teeth of males and females of the Total Bronze Age group is made in Table 42, and a similar comparison of the mandibular crown indices in Table 43.

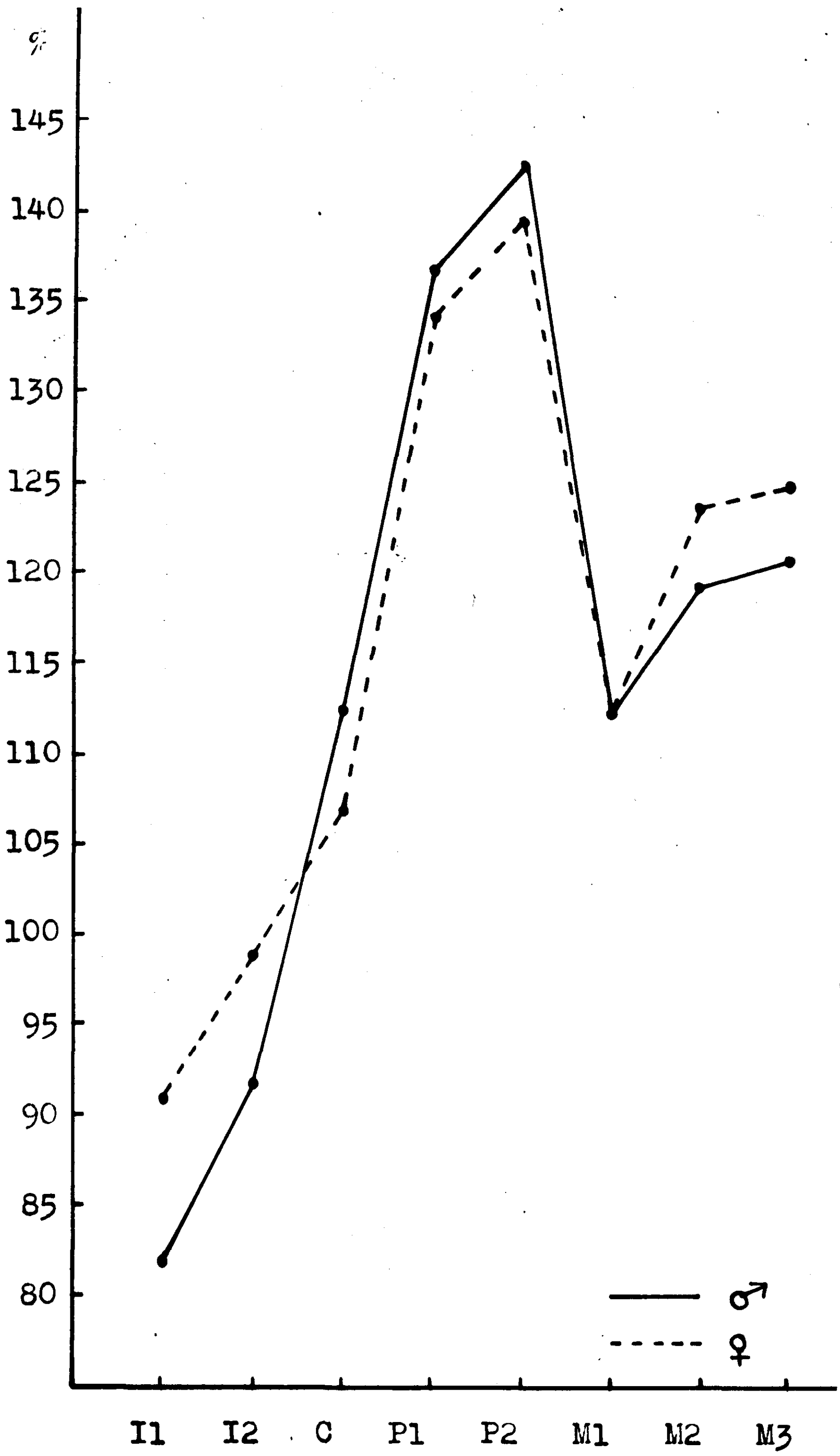


Fig. 33. The mean values of the crown indices of the maxillary teeth in the Bronze Age group.

Table 42. BRONZE AGE.

Mean crown indices of maxillary teeth of total Bronze Age group; comparison of males and females.

Tooth	Sex	N.I. [x]	N.T. [x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	5	6	82.2	77.3-87.5	3.8	1.6	9.2	3.8	2.4
	F	3	6	91.4	80.9-100.0	8.4	3.5			
I.2.	M	10	14	91.9	78.4-108.8	8.6	2.3	7.1	4.7	1.5
	F	5	7	99.0	81.1-111.7	10.7	4.1			
C.	M	15	23	112.5	97.3-135.3	8.5	1.8	5.2	2.4	2.2
	F	7	11	107.3	102.6-118.4	5.2	1.6			
P.1.	M	17	27	137.3	122.7-156.3	7.8	1.5	2.8	3.3	0.8
	F	7	11	134.5	118.4-146.2	9.6	2.9			
P.2.	M	16	26	143.0	127.9-156.3	8.2	1.6	3.3	2.4	1.4
	F	7	12	139.7	125.8-149.2	6.3	1.8			

M.1./

Table 42. (Continued).

Tooth	Sex	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	M	12	18	112.5	106.9-119.6	3.5	0.8	0.1	1.2	0.1
	F	8	12	112.6	105.3-116.5	3.2	0.9			
M.2.	M	16	26	119.5	110.0-139.8	6.1	1.2	4.4	1.9	2.3
	F	6	10	123.9	115.5-129.0	4.7	1.5			
M.3.	M	11	15	121.2	109.5-149.4	9.5	2.5	4.1	3.7	1.1
	F	5	8	125.3	114.1-136.6	7.6	2.7			

x N.I. – Number of individuals
x N.T. – Number of teeth

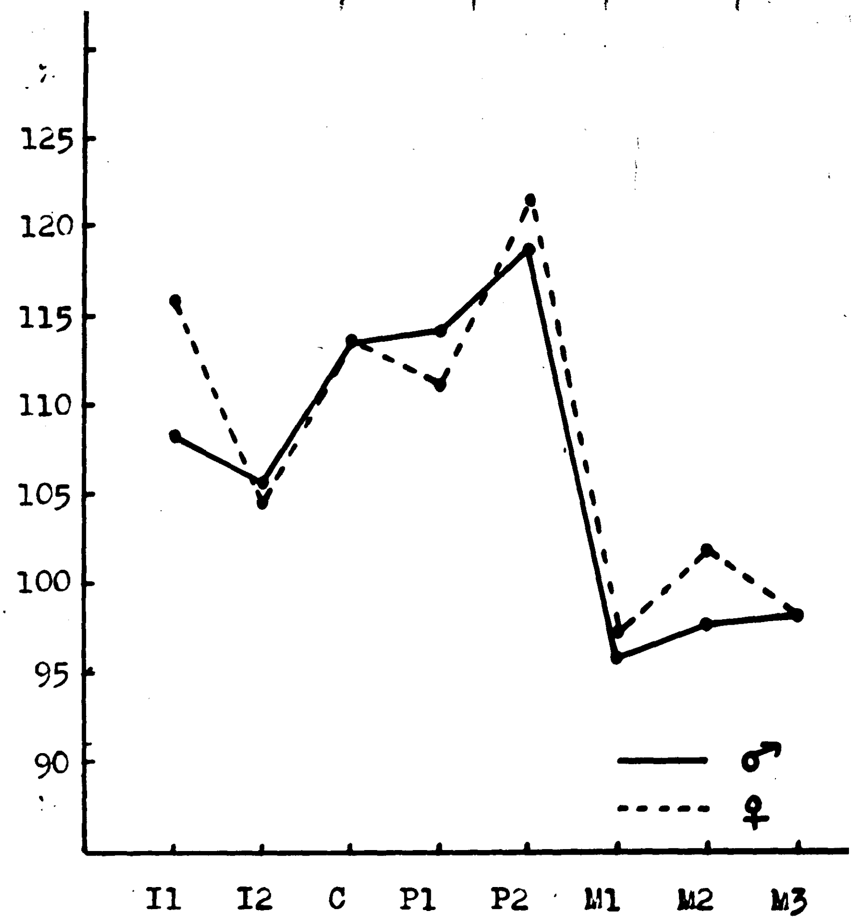


Fig. 34. The Mean values of the crown indices of the mandibular teeth in the Bronze Age group.

Table 43. BRONZE AGE.

Mean crown indices of mandibular teeth of total Bronze Age group; comparison of males and females.

Tooth	Sex	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	7	12	108.4	91.4-136.2	13.5	3.9	7.3	-	-
	F	2	4	115.7	107.1-125.0	-	-			
I.2.	M	9	14	105.5	93.8-117.2	7.4	2.0	0.9	4.4	0.2
	F	6	8	104.6	92.5-122.6	10.9	3.9			
C.	M	17	24	113.5	102.7-125.7	6.0	1.2	0.2	2.2	0.1
	F	7	11	113.7	105.4-122.2	6.2	1.9			
P.1.	M	20	29	113.9	104.5-124.2	5.6	1.0	2.6	2.3	1.1
	F	6	10	111.3	101.4-121.5	6.7	2.1			
P.2.	M	16	26	118.6	109.3-130.9	6.3	1.2	2.8	1.9	1.5
	F	7	12	121.4	109.9-127.7	5.4	1.5			

M.1./

Table 43. (Continued).

Tooth	Sex	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	M	16	22	95.6	84.7-103.8	5.5	1.2	1.5	1.8	0.8
	F	5	9	97.1	91.3-102.9	3.8	1.3			
M.2.	M	17	23	97.5	85.0-106.3	6.2	1.3	4.2	2.1	2.0
	F	5	10	101.7	95.4-110.4	5.3	1.7			
M.3.	M	13	20	98.0	90.6-114.6	5.6	1.2	0	-	-
	F	5	8	98.0	92.5-102.9	4.4	1.6			

x N.I. - Number of individuals
x N.T. - Number of teeth

There are no significant differences between male and female crown indices. The critical ratio for the crown index of the maxillary first incisor is just below the level of significance. The index in this tooth is larger in the females than in the males, a result which might be expected since the male maxillary first incisor is significantly larger in the mesiodistal diameter than the female tooth, while there is little sex difference in the labiolingual diameter of this tooth. The fact that the crown index of the first maxillary incisor is higher in the females than in the males indicates that in the latter this tooth is proportionately greater in the mesiodistal diameter than it is in the females.

The Bronze Age crown indices thus give little or no indication of any sex difference in crown proportion, except perhaps in the case of the maxillary first incisor.

Conclusions.

The information gained from odontometry about the dentition of the Bronze Age population of Scotland may be summarised as follows:-

1. There seems to be virtually no difference between the Southern and Northern subgroups, and this agrees well with the current practice of regarding the Bronze Age population of Scotland as homogeneous.

No significant differences exist between Southern and Northern groups for the mesiodistal diameter of either maxillary or mandibular teeth, and this is true also for the crown index. For labiolingual diameter, three teeth show differences which are just on the borderline of significance, but two of these calculations involve small numbers of observations.

2. There appears also to be little difference in tooth size or shape between the sexes, except in the maxillary first incisor. In the mesiodistal diameter this tooth is both actually and proportionally greater in the male than in the female. The comparison between males and females in respect of the mesiodistal diameter of this tooth provides the only statistically significant sex difference in the Bronze Age group.

A fact that should be noted is that, contrary to expectation, the/

the mean mesiodistal and labiolingual tooth diameters in the female are sometimes equal to, or greater than, those in the male, though in the latter case the difference is always small and never approaches the level of significance. Whether these results are due solely to shortage of material and unreliability of measurements due to attrition, or whether they represent the true state of affairs, is impossible to determine. Further light might be thrown on the problem by a study of Bronze Age skulls in England, or in the Continental homeland of the Beaker people, the Rhine valley.

ODONTOMETRY RESULTS. IRON AGE GROUP.

From the Iron Age material, those skulls which could be classified as Viking were separated. The remainder were then designated as the Long Cist group since most of them were derived from this type of grave. No distinction was made within the Long Cist group between those graves which formed part of large cemeteries, e.g. the Lasswade skulls, and the isolated examples; nor was any geographical subdivision attempted. It is possible that some of the skulls from the North of Scotland which have been included in the Long Cist category are really those of Vikings, but in the absence of grave goods differentiation is impossible. There is however evidence that the Saverough skull from Orkney (a strong Norse area) should be included with the Long Cist and not the Viking group - i.e. that it was associated with pottery of broch type, and thus appears to belong to the pre-Viking Iron Age period(R.C.A.M. Inventory, Orkney, 1946).

Only one of the other skulls from long cist ~~s~~ was associated with datable grave goods. This was the Burnmouth skull with which were buried two bronze spoons of Early Iron Age type (Craw, 1924). None of the other long cists contained grave goods of/

of any kind. Skulls from Torwoodlee and Rennibister have been included in the Long Cist group, as they appear to belong to the same period, although they were not found in long cists. The female from Torwoodlee Broch had been buried in the broch ditch, in the tumbled infilling which resulted from the slighting of the broch by the Romans. Piggott (1953) believes that the destruction of the broch can be dated fairly closely to the early second century A.D., and the skull, which Wells (in Piggott, 1953) describes as typically Romano-British, belongs therefore to the earlier part of the Iron Age. The skulls from Rennibister, Orkney were found on the floor of the earth house of that name, and Bryce (1927) assigns them to the pre-Viking Iron Age population.

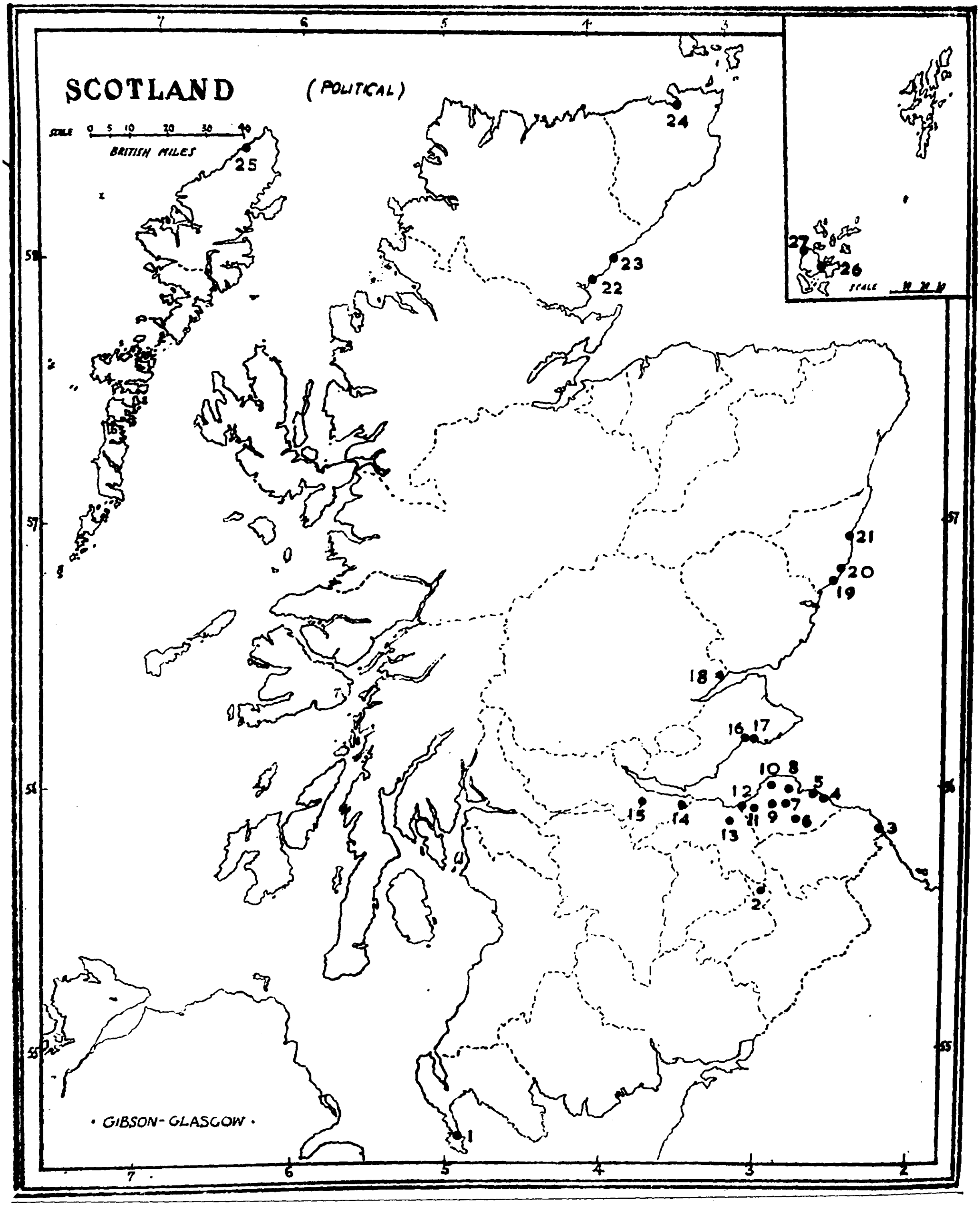
Some explanation is also necessary of the inclusion of the Ackergill and Keiss skulls in the Viking group. A bronze chain of Viking type (used to link two of the characteristic tortoise brooches) was found in one of the Ackergill graves, and this is sufficient to assign the whole group to <u>circa</u> 10th century Viking period (Edwards, 1926 & 1927). The graves at Ackergill were also of a distinctive type, being surrounded by a low cairn of stones with an outer kerb. Edwards (1926) noticed that the graves at Keiss, described by Laing & Huxley (1866)

(1866) and assigned by them to an early stone period, were exactly similar in plan to those at Ackergill, and on this ground he suggested that the Keiss burials should be regarded as those of Vikings. Following this line of argument, the Keiss skulls have here been included with the Ackergill series in the Viking group.

The Long Cist group consists of material from the following sites:-

Site	No. indivs.	References.
1. Terally, Wigtownshire	3	Livens, 1958
2. Torwoodlee, Galashiels	1	Piggott, 1953
3. Burnmouth, Berwick	1	Craw, 1924
4. Winterfield, Dunbar	1	Turner, 1915 Wells, 1959
5. Kirkhill, Dunbar	2	Calder & Feachem, 1953 Wells, 1959
6. Nunraw, Garvald	1	Abercromby & Pirrie, 1906. Wells, 1959
7. East Fortune, E. Lothian	2	

Site	No. indivs.	References.
8. Stonelaws, E. Lothian	1	Wells, 1959
9. Camptown, Drem	3	Wells, 1959
10. Craig's Quarry, Dirleton	2	Wells, 1959
11. Longniddry, E. Lothian	2	Stevenson, 1954 Wells, 1959
12. Cockenzie, E. Lothian	1	Turner, 1915 Wells, 1959
13. Lasswade, Midlothian	8	Henshall, 1958 Wells, 1959
14. Kirkliston, W. Lothian	1	Simpson, 1861 Turner, 1915.
15. Linlithgow Brige, W. Lothian	1	Disc. & Ex. p. 37. 1957
16. Lundin Links, Fife	6	Turner, 1915
17. Largo, Fife	1	Turner, 1915
18. Kingoodie, Longforgan, Perthshire	1	Disc. & Ex. p.30 1958
19. Johnshaven, Kincardine	1	
20. Inverbervie, Kincardine	1	
21. Stonehaven, Kincardine	2	

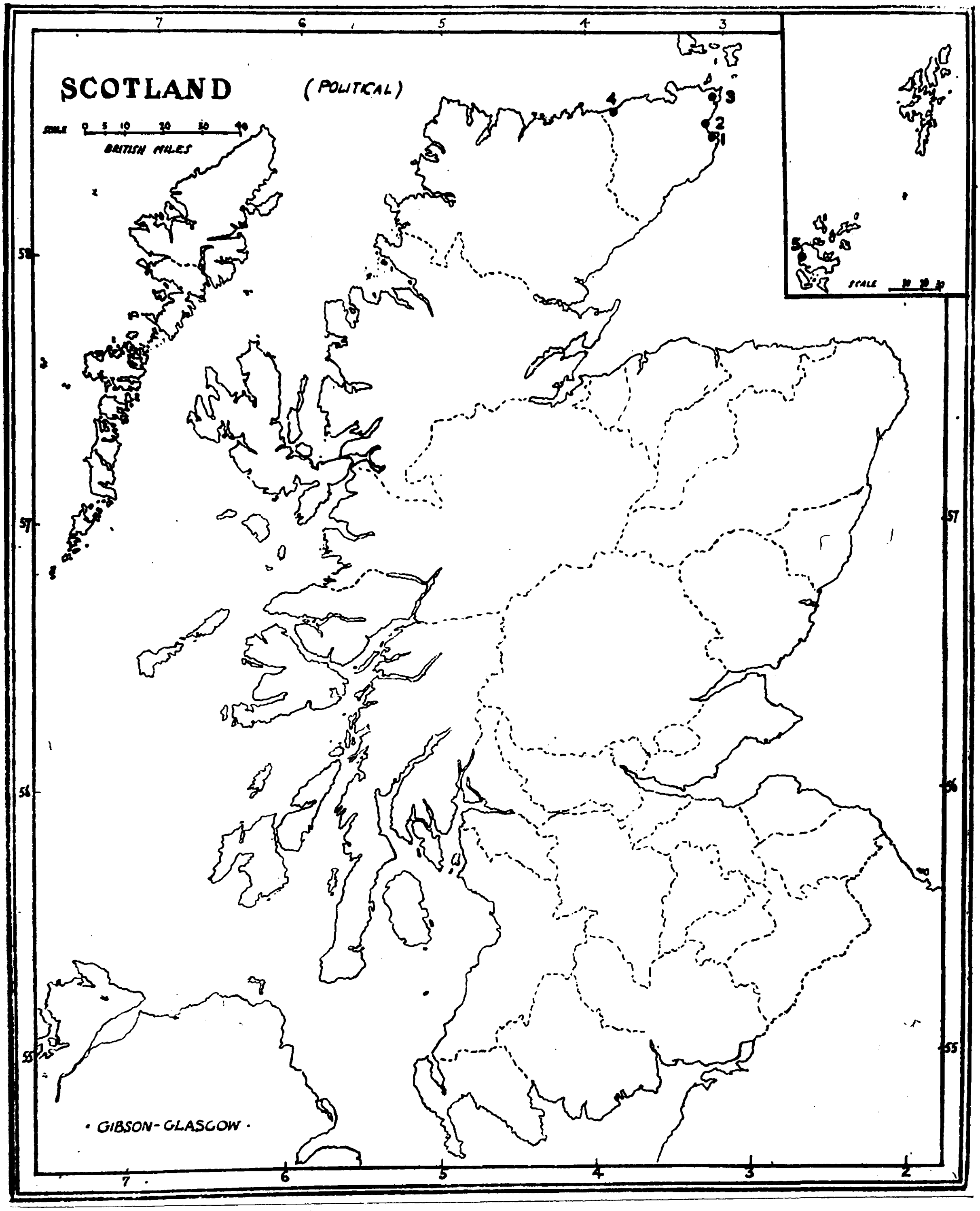


Map 8. Distribution map of Long Cist skulls.

Site	No. indivs.	References
22. Dunrobin Castle, Sutherland	1	Turner, 1915
23. Kintradwell, Sutherland	1	Tait, 1868 Turner, 1915
24. Dunnet Bay, Caithness	2	
25. Galson, Lewis	2	Stevenson, 1954
26. Rennibister, Orkney	6	Marwick, 1927 Bryce, 1927
27. Saverough, Birsay, Orkney	1	P.S.A.S. 5. 10. 1863 Callander, 1930. R.C.A.M. Orkney. p.23 1946. Inventory No.40

The distribution of these sites is shown on Map 8, and that of the Viking material in the following list on Map 9.

Site	No. indivs.	References
1. Ackergill, Caithness	7	Edwards, 1926 Edwards, 1927 Bryce, 1927
2. Keiss, Caithness	5	P.S.A.S. 7. 38 & 54. 1867 Laing & Huxley, 1866 Edwards, 1926



Map 9. Distribution map of Viking skulls.

Site	No. indivs.	References
3. Huna, Caithness	1	Aitchison & Johnston, 1952
4. Reay, Caithness	1	Edwards, 1927
5. Skara Brae, Orkney	2	Childe, 1930

Although the Viking group was rather small, an attempt has been made to compare it with the Long Cist group. Mean mesiodistal diameters of the maxillary teeth of Long Cist and Viking groups are given in Tables 44-46, and mean mesiodistal diameters of the mandibular teeth of the same groups in Tables 47-49.

Table 44. IRON AGE.

Mean mesiodistal crown diameters of maxillary teeth of Iron Age males; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	7	11	85	82–91	3.2	1.0	4	–	–
	V	2	4	89	85–92	–	–			
I.2.	LC	9	13	66	59–71	3.6	1.0	6	3.4	1.8
	V	4	6	72	63–82	7.7	3.2			
C.	LC	15	26	78	67–88	4.5	0.9	0	–	–
	V	4	6	78	72–84	5.4	2.3			
P.1.	LC	15	24	65	60–72	3.6	0.7	7	1.8	3.9
	V	4	6	72	67–78	4.0	1.7			
P.2.	LC	15	26	66	62–73	2.6	0.5	1	1.9	0.5
	V	3	5	67	62–70	3.9	1.8			
M.1.	LC	9	17	104	96–110	4.1	1.0	–	–	–
	V	0	0	–	–	–	–			
M.2.	LC	14	24	90	80–98	6.1	1.2	7	–	–
	V	3	4	97	91–104	–	–			
M.3.	LC	12	21	80	64–92	6.6	1.4	7	1.8	3.9
	V	4	5	87	84–91	2.6	1.2			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 45. IRON AGE.

Mean mesiodistal crown diameters of maxillary teeth of Iron Age females; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	3	6	85	82–90	3.7	1.5	5	–	–
	V	1	2	80	–	–	–			
I.2.	LC	5	7	66	59–75	3.2	1.2	4	1.5	<u>2.6</u>
	V	4	5	62	60–64	1.9	0.9			
C.	LC	10	15	72	67–82	4.3	1.1	2	1.6	1.3
	V	7	10	74	70–80	3.7	1.2			
P.1.	LC	12	19	61	57–69	2.9	0.7	2	1.6	1.3
	V	5	8	63	58–69	3.9	1.4			
P.2.	LC	11	19	63	58–69	2.7	0.6	1	1.3	0.8
	V	5	7	62	58–66	2.8	1.1			
M.1.	LC	11	19	101	88–108	5.6	1.3	1	2.0	0.5
	V	5	8	102	95–106	4.2	1.5			
M.2.	LC	13	21	88	79–95	3.9	0.8	2	3.2	0.6
	V	5	8	90	76–100	8.8	3.1			
M.3.	LC	10	15	79	72–86	4.6	1.2	1	4.4	0.2
	V	4	5	78	68–93	9.2	4.2			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 46. IRON AGE.

Mean mesiodistal crown diameters of maxillary teeth of Iron Age males and females; comparison of Long Cist and Viking groups.
(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	13	21	85	78-92	3.5	0.8	1	2.4	0.4
	V	3	6	86	80-92	5.4	2.3			
I.2.	LC	18	26	65	58-75	4.4	0.9	3	2.5	1.2
	V	8	11	68	60-82	7.5	2.3			
C.	LC	31	50	75	66-88	5.2	0.7	0	-	-
	V	11	16	75	70-84	4.7	1.2			
P.1.	LC	33	54	63	57-72	3.6	0.5	4	1.7	2.4
	V	9	14	67	58-78	6.1	1.7			
P.2.	LC	32	54	65	58-73	3.1	0.4	1	1.2	0.8
	V	8	12	64	58-70	3.9	1.1			
M.1.	LC	26	46	102	88-110	4.8	0.7	0	-	-
	V	5	8	102	95-106	4.2	1.5			
M.2.	LC	35	55	89	79-98	5.2	0.7	3	2.5	1.2
	V	8	12	92	76-104	8.3	2.4			
M.3.	LC	26	40	79	64-92	5.6	0.9	4	2.6	1.5
	V	8	10	83	68-93	8.0	2.5			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 47. IRON AGE.

Mean mesiodistal crown diameters of mandibular teeth of Iron Age males; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	4	7	51	49-54	1.8	0.7	-	-	-
	V	0	0	-	-	-	-			
I.2	LC	6	10	59	55-63	2.6	0.8	4	-	-
	V	3	4	63	58-67	-	-			
C.	LC	13	25	69	63-77	3.7	0.7	0	-	-
	V	5	6	69	67-72	1.9	0.8			
P.1.	LC	13	24	67	60-75	4.2	0.9	5	1.3	3.8
	V	7	12	72	67-78	3.4	1.0			
P.2.	LC	15	27	69	63-81	4.8	0.9	3	1.6	1.8
	V	5	8	72	66-78	3.5	1.3			
M.1.	LC	10	16	109	102-114	3.5	0.9	2	-	-
	V	2	4	111	109-112	-	-			
M.2.	LC	15	25	102	91-111	5.0	1.0	5	2.0	2.5
	V	5	7	107	101-111	4.0	1.7			
M.3.	LC	15	23	102	83-114	7.6	1.6	6	3.0	2.0
	V	5	7	108	96-115	6.6	2.5			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 48. IRON AGE.

Mean mesiodistal crown diameters of mandibular teeth of Iron Age females; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	N.I. [x]	N.T. [x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	2	3	51	48-53	-	-	-	-	-
	V	0	0	-	-	-	-			
I.2	LC	7	12	58	54-63	3.0	0.9	5	-	-
	V	2	3	63	61-67	-	-			
C.	LC	9	14	64	60-68	2.4	0.6	1	1.2	0.8
	V	5	7	65	63-68	2.6	1.0			
P.1.	LC	9	14	65	58-70	3.7	1.0	0	-	-
	V	5	8	65	58-73	4.5	1.6			
P.2.	LC	9	14	66	60-76	3.9	1.1	2	1.6	1.3
	V	5	7	64	59-67	3.0	1.2			
M.1.	LC	11	17	104	97-114	5.3	1.3	3	2.9	1.0
	V	5	8	107	97-115	3.5	1.3			
M.2.	LC	11	17	101	95-111	4.0	1.0	3	2.1	1.4
	V	5	8	98	90-104	4.9	1.8			
M.3.	LC	10	14	98	85-107	7.1	1.9	4	2.6	1.5
	V	3	5	94	90-101	3.9	1.8			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 49. IRON AGE.

Mean mesiodistal crown diameters of mandibular teeth of Iron Age males and females; comparison of Long Cist and Viking groups.
(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	12	20	53	48-60	2.8	0.6	-	-	-
	V	0	0	-	-	-	-			
I.2.	LC	21	35	58	50-63	3.3	0.6	5	1.6	3.1
	V	5	7	63	58-67	4.0	1.5			
C.	LC	30	51	67	57-77	4.4	0.6	0	-	-
	V	10	13	67	63-72	3.0	0.8			
P.1.	LC	34	55	66	58-75	3.5	0.5	3	1.3	2.3
	V	12	20	69	58-78	5.2	1.2			
P.2.	LC	34	59	68	60-81	4.1	0.5	0	-	-
	V	10	15	68	59-78	5.2	1.3			
M.1.	LC	36	59	108	97-123	5.2	0.7	0	-	-
	V	7	12	108	97-115	6.0	1.7			
M.2.	LC	39	64	102	91-111	4.7	0.6	0	-	-
	V	10	15	102	97-111	6.2	1.6			
M.3.	LC	33	50	100	82-114	7.9	1.1	2	2.6	0.8
	V	8	12	102	90-115	9.1	2.6			

x N.I. - Number of individuals
x N.T. - Number of teeth

A number of the differences in mesiodistal tooth diameter between Long Cist and Viking groups are seen to be significant, with critical ratios well above the level of significance. The mean mesiodistal diameters of the maxillary first premolars and third molars of the Viking males are significantly larger than those of the Long Cist males. For the female maxillary teeth, only one result is just significant (C.R. 2.6), and this is for the second incisor, which is larger in the Long Cist group than in the Vikings. When the sexes are combined, none of the differences are significant, though the critical ratio (2.4) of the calculation for the first premolar almost reaches a significant level. In this instance the Viking teeth are the larger.

Of the mandibular teeth, the first premolars of the males and the second incisors of the combined sex group show, between Long Cist and Viking groups, significant differences whose critical ratios are over 3.0, while the difference between the second molars of Long Cist and Viking males is just significant, with a critical ratio for the calculation of 2.5. In each case the mean mesiodistal diameter is greater in the Viking group. No significant differences can be demonstrated for the females.

All these results must, however, be treated with caution on account of the extremely small numbers in the Viking group.

There/

There are fewer than ten observations for the Viking group in nearly all the significant results.

A comparison of mean mesiodistal diameters of the maxillary teeth of males and females of the Total Iron Age group is made in Table 50, and a similar comparison for the mandibular teeth in Table 51.

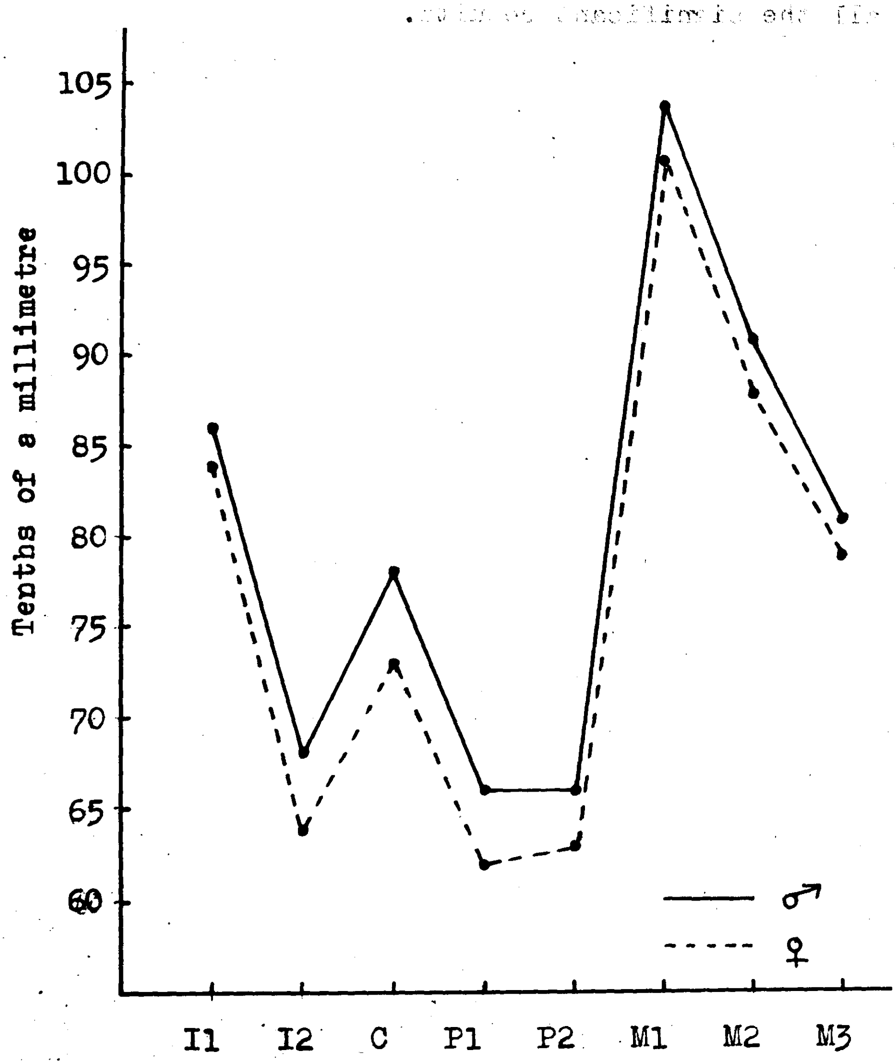


Fig. 35. The mean values of the mesiodistal diameters of the maxillary teeth in the Iron Age group.

Table 50. IRON AGE.

Mean mesiodistal crown diameters of maxillary teeth of total Iron **Age group;** comparison of males and females. (1/10 m.m.)

Tooth	Sex	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	9	15	86	82–92	3.6	0.9	2	1.7	1.2
	F	4	8	84	80–90	4.0	1.4			
I.2.	M	13	19	68	59–82	5.8	1.3	4	1.8	2.2
	F	9	12	64	59–75	4.6	1.3			
C.	M	19	32	78	67–88	4.5	0.8	5	1.1	4.5
	F	17	25	73	67–82	4.1	0.8			
P.1.	M	19	30	66	60–78	4.5	0.8	4	1.0	4.0
	F	17	27	62	57–69	3.3	0.6			
P.2.	M	18	31	66	62–73	2.8	0.5	3	0.7	4.3
	F	16	26	63	58–69	2.7	0.5			
M.1.	M	9	17	104	96–110	4.1	1.0	3	1.4	2.1
	F	16	27	101	88–108	5.2	1.0			
M.2.	M	17	28	91	80–104	6.4	1.2	3	1.6	1.9
	F	18	29	88	76–100	5.6	1.0			
M.3.	M	16	26	81	64–92	6.8	1.3	2	1.8	1.1
	F	14	20	79	68–93	5.8	1.3			

x N.I. – Number of individuals
x N.T. – Number of teeth

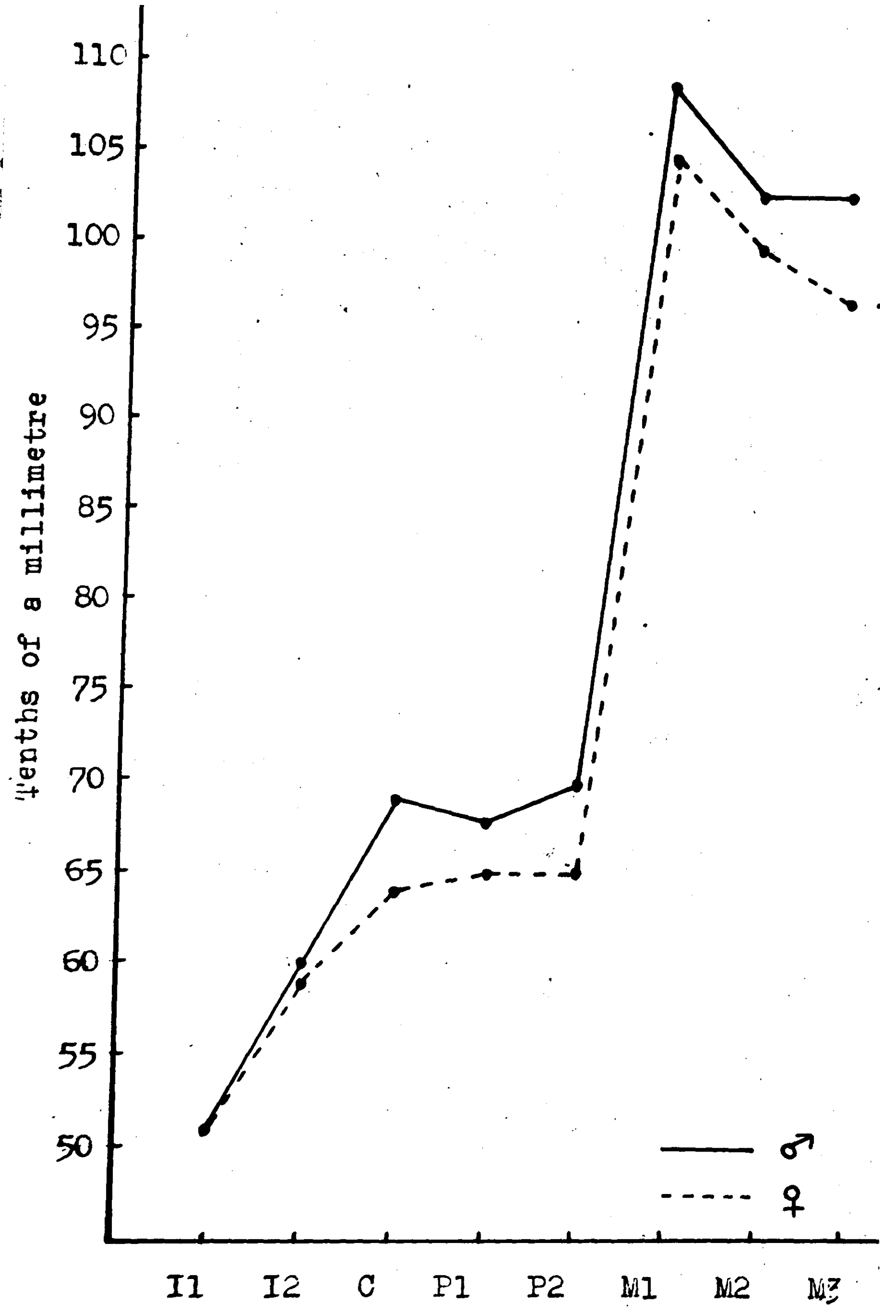


Fig. 36. The mean values of the mesiodistal diameters of the mandibular teeth in the Iron Age group.

Table 51. IRON AGE.

Mean mesiodistal crown diameters of mandibular teeth of total Iron Age group; comparison of males and females. (1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	4	7	51	49-54	1.8	0.7	0	-	-
	F	2	3	51	48-53	-	-			
I.2.	M	9	14	60	55-67	3.5	0.9	1	1.3	0.8
	F	9	15	59	54-67	3.7	0.9			
C.	M	18	31	69	63-77	3.3	0.6	5	0.8	<u>6.3</u>
	F	14	21	64	60-68	2.5	0.5			
P.1.	M	20	36	68	60-78	4.6	0.8	3	1.1	<u>2.7</u>
	F	14	22	65	58-73	3.9	0.8			
P.2.	M	20	35	70	63-81	4.6	0.8	5	1.1	<u>4.5</u>
	F	14	21	65	59-76	3.7	0.8			
M.1.	M	12	20	109	102-114	3.3	0.7	4	1.4	<u>2.9</u>
	F	16	25	105	97-115	6.0	1.2			
M.2.	M	20	32	103	91-111	5.1	0.9	3	1.3	2.3
	F	16	25	100	90-111	4.4	0.9			
M.3.	M	20	30	103	83-115	7.5	1.4	6	2.1	<u>2.9</u>
	F	13	19	97	85-107	6.6	1.5			

x N.I. - Number of individuals
x N.T. - Number of teeth

The mean mesiodistal diameters of the maxillary teeth of males of the Total Iron Age group are without exception greater than those of the females. This sex difference can be shown to be highly significant in the case of the canines, first premolars and second premolars. The critical ratio of the calculations for all these teeth is 4.0 or over.

The mean mesiodistal diameters of the male mandibular teeth are larger than the mean diameters of the female teeth, with the exception of the first incisor, which has the same mean diameter in both sexes. The sex difference in the mesiodistal diameters of the mandibular teeth is most marked for the canines (C.R. 6.3) and the second premolars (C.R. 4.5). The differences for the first premolars, first molars and third molars are also significant, but at a lower level.

A clear sex difference can thus be demonstrated in the mesiodistal diameters of Scottish Iron Age teeth. In both maxilla and mandible, the canine is the tooth which shows the greatest sex difference, and this is more strongly marked in the mandibular canine than in the maxillary canine. These findings correspond exactly to the results obtained by Moorrees (1957) for the Aleuts, in whom also "This sex difference is most pronounced for the canines and is larger for the mandibular canines (C.R. 8.6)/

8.6) than for the maxillary canines (C.R. 6.0)".

Relative size of molars.

Iron Age males and females both show a gradual decrease in mesiodistal diameter from the first molar to the third molar in the maxilla (Fig. 35).

In the mandible, however, there is a slight variation between males and females in the pattern of reduction. In the females, there is again a gradual decrease in mesiodistal diameter from the first to the third molar, while the males show a decrease from the first to the second and third molars, which are equal in size (Fig. 36).

Mean labiolingual diameters of the maxillary teeth of Long Cist and Viking groups are given in Tables 52-54, and mean labiolingual diameters of the mandibular teeth of the same groups in Tables 55-57.

Table 52. IRON AGE.

Mean labiolingual crown diameters of maxillary teeth of Iron Age males; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	10	17	72	66–81	3.1	0.8	5	1.4	3.6
	V	5	7	77	73–80	3.1	1.2			
I.2.	LC	11	15	61	54–73	5.2	1.3	4	2.2	1.8
	V	5	7	65	60–72	4.7	1.8			
C.	LC	15	25	83	75–91	4.0	0.8	2	1.0	2.0
	V	5	8	85	82–87	1.6	0.6			
P.1.	LC	14	23	89	81–100	5.8	1.2	3	2.3	1.3
	V	5	9	92	82–99	6.0	2.0			
P.2.	LC	15	25	91	83–98	4.6	0.9	1	1.9	0.5
	V	4	7	92	88–98	4.4	1.7			
M.1.	LC	9	18	115	111–120	2.5	0.6	4	–	–
	V	3	4	119	114–122	–	–			
M.2.	LC	14	22	109	96–116	5.2	1.1	8	1.9	4.2
	V	4	5	117	113–120	3.3	1.5			
M.3.	LC	12	21	104	89–119	6.7	1.5	8	–	–
	V	4	4	112	107–115	–	–			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 53. IRON AGE.

Mean labiolingual crown diameters of maxillary teeth of Iron Age females; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	5	8	70	62-75	4.4	1.6	1	-	-
	V	2	4	71	70-73	-	-			
I.2.	LC	6	10	61	51-70	6.4	2.1	0	-	-
	V	4	6	61	60-63	1.5	0.6			
C.	LC	10	15	77	70-83	4.7	1.2	2	1.7	1.2
	V	8	11	79	74-86	4.0	1.2			
P.1.	LC	10	17	85	74-91	4.2	1.0	1	1.6	0.6
	V	4	6	86	82-89	2.8	1.2			
P.2.	LC	10	17	88	79-93	4.2	1.0	2	1.6	1.2
	V	5	8	86	80-90	3.3	1.2			
M.1.	LC	10	16	111	98-120	6.4	1.6	2	1.8	1.1
	V	3	5	113	110-115	1.9	0.9			
M.2.	LC	12	19	105	91-118	6.4	1.5	3	3.1	1.0
	V	5	8	108	100-119	7.6	2.7			
M.3.	LC	10	16	100	90-110	5.9	1.5	8	2.7	<u>3.0</u>
	V	4	5	92	90-101	4.9	2.2			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 54. IRON AGE.

Mean labiolingual crown diameters of maxillary teeth of Iron Age males and females; comparison of Long Cist and Viking groups.
(1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	18	30	71	62–81	3.5	0.6	4	1.3	3.1
	V	7	11	75	70–80	3.8	1.2			
I.2.	LC	21	31	60	51–73	5.2	0.9	3	1.4	2.1
	V	9	13	63	60–72	4.1	1.1			
C.	LC	31	48	80	70–91	5.5	0.8	2	1.3	1.5
	V	13	19	82	74–87	4.4	1.0			
P.1.	LC	30	51	87	74–100	5.3	0.7	3	1.7	1.8
	V	9	15	90	82–99	5.8	1.5			
P.2.	LC	31	52	89	79–98	4.3	0.6	0	–	–
	V	9	15	89	80–98	5.1	1.3			
M.1.	LC	25	44	113	98–120	4.7	0.7	2	1.5	1.3
	V	6	9	115	110–122	4.0	1.3			
M.2.	LC	33	50	108	91–118	5.8	0.8	3	2.2	1.4
	V	9	13	111	100–120	7.7	2.1			
M.3.	LC	26	41	102	89–119	6.3	1.0	1	3.8	0.3
	V	8	9	101	90–115	11.0	3.7			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 55. IRON AGE.

Mean labiolingual crown diameters of mandibular teeth of Iron Age males; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	6	10	57	50–61	3.7	1.2	7	–	–
	V	2	3	64	61–65	–	–			
I.2.	LC	6	12	60	55–63	2.3	0.7	7	1.8	3.9
	V	3	5	67	63–72	3.8	1.7			
C.	LC	12	20	74	65–82	4.8	1.1	8	–	–
	V	4	4	82	78–87	–	–			
P.1.	LC	12	23	75	68–82	3.9	0.8	6	1.4	4.3
	V	7	12	81	74–87	4.3	1.2			
P.2.	LC	15	27	81	73–92	4.5	0.9	4	2.1	1.9
	V	5	8	85	76–94	5.4	1.9			
M.1.	LC	11	15	106	101–110	2.6	0.7	2	1.6	1.3
	V	3	5	108	105–112	3.0	1.4			
M.2.	LC	15	21	100	90–109	5.0	1.1	3	1.6	1.9
	V	5	8	103	100–107	3.1	1.1			
M.3.	LC	15	21	98	86–109	6.0	1.3	4	2.6	1.5
	V	4	6	102	94–108	5.2	2.2			

x N.I. – Number of individuals
x N.T. – Number of teeth

Table 56. IRON AGE.

Mean labiolingual crown diameters of mandibular teeth of Iron Age females; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	3	5	57	52-65	6.7	3.0	-	-	-
	V	0	0	-	-	-	-			
I.2.	LC	6	10	60	53-69	5.5	1.7	2	-	-
	V	2	3	62	56-65	-	-			
C.	LC	7	11	70	64-78	4.0	1.2	1	-	-
	V	4	4	71	64-77	-	-			
P.1.	LC	8	12	71	67-78	4.1	1.2	4	1.8	2.2
	V	4	6	75	70-77	3.0	1.3			
P.2.	LC	8	14	77	72-91	5.7	1.5	2	2.3	0.9
	V	5	7	79	72-84	4.4	1.7			
M.1.	LC	10	15	100	85-114	7.2	1.8	2	2.5	0.8
	V	5	7	102	94-106	4.7	1.8			
M.2.	LC	12	18	95	85-106	6.0	1.4	1	2.0	0.5
	V	5	8	96	89-100	4.0	1.4			
M.3.	LC	9	13	93	81-103	8.1	2.3	2	3.1	0.6
	V	3	5	91	87-97	4.7	2.1			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 57. IRON AGE.

Mean labiolingual crown diameters of mandibular teeth of Iron Age males and females; comparison of Long Cist and Viking groups. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	15	25	57	50–65	4.3	0.9	7	–	–
	V	2	3	64	61–65	–	–			
I.2.	LC	19	34	60	53–69	4.1	0.7	5	1.9	2.6
	V	5	8	65	56–72	4.9	1.8			
C.	LC	27	43	73	64–83	5.4	0.7	3	2.7	1.1
	V	8	8	76	64–87	7.3	2.6			
P.1.	LC	32	52	74	67–85	4.3	0.6	5	1.3	3.8
	V	11	18	79	70–87	4.9	1.2			
P.2.	LC	43	59	79	70–92	5.4	0.7	3	1.7	1.8
	V	10	15	82	72–94	5.8	1.5			
M.1.	LC	35	54	103	85–114	5.3	0.7	2	1.7	1.2
	V	8	12	105	94–112	5.1	1.5			
M.2.	LC	39	60	98	85–109	5.3	0.7	2	1.5	1.3
	V	10	16	100	89–107	5.1	1.3			
M.3.	LC	32	47	96	81–109	7.0	1.0	1	2.4	0.4
	V	7	11	97	87–108	7.2	2.2			

x N.I. – Number of individuals
x N.T. – Number of teeth

Results of comparisons of the labiolingual diameters of Long Cist and Viking teeth are similar to those obtained from comparison of the mesiodistal diameters of the teeth of these groups.

Significant differences in labiolingual diameter exist between the groups for the maxillary first incisors and second molars of the males, the mean value for the Viking teeth being the larger in both cases. The mean labiolingual diameter of the maxillary third molar of the Long Cist females is significantly larger than that of the Viking females. The significant difference previously noted between Long Cist and Viking first incisors in the males is maintained in the first incisors of the combined sex group, but at a slightly lower level of significance.

In the mandible, the mean labiolingual diameters of the second incisors and first premolars of the Viking males are significantly larger than those of the Long Cist males. No significant results were obtained for the females, while in the combined sex group the second incisors and first premolars again show significant differences between Long Cist and Viking, though in both instances the critical ratios are lower than in the comparison of males alone.

The/

The small number of observations in the Viking group precludes great importance being attached to these results.

A comparison of mean labiolingual diameters of the maxillary teeth of males and females of the Total Iron Age group is made in Table 58, and a similar comparison for the mandibular teeth in Table 59.

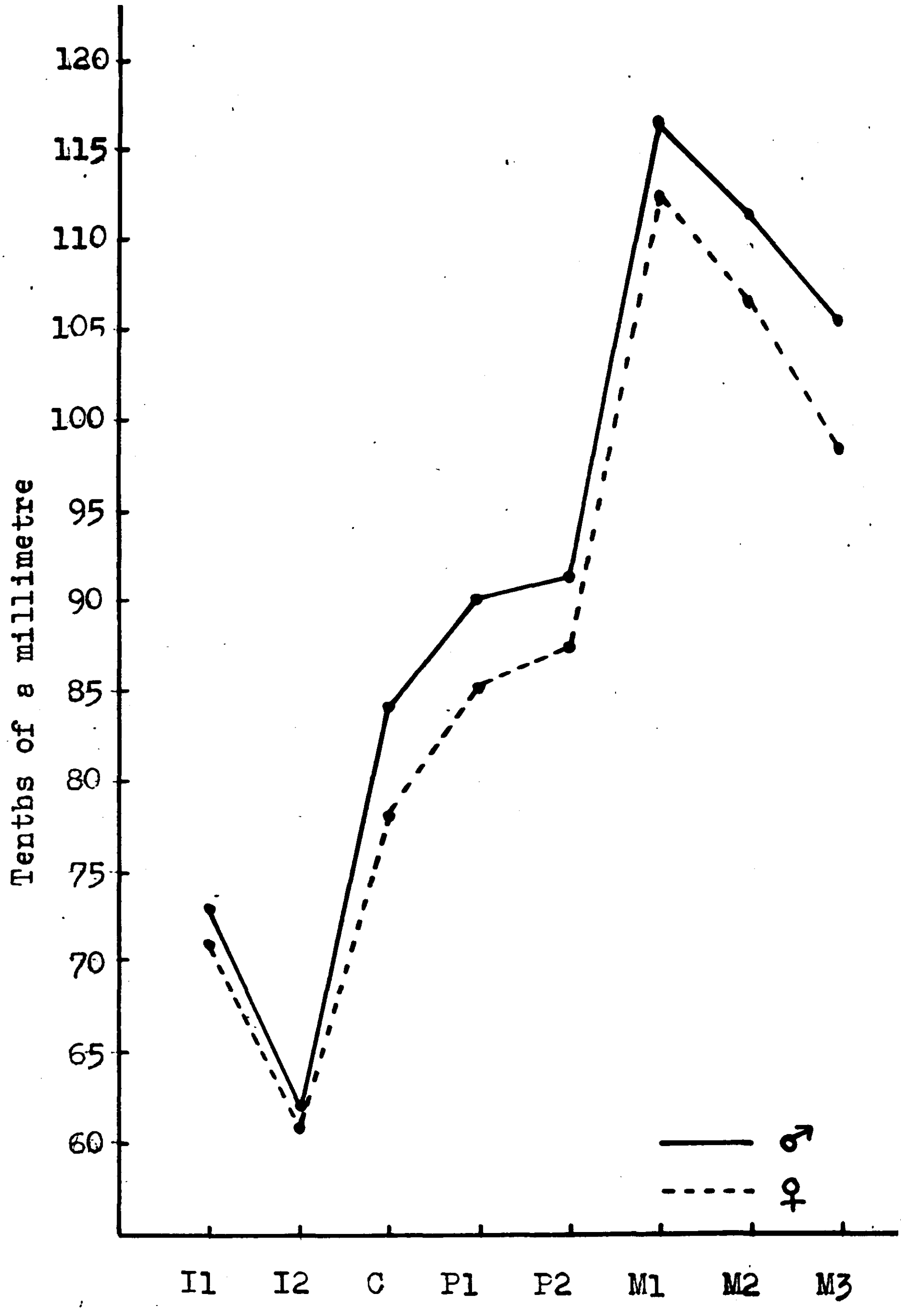


Fig. 37. The mean values of the labiolingual diameters of the maxillary teeth in the Iron Age group.

Table 58. IRON AGE.

Mean labiolingual crown diameters of maxillary teeth of total Iron Age group; comparison of males and females. (1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	15	24	73	66-81	3.9	0.8	2	1.3	1.5
	F	7	12	71	62-75	3.6	1.0			
I.2.	M	16	22	62	54-73	5.4	1.1	1	1.7	0.6
	F	10	16	61	51-70	5.0	1.3			
C.	M	20	33	84	75-91	3.6	0.6	6	1.1	5.5
	F	18	26	78	70-86	4.5	0.9			
P.1.	M	19	32	90	81-100	5.8	1.0	5	1.3	3.8
	F	14	23	85	74-91	3.6	0.8			
P.2.	M	19	32	91	83-98	4.5	0.8	4	1.1	3.6
	F	15	25	87	79-93	4.1	0.8			
M.1.	M	12	22	116	111-122	3.0	0.6	4	1.3	3.1
	F	13	21	112	98-120	5.7	1.2			
M.2.	M	18	27	111	96-120	5.7	1.1	5	1.7	2.9
	F	17	27	106	91-119	6.7	1.3			
M.3.	M	16	25	105	89-119	6.9	1.4	7	2.0	3.5
	F	14	21	98	90-110	6.5	1.4			

x N.I. - Number of individuals
x N.T. - Number of teeth

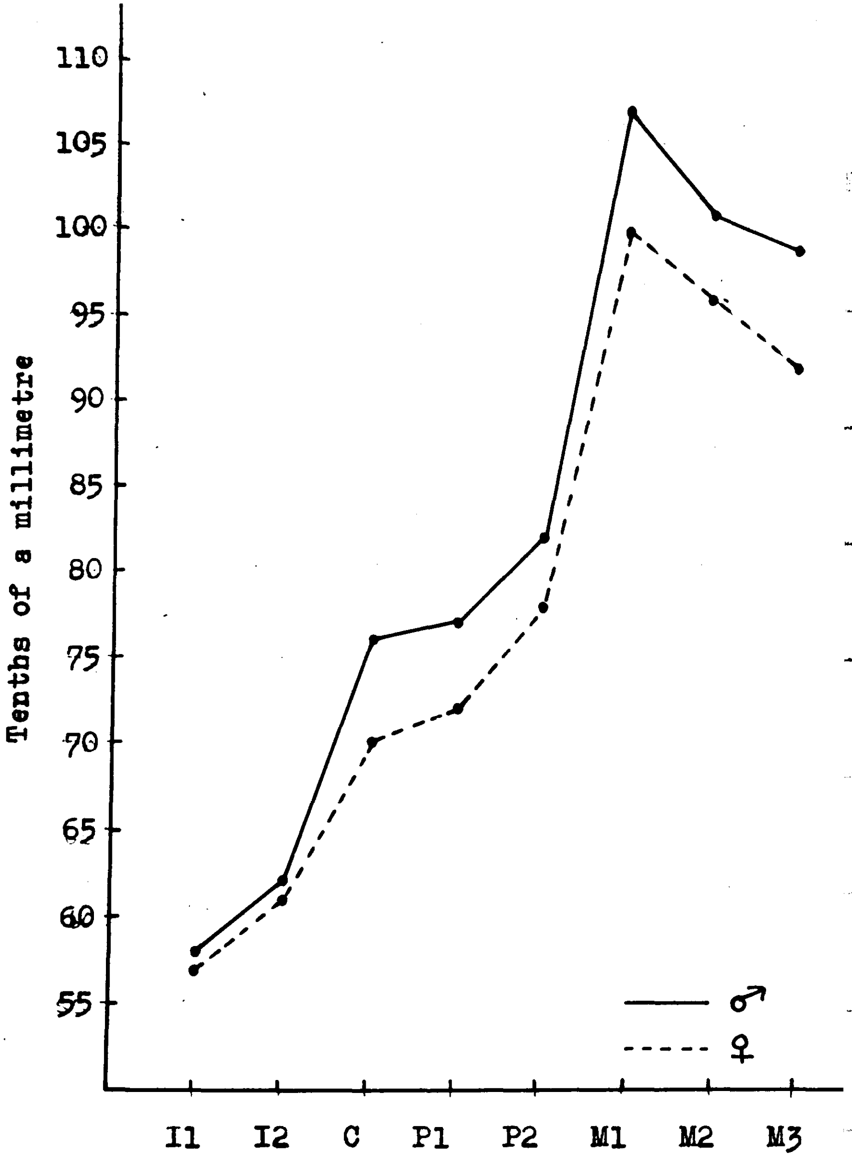


Fig. 38. The mean values of the labiolingual diameters of the mandibular teeth in the Iron Age group.

Table 59. IRON AGE.

Mean labiolingual crown diameters of mandibular teeth of total Iron Age group; comparison of males and females. (1/10 m.m.)

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	8	13	58	50–65	4.5	1.3	1	3.3	0.3
	F	3	5	57	52–65	6.7	3.0			
I.2.	M	9	17	62	55–72	4.5	1.1	1	1.9	0.5
	F	8	13	61	53–69	5.3	1.5			
C.	M	16	24	76	65–87	5.4	1.1	6	1.6	3.7
	F	11	15	70	64–78	4.5	1.2			
P.1.	M	19	35	77	68–87	4.8	0.8	5	1.3	3.8
	F	12	18	72	67–78	4.0	1.0			
P.2.	M	20	35	82	73–94	4.9	0.8	4	1.4	2.9
	F	13	21	78	72–91	5.3	1.2			
M.1.	M	14	20	107	101–112	2.9	0.6	7	1.5	4.7
	F	15	22	100	85–114	6.5	1.4			
M.2.	M	20	29	101	90–109	4.7	0.9	5	1.4	3.6
	F	17	26	96	85–106	5.4	1.1			
M.3.	M	19	27	99	86–109	5.9	1.1	7	2.0	3.5
	F	12	18	92	81–103	7.2	1.7			

x N.I. – Number of individuals
x N.T. – Number of teeth

Mean labiolingual diameters of both maxillary and mandibular teeth of the Total Iron Age group are without exception larger in the male than in the female. In both maxilla and mandible, the sex differences, with the exception of those for the first and second incisors, are all significant and the critical ratios are high. The teeth which show the greatest sex difference are the maxillary canines (C.R. 5.5) and the mandibular first molars (C.R. 4.7).

In the Scottish Iron Age material, sex differentiation is even more clearly marked for the labiolingual diameters than for the mesiodistal diameters. This is the converse of Moorrees' (1957) findings on the Aleut dentition. The labiolingual diameters of the maxillary teeth of the Aleut and of the Scottish Iron Age group show one similarity, in that the sex difference is most pronounced in the canine. In the mandible, however, the greatest sex difference is shown in the Aleut by the canine, but in the Scottish Iron Age group by the first molar.

Mean crown indices of the maxillary teeth of Long Cist and Viking groups are given in Tables 60-62, and mean crown indices of the mandibular teeth of the same groups in Tables 63-65.

Table 60. IRON AGE.

Mean crown indices of maxillary teeth of Iron Age males; comparison of Long Cist and Viking groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	7	11	83.9	77.6-89.0	3.5	1.1	7.1	-	-
	V	2	3	91.0	87.0-94.1	-	-			
I.2.	LC	9	13	93.5	81.8-114.8	9.9	2.8	0.4	6.0	0.1
	V	4	6	93.1	78.0-109.4	12.7	5.3			
C.	LC	15	25	107.8	98.7-119.4	5.4	1.1	3.8	3.0	1.3
	V	4	5	111.6	102.4-118.1	6.1	2.8			
P.1.	LC	14	23	137.5	120.8-150.0	7.2	1.5	4.1	3.2	1.3
	V	4	6	133.4	124.4-140.3	6.7	2.8			
P.2.	LC	15	24	137.8	123.2-150.0	6.8	1.4	3.6	3.6	1.0
	V	3	5	141.4	130.9-150.0	7.2	3.3			

M.1./

Table 60. (Continued).

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	LC	9	17	110.9	106.4-117.7	3.2	0.8	-	-	-
	V	0	0	-	-	-	-			
M.2.	LC	14	22	121.4	112.4-142.0	7.4	1.6	0.7	-	-
	V	2	3	120.7	115.4-123.7	-	-			
M.3.	LC	12	21	130.9	117.4-157.8	12.1	2.6	4.1	-	-
	V	3	3	126.8	124.4-129.5	-	-			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 61. IRON AGE.

Mean crown indices of maxillary teeth of Iron Age females; comparison of Long Cist and Viking groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	3	6	83.5	79.8-90-4	4.9	2.0	5.3	-	-
	V	1	2	(88.8)	-	-	-			
I.2.	LC	5	7	96.2	89.7-105.1	5.3	2.0	1.9	-	-
	V	3	4	98.1	93.8-105.0	-	-			
C.	LC	10	15	107.4	95.9-118.6	7.0	1.8	0.3	2.9	0.1
	V	7	10	107.7	94.9-120.0	7.4	2.3			
P.1.	LC	10	17	139.6	127.6-157.9	7.6	1.9	4.6	3.1	1.5
	V	4	6	135.0	129.0-145.0	6.0	2.4			
P.2.	LC	10	17	140.0	131.3-148.4	4.6	1.1	2.0	1.3	1.5
	V	5	7	138.0	136.4-141.0	1.6	0.6			

M.1./

Brackets indicate a result which is not a true mean value since only one calculation could be made.

Table 61. (Continued).

Tooth	Gp.	N.I. [x]	N.T. [x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	LC	10	16	110.7	96.3-115.2	4.4	1.1	1.1	1.6	0.7
	V	3	5	109.6	106.6-112.2	2.5	1.1			
M.2.	LC	12	19	120.5	111.0-132.1	5.6	1.3	0.3	2.2	0.1
	V	5	8	120.2	115.8-131.6	5.0	1.8			
M.3.	LC	10	15	126.6	115.4-136.1	6.2	1.6	7.9	4.3	1.8
	V	4	5	118.7	108.6-132.4	8.9	4.0			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 62. **IRON AGE.**

Mean crown indices of maxillary teeth of Iron Age males and females; comparison of Long Cist and Viking groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	13	21	83.6	77.6-90.4	3.6	0.8	6.5	1.5	<u>4.3</u>
	V.	3	5	90.1	87.0-94.1	2.9	1.3			
I.2.	LC	18	26	93.9	81.8-114.8	7.9	1.5	1.2	3.5	0.3
	V	7	10	95.1	78.0-109.4	10.2	3.2			
C.	LC	31	48	107.3	95.9-119.4	5.7	0.8	1.7	2.0	0.9
	V	11	15	109.0	94.9-120.0	7.0	1.8			
P.1.	LC	30	51	137.3	120.8-157.9	7.3	1.0	3.1	2.0	1.6
	V	8	12	134.2	124.4-145.0	6.1	1.7			
P.2.	LC	31	50	138.6	123.2-150.0	5.7	0.8	0.8	1.6	0.5
	V	8	12	139.4	130.9-150.0	4.8	1.4			

M.1./

Table 62. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	LC	25	43	110.8	96.3-117.7	3.4	0.5	1.2	1.2	1.0
	V	3	5	109.6	106.6-112.2	2.5	1.1			
M.2.	LC	33	50	121.6	111.0-142.0	6.3	0.9	1.3	1.7	0.8
	V	7	11	120.3	115.4-131.6	4.7	1.4			
M.3.	LC	26	40	129.5	115.4-157.8	10.0	1.6	7.8	3.3	2.4
	V	7	8	121.7	108.6-132.4	8.1	2.9			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 63. IRON AGE.

Mean crown indices of mandibular teeth of Iron Age males; comparison of Long Cist and Viking groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	4	6	108.8	94.3-119.6	11.4	4.8	-	-	-
	V	0	0	-	-	-	-			
I.2.	LC	5	8	101.0	94.8-109.1	5.4	1.9	6.2	-	-
	V	2	3	107.2	104.5-110.3	-	-			
C.	LC	12	20	109.5	98.5-117.9	5.3	1.2	8.7	-	-
	V	4	4	118.2	113.0-126.1	-	-			
P.1.	LC	12	23	112.8	101.4-123.4	6.9	1.4	0.5	2.5	0.2
	V	7	12	113.3	101.4-122.4	7.3	2.1			
P.2.	LC	15	26	117.3	102.8-130.4	6.5	1.3	1.3	3.1	0.4
	V	5	8	118.6	105.6-131.8	7.7	2.8			

M.1./

Table 63. (Continued).

Tooth	Gp.	N.I. [x]	N.T. [x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	LC	10	14	97.4	93.0-103.8	3.3	0.9	1.5	-	-
	V	2	4	98.9	97.3-100.9	-	-			
M.2.	LC	14	19	99.3	88.2-108.2	5.5	1.3	2.0	1.6	1.3
	V	5	7	97.3	92.8-102.0	2.7	1.0			
M.3.	LC	15	21	96.3	91.3-109.6	5.7	1.2	0.9	1.6	0.6
	V	4	6	95.4	92.5-98.2	2.6	1.1			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 64.   IRON AGE.

Mean crown indices of mandibular teeth of Iron Age females; comparison of Long Cist and Viking groups.

Tooth	Gp.	N.I.x	N.T.x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	2	3	117.2	108.3-122.6	-	-	-	-	-
	V	0	0	-	-	-	-			
I.2.	LC	6	10	105.0	96.4-116.4	7.3	2.3	5.5	-	-
	V	2	3	99.5	83.6-108.3	-	-			
C.	LC	7	11	109.0	103.0-118.3	6.3	1.9	3.9	-	-
	V	3	3	105.1	94.1-113.2	-	-			
P.1.	LC	8	12	110.8	101.5-120.7	6.2	1.8	4.2	3.8	1.1
	V	4	6	115.0	105.5-124.1	8.0	3.3			
P.2.	LC	8	13	116.9	109.1-125.8	5.3	1.5	6.7	3.4	2.0
	V	5	6	123.6	115.4-135.6	7.1	3.0			

M.1./

Table 64. (Continued).

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	LC	9	14	95.5	87.6-101.9	3.9	1.1	1.2	2.0	0.6
	V	5	7	94.3	87.9-100.0	4.5	1.7			
M.2.	LC	11	15	94.5	85.9-102.9	4.8	1.2	3.6	1.8	2.0
	V	5	8	98.1	92.7-105.6	3.8	1.4			
M.3.	LC	9	13	95.4	81.8-107.5	6.4	1.8	1.9	2.8	0.7
	V	3	5	97.3	94.1-105.4	4.6	2.1			

x N.I. - Number of individuals
x N.T. - Number of teeth

Table 65. IRON AGE.

Mean crown indices of mandibular teeth of Iron Age males and females; comparison of Long Cist and Viking groups.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	LC	12	19	108.8	94.3-122.6	8.4	1.9	-	-	-
	V	0	0	-	-	-	-			
I.2.	LC	18	30	104.0	94.8-116.4	6.0	1.1	0.6	4.2	0.1
	V	4	6	103.4	83.6-110.3	9.9	4.1			
C.	LC	27	43	109.5	98.5-119.0	5.6	0.8	3.0	3.9	0.8
	V	7	7	112.5	94.1-126.1	10.0	3.8			
P.1.	LC	31	51	112.2	101.4-123.4	6.1	0.9	1.7	1.9	0.9
	V	11	18	113.9	101.4-124.1	7.3	1.7			
P.2.	LC	33	57	117.0	102.8-130.4	6.8	0.9	3.7	2.3	1.6
	V	10	14	120.7	105.6-135.6	7.6	2.1			

M.1./

Table 65. (Continued).

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	LC	33	52	96.3	87.6-104.8	3.8	0.5	0.4	1.4	0.3
	V	7	11	95.9	87.9-100.9	4.3	1.3			
M.2.	LC	37	54	97.2	85.9-108.2	5.6	0.8	0.5	1.1	0.5
	V	10	15	97.7	92.7-105.6	3.2	0.8			
M.3.	LC	32	46	96.1	81.8-109.8	5.5	0.8	0.2	1.4	0.1
	V	7	11	96.3	92.5-105.4	3.6	1.1			

x N.I. - Number of individuals
x N.T. - Number of teeth

The maxillary first incisor of the combined sex group is the only tooth to show a significant difference in crown index between Long Cist and Viking groups. The crown index of this tooth is higher in the Viking than in the Long Cist group, i.e. the maxillary first incisor is proportionately greater in the labiolingual diameter in the Viking group. But the value of this result must be doubtful, since only five Viking teeth are involved in the comparison.

No other results are significant, and there appears to be no general tendency for either group to show higher indices.

A comparison of mean crown indices of the maxillary teeth of males and females of the Total Iron Age group is made in Table 66, and a similar comparison for the mandibular teeth in Table 67.

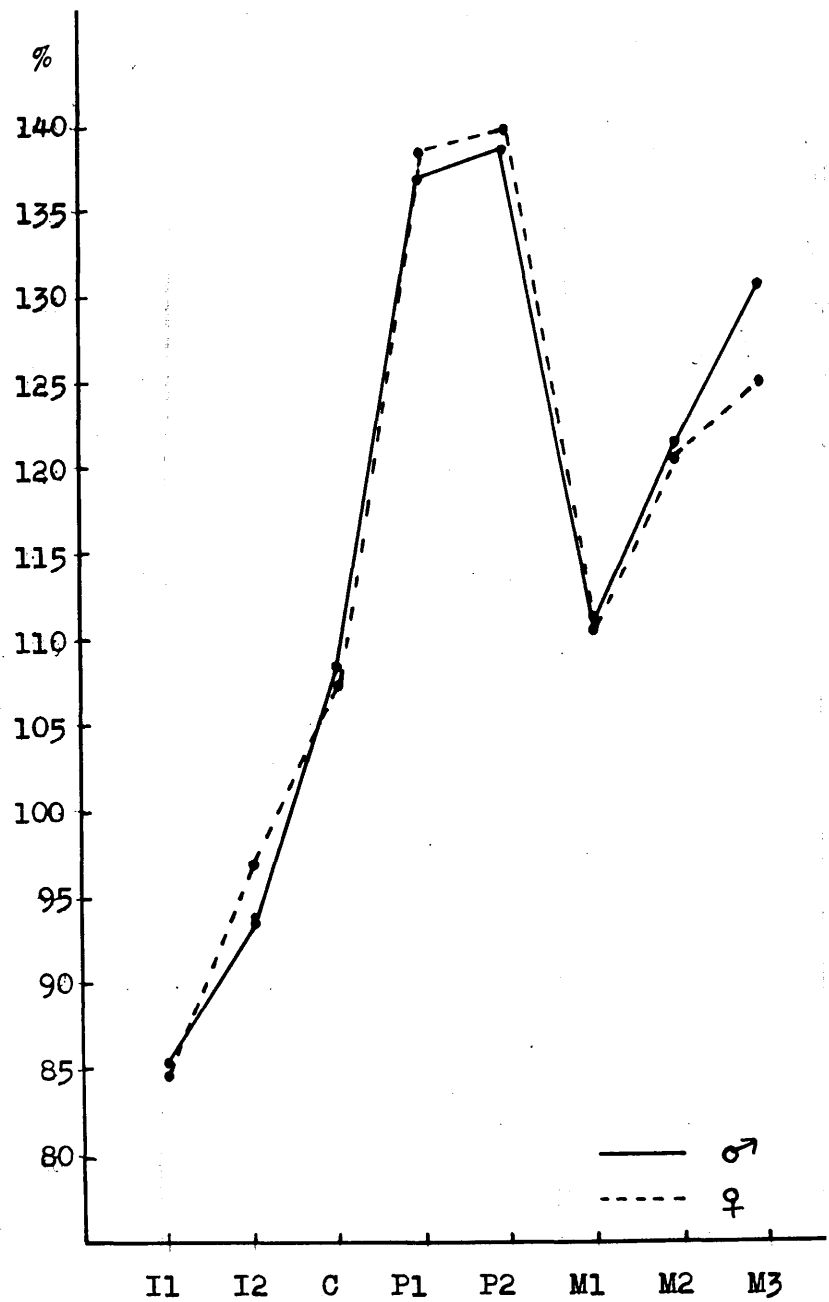


Fig. 39. The mean values of the crown indices of the maxillary teeth in the Iron Age group.

Table 66. IRON AGE.

Mean crown indices of maxillary teeth of total Iron Age group; comparison of males and females.

Tooth	Sex	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	9	14	85.4	77.6-94.1	4.6	1.2	0.6	2.1	0.3
	F	4	8	84.8	79.8-90.4	4.8	1.7			
I.2.	M	13	19	93.4	78.0-114.8	10.5	2.4	3.5	2.8	1.3
	F	8	11	96.9	89.7-105.1	5.0	1.5			
C	M	19	30	108.4	98.7-119.4	5.5	1.0	0.9	1.7	0.5
	F	17	25	107.5	94.9-120.0	7.0	1.4			
P.1.	M	18	29	136.6	120.8-150.0	7.2	1.3	1.8	2.0	0.9
	F	14	23	138.4	127.6-157.9	7.4	1.5			
P.2.	M	18	29	138.4	123.2-150.0	6.8	1.3	1.0	1.5	0.7
	F	15	24	139.4	131.3-148.4	4.0	0.8			

M.1./

Table 66. (Continued).

Tooth	Sex	N.I.x	N.T.x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	M	9	17	110.9	106.4-117.7	3.2	0.8	0.5	1.2	0.4
	F	13	21	110.4	96.3-115.2	4.0	0.9			
M.2.	M	16	25	121.3	112.4-142.0	7.1	1.4	0.9	1.7	0.5
	F	17	27	120.4	111.0-132.1	5.3	1.0			
M.3.	M	15	24	130.4	117.4-157.8	11.4	2.3	5.8	2.9	2.0
	F	14	20	124.6	108.6-136.1	7.6	1.7			

x N.I. - Number of individuals
x N.T. - Number of teeth

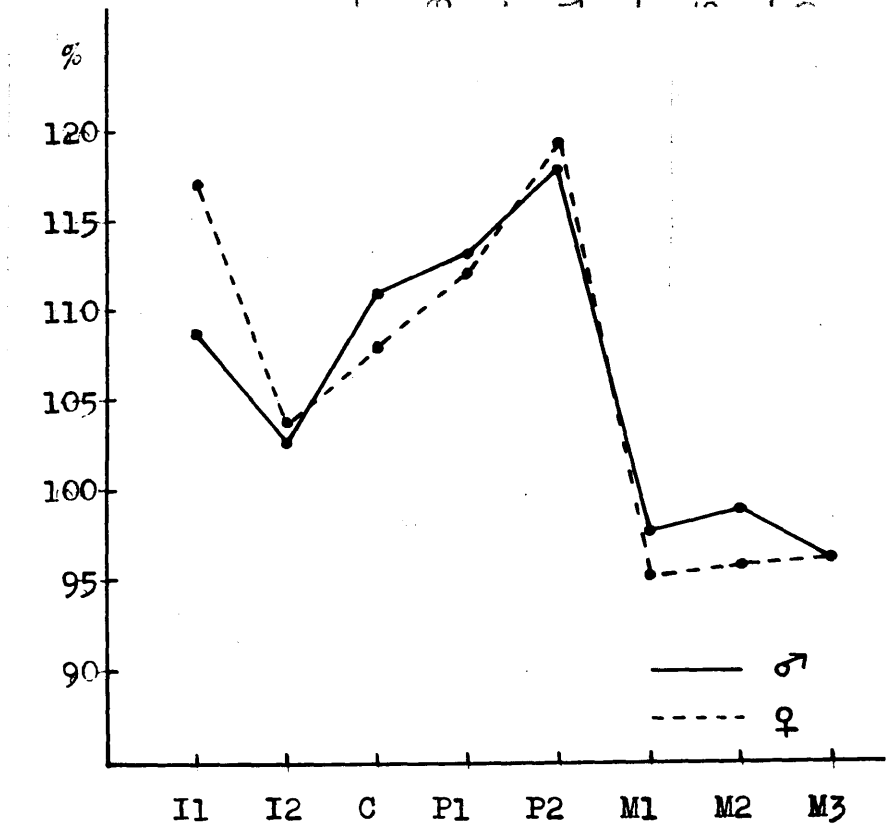


Fig. 40. The mean values of the crown indices of the mandibular teeth in the Iron Age group.

Table 67. IRON AGE.

Mean crown indices of mandibular teeth of total Iron Age group; comparison of males and females.

Tooth	Sex	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	M	4	6	108.8	94.3-119.6	11.4	4.8	8.4	-	-
	F	2	3	117.2	108.3-122.6	-	-			
I.2.	M	7	11	102.7	94.8-110.3	5.5	1.7	1.1	2.9	0.4
	F	8	13	103.8	83.6-116.4	8.8	2.4			
C.	M	16	24	110.9	98.5-126.1	6.2	1.3	2.7	2.3	1.2
	F	10	14	108.2	94.1-118.3	6.9	1.9			
P.1.	M	19	35	113.0	101.4-123.4	6.9	1.2	0.8	2.0	0.4
	F	12	18	112.2	101.5-124.1	6.9	1.6			
P.2.	M	20	34	117.6	102.8-131.8	6.6	1.1	1.4	1.9	0.7
	F	13	19	119.0	109.1-135.6	6.6	1.5			

M.1./

Table 67. (Continued).

Tooth	Sex	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	M	12	18	97.7	93.0-103.8	3.0	0.7	2.6	1.1	2.4
	F	14	21	95.1	87.6-101.9	4.1	0.9			
M.2.	M	19	26	98.8	88.2-108.2	5.0	1.0	3.1	1.4	2.2
	F	16	23	95.7	85.9-105.6	4.7	1.0			
M.3.	M	19	27	96.1	91.3-109.6	5.2	1.0	0.2	1.7	0.1
	F	12	18	95.9	81.8-107.5	5.9	1.4			

x N.I. - Number of individuals
x N.T. - Number of teeth

In the Total Iron Age group, no significant differences exist between the crown indices of male and female teeth in either maxilla or mandible, and no tendency can be observed for either sex to show consistently higher indices. The critical ratio for the crown index of the mandibular first molar is, however, just below the level of significance. The crown index of this tooth is higher in the males than in the females; i.e., in the latter the mandibular first molar is proportionately greater in the mesiodistal diameter than it is in the males.

Conclusions.

The results of odontometry of Scottish Iron Age skulls may be summarised as follows:-

1. Significant differences in mesiodistal and labiolingual crown diameters appear to exist between the Long Cist and Viking teeth, particularly with regard to the males. The mean diameters of the teeth of Viking males are almost invariably greater than those of the Long Cist males. There is a closer approximation between the tooth measurements of Long Cist and Viking females; only two differences between the females of these two groups are statistically significant, and in both instances the tooth measurement is greater in the Long Cist females. In spite of apparently high levels of significance, it is felt that these results should be accepted with caution, since the number of Viking teeth is in all cases very small.

No difference could be detected between the crown indices of the two groups.

2. There is a clearly marked sex difference in size of the teeth of the Total Iron Age group. The mean diameters of the male teeth are in virtually every case greater than the mean diameters of the female teeth. The only exception is the mesiodistal diameter of the mandibular first incisor, which is the/

the same in both sexes. Many of the sex differences are seen to be significant, with relatively high critical ratios.

Crown indices do not appear to differ in the sexes in either jaw, and the critical ratios are in general low.

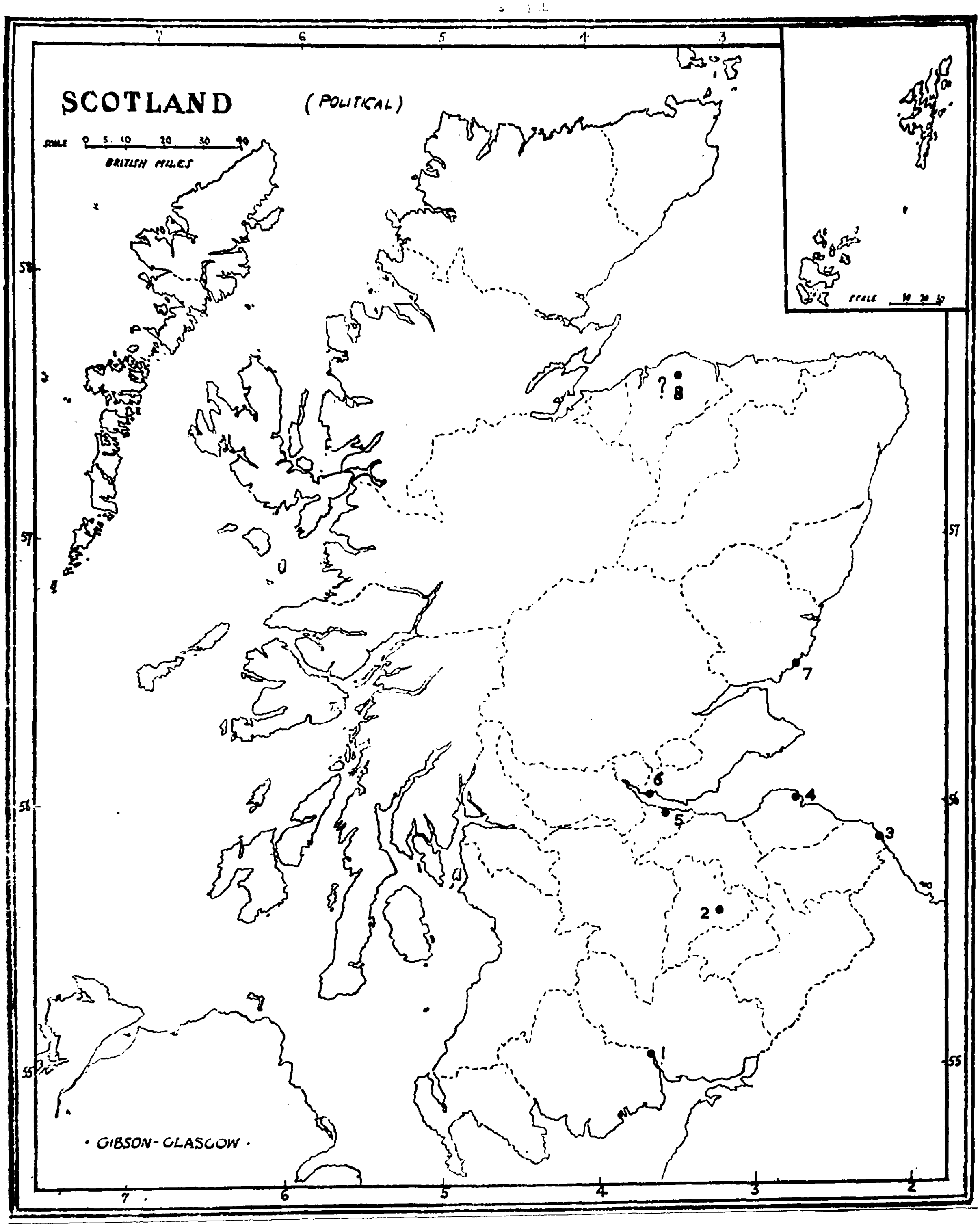
3. It would seem that, for Scottish Iron Age teeth at least, the actual dimensions of the teeth show differences between subgroups or between the sexes more clearly than does the shape of the tooth, in the form of the crown index.

ODONTOMETRY RESULTS. MEDIAEVAL GROUP.

This is a small and unimportant group of skulls. Several were derived from pre-Reformation burial grounds at Greyfriars Dumfries, Culross, Arbroath, Peebles and an unspecified monastery site in Morayshire (where, it was stated in a note with the skull, the ground had not been disturbed for 500 years). Two skulls from Blackness are stated (Ritchie, 1959) to have come from the site of a mediaeval chapel adjacent to the castle. The Seacliff cemetery is thought probably to have belonged to the mediaeval village of Auldhame (Ritchie, 1959). The Eyemouth skulls were found in a sandbank in association with fragments of 13th or 14th century pottery.

The group is small and probably ill-assorted. As has already been pointed out (vide supra) many of these skulls may have been those of ecclesiastics, who in all likelihood did not belong to the area in which they were buried. Dating also is tentative, and it is quite possible that some of the material belongs to the 16th or even later centuries.

The group consists of skulls from the following sites, whose/



Map 10. Distribution map of Mediaeval skulls.

whose distribution is illustrated by Map 10.

Site	No. indivs.	References
1. Greyfriars, Dumfries	4	
2. Holy Cross Church, Peebles	2	
3. Eyemouth, Berwickshire	3	
4. Seacliff, E. Lothian	4	Ritchie, 1959
5. Blackness, W. Lothian	2	Ritchie, 1959
6. Culross Abbey, Fife	2	
7. Arbroath Abbey, Angus	1	
8. Monastery, Morayshire	1	

All the skulls for which sex had been determined are males, and thus no sex comparisons are possible. In view of the small numbers no statistical preparation was done, and tables of mean values and ranges of variation are given for the sake of completeness, in tables 68-79.

TABLE 68. MEDIAEVAL

Mean mesiodistal crown diameters of maxillary teeth of Mediaeval males (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	1	(86)	-
I.2.	2	3	59	57-61
C.	6	8	74	72-77
P.1.	6	9	62	58-68
P.2.	6	8	61	57-66
M.1.	3	5	100	97-105
M.2.	6	7	92	85-103
M.3.	6	8	83	70-97

TABLE 69. MEDIAEVAL.

Mean mesiodistal crown diameters of maxillary teeth of Mediaeval males and females (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	3	5	86	83-90
I.2.	6	8	61	57-66
C.	11	16	73	66-77
P.1.	10	15	62	58-68
P.2.	10	16	62	58-70
M.1.	8	13	101	96-105
M.2.	13	18	89	78-103
M.3.	8	12	82	70-97

TABLE 70. MEDIAEVAL.

Mean mesiodistal crown diameters of mandibular teeth of Mediaeval males (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	1	(52)	-
I.2.	4	7	58	57-61
C.	7	10	66	63-70
P.1.	6	9	65	64-67
P.2.	7	12	64	62-67
M.1.	8	13	110	105-115
M.2.	8	15	101	94-116
M.3.	5	8	103	96-110

TABLE 71. MEDIAEVAL.

Mean mesiodistal crown diameters of mandibular teeth of Mediaeval males and females (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	4	7	51	49-52
I.2.	8	14	57	51-61
C.	12	19	64	60-70
P.1.	12	19	65	59-69
P.2.	12	21	65	62-73
M.1.	12	20	108	98-115
M.2.	12	23	100	91-116
M.3.	6	10	103	96-110

TABLE 72. MEDIAEVAL

Mean labiolingual crown diameters of maxillary teeth of Mediaeval males (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	2	2	72	68-75
I.2.	3	4	65	61-69
C.	6	9	85	80-94
P.1.	6	10	87	78-92
P.2.	6	8	88	82-97
M.1.	5	7	115	111-119
M.2.	5	9	112	106-120
M.3.	5	7	102	87-114

TABLE 73. MEDIAEVAL.

Mean labiolingual crown diameters of maxillary teeth of Mediaeval males and females (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	5	8	72	68-75
I.2.	8	11	62	52-69
C.	11	17	82	74-94
P.1.	10	16	87	78-94
P.2.	10	16	89	81-99
M.1.	10	15	114	108-120
M.2.	12	20	111	100-121
M.3.	7	11	105	87-125

TABLE 74. MEDIAEVAL

Mean labiolingual crown diameters of mandibular teeth of Mediaeval males (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	3	4	57	56-58
I.2.	5	8	61	60-63
C.	7	12	75	69-80
P.1.	6	9	74	69-78
P.2.	7	13	77	70-84
M.1.	7	12	105	101-108
M.2.	8	15	101	94-113
M.3.	6	9	100	94-107

TABLE 75. MEDIAEVAL.

Mean labiolingual crown diameters of mandibular teeth of Mediaeval males and females (1/10 m.m.).

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	6	10	59	56-61
I.2.	10	17	62	58-68
C.	12	21	74	67-80
P.1.	12	19	74	67-95
P.2.	12	22	77	69-87
M.1.	11	20	103	94-108
M.2.	12	23	98	85-113
M.3.	7	11	100	94-107

TABLE 76. MEDIAEVAL.

Mean crown indices of maxillary teeth of Mediaeval males.

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	1	(79.1)	-
I.2.	2	3	109.7	100.0-116.9
C.	6	8	114.0	108.0-122.1
P.1.	6	9	140.2	134.5-147.5
P.2.	6	8	144.8	132.8-155.7
M.1.	3	5	115.8	112.4-118.0
M.2.	5	6	125.2	113.5-130.4
M.3.	4	6	121.6	106.2-131.3

TABLE 77. MEDIAEVAL.

Mean crown indices of maxillary teeth of Mediaeval males and females.

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	3	5	84.6	79.1-89.2
I.2.	6	8	104.5	96.9-116.9
C.	11	16	112.0	102.6-122.1
P.1.	10	15	141.1	134.5-147.5
P.2.	10	16	144.0	132.8-155.7
M.1.	8	13	113.7	106.8-118.0
M.2.	12	17	125.7	113.5-133.3
M.3.	6	10	130.4	106.2-164.9

TABLE 78. MEDIAEVAL.

Mean crown indices of mandibular teeth of Mediaeval males.

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	1	1	(111.5)	-
I.2.	4	7	105.2	100.0-107.0
C.	7	10	113.4	98.6-123.1
P.1.	6	9	113.2	106.2-121.9
P.2.	7	12	118.9	109.4-127.3
M.1.	7	11	95.6	91.2-100.0
M.2.	8	15	99.7	95.0-104.9
M.3.	5	8	96.8	91.6-103.0

TABLE 79. MEDIAEVAL.

Mean crown indices of mandibular teeth of Mediaeval males and females.

Tooth	No. indivs.	No. teeth	Mean	Range
I.1.	4	7	116.5	111.5-122.4
I.2.	8	14	109.1	100.0-121.4
C.	12	19	114.3	95.7-128.3
P.1.	12	19	114.4	100.0-153.2
P.2.	12	21	117.9	109.4-127.3
M.1.	11	18	95.8	89.6-101.9
M.2.	12	23	98.0	88.5-104.9
M.3.	6	10	97.3	91.6-104.1

ODONTOMETRY RESULTS. COMPARISON OF MAIN GROUPS.

Numbers of observations are sufficiently great to permit statistical comparisons between the males of the Total Bronze Age and Total Iron Age groups, and between the females of the same groups. No such comparisons can be made between Total Neolithic or Mediaeval and the other groups, since the numbers of sexed skulls in the former two groups are very small.

Mean mesiodistal diameters of the maxillary and mandibular teeth of Total Bronze Age and Iron Age groups are compared in Tables 80-83.

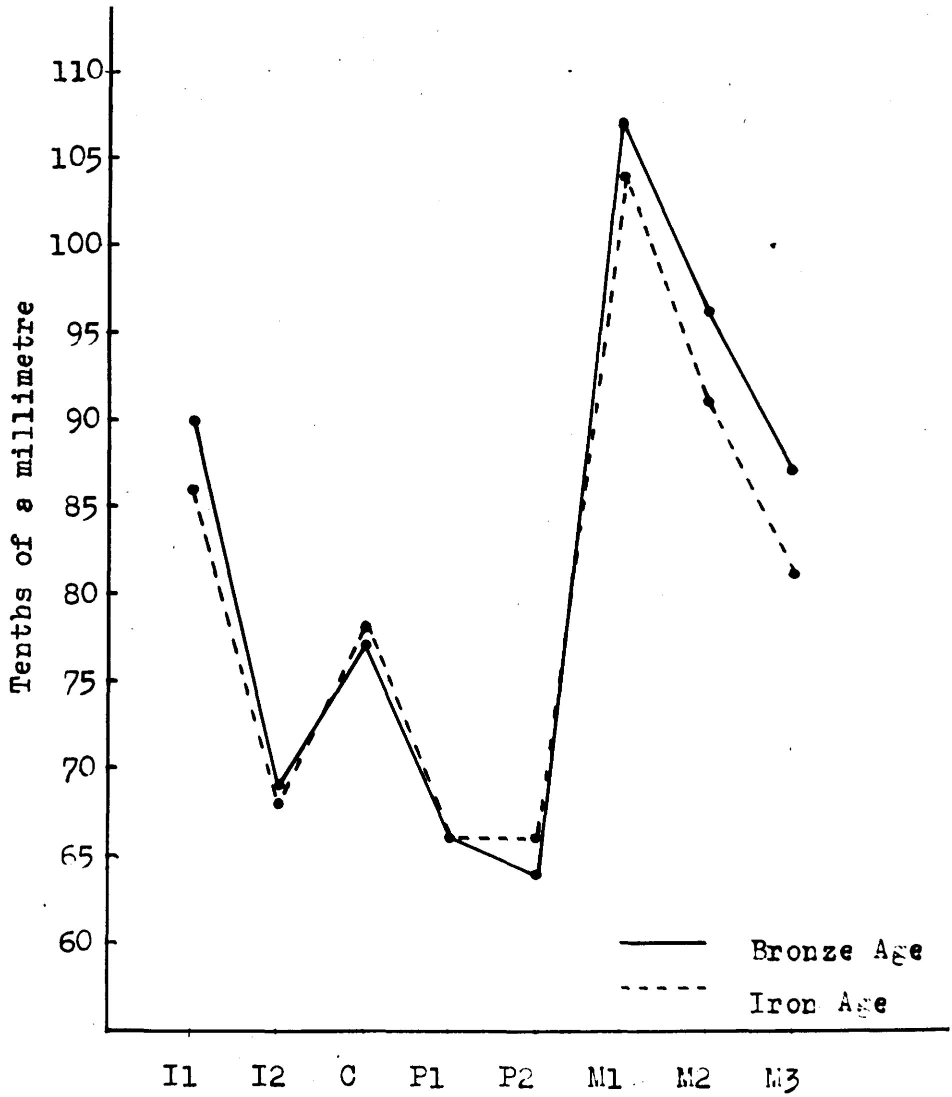


Fig. 41. The mean values of the mesiodistal diameters of the maxillary teeth in Bronze Age and Iron Age males.

Table 80.

Comparison of mean mesiodistal crown diameters of maxillary teeth of total Bronze Age and total Iron Age males. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	5	7	90	80-97	6.1	2.3	4	2.5	1.6
	IA	9	15	86	82-92	3.6	0.9			
I.2.	BA	10	16	69	55-78	6.0	1.5	1	2.0	0.5
	IA	13	19	68	59-82	5.8	1.3			
C.	BA	15	24	77	68-86	4.8	1.0	1	1.3	0.8
	IA	19	32	78	67-88	4.5	0.8			
P.1.	BA	19	29	66	59-75	3.9	0.7	0	-	-
	IA	19	30	66	60-78	4.5	0.8			
P.2.	BA	19	31	64	55-72	4.6	0.8	2	0.9	2.2
	IA	18	31	66	62-73	2.8	0.5			
M.1.	BA	16	27	107	96-122	6.5	1.3	3	1.6	1.9
	IA	9	17	104	96-110	4.1	1.0			
M.2.	BA	18	29	96	84-106	5.4	1.0	5	1.6	<u>3.1</u>
	IA	17	28	91	80-104	6.4	1.2			
M.3.	BA	11	16	87	75-96	6.1	1.5	6	2.0	<u>3.0</u>
	IA	16	26	81	64-92	6.8	1.3			

x N.I. - Number of individuals
x N.T. - Number of teeth

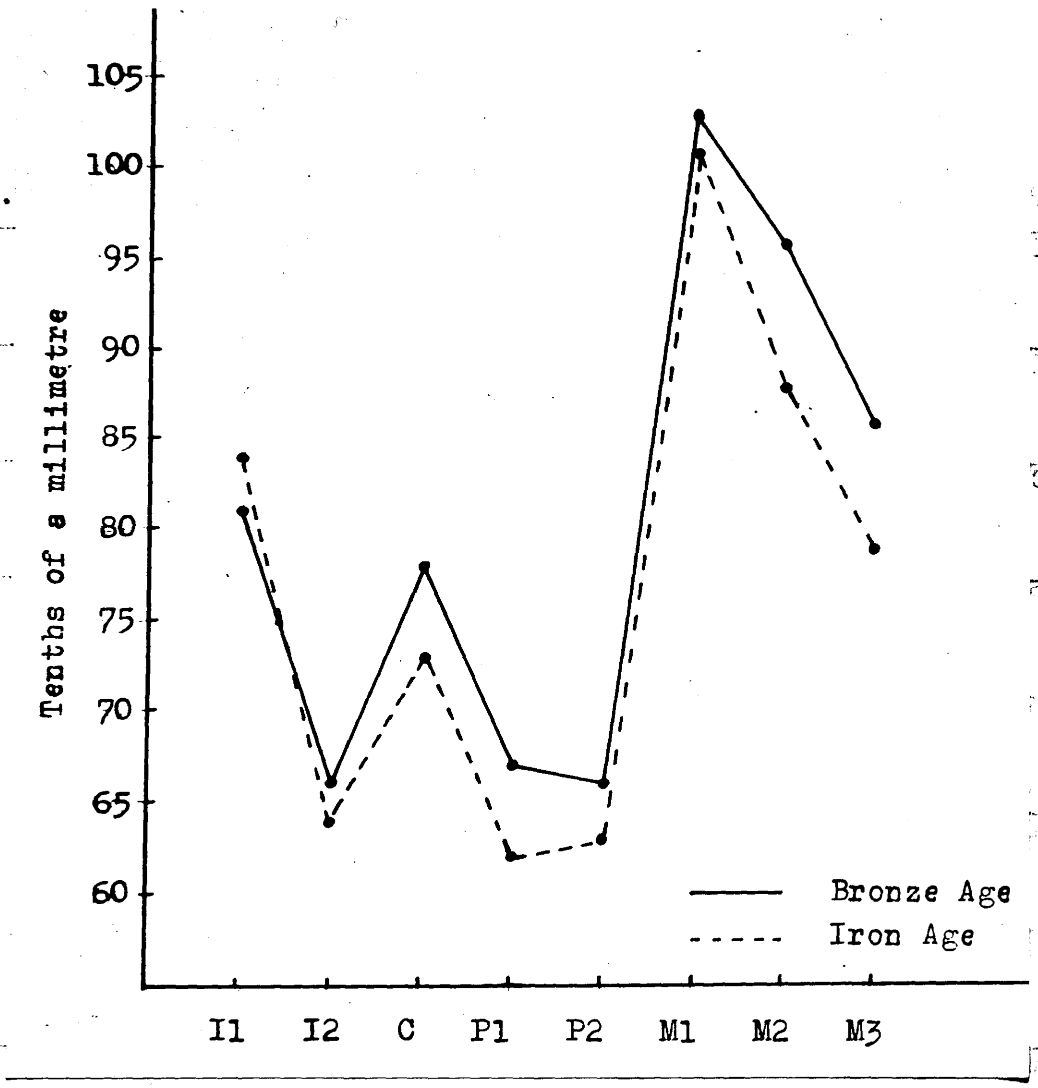


Fig. 42. The mean values of the mesiodistal diameters of the maxillary teeth in Bronze Age and Iron Age females.

Table 81.

Comparison of mean mesiodistal crown diameters of maxillary teeth of total Bronze Age and total Iron Age females. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	3	6	81	76-89	5.6	2.3	3	2.7	1.1
	IA	4	8	84	80-90	4.0	1.4			
I.2.	BA	5	8	66	60-74	5.3	1.9	2	2.3	0.9
	IA	9	12	64	59-75	4.6	1.3			
C.	BA	7	11	78	74-85	3.3	1.0	5	1.3	3.8
	IA	17	25	73	67-82	4.1	0.8			
P.1.	BA	7	11	67	61-76	5.2	1.6	5	1.7	2.9
	IA	17	27	62	57-69	3.3	0.6			
P.2.	BA	9	14	66	60-70	4.4	1.2	3	1.3	2.3
	IA	16	26	63	58-69	2.3	0.5			
M.1.	BA	8	12	103	97-114	4.8	1.4	2	1.7	1.2
	IA	16	27	101	88-108	5.2	1.0			
M.2.	BA	7	11	96	90-106	4.5	1.4	8	1.7	4.7
	IA	18	29	88	76-100	5.6	1.0			
M.3.	BA	5	7	86	82-89	2.7	1.0	7	1.6	4.4
	IA	14	20	79	68-93	5.8	1.3			

x N.I. - Number of individuals

x N.T. - Number of teeth

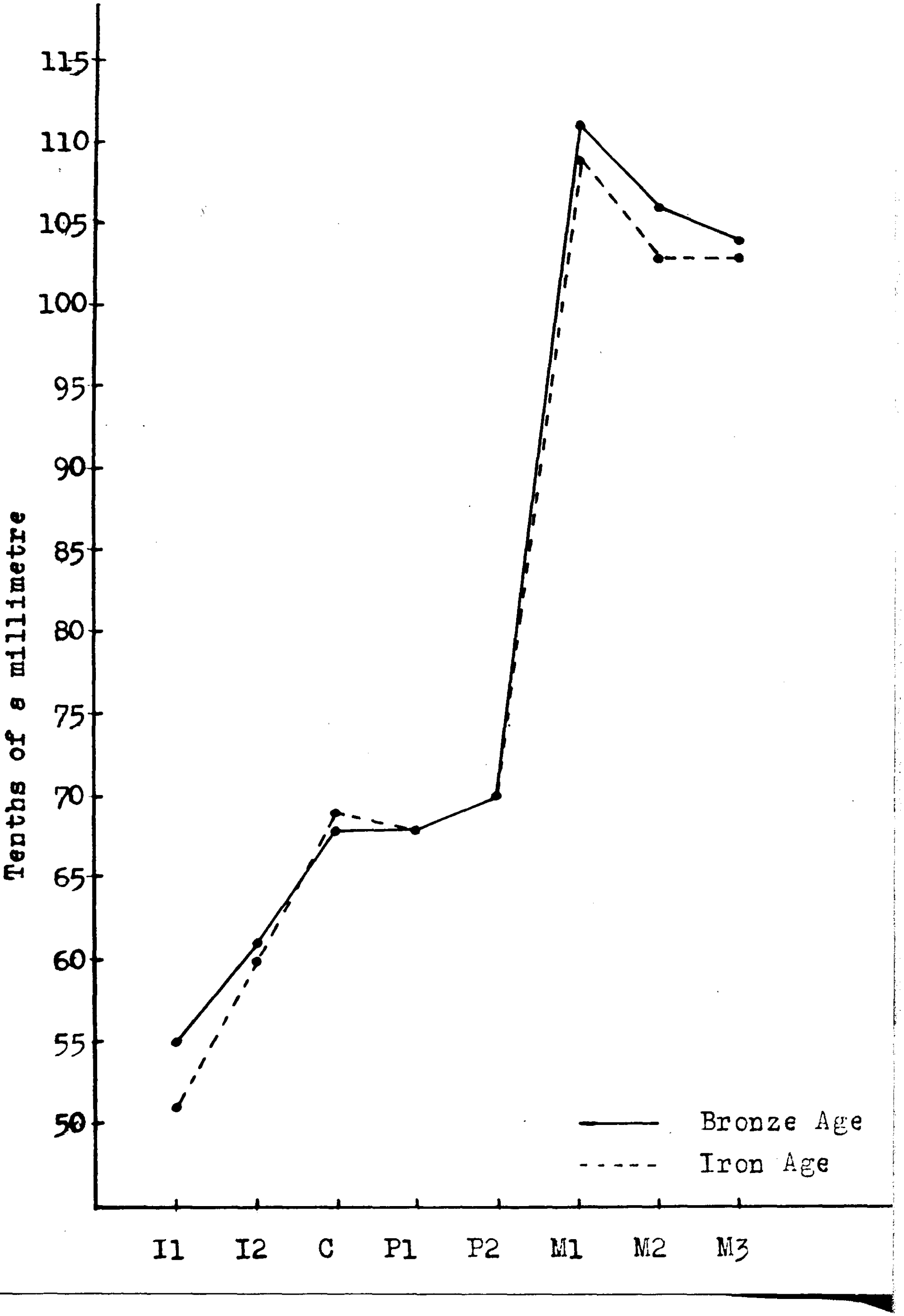


Fig. 43. The mean values of the mesiodistal diameters of the mandibular teeth in Bronze Age and Iron Age males.

Table 82.

Comparison of mean mesiodistal crown diameters of mandibular teeth of total Bronze Age and total Iron age males. (1/10 m.m.)

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	7	12	55	47-60	4.5	1.3	4	1.5	<u>2.7</u>
	IA	4	7	51	49-54	1.8	0.7			
I.2.	BA	11	16	61	54-68	3.8	1.0	1	1.3	0.8
	IA	9	14	60	55-67	3.5	0.9			
C.	BA	17	25	68	61-75	3.7	0.7	1	0.9	1.1
	IA	18	31	69	63-77	3.3	0.6			
P.1.	BA	22	32	68	62-73	2.9	0.5	0	-	-
	IA	20	36	68	60-78	4.6	0.8			
P.2.	BA	17	29	70	65-76	3.3	0.6	0	-	-
	IA	20	35	70	63-81	4.6	0.8			
M.1.	BA	20	30	111	99-120	5.2	0.9	2	1.1	1.8
	IA	12	20	109	102-114	3.3	0.7			
M.2.	BA	20	30	106	90-119	7.1	1.3	3	1.6	1.9
	IA	20	32	103	91-111	5.1	0.9			
M.3.	BA	14	22	104	89-117	6.9	1.5	1	2.1	0.5
	IA	20	30	103	83-115	7.5	1.4			

x N.I.- Number of individuals
x N.T.- Number of teeth

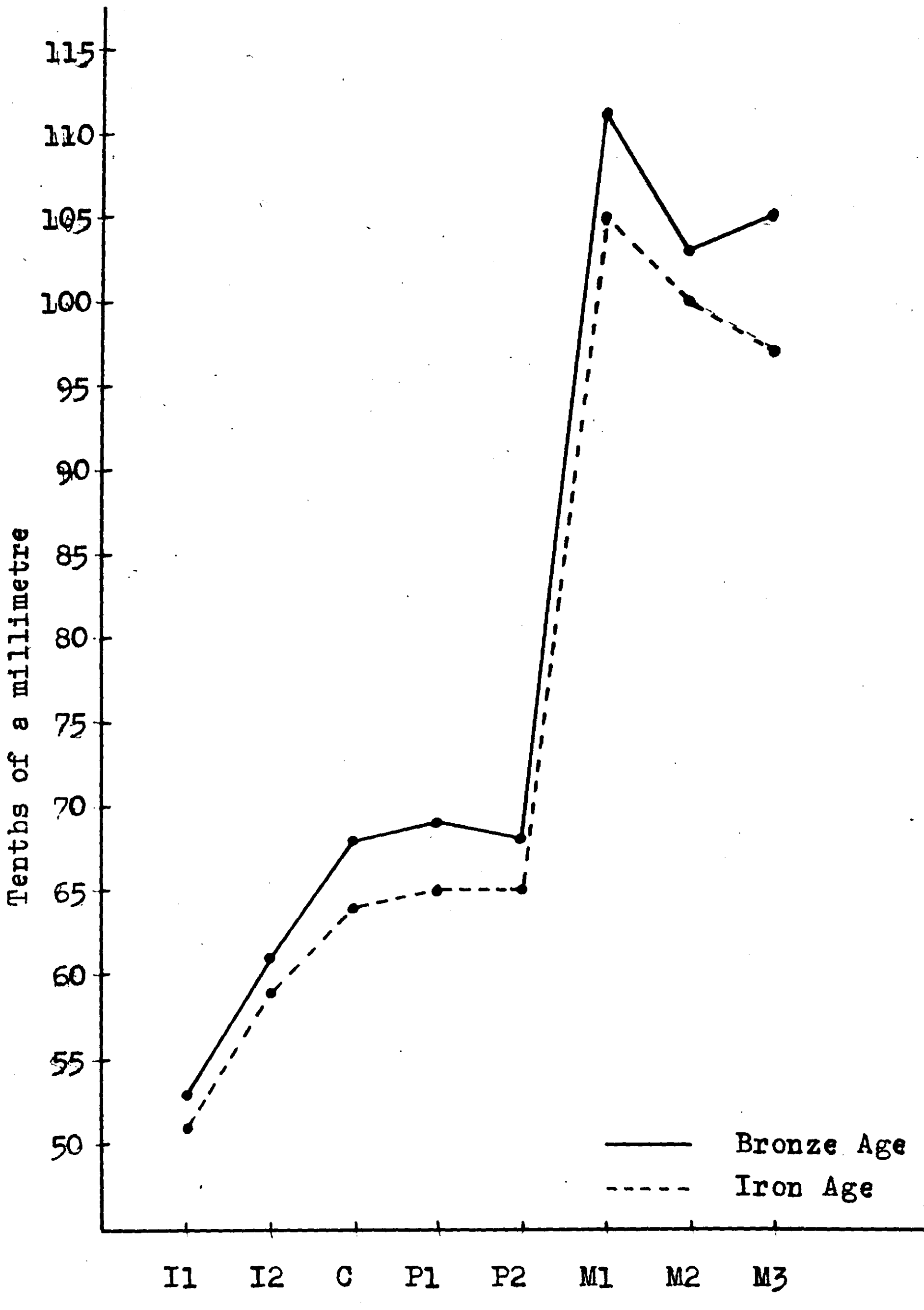


Fig. 44. The mean values of the mesiodistal diameters of the mandibular teeth in Bronze Age and Iron Age females.

Table 83.

Comparison of mean mesiodistal crown diameters of mandibular teeth of total Bronze Age and total Iron Age females. (1/10 m.m.)

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	2	4	53	48-57	-	-	2	-	-
	IA	2	3	51	48-53	-	-			
I.2.	BA	6	8	61	53-67	6.0	2.1	2	2.3	0.9
	IA	9	15	59	54-67	3.7	0.9			
C.	BA	7	13	68	62-74	4.8	1.3	4	1.4	2.9
	IA	14	21	64	60-68	2.5	0.5			
P.1.	BA	6	11	69	64-74	3.4	1.0	4	1.3	3.1
	IA	14	22	65	58-73	3.9	0.8			
P.2.	BA	7	13	68	64-75	2.9	0.8	3	1.1	2.7
	IA	14	21	65	59-76	3.7	0.8			
M.1.	BA	6	11	111	105-115	3.4	1.0	6	1.6	3.8
	IA	16	25	105	97-115	6.0	1.2			
M.2.	BA	7	12	103	93-110	5.3	1.5	3	1.7	1.8
	IA	16	25	100	90-111	4.4	0.9			
M.3.	BA	5	8	105	101-109	3.0	1.1	8	1.9	4.2
	IA	13	19	97	85-107	6.6	1.5			

x N.I. - Number of individuals
x N.T. - Number of teeth

The mesiodistal diameters of the maxillary second molar and third molar and of the mandibular first incisor of the Bronze Age males are significantly larger than those of the Iron Age males. In none of the other teeth was there any significant difference in mesiodistal diameter between Bronze Age and Iron Age males, but the majority of the teeth of the Bronze Age males show mean values which are larger than, or equal to, those of the teeth of the Iron Age males. In three teeth - the maxillary canine and second premolar, and the mandibular canine - the mean mesiodistal diameter is greater in the Iron Age males than in the Bronze Age males.

Greater differences are found between the Bronze Age and Iron Age females in respect of mesiodistal tooth diameters. Significant differences exist for the maxillary canine, first premolar, second molar and third molar, and for the mandibular canine, first premolar, second premolar, first molar and third molar. In all these teeth the mean value for Bronze Age females is greater than that for Iron Age females. In only one tooth, the maxillary first incisor, is the mean mesiodistal diameter for the Iron Age females greater than that for the Bronze Age females.

In general, it can be stated that the mesiodistal diameter is/

is greater in the teeth of the Bronze Age individual than in those of his Iron Age counterpart, and that the difference is more marked in the females than in the males.

Relative size of molars.

In both the Bronze Age group and the Iron Age group, the maxillary molars show a gradual decrease in size from the first to the third molar in both sexes (Figs. 41 & 42).

In the mandible, there are some differences between the Bronze Age and the Iron Age groups in the pattern of molar reduction. The Bronze Age males show a gradual decrease in mesiodistal diameter from the first molar to the third molar, while the Iron Age males show a slight variation in the relationship of the third molar to the second molar (Fig. 43). In comparing the females of Bronze Age and Iron Age groups, this situation is found to be reversed, as it can be seen from Fig. 44 that the Iron Age females show a gradual decrease in mesiodistal diameter from the first molar to the third molar, while the Bronze Age females show a marked deviation from this pattern.

Mean labiolingual diameters of the maxillary and mandibular teeth of Total Bronze Age and Iron Age groups are compared in Tables 84-87.

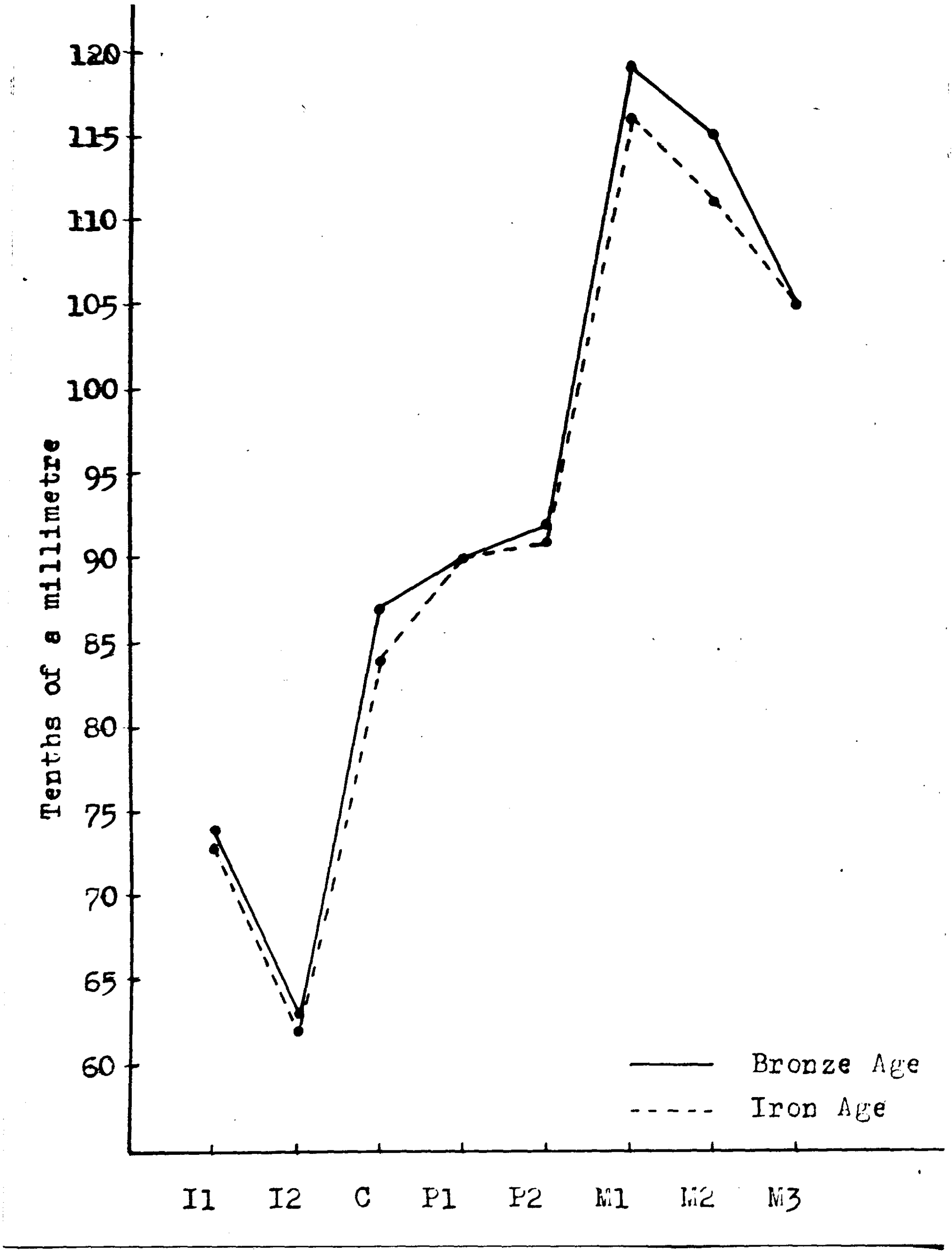


Fig. 45. The mean values of the labiolingual diameters of the maxillary teeth in Bronze Age and Iron Age males.

Table 84.

Comparison of mean labiolingual crown diameters of maxillary teeth of total Bronze Age and total Iron Age males.

(1/10 m.m.)

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	8	11	74	68–79	4.0	1.2	1	1.4	0.7
	IA	15	24	73	66–81	3.9	0.8			
I.2.	BA	11	16	63	55–74	4.9	1.2	1	1.6	0.6
	IA	16	22	62	54–73	5.4	1.1			
C.	BA	16	24	87	71–99	6.2	1.3	3	1.4	2.1
	IA	20	33	84	75–91	3.6	0.6			
P.1.	BA	18	28	90	83–102	5.4	1.0	0	–	–
	IA	19	32	90	81–100	5.8	1.0			
P.2.	BA	16	26	92	84–102	5.9	1.2	1	1.4	0.7
	IA	19	32	91	83–98	4.5	0.8			
M.1.	BA	13	19	119	110–128	6.2	1.4	3	1.5	2.0
	IA	12	22	116	111–122	3.0	0.6			
M.2.	BA	16	27	115	105–123	5.5	1.1	4	1.6	2.5
	IA	18	27	111	96–120	5.7	1.1			
M.3.	BA	11	15	105	94–130	10.1	2.6	0	–	–
	IA	16	25	105	89–119	6.9	1.4			

x N.I. – Number of individuals
x N.T. – Number of teeth

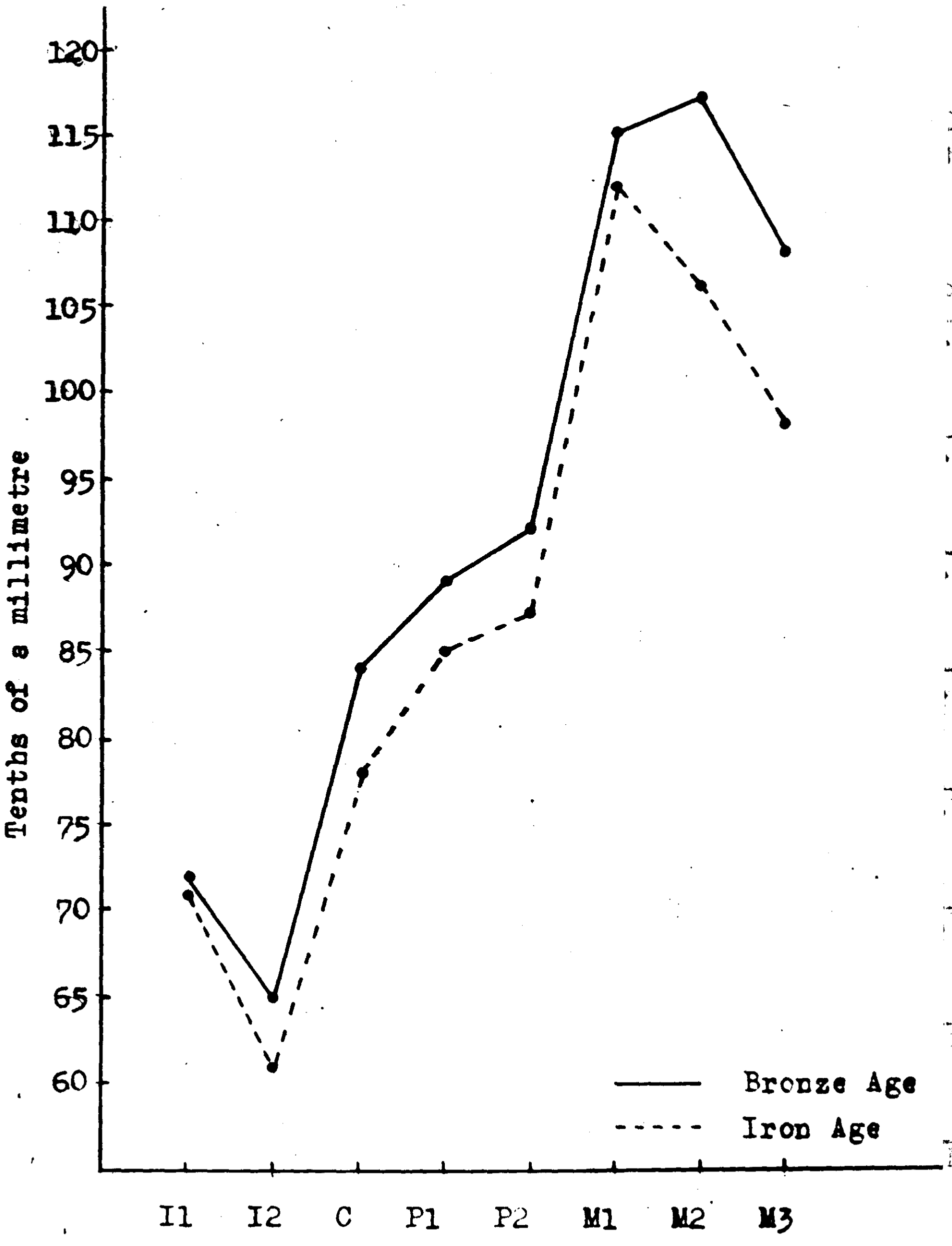


Fig. 46. The mean values of the labiolingual diameters of the maxillary teeth in Bronze Age and Iron Age females.

Table 85.

Comparison of mean labiolingual crown diameters of maxillary teeth of total Bronze Age and total Iron Age females. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	4	7	72	68–76	3.0	1.2	1	1.6	0.6
	IA	7	12	71	62–75	3.6	1.0			
I.2.	BA	5	8	65	60–69	2.7	1.0	4	1.6	2.5
	IA	10	16	61	51–70	5.0	1.3			
C.	BA	7	11	84	79–90	3.7	1.1	6	1.4	4.3
	IA	18	26	78	70–86	4.5	0.9			
P.1.	BA	7	12	89	83–96	3.8	1.1	4	1.4	2.9
	IA	14	23	85	74–91	3.6	0.8			
P.2.	BA	7	12	92	83–96	4.1	1.2	5	1.4	3.6
	IA	15	25	87	79–93	4.1	0.8			
M.1.	BA	8	12	115	109–122	3.7	1.1	3	1.6	1.9
	IA	13	21	112	98–120	5.7	1.2			
M.2.	BA	7	12	117	109–126	5.3	1.5	11	2.0	5.5
	IA	17	27	106	91–119	6.7	1.3			
M.3.	BA	5	8	108	97–112	6.1	2.2	10	2.6	3.8
	IA	14	21	98	90–110	6.5	1.4			

x N.I. – Number of individuals
x N.T. – Number of teeth

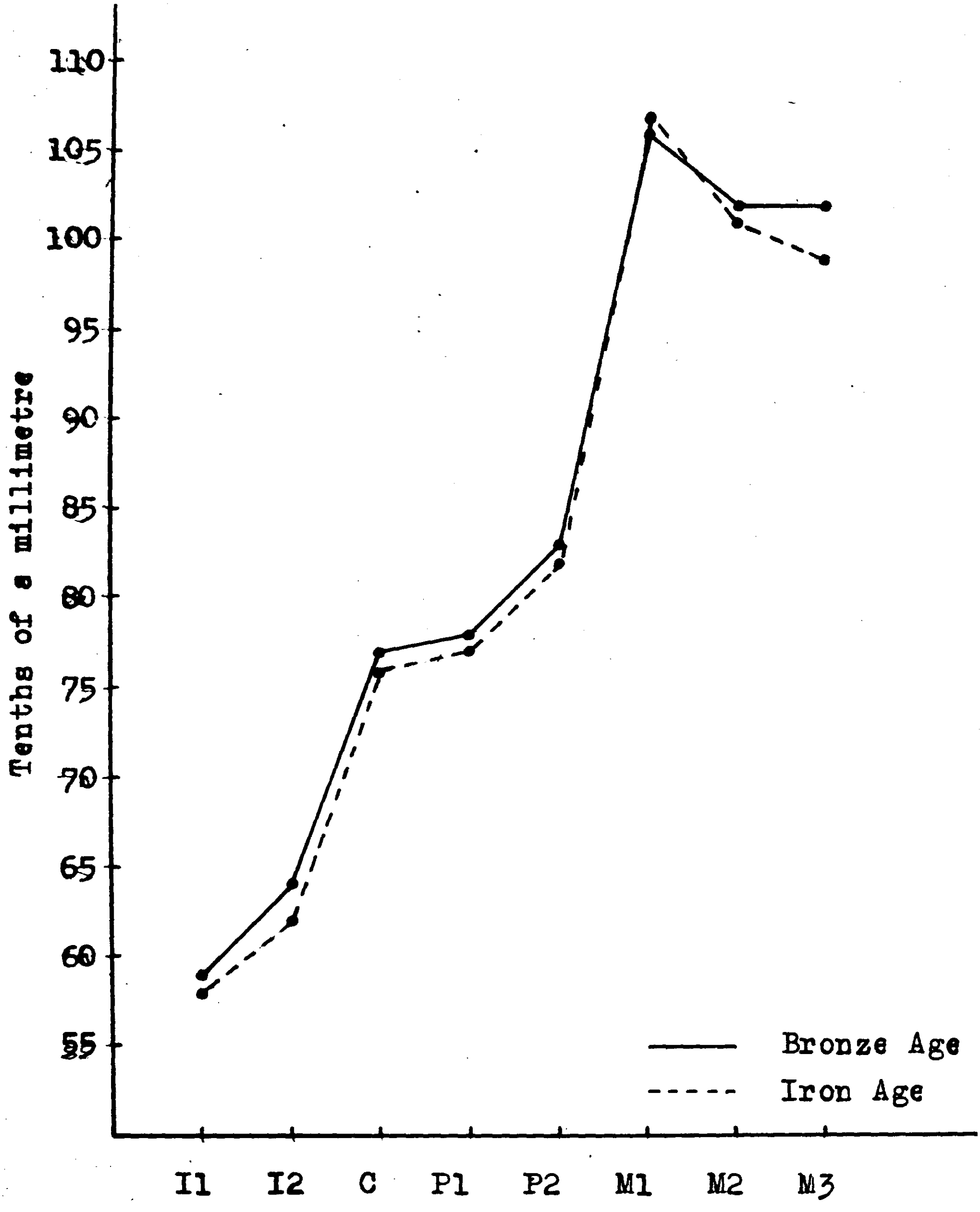


Fig. 47. The mean values of the labiolingual diameters of the mandibular teeth in Bronze Age and Iron Age males.

Table 86.

Comparison of mean labiolingual crown diameters of mandibular teeth of total Bronze Age and total Iron Age males.(1/10 m.m.)

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	9	16	59	53–64	3.1	0.8	1	1.5	0.7
	IA	8	13	58	50–65	4.5	1.3			
I.2.	BA	11	17	64	58–70	3.5	0.9	2	1.4	1.4
	IA	9	17	62	55–72	4.5	1.1			
C.	BA	17	25	77	64–88	5.8	1.2	1	1.6	0.6
	IA	16	24	76	65–87	5.4	1.1			
P.1.	BA	20	29	78	69–85	3.9	0.7	1	1.1	0.9
	IA	19	35	77	68–87	4.8	0.8			
P.2.	BA	17	27	83	77–90	3.7	0.7	1	1.1	0.9
	IA	20	35	82	73–94	4.9	0.8			
M.1.	BA	16	24	106	94–114	5.5	1.1	1	1.3	0.8
	IA	14	20	107	101–112	2.9	0.6			
M.2.	BA	18	25	102	83–112	7.3	1.5	1	1.7	0.6
	IA	20	29	101	90–109	4.7	0.9			
M.3.	BA	14	21	102	87–110	6.9	1.5	3	1.9	1.6
	IA	19	27	99	86–109	5.9	1.1			

x N.I. – Number of individuals
x N.T. – Number of teeth

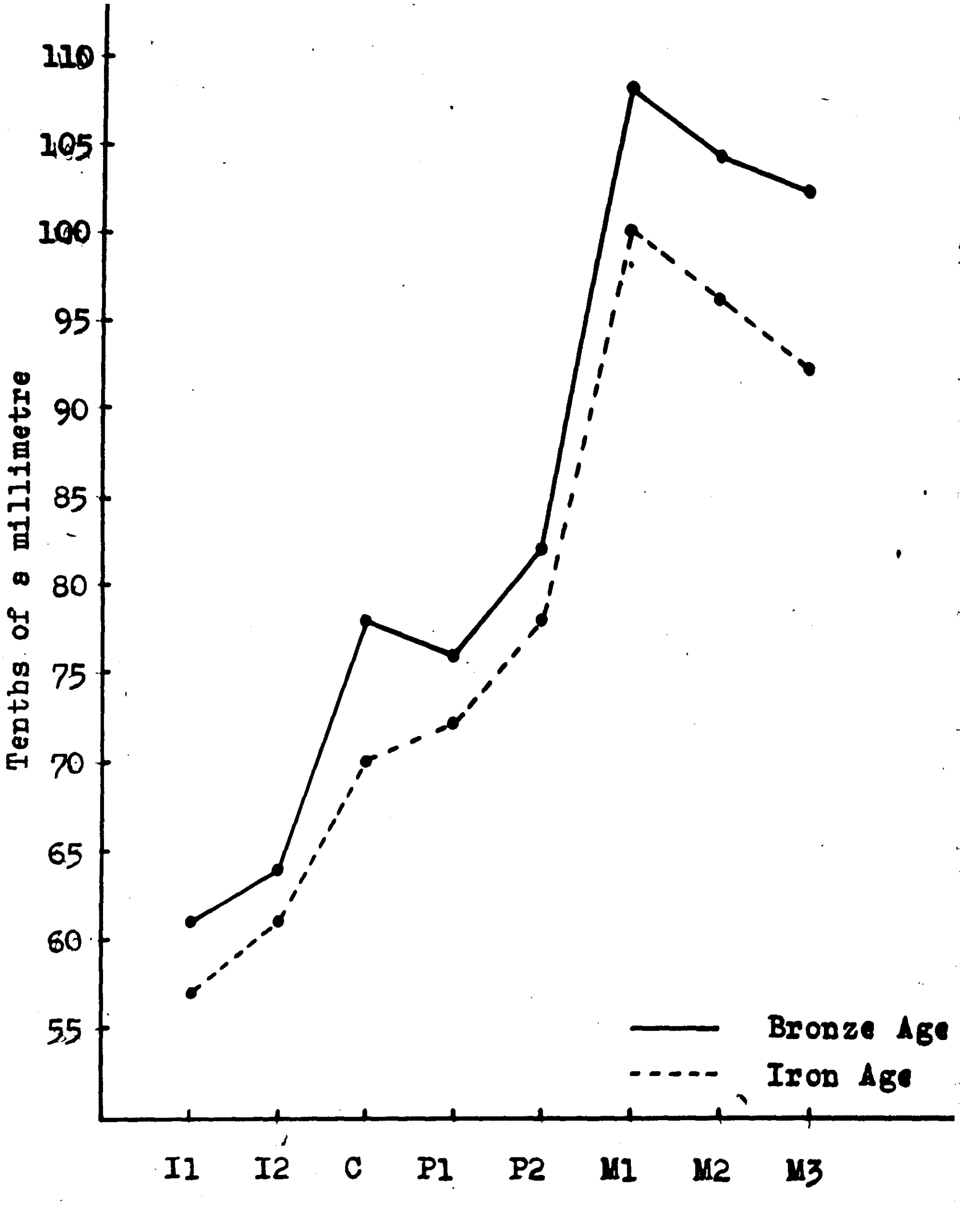


Fig. 48. Mean values of the labiolingual diameters of the mandibular teeth in Bronze Age and Iron Age females.

Table 87.

Comparison of mean labiolingual crown diameters of mandibular teeth of total Bronze Age and total Iron Age females. (1/10 m.m.)

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	2	4	61	60-62	-	-	4	-	-
	IA	3	5	57	52-65	6.7	3.0			
I.2.	BA	6	8	64	60-65	1.8	0.6	3	1.6	1.9
	IA	8	13	61	53-69	5.3	1.5			
C.	BA	7	12	78	73-82	2.9	0.8	8	1.4	5.7
	IA	11	15	70	64-78	4.5	1.2			
P.1.	BA	6	11	76	73-80	2.7	0.8	4	1.3	3.1
	IA	12	18	72	67-78	4.0	1.0			
P.2.	BA	7	12	82	76-86	3.0	0.9	4	1.5	2.7
	IA	13	21	78	72-91	5.3	1.2			
M.1.	BA	5	9	108	105-111	2.3	0.8	8	1.6	5.0
	IA	15	22	100	85-114	6.5	1.4			
M.2.	BA	6	11	104	98-106	2.3	0.7	8	1.3	6.2
	IA	17	26	96	85-106	5.4	1.1			
M.3.	BA	6	9	102	95-106	3.5	1.2	10	2.1	4.8
	IA	12	18	92	81-103	7.2	1.7			

x N.I. - Number of individuals
x N.T. - Number of teeth

The same trends are apparent with labiolingual as with mesiodistal tooth diameters. For the male maxillary teeth, only one result is just significant (C.R. 2.5), and this is for the second molar, which is larger in the Bronze Age group than in the Iron Age group. No significant differences exist between Bronze Age and Iron Age males in respect of the labiolingual diameter of mandibular teeth, and the mean values for the two groups are very close. The only instance in which the mean labiolingual diameter of an Iron Age tooth is greater than that of the Bronze Age tooth, is that of the mandibular first molar in the male.

The mean labiolingual diameters of the teeth of Bronze Age females are all larger than those of Iron Age females. Significant differences exist between the groups for all the teeth except the maxillary first incisor and first molar, and the mandibular first incisor and second incisor.

In general, the mean labiolingual diameters of Bronze Age teeth are greater than those of Iron Age teeth. The differences are more marked in the females than in the males.

Mean crown indices of the maxillary and mandibular teeth of Total Bronze Age and Iron Age groups are compared in Tables 88-91.

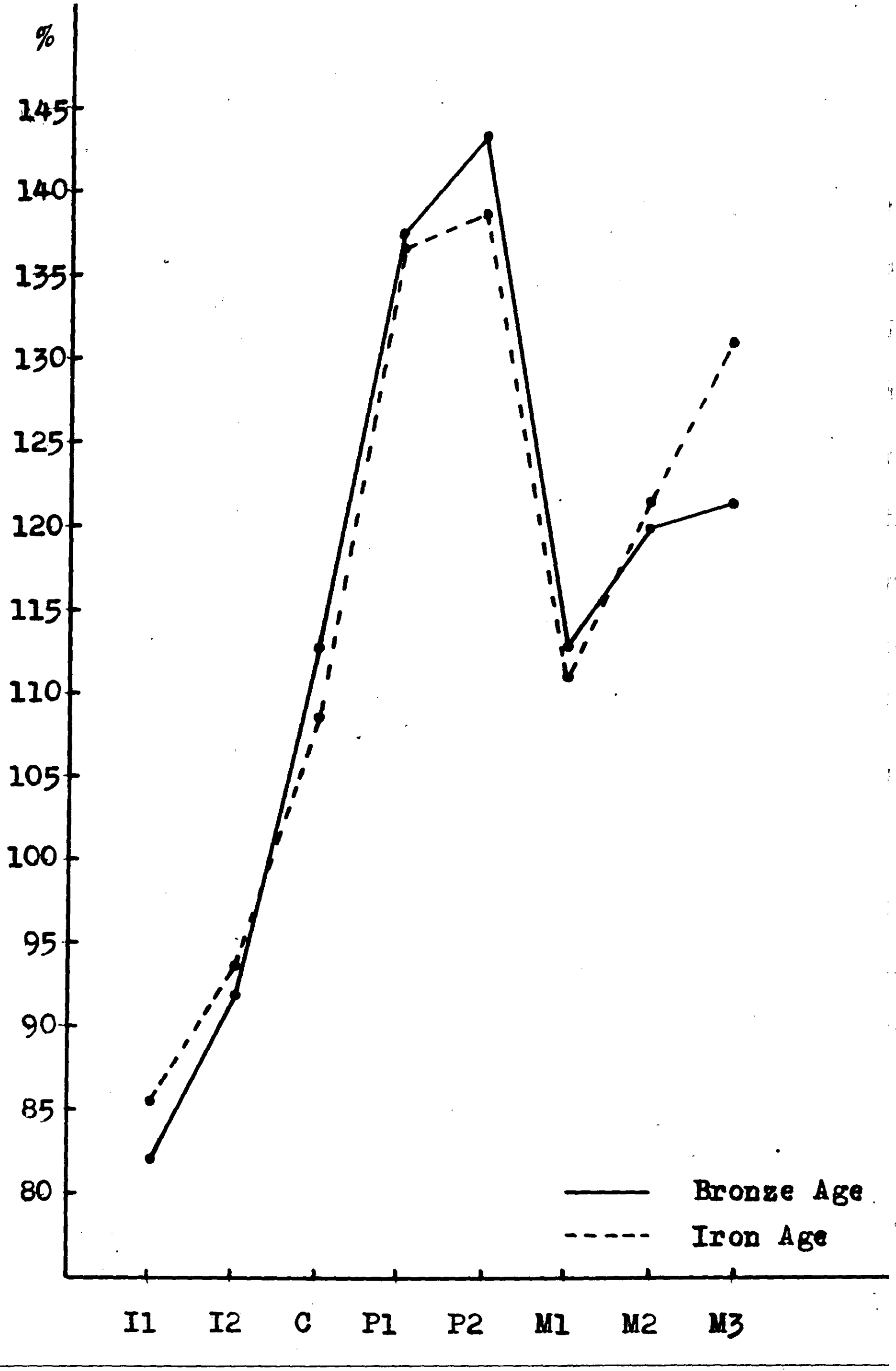


Fig. 49. The mean values of the crown indices of the maxillary teeth in Bronze Age and Iron Age males.

Table 88.

Comparison of mean crown indices of maxillary teeth of total Bronze Age and total Iron Age males.

Tooth	Gp.	N.I. (x)	N.T. (x)	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	5	6	82.2	77.3-87.5	3.8	1.6	3.2	2.0	1.6
	IA	9	14	85.4	77.6-94.1	4.6	1.2			
I.2.	BA	10	14	91.9	78.4-108.8	8.6	2.3	1.5	3.3	0.5
	IA	13	19	93.4	78.0-114.8	10.5	2.4			
C.	BA	15	23	112.5	97.3-135.3	8.5	1.8	4.1	2.1	2.0
	IA	19	30	108.4	98.7-119.4	5.5	1.0			
P.1.	BA	17	27	137.3	122.7-156.3	7.8	1.5	0.7	2.0	0.4
	IA	18	29	136.6	120.8-150.0	7.2	1.3			
P.2.	BA	16	26	143.0	127.9-156.3	8.2	1.6	4.6	2.1	2.2
	IA	18	29	138.4	123.2-150.0	6.8	1.3			

M.1./

Table 88. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	BA	12	18	112.5	106.9-119.6	3.5	0.8	1.6	1.1	1.5
	IA	9	17	110.9	106.4-117.7	3.2	0.8			
M.2.	BA	16	26	119.5	110.0-139.8	6.1	1.2	1.8	1.8	1.0
	IA	16	25	121.3	112.4-142.0	7.1	1.4			
M.3.	BA	11	15	121.2	109.5-149.4	9.5	2.5	9.2	3.4	2.7
	IA	15	24	130.4	117.4-157.8	11.4	2.3			

x N.I. - Number of individuals
x N.T. - Number of teeth

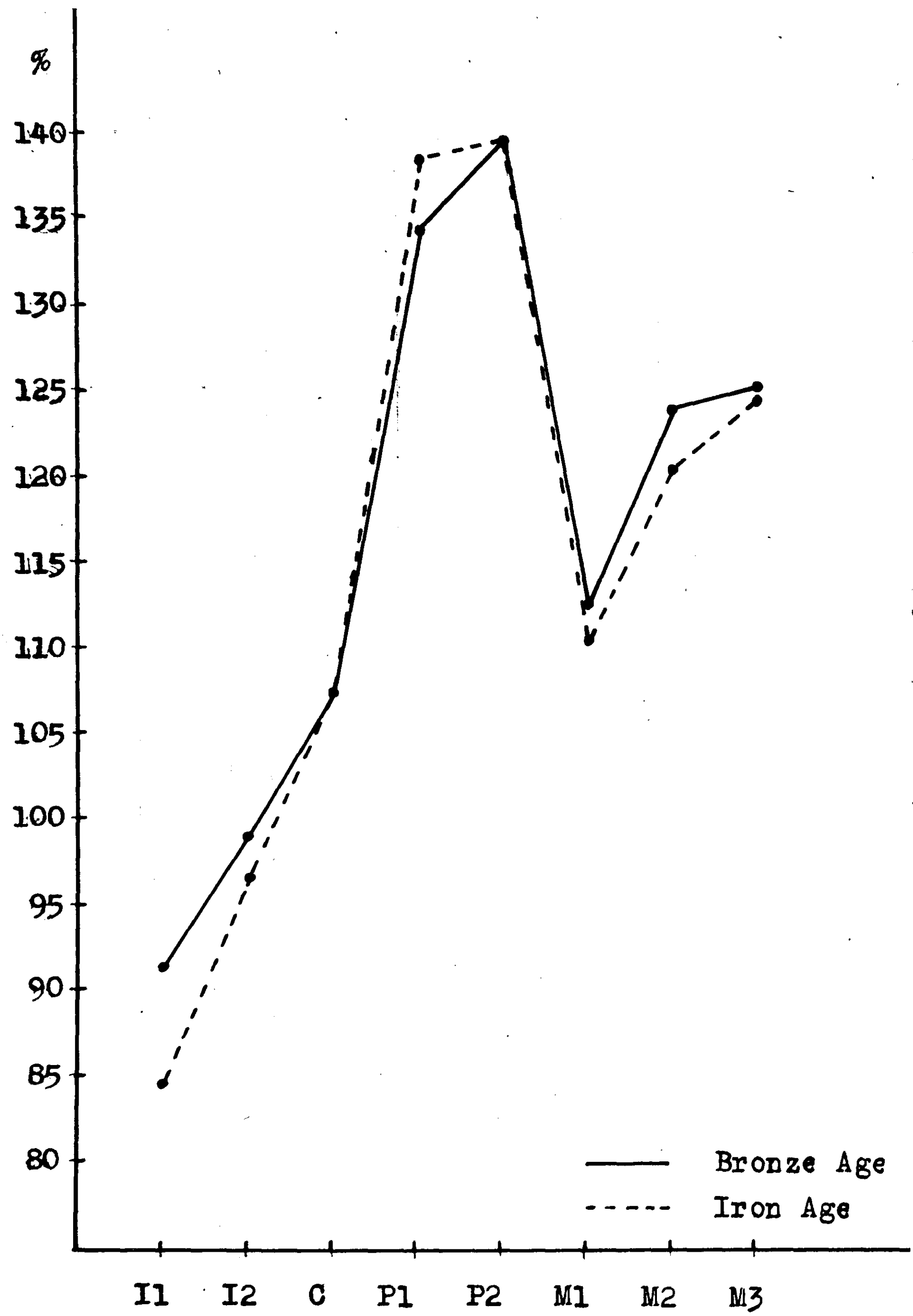


Fig. 50. The Mean values of the crown indices of the maxillary teeth in Bronze Age and Iron Age females.

Table 89.

Comparison of mean crown indices of maxillary teeth of total Bronze Age and total Iron Age females.

Tooth	Gp.	x N.I.	x N.T.	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	3	6	91.4	80.9-100.0	8.4	3.5	6.6	3.9	1.7
	IA	4	8	84.8	79.8-90.4	4.8	1.7			
I.2.	BA	5	7	99.0	81.1-111.7	10.7	4.1	2.1	4.4	0.5
	IA	8	11	96.9	89.7-105.1	5.0	1.5			
C.	BA	7	11	107.3	102.6-118.4	5.2	1.6	0.2	2.1	0.1
	IA	17	25	107.5	94.9-120.0	7.0	1.4			
P.1.	BA	7	11	134.5	118.4-146.2	9.6	2.9	3.9	3.3	1.2
	IA	14	23	138.4	127.6-157.9	7.4	1.5			
P.2.	BA	7	12	139.7	125.8-149.2	6.3	1.8	0.3	2.0	0.2
	IA	15	24	139.4	131.3-148.4	4.0	0.8			

M.1./

Table 89. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	BA	8	12	112.6	105.3-116.5	3.2	0.9	2.2	1.3	1.7
	IA	13	21	110.4	96.3-115.2	4.0	0.9			
M.2.	BA	6	10	123.9	115.5-129.0	4.7	1.5	3.5	1.8	1.9
	IA	17	27	120.4	111.0-132.1	5.3	1.0			
M.3.	BA	5	8	125.3	114.1-136.6	7.6	2.7	0.7	3.2	0.2
	IA	14	20	124.6	108.6-136.1	7.6	1.7			

x N.I. – Number of individuals
x N.T. – Number of teeth

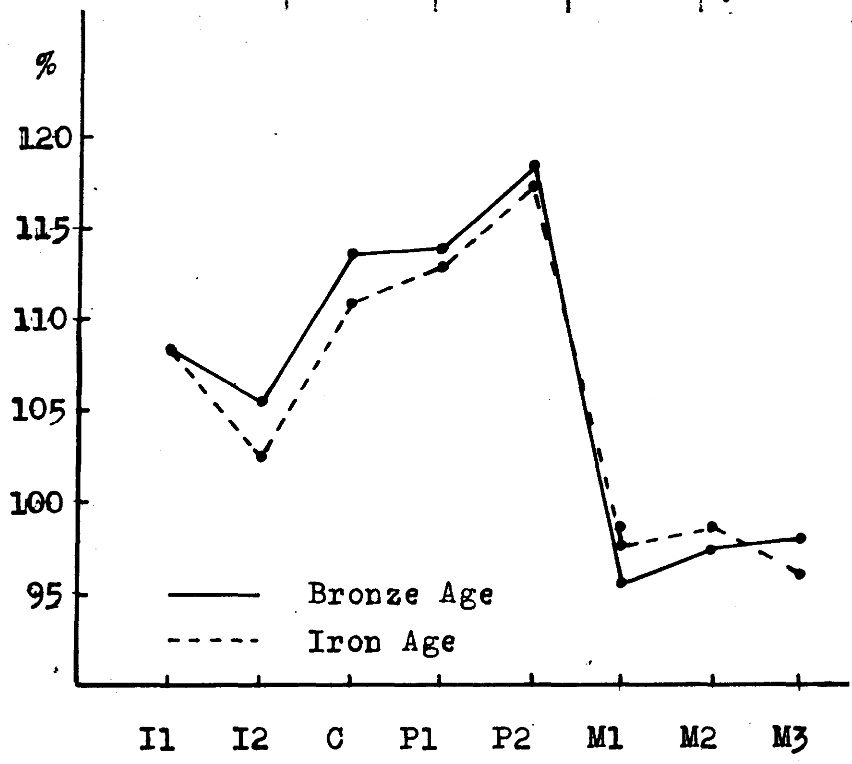


Fig. 51. The mean values of the crown indices of the mandibular teeth in Bronze Age and Iron Age males.

Table 90.

Comparison of mean crown indices of mandibular teeth of total Bronze Age and total Iron Age **males**.

Tooth	Gp.	N.I.[x]	N.T.[x]	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	7	12	108.4	91.4-136.2	13.5	3.9	0.4	6.2	0.1
	IA	4	6	108.8	94.3-119.6	11.4	4.8			
I.2.	BA	9	14	105.5	93.8-117.2	7.4	2.0	2.8	2.6	1.1
	IA	7	11	102.7	94.8-110.3	5.5	1.7			
C.	BA	17	24	113.5	102.7-125.7	6.0	1.2	2.6	1.8	1.4
	IA	16	24	110.9	98.5-126.1	6.2	1.3			
P.1.	BA	20	29	113.9	104.5-124.2	5.6	1.0	0.9	1.6	0.6
	IA	19	35	113.0	101.4-123.4	6.9	1.2			
P.2.	BA	16	26	118.6	109.3-130.9	6.3	1.2	1.0	1.6	0.6
	IA	20	34	117.6	102.8-131.8	6.6	1.1			

M.1./

Table 90. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	BA	16	22	95.6	84.7-103.8	5.5	1.2	2.1	1.4	1.5
	IA	12	18	97.7	93.0-103.8	3.0	0.7			
M.2.	BA	17	23	97.5	85.0-106.3	6.2	1.3	1.3	1.6	0.8
	IA	19	26	98.8	88.2-108.2	5.0	1.0			
M.3.	BA	13	20	98.0	90.6-114.6	5.6	1.2	1.9	1.6	1.2
	IA	19	27	96.1	91.3-109.6	5.2	1.0			

x N.I. - Number of individuals
x N.T. - Number of teeth

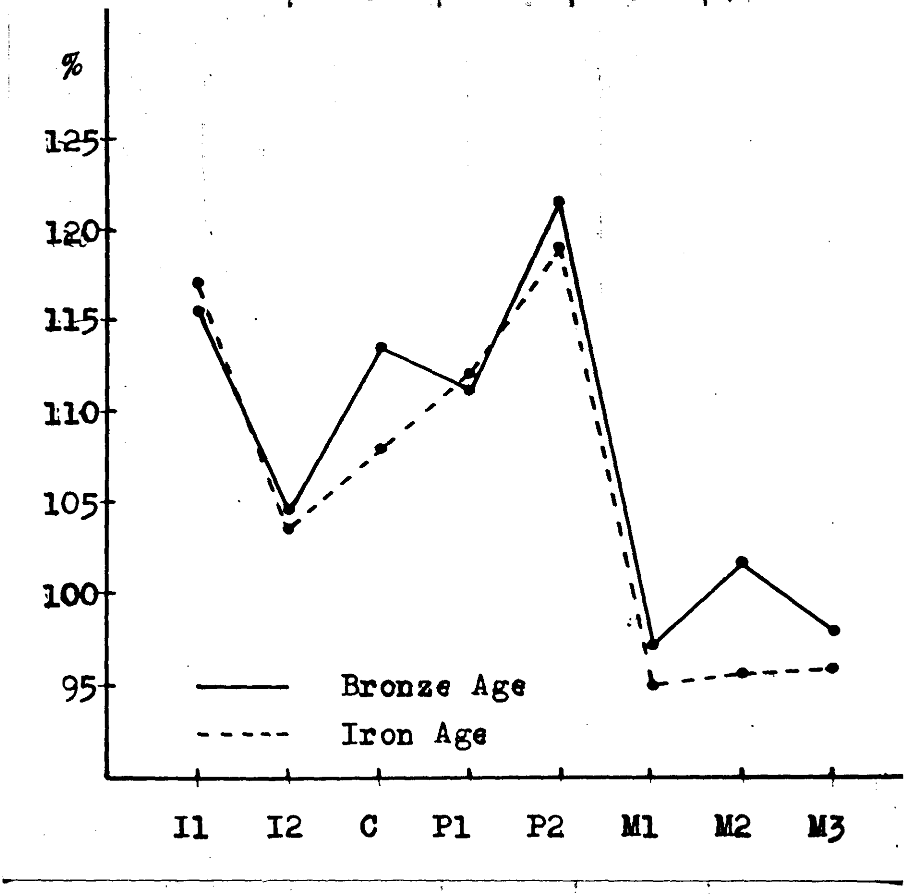


Fig. 52. The mean values of the crown indices of the mandibular teeth in Bronze Age and Iron Age females.

Table 91.

Comparison of mean crown indices of mandibular teeth of total Bronze Age and total Iron Age females.

Tooth	Gp.	N.I.x	N.T.x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
I.1.	BA	2	4	115.7	107.1-125.0	-	-	1.5	-	-
	IA	2	3	117.2	108.3-122.6	-	-			
I.2.	BA	6	8	104.6	92.5-122.6	10.9	3.9	0.8	4.6	0.2
	IA	8	13	103.8	83.6-116.4	8.8	2.4			
C.	BA	7	11	113.7	105.4-122.2	6.2	1.9	5.5	2.7	2.0
	IA	10	14	108.2	94.1-118.3	6.9	1.9			
P.1.	BA	6	10	111.3	101.4-121.5	6.7	2.1	0.9	2.6	0.3
	IA	12	18	112.2	101.5-124.1	6.9	1.6			
P.2.	BA	7	12	121.4	109.9-127.7	5.4	1.5	2.4	2.1	1.1
	IA	13	19	119.0	109.1-135.6	6.6	1.5			

M.1./

Table 91. (Continued).

Tooth	Gp.	N.I. x	N.T. x	Mean	Range	S.D.	S.e.M.	D.	S.e.D.	C.R.
M.1.	BA	5	9	97.1	91.3-102.9	3.8	1.3	2.0	1.6	1.3
	IA	14	21	95.1	87.6-101.9	4.1	0.9			
M.2.	BA	5	10	101.7	95.4-110.4	5.3	1.7	6.0	2.0	3.0
	IA	16	23	95.7	85.9-105.6	4.7	1.0			
M.3.	BA	5	8	98.0	92.5-102.9	4.4	1.6	2.1	2.1	1.0
	IA	12	18	95.9	81.8-107.5	5.9	1.4			

x N.I. - Number of individuals
x N.T. - Number of teeth

In all the crown index tables for maxillary and mandibular teeth of both sexes, only two results are significant - those for the male maxillary third molar, where the Iron Age index is the higher; and for the female mandibular second molar, where the Bronze Age index is the higher.

No general trend can be perceived in the figures, and it would seem that there is less tendency to difference in shape of teeth between these populations than to difference in size.

The only way in which Neolithic and Mediaeval results can be compared with those for the other groups is by using the combined sex group. Since the proportion of the sexes is not known, and is likely to vary from one group to another, it was felt that no attempt could be made to carry out a complete statistical evaluation of these data. The mean figures for the combined sexes of all groups are therefore simply tabulated. The corresponding figures for 5th-10th century Alamanni (Schwerz, 1917), American Whites (Black, 1902) and Lapps (Selmer-Olsen, 1949) are included for comparison in Tables 92-97.

TABLE 92. MESIODISTAL DIAMETER OF MAXILLARY TEETH OF VARIOUS RACES.

Tooth	Neo.	B.A.	I.A.	Med.	Alamanni	Am. Whites	Lapps
I.1.	88	87	85	86	87	90	83
I.2.	72	69	66	61	67	64	67
C.	79	77	75	73	77	76	76
P.1.	66	67	64	62	68	72	67
P.2.	66	66	64	62	66	68	64
M.1.	105	104	102	101	106 99	107	101
M.2.	96	97	90	89	95	92	91
M.3.	86	86	80	82	88	86	80

TABLE 93. MESIODISTAL DIAMETER OF MANDIBULAR TEETH OF VARIOUS RACES

Tooth	Neo.	B.A.	I.A.	Med.	Alamanni	Am. Whites	Lapps
I.1.	53	54	53	51	56	54	53
I.2.	64	61	59	57	62	59	59
C.	68	68	67	64	77	69	67
P.1.	69	69	67	65	69	69	67
P.2.	68	70	68	65	71	71	67
M.1.	112	110	108	108	110	112	108
M.2.	107	105	102	100	107	107	103
M.3.	106	105	101	103	108	107	97

TABLE 94. LABIOLINGUAL DIAMETER OF MAXILLARY TEETH OF VARIOUS RACES.

Tooth	Neo.	B.A.	I.A.	Med.	Alamanni	Am. Whites	Lapps
I.1.	73	73	72	72	75	70	69
I.2.	66	64	61	62	66	60	61
C.	90	85	81	82	84	80	79
P.1.	88	90	87	87	90	91	86
P.2.	93	92	89	89	93	88	86
M.1.	116	117	113	114	115 110	118	110
M.2.	117	115	109	111	114	115	106
M.3.	114	106	102	105	110	106	97

TABLE 95. LABIOLINGUAL DIAMETER OF MANDIBULAR TEETH OF VARIOUS RACES

Tooth	Neo.	B.A.	I.A.	Med.	Alamanni	Am. Whites	Lapps
I.1.	66	59	58	59	67	60	57
I.2.	67	63	61	62	70	64	61
C.	79	77	74	74	80	79	72
P.1.	75	77	76	74	80	77	73
P.2.	80	83	80	77	85	80	76
M.1.	106	106	104	103	102	103	102
M.2.	102	103	99	98	104	101	98
M.3.	101	101	96	100	100	98	94

TABLE 96. CROWN INDEX OF MAXILLARY TEETH OF VARIOUS RACES.

Tooth	Neo.	B.A.	I.A.	Med.	Alamanni	Am.Whites	Lapps
I.1.	82.4	84.2	84.9	84.6	-	-	82.6
I.2.	91.8	93.5	94.3	104.5	-	-	91.2
C.	114.3	109.8	107.7	112.0	-	-	104.1
P.1.	133.1	136.2	136.7	141.1	-	-	131.7
P.2.	139.7	140.5	138.8	144.0	-	-	134.7
M.1.	111.3	112.6	110.7	113.7	-	-	108.7
M.2.	122.2	119.2	121.4	125.7	-	-	116.6
M.3.	133.8	122.4	128.2	130.4	-	-	122.4

TABLE 97. CROWN INDEX OF MANDIBULAR TEETH OF VARIOUS RACES.

Tooth	Neo.	B.A.	I.A.	Med.	Alamanni	Am.Whites	Lapps
I.1.	126.1	109.8	108.8	116.5	-	-	108.6
I.2.	105.5	105.2	103.9	109.1	-	-	103.9
C.	117.5	112.9	109.9	114.3	-	-	108.6
P.1.	108.2	112.6	112.6	114.4	-	-	109.3
P.2.	117.0	118.7	117.7	117.9	-	-	114.6
M.1.	95.3	96.4	96.2	95.8	-	-	93.8
M.2.	96.2	98.1	97.3	98.0	-	-	95.5
M.3.	95.9	97.4	96.1	97.3	-	-	96.2

Although no statistical evaluation has been made of the figures in these tables, a number of interesting points arises in connection with the tables of mesiodistal and labiolingual diameters.

There is a considerable degree of similarity between the Neolithic and Bronze Age groups, and between the Iron Age and Mediaeval groups. Of the Neolithic-Bronze Age pair, sometimes one and sometimes the other shows the higher mean value, and the same is true of the Iron Age-Mediaeval pair. The figures for the Neolithic-Bronze Age pair are invariably greater than those for the Iron Age-Mediaeval pair.

The teeth of the Alamanni are very similar in size to those of the Neolithic and Bronze Age groups. The mesiodistal diameter of the mandibular canine in the Alamanni is considerably larger than either mesiodistal diameter for the Neolithic-Bronze Age pair. The fact that the figure quoted for this diameter of the mandibular canine is the same as that already stated for the mesiodistal diameter of the maxillary canine of the Alamanni leads one to suspect that an error has been made. Since the Alamanni were an Iron Age people with Scandinavian affinities (Schwerz, 1917) one would expect their teeth to be similar to those of the Vikings. On inspection, there is slightly better agreement/

agreement between the mean values for Viking teeth and those for the Alamanni, than between the latter and the values for Total Iron Age teeth. The Viking teeth are still not as similar in size to those of the Alamanni as are the teeth of the Neolithic and Bronze Age groups. However, the Scottish Viking group is not an entirely satisfactory one, since it does not contain sufficient material to be truly representative, and no further conclusions can be drawn from tooth measurements concerning the relationships of the Alamanni.

The figures for American Whites do not show particular agreement with any group. In respect of nine measurements, the American White teeth are larger than those of any Scottish group. This may in part be due to the greater amount of wear found in prehistoric teeth.

The teeth of the Lapps are in a number of cases smaller than those of any other group, and for the rest they show greatest agreement with the Iron Age group.

No particular trends can be noted in the crown indices. Crown indices had not been calculated for Alamanni or American Whites, and the indices for Lapp teeth are in general close to those for one or other of the Scottish groups.

ODONTOMETRY RESULTS - DISCUSSION.

Had the material been more plentiful and in better condition, much more definite information might have been derived from odontometry. At present only tentative conclusions can be drawn about variations in size of prehistoric Scottish teeth, and none at all about variations in their shape, as indicated by the crown indices.

Sex differences in tooth size, the male teeth being larger in both dimensions, can be clearly demonstrated in the Iron Age population, and it is probable that similar sex differences exist in the Neolithic material. On the other hand, the Bronze Age teeth do not show any sex differentiation, though whether this represents the true state of affairs cannot be decided without a study of larger series of skulls from related populations.

The findings for Neolithic and Iron Age peoples conform to the results obtained for a number of other races, in all of which the teeth of the males were found to be larger in both dimensions than those of the females. These sex differences were shown to be statistically significant in the case of the Javanese/

Javanese (Mijsberg, 1931), of the Norwegian Lapps (Selmer-Olsen, 1949), and of the Aleuts (Moorrees, 1957); and in the present study, of the Scottish Iron Age group. The teeth of the Scottish Iron Age skulls correspond to those of the Aleuts and Javanese, in that sex differences are most marked in the canines. In the Lapps, the canines and second molars showed nearly equal sex differences. The second molars of the Scottish Iron Age group, however, were found to show statistically significant sex differences only in the labiolingual diameters. In the Javanese and Lapps the sex differences were more marked in the labiolingual diameters than in the mesiodistal diameters, and this was found to be the case also in the Scottish Iron Age group. On the other hand, the greatest sex differences in the Aleuts were found in the mesiodistal diameters.

Differences in tooth size can be shown to exist between the Bronze Age and Iron Age people. In general, the Bronze Age teeth are larger in both dimensions than the Iron Age teeth. In the males, the differences between the groups are small and only a few of them are statistically significant. The teeth of the females show very much greater differences, which often have a high level of statistical significance.

It is doubtful to what extent deductions concerning the underlying/

underlying factors which may have been responsible for these differences, can be drawn from these results, since the racial origins and affinities of the Long Cist people (who constitute the major part of the Iron Age group) have not been determined with any certainty. If the Long Cist people are considered to be, to any important degree, descendants of the earlier Bronze Age population, then it can be postulated that reduction in size of the dentition has occurred within the Bronze Age race. If, however, the Long Cist people are regarded as chiefly members of an invading Celtic Iron Age stock, then smaller teeth may have been a feature of Celtic peoples, and thus reduction of the teeth may have occurred in the Celtic race at a period very much earlier than their invasion of Scotland. A study of the Iron Age population of England might throw further light on the problem.

Within the Iron Age group, there would seem to be some significant differences in tooth size between the Vikings and the Long Cist people. These differences are chiefly found in the males, of whom the Vikings have the larger teeth. The teeth of the Long Cist females, on the contrary, are sometimes larger than those of the Viking females, and in general the differences/

differences are much smaller than those between the males of the two groups. A much greater quantity of Viking material would be required before a clear indication of the relationship of Vikings and Long Cist people could be given. In contrast to the Iron Age group, the Bronze Age group appears to be reasonably homogeneous.

Racial differences in tooth size have in general been less clearly marked than sex differences. A number of authors (e.g. Campbell, 1925; Janzer, 1927; Drennan, 1929; Shaw, 1931) provided tables which showed differences in mean tooth diameters between various populations, but theymade no statistical evaluation of these differences. Nelson (1938) was able to demonstrate statistically significant differences in size between the teeth of Pecos Indians and those of other races. Moorrees (1957) found significant differences in tooth size between Aleuts and other populations only for the mesiodistal diameters. Selmer-Olsen (1949), with a large amount of Lapp material, was able to show that there were significant differences not only between the Lapps and other races, but also, within the Lapp race, between the populations of different areas.

Thus/

Thus the present study has produced a little more evidence to support the theory that there are in fact sex differences and racial differences in tooth measurements. These differences are small, and can only be evaluated with complete accuracy when large quantities of material are available. Certain anomalies in the results obtained for the Scottish groups (notably the absence of sex differentiation in Bronze Age teeth) may be due to the lack of a sufficient quantity of undamaged material.

It must be emphasized that, although significant differences can be demonstrated between some of the racial groups, the wide range of variation in the observations precludes the possibility of assigning individual skulls to any particular group on the basis of tooth measurements.

It has been already stated that no significant sex or racial differences were found in the crown indices of Scottish teeth.

No satisfactory sex difference has been observed in the crown indices for any of the few races so far studied. Nor is there any conclusive evidence of racial differences. Nelson (1938) and Selmer-Olsen (1949) both claimed that racial differences in crown index could be detected in their Pecos Indian and Lapp/

Lapp material. Pedersen (1949), however, found that there was no "material difference in general crown form" between the East Greenland Eskimos and other races. Moorrees (1957) used the results of all these authors for purposes of comparison with the Aleut material, and stated that the general crown shape was quite similar in all these populations. The only racial group whose crown indices differed markedly from those of other populations was the Tristanites (Moorrees, 1957).

It would appear that the shape of tooth crowns is a less reliable racial characteristic than the actual size, as expressed in the diameters. This is unusual, since in craniometry the indices are regarded as much more reliable criteria than absolute measurements.

MORPHOLOGICAL CHARACTERISTICS.

The variability of certain characteristics of the dentition, e.g. the number of cusps of the molars, is believed to have some racial and evolutionary significance. Notes were made of as many as possible of these characteristics, though no information concerning the roots of the teeth was available, for the same reason that root measurements were impossible, i.e. that to obtain the information it would have been necessary in most cases to destroy part of the specimen.

Skeletal material from 49 Neolithic, 47 Bronze Age, 50 Long Cist, 14 Viking and 18 Mediaeval individuals provided some morphological information. Owing to the poor condition of the material, however, it was impossible in many instances to make anything approaching a complete record. Many teeth had fallen from their sockets and disappeared, while attrition had removed the cusp and fissure patterns from the occlusal surfaces of other teeth. Post mortem loss of one or other jaw, or sections of them, rendered dubious the data concerning numbers of teeth present.

Results are given in the form of the number of individuals who/

who showed a particular trait, and also, wherever there were sufficient data, as a percentage. The numbers of observations in the different groups were too small for sex differentiation to be worthwhile.

The findings for each trait will be discussed separately.

Shovel shaped incisors.

No shovel shaped incisors were observed in any of the populations examined. This was expected, since "shoveling" of the incisors is regarded as a characteristic of Mongoloid races, and is nearly absent in white races (Hrdlicka, 1920; Moorrees, 1957).

Number of cusps of mandibular second premolar.

This tooth may have either two or three main cusps, and there seems to be some doubt as to which is the ancestral form. In spite of some rather contradictory statements, Moorrees (1957) appears to believe that the two-cusped variety is the original one. The frequency of the two types in the Scottish groups is shown in Table 98.

TABLE 98.

	2 cusps		3 cusps	
	No. indivs.	%	No. indivs.	%
Neolithic	2	-	1	-
Bronze Age	14	58.3	10	41.7
Long Cist	15	60.0	10	40.0
Viking	6	-	2	-
Mediaeval	5	-	1	-

In all the groups studied, there is a higher proportion of the two-cusped than of the three-cusped form. Comparable percentages have so far been published for Finnish Lapps (Kajava, 1912), East Greenland Eskimos (Pedersen, 1949) and Aleuts (Moorrees, 1957). In these races, the percentage of the three-cusped type was respectively 25.2, 36.2, and 21.4. The Scottish groups are really too small to allow valid comparisons to be made, but it is interesting to note that in the two largest groups, those of the Bronze Age and Long Cist people, the percentage of three-cusped premolars is higher than in any of these published/

published reports.

In his paper on the dentition of the Alamanni, Schwerz (1917) stated that the ~~three-~~cusped premolar was present in only 5.6% of his material. He used a highly complex system of evaluation of cusp numbers, and his results are not directly comparable with those obtained in the present work. Nevertheless, the Alamanni showed a markedly lower incidence of three-cusped premolars than any other race.

De Terra (1905) has also published some information concerning the cusp number of lower second premolars in a wide variety of races. His figures (reworked as percentages) gave 13% of three-cusped premolars in the Alamanni, 22% in "Römergräber" skulls and 17% in recent Europeans of unspecified race. De Terra did not believe that the number of cusps of the premolars had any racial significance. The wide variation in the proportion of the two types of lower second premolar in white races supports this belief.

Number of cusps of maxillary molars.

The original number of cusps of all the maxillary molars of Hominidae would appear to have been four. In modern races, this/

this cusp number is usually retained in the first molar, but the second and third molars show varying degrees of reduction to a three-cusped form, by loss of the distolingual cusp. Reduction has affected third molars to a greater extent than second molars, and is also more marked in "civilized" than in "primitive" races (Duckworth, 1904). For brevity, the number of cusps of an individual molar series may be indicated by means of the "cusp formula". The primitive formula of 4-4-4 has been reduced in modern civilized races to a 4-4-3 or 4-3-3 formula.

There is no clearly defined division between four- and three-cusped molars, since intermediate forms exist in which the distolingual cusp is represented by a small cuspule or low ridge. In the present study, molars with a recognisable distolingual cusp were included in the four-cusp category, irrespective of the size of this cusp. Those molars which presented a distolingual ridge or a small tubercle were classified with the three-cusp group.

The numbers and percentages of four-cusped and three-cusped maxillary molars in the five Scottish groups are shown in Tables 99-101.

TABLE 99. FIRST MAXILLARY MOLAR.

	4 cusps	
	No. indivs.	%
Neolithic	28	100.0
Bronze Age	35	100.0
Long Cist	30	100.0
Viking	9	100.0
Mediaeval	14	100.0

TABLE 100. SECOND MAXILLARY MOLAR

	4 cusps		3 cusps	
	No. indivs.	%	No. indivs.	%
Neolithic	20	83.3	4	16.7
Bronze Age	19	57.6	14	42.4
Long Cist	18	64.3	10	35.7
Viking	3	-	6	-
Mediaeval	7	58.3	5	41.7

TABLE 101. THIRD MAXILLARY MOLAR.

	4 cusps		3 cusps	
	No. indivs.	%	No. indivs.	%
Neolithic	8	53.3	7	46.7
Bronze Age	6	31.6	13	68.4
Long Cist	2	8.7	21	91.3
Viking	2	-	4	-
Mediaeval	1	-	6	-

The numbers of observations for Viking and Mediaeval groups are so small that the figures may be the result of chance, and reliance cannot be placed upon them. Discussion will therefore be confined to the Neolithic, Bronze Age and Long Cist groups.

The first maxillary molar is invariably found to have four cusps. No reduction in this tooth has taken place in any group.

The second molar shows some degree of reduction to the three-cusped type, but in each of the three Scottish groups the four-cusped type of molar still predominates. The Neolithic group retains the highest proportion (83.3%) of the four-cusped type. Greater reduction is evident in the Bronze Age and Long Cist groups, which exhibit respectively 57.6% and 64.3% of

four-cusped/

four-cusped second molars.

A markedly greater reduction is shown by the third molar of all three groups. The Neolithic group again shows least reduction in cusp number, and the number of four-cusped molars (53.3%) is slightly greater than the number of three-cusped molars. There is a sharp and progressive drop in the proportion of the four-cusped type in the Bronze Age group (31.6% of four-cusped third molars), and Long Cist group (8.7% of four-cusped third molars). In both Bronze Age and Long Cist groups, the three-cusped type of third molar predominates, and in the Long Cist group it does so to a remarkable degree.

The degree of cusp reduction of maxillary molars was also studied by means of cusp formulae. The number of complete molar series is small, and it is therefore impossible to present the frequency of molar cusp formulae in the form of percentage values.

There are four molar cusp formulae: 4-4-4, 4-4-3, 4-3-4 and 4-3-3. The formula 4-3-4 does not occur in any Scottish group. The numbers of individuals in the various groups, with formulae of 4-4-4, 4-4-3 and 4-3-3 are listed in Table 102.

TABLE 102. CUSP FORMULAE OF MAXILLARY MOLARS.

	4-4-4	4-4-3	4-3-3
Neolithic	8	6	1
Bronze Age	6	5	8
Long Cist	2	11	7
Viking	2	0	4
Mediaeval	1	4	3
	19	26	23

The distribution of molar cusp formulae corroborates the results already obtained from study of the percentage frequency of cusp numbers in individual teeth. The unreduced 4-4-4 formula occurs more frequently in the Neolithic than in any other group, and within the Neolithic group this formula predominates. The three formulae are almost equally represented in the Bronze Age group, but the totally reduced 4-3-3 and the unreduced 4-4-4 formulae account for almost 75% of the total. On the other hand, the Long Cist group shows a preponderance of the partially reduced 4-4-3 formula.

The results may be summarised as follows:-

First/

First molar - in all groups, invariably the unreduced four-cusped type.

Second molar - in the Neolithic group, slight reduction to the three-cusped type; Bronze Age and Long Cist groups show a greater but not progressive reduction.

Third molar - in the Neolithic group, considerable reduction to the three-cusped form, which however still does not reach 50% of the total; the Bronze Age group shows a greater reduction and the Long Cist group a very great reduction.

It can be seen that within each group the tendency to cusp reduction becomes progressively greater towards the back of the molar series. There is also a tendency for cusp reduction to become progressively greater in skulls from the later periods. Thus, in respect of the cusp numbers of maxillary molars, the Neolithic group shows the most primitive condition, while there is progressive modification in the molars of the Bronze Age and Long Cist groups.

Some comparisons may be made with the results reported for other races. Unfortunately, the work of a number of authors (de Terra, 1905; Hillebrand, 1909; Schwerz, 1917; Shaw, 1931; Nelson,/

Nelson, 1938) cannot be used for comparison, since different methods of estimating cusp numbers have been used, with the introduction of varying numbers of intermediate classes (termed 3+ , $3\frac{1}{2}$, 4/3 etc.).

The only results so far reported for prehistoric or early historic white races are those published by de Terra (1905) and Schwerz (1917). Not only have these authors used a classification system which is not comparable with that used in the present work (as explained in the previous paragraph), but the dating of their material is also uncertain, since they have presented little or no archaeological data.

The findings on seven other racial groups have been listed in Tables 103-105, in order to facilitate comparisons between them and the figures reported for the Scottish groups in Tables 99-101.

TABLE 103. FIRST MAXILLARY MOLAR

Race	4 cusps	3 cusps	Author
Australian aborigines	100.0	0	Campbell, 1925
New Pomeranians	-	-	Janzer, 1927
Bushmen	100.0	0	Drennan, 1929

TABLE 103 (contd)

Race	4 cusps	3 cusps	Author
Aleuts	100.0	0	Moorrees, 1957
East Greenland Eskimos	100.0	0	Pedersen, 1949
*Texas Indians	99.6	0	Goldstein, 1948
Europeans	100.0	0	Zuckerkandl, 1902

TABLE 104. SECOND MAXILLARY MOLAR

Race	4 cusps	3 cusps	Author
Australian aborigines	100.0	0	Campbell, 1925
*New Pomeranians	89.0	10.4	Janzer, 1927
Bushmen	100.0	0	Drennan, 1929
Aleuts	69.1	30.9	Moorrees, 1957
East Greenland Eskimos	65.7	34.3	Pedersen, 1949
*Texas Indians	59.3	39.4	Goldstein, 1948
Europeans	45.6	54.4	Zuckerkandl, 1902

TABLE 105. THIRD MAXILLARY MOLAR

Race	4 cusps	3 cusps	Author
Australian aborigines	77.0	23.0	Campbell, 1925
*New Pomeranians	63.5	28.4	Janzer, 1927
Bushmen	‡	‡	Drennan, 1929
Aleuts	31.0	69.0	Moorrees, 1957
*East Greenland Eskimos	30.7	61.4	Pedersen, 1949
*Texas Indians	36.7	53.8	Goldstein, 1948
Europeans	10.2	71.4	Zuckerkandl, 1902

* In these results, small percentages of molars carrying 6, 5 or 2 cusps were also recorded.

‡ Intermediate classes were used, therefore this result cannot be included.

The Scottish skulls conform with other groups in having retained the four-cusped pattern in the first molars.

The proportions of four-cusped second molars in the Scottish Bronze Age and Long Cist groups are quite close to the figures reported/

reported for Aleuts, East Greenland Eskimos and Texas Indians, and slightly higher than the figure reported for Europeans. The Neolithic percentage of four-cusped second molars, on the other hand, is higher than for other populations except Australian aborigines, Bushmen and New Pomeranians. The Neolithic group, however, shows only slightly greater reduction than do the New Pomeranians.

The percentage of four-cusped third molars is almost identical in Scottish Bronze Age, East Greenland Eskimo and Aleut populations, while the figure for the latter group is said to approximate the occurrence in other, unspecified, races (Moorrees, 1957). The Long Cist percentage is slightly lower than that reported for Europeans, and the Neolithic percentage is higher than for any group except Australian aborigines and New Pomeranians.

From the comparison of the Scottish groups with these other races, it would appear that the degree of cusp reduction of the second and third maxillary molars in Scottish skulls of successive periods can be correlated with the degree of reduction reached by a number of modern races. Thus the Scottish Neolithic skulls show little more reduction in cusp number than those of modern New Pomeranians, while the Scottish Bronze Age and/

and modern Mongoloid populations show similar degrees of cusp reduction. In the second molar, the Long Cist group also shows affinity with the modern Mongoloid races, but the third molar of this group has been reduced to the same extent as in modern Europeans.

On the basis of these findings, a tentative hypothesis may be put forward: that the stages of cusp reduction through which the European molars appear to have passed can be correlated with the stages of reduction reached by various non-white populations. It could follow from this that reduction of the cusps of the maxillary molars is progressing in the same manner, but at different rates in the major divisions of the human race. Further development of this theory must await adequate information concerning cusp numbers in early non-European races.

In any case, Hjelmman's (1928) observation that "non-European populations exhibit less reduction in cusp numbers than Europeans" must be restricted in its application to the modern representatives of these races, since it has been deomonstrated that prehistoric Scottish skulls of European stock showed similar degrees of cusp reduction to modern Melanesian or Mongoloid races.

Tubercle/

Tuberc1e of Carabelli.

The incidence of this accessory mesiolingual cusp on the maxillary molars is shown in Table 106. No differentiation has been made between varying degrees of prominence of the cusp. In many cases, it was impossible on account of attrition or loss of teeth to decide whether there had been a tubercle of Carabelli or not, therefore the numbers of individuals who could be definitely stated to lack it have also been included in the table.

TABLE 106.

	Tubercle present				Tubercle absent
	6/6	7/7	8/8	Total	
Neolithic	7	1	3	11	15
Bronze Age	5	0	0	5	27
Long Cist	3	0	0	3	22
Viking	0	0	0	0	5
Mediaeval	2	0	0	2	9

There is a markedly higher incidence of the tubercle of Carabelli in the Neolithic group than in any other. Also it is notable, that the tubercle occurs on all three maxillary molars in/

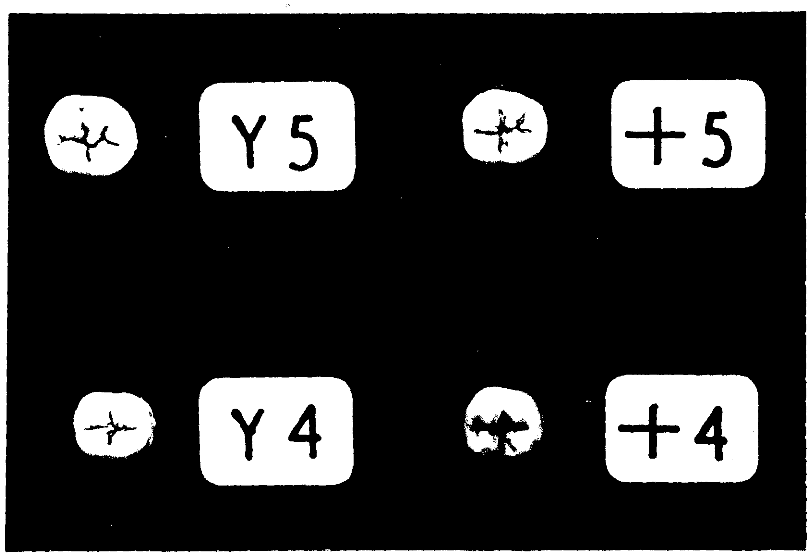


Fig. 53. Lower right molars illustrating the Dryopithecus pattern (Y 5) and its modifications. In the Y 5 and Y 4 types, the distobuccal and mesiolingual cusps are in contact. In the + 5 and + 4 patterns the mesiobuccal and distolingual cusps make contact.

in this group, whereas it is confined to the first molars in all the other groups. This can perhaps be related to the greater persistence of the four-cusped type of maxillary molar in the Neolithic group, as Bolk (1915) observed the tubercle of Carabelli more frequently in quadricuspal than in tricuspal second molars.

Number of cusps of mandibular molars.

The original number of cusps of each mandibular molar was five, and the basic pattern of cusps and grooves has been named the Dryopithecus pattern, after a group of primates in which it appears and which are believed to be related ancestrally to both anthropoids and man (Gregory, 1916). The Dryopithecus pattern is characterized by a Y shaped arrangement of the principal fissures, and is often referred to as the Y5 pattern. (Fig. 53).

Modification of this pattern may result either in loss of one of the cusps (Y4), or in change from Y to + arrangement of the fissures (+ 5), or in loss of a cusp together with change to a + arrangement of fissures (+ 4) (Fig. 53).

Previous studies have shown that the first molar usually retains a five-cusped form, while the second molar is modified to the +4 variety, and the third molar shows a considerable degree/

degree of variation. (Duckworth, 1904). As in the case of the maxillary molars, the "civilized" races are considered to show greater modification in the mandibular molars than do the "primitive" races (Hellman, 1928).

In the present study, it was found that the cusp number could more often be observed with certainty than the fissure pattern. The two features have therefore been dealt with separately.

The numbers and percentages of five-cusped and four-cusped mandibular molars in the five Scottish groups are shown in Tables 107-109.

TABLE 107. FIRST MANDIBULAR MOLAR

	5 cusps		4 cusps	
	No. indivs.	%	No. Indivs.	%
Neolithic	17	100.0	0	-
Bronze Age	25	89.3	3	10.7
Long Cist	35	94.6	2	5.4
Viking	5	-	0	-
Mediaeval	11	-	0	-

TABLE 108. SECOND MANDIBULAR MOLAR.

	5 cusps No. indivs.	%	4 cusps No. indivs.	%
Neolithic	3	17.6	14	82.4
Bronze Age	0	0	32	100.0
Long Cist	1	2.4	40	97.6
Viking	0	-	10	-
Mediaeval	0	-	9	-

TABLE 109. THIRD MANDIBULAR MOLAR.

	5 cusps No. indivs.	%	4 cusps No. indivs.	%
Neolithic	5	41.7	7	58.3
Bronze Age	5	21.7	18	78.3
Long Cist*	8	27.6	21	72.4
Viking	0	-	5	-
Mediaeval	4	-	3	-

* In addition, two Long Cist skulls had third molars with only three cusps.

The Scottish Neolithic, Bronze Age and Long Cist groups show less variation in the degree of reduction of the mandibular molars than in the degree of reduction of the maxillary molars.

There is a slight tendency to reduction to four cusps in the first molars of the Bronze Age and Long Cist groups, whereas the Neolithic group retains the five-cusped form without variation.

In the case of the second molars, there is a slight tendency in the Neolithic group to retain the five-cusped pattern, and an even slighter similar tendency in the Long Cist group. The Bronze Age group shows complete reduction to the four-cusped form.

Bronze Age and Long Cist third molars show similar proportions (78.4% and 72.4% respectively) of the predominant four-cusped variety. The Neolithic group contains only 58.3% of four-cusped third molars, and thus shows less reduction of the third molar than the other two groups.

The cusp formulae most often found in the mandible were 5-4-5 and 5-4-4. The distribution of the various formulae recorded are shown in Table 110. No percentages have been worked, since the numbers of observations are too small.

TABLE 110. MANDIBULAR MOLAR CUSP FORMULAE.

	5-5-5	5-4-5	5-5-4	5-4-4	5-4-3	4-4-4
Neolithic	1	3	2	5	0	0
Bronze Age	0	5	0	14	0	1
Long Cist	0	6	0	18	2	2
Viking	0	0	0	2	0	0
Mediaeval	0	4	0	3	0	0
	1	18	2	42	2	3

In general, it appears that the Neolithic group shows the greatest tendency to retain the ancestral five-cusped form in all three mandibular molars. There is little difference between the Bronze Age and Long Cist groups.

Comparisons may again be made between the Scottish groups and a number of other races. The results for the latter are given in Tables 111-113 for ease of comparison.

Tables 111-113. Number of cusps of mandibular molars of various races (percentage of types).

TABLE 111. FIRST MANDIBULAR MOLAR.

Race	5 cusps	4 cusps	Author
Australian aborigines	94	6	Campbell, 1925
New Pomeranians	87.0	13.0	Janzer, 1927

TABLE 111. (contd.)

Race	5 cusps	4 cusps	Author
Bushmen	100.0	0	Drennan, 1929
Aleuts	100.0	0	Moorrees, 1957
1East Greenland Eskimos	97.2	1.4	Pedersen, 1949
1Texas Indians	87.5	0.6	Goldstein, 1948
Alamanni	86.4	13.7	De Terra, 1905
Römergräber	100.0	0	De Terra, 1905
9th cent. Hungarians	83	17	Hellman, 1928
Europeans	95.4	4.6	Zuckerkandl, 1902
Europeans	82.0	18.0	De Jonge Cohen, 1920.
European whites	89	11	Hellman, 1928
American whites	87	13	Hellman, 1928

TABLE 112. SECOND MANDIBULAR MOLARS.

Race	5 cusps	4 cusps	Author
Australian aborigines	32	68	Campbell, 1925
New Pomeranians	7.9	92.1	Janzer, 1927

TABLE 112 (contd.)

Race	5 cusps	4 cusps	Author
Bushmen	*	*	Drennan, 1929
Aleuts	55.5	44.5	Moorrees, 1957
1East Greenland Eskimos	55.7	31.3	Pedersen, 1949
1Texas Indians	25.3	72.3	Goldstein, 1948
Alamanni	10.0	90.0	De Terra, 1905
Römergräber	3.0	96.9	De Terra, 1905
9th cent. Hungarians	13	86	Hellman, 1928
Europeans	16.5	83.3	Zuckerkandl, 1902
2Europeans	9.7	89.7	De Jonge Cohen, 1920
European whites	1	99	Hellman, 1928
American whites	6	94	Hellman, 1928

TABLE 113. THIRD MANDIBULAR MOLARS.

Race	5 cusps	4 cusps	Author
Australian aborigines	73	27	Campbell, 1925
2New Pomeranians	59.7	40.0	Janzer, 1927

TABLE 113. (contd.)

Race	5 cusps	4 cusps	Author
Bushmen	*	*	Drennan, 1929
3Aleuts	92.9	7.1	Moorrees, 1957
1East Greenland Eskimos	74.5	9.1	Pedersen, 1949
1Texas Indians	46.2	40.7	Goldstein, 1948
2Alamanni	24.9	66.8	De Terra, 1905
Römergräber	85.2	14.8	De Terra, 1905
9th cent. Hungarians	40	60	Hellman, 1928
2Europeans	43.0	51.0	Zuckerkandl,1902
2Europeans	49.0	46.5	De Jonge Cohen, 1920
European whites	38	62	Hellman, 1928
American whites	-	-	Hellman, 1928

2 In these results, small percentages of molars carrying 3 cusps were also recorded.

1 In these results, relatively high percentages of molars carrying 6 cusps were also recorded.

* Intermediate classes were used, therefore this result cannot/

cannot be included.

3 Percentage values for the Aleuts reworked from the absolute numbers given, since the published percentages (75/25%) are erroneous.

In the races listed in Tables 111-113, cusp reduction in the mandibular molars has not progressed in the same order as in the case of the maxillary molars. It would appear from the published figures that Australian aborigines show greater cusp reduction in the second mandibular molars than Aleuts or East Greenland Eskimos, and the same teeth in New Pomeranians are further reduced than those in several European groups. Similarly, Aleuts and De Terra's European Römergräber skulls show a considerably greater degree of retention of five-cusped third mandibular molars than do Australian aborigines. It is therefore impossible to detect a process of increasing cusp reduction in progression from the most primitive to the most advanced races, as could be done for the maxillary molars. It is thus not surprising that no clear cut progression of cusp reduction could be detected in the Scottish groups, and that no relationship could be established between the Scottish groups and the non-European races of Tables 111-113 in the manner which was possible/

possible for the maxillary teeth.

Complete retention of the five-cusped type of mandibular first molar is found in Scottish Neolithic, Aleut, Bushman and Römergräber skulls. There is a slight reduction to the four-cusped type in the other groups, and the degree of reduction is similar in all these groups, the proportion of five-cusped first molars ranging from 82-97%.

The Scottish groups show degrees of cusp reduction of the second molars, which fall within the same range as the figures reported for New Pomeranians and all the European groups of Tables 111-113.

In the third molar, the five-cusped pattern has been retained to the same extent in the Scottish Neolithic group, 9th century Hungarians and the Europeans of Zuckerkandl. In the Scottish Bronze Age and Long Cist groups, the five-cusped type of third molar is present in slightly smaller proportions, which are similar to the percentage recorded for the Alamanni by de Terra.

The cusp formulae found most often in Scottish prehistoric skulls (i.e. the 5-4-4 and 5-4-5 formulae) are also those recorded most frequently among Europeans by Zuckerkandl (1902), who reported 50.0% frequency of the 5-4-4 formula and 30.5% frequency/

frequency of the 5-4-5 formula.

It seems that cusp reduction in the mandibular molars has progressed in a different manner to that in the maxillary molars. Wide variations in cusp reduction have been recorded for different groups of Europeans; and of non-European races, the greatest degree of cusp retention does not always occur in the most primitive races.

Fissure patterns of mandibular molars.

The distribution of Y and + groove patterns in all three molars of the various Scottish groups is shown in Table 114.

TABLE 114. GROOVE PATTERNS OF MANDIBULAR MOLARS.

	First molar		Second molar		Third molar	
	Y	+	Y	+	Y	+
Neolithic	9	1	0	15	0	8
Bronze Age	14	2	0	28	0	13
Long Cist	11	8	1	30	2	17
Viking	0	2	0	10	0	3
Mediaeval	3	3	0	7	0	5

In every group except the Long Cist, the second and third molars show only the + pattern, and in the Long Cist group there/

there are only three exceptions to this general rule. The first molars are more variable. All the Neolithic skulls but one show the Y pattern, and there is a gradually increasing proportion of the + pattern in the Bronze Age and Long Cist groups.

These results seem to indicate that already by the Neolithic period the modification from the Y to the + pattern was almost complete in the second and third molars. The first molars, on the other hand, show a preponderance of the Y pattern, though the proportion of the + pattern gradually increases from the Neolithic group through the Bronze Age to the Long Cist group.

Hellman (1928) also reported that in all three of his white groups the + pattern predominated in the second and third molars, the proportion of this form ranging from 83-96%. The first molars showed between 86 and 94% of the Y pattern. These figures agree closely with the proportions recorded for the Scottish Neolithic and Bronze Age groups. Hellman found that both in cusp number and fissure pattern the 9th century Hungarians showed less modification than the modern Europeans, and this is analogous to the trend observed in the Scottish groups.

Reports concerning the fissure patterns of mandibular molars of non-European races are to some extent contradictory. Hellman/

Fig. 54. Supernumerary mesiobuccal cusp on the upper third molar of a Neolithic skull from Clachaig, Arran.

Hellman (1928) found that the negro races tended to retain the Y pattern to a greater extent than the whites, while the Mongol races had completely lost the Y formation in the second and third molars. This is corroborated by the marked modification to the + pattern observed (Moorrees, 1957) in the Aleuts, in whom the + pattern was found in 58.6% of first molars and 100% of second and third molars. The East Greenland Eskimos (Pedersen, 1949) on the other hand, showed the + pattern in only 4% of first molars and 60-66% of second and third molars.

Supernumerary cusps.

Very few supernumerary cusps were observed, and these were nearly all on the buccal surfaces of upper molars (Fig. 54). Most of them occurred in the Neolithic group. Details of the exact location of each supernumerary cusp recorded are given in Table 115.

TABLE 115. DISTRIBUTION OF SUPERNUMERARY CUSPS.

Group	Tooth	Location on tooth
Neolithic	$\underline{/8}$	Mesiobuccal
"	$\underline{/8}$	"
"	$\underline{7/}$	"
Bronze Age	$\underline{/6}$	Mesiobuccal
"	$\overline{4/}$	Lingual
Long Cist	$\underline{7/}$	Mesiobuccal
Mediaeval	$\underline{7/}$	Distobuccal

Supernumerary cusps occurring on the buccal surfaces of second and third molars were named "paramolar cusps" by Bolk (1916), who believed that they represented rudiments of deciduous molars which had been eliminated from the end of the functional deciduous molar series at an early stage in mammalian evolution. Bolk stated that paramolar cusps were not, and would not be, found on first permanent molars, since he considered that these teeth formed part of the deciduous dentition. More recently, paramolar cusps have been demonstrated on first permanent molars (Dahlberg, 1945).

Paramolar cusps on the anterior part of the buccal surfaces of lower permanent molars and lower second deciduous molars were termed "protostylids" by Dahlberg (1950), and were considered by him to be of special significance because of their occurrence in such early hominid forms as the Australopithecinae and Sinanthropus pekinensis. He found protostylids in 46% of Pima Indians from Arizona, but stated that only eleven other isolated instances had been reported in modern man.

Of the supernumerary cusps listed in Table 115, all but one are paramolar cusps (Fig. 54). Five of them were found on maxillary second or third molars, but the Bronze Age example was situated on a maxillary first permanent molar. This provides a little/

Fig. 55. Tubercle of Carabelli and supernumerary mesiobuccal cusp on the upper third molar of a second Neolithic skull from Clachaig.

Fig. 56. Supernumerary maxillary lateral incisor in a Neolithic skull from Knowe of Lairo, Orkney. At the right of the photograph, the upper left canine is visible. Between this tooth and the peg-shaped supernumerary are the sockets of the central and lateral incisors of both sides.

little further evidence against Bolk's (1916) theory. No protostylids were observed in the Scottish skulls, as might be expected in view of their extreme rarity in most races.

The number of paramolar cusps found in the Neolithic skulls may be associated with the relatively high incidence of the tubercle of Carabelli in this group. In one Western Neolithic skull, a second maxillary molar showed both a tubercle of Carabelli and a paramolar cusp (Fig. 55).

Supernumerary and congenitally missing teeth.

The incisor region, especially in the maxilla, is the commonest site for supernumerary teeth, either of normal shape or of the conical variety (Stones, 1954; Moorrees, 1957).

Only three supernumerary teeth were observed. Two of these were supernumerary maxillary lateral incisors, one occurring in a Neolithic skull (Fig. 56) and the other in a Long Cist individual. The third case was a supernumerary mandibular incisor, situated between the central incisors of a Long Cist mandible (Fig. 57). In form, the supernumerary incisor in the Neolithic skull was peg-shaped, while those in the Long Cist skulls resembled normal teeth.

Reduction in number of teeth was more often found than an increase/

Fig. 57. Supernumerary mandibular incisor in a Long Cist skull from Kirkhill. The supernumerary tooth is of normal shape.

increase, and the missing teeth were usually the third molars of one or both jaws. The incidence of missing third molars is given in Table 116. Considerable difficulty was encountered in compiling this table, since in some cases only one jaw was present, and in others *post mortem* damage had occurred in one or more of the third molar areas. For this reason, the figures quoted in Table 116 may be slightly too low. On the other hand, it is possible that a number of deeply embedded teeth have been included in this table. This possibility is considered to be remote, as teeth were only recorded as missing when there was no evidence of any swelling of the alveolar bone sufficient to contain a tooth. Radiological examination, however, could not be carried out, and teeth in abnormal situations or very deeply embedded may have remained undetected.

TABLE 116. CONGENITALLY MISSING THIRD MOLARS.

Both jaws present	Neo.	B.A.	L.C.	Viking	Med.
4 molars missing	-	-	-	1	2
3 " "	-	1	1	1	1
2 " "	1	2	3	-	-
1 " "	-	4	2	-	-
Maxilla only					
2 molars missing	1	2	1	-	1
1 " "	1	-	-	-	1
Mandible only					
2 molars missing	1	-	-	-	-
	4	9	7	2	5

The material was too fragmentary for accurate assessment to be made of variations in incidence of missing third molars in the Scottish groups. The proportion of individuals affected appeared to be greatest in the Mediaeval and Bronze Age groups.

Bilateral absence of upper lateral incisors was observed in two skulls, one from the Neolithic group and the other from the Long Cist group (Fig. 72).

No missing mandibular premolars were noted in any of the Scottish groups. Jackson (1914), however, reported absence of both mandibular/

Fig. 58. Part of a Long Cist mandible from Lasswade with large irregular exostoses in the canine-premolar areas.

mandibular second premolars in two Neolithic mandibles from the Dog Holes, Lancashire. He considered that this was the result of ritual extraction, but it seems just as probable that these teeth were in fact congenitally absent.

At present there appears to be little possibility of assigning racial significance to the incidence of congenitally missing teeth among prehistoric Scottish peoples, though this has been found possible for certain other races. Pedersen (1949) and Moorrees (1957) drew attention to the high incidence of missing third molars in Eskimoid populations, while Tratman (1940, 1950) observed that mandibular incisors were more commonly absent in a Mongoloid group than in people of Indo-European stock.

Exostoses.

These localized overgrowths of bone were found in all the Scottish groups. Torus palatinus was infrequent, but mandibular exostoses were quite common, ranging in size from small, flat plates of bone in the premolar or molar regions to large knobs (Fig. 58) or ridges sometimes extending from the canine to the third molar. The incidence of the condition in the mandible and in the maxilla is shown in Table 117. No attempt has been made to subdivide the exostoses on the basis of size.

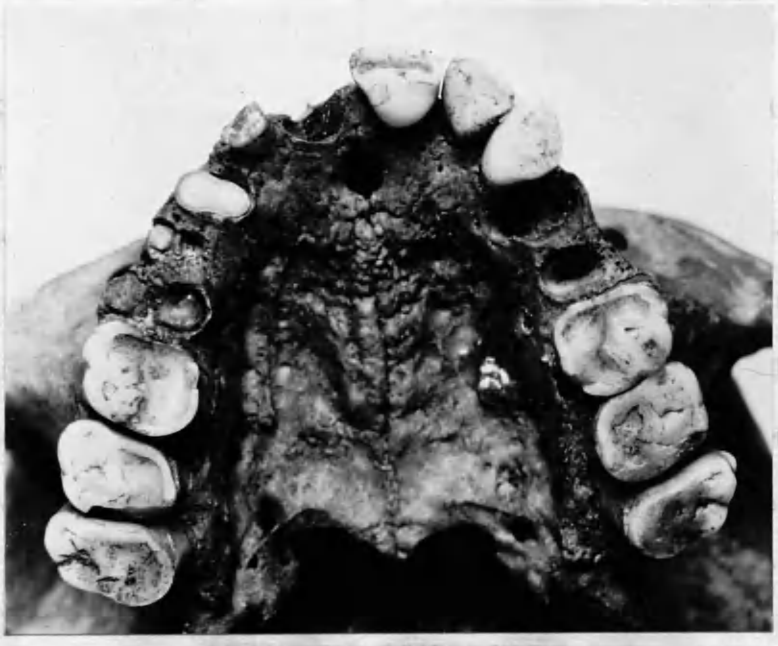


Fig. 59. Torus palatinus in a Neolithic skull from Clachaig.

TABLE 117. INCIDENCE OF EXOSTOSES.

	Torus mandibularis		Torus palatinus	
	Present	Absent	Present	Absent
Neolithic	4	7	4	23
Bronze Age	9	27	1	35
Long Cist	20	19	0	39
Viking	10	4	0	12
Mediaeval	4	10	0	14

Exostosis of the alveolar margin in the maxillary molar region was also seen, in one Neolithic, two Bronze Age and two Mediaeval skulls, in none of which palatal torus was present.

The Neolithic group shows the highest incidence of palatal torus (Fig. 59). The greatest proportion of mandibular exostoses is found in the Long Cist and Viking skulls.

There has been considerable controversy over the cause of exostoses. Hrdlicka (1940) believed that they were purely functional in origin, arising as a result of excessive use of the jaws. But Shaw (1931), Drennan (1937) and Moorrees (1957) considered that tori were to be regarded as a racial characteristic.

Since accurate information is not available concerning differences in the diet or habits of the prehistoric races of Scotland, it/

it is not possible to decide whether the high proportion of mandibular exostoses among the Vikings and Long Cist people is the result of exceptionally hard use of the jaws, or of heredity. Nor can any explanation be suggested for the fact that palatal tori are almost confined to the Neolithic group.

Fig. 60. Marked attrition facets on the buccal cusps of the first permanent molar of a Long Cist child aged <u>circa</u> 15 from Camptown, Drem.

Fig. 61. Second degree attrition of the maxillary teeth in a Mediaeval skull from Seacliff. Nearly all adults showed a similar or greater degree of attrition. In this skull, the upper left third molar was unerupted and is therefore unworn.

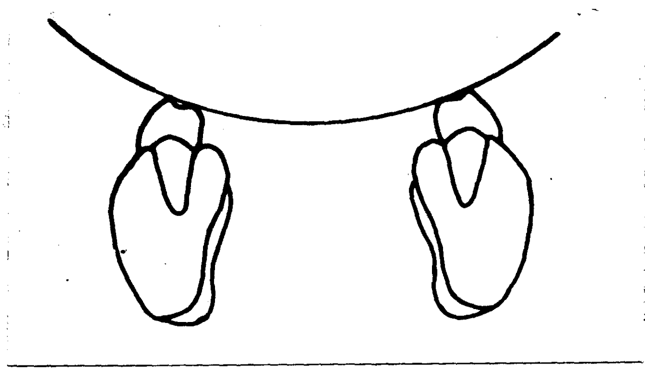
ATTRITION AND OCCLUSION.

A. Attrition.

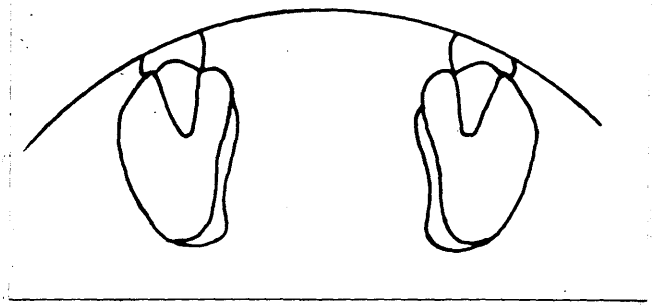
Nearly all the teeth showed some degree of attrition, and many of them were heavily worn. The rate of wear was much greater in these early Scottish skulls than in modern man, as can be demonstrated in an adolescent. Several incompletely formed teeth allowed a reasonably accurate assessment of the age of a Long Cist individual at 14-15 years, and in this skull the first permanent molars already showed considerable wear after only nine years of use (Fig. 60). This rapid attrition was due partly to the rougher and tougher nature of the prehistoric diet, and partly to the inclusion in the food of small particles of grit from the querns in which grain was milled by hand.

Anterior teeth usually showed horizontal wear of the incisal edges, where enamel was rapidly removed so that in most adults dentine was exposed and a flattened surface replaced the sharp incisal edge (Fig. 61).

In the case of the premolars and molars, the cusps were gradually worn away until a flat occlusal surface was produced. Dentine was exposed first at the tips of the cusps in small circular/



a.



b.

Fig. 62. Diagram illustrating the effect of attrition on the occlusal plane.
a. Shows the normal Monson curve.
b. Shows the reversal of this curve as a result of marked attrition.

circular areas which became gradually larger until finally they coalesced (Fig. 61). Wear of the cusps was not, however, evenly distributed over the entire occlusal surface. The buccal cusps of the mandibular teeth and the lingual cusps of the maxillary teeth were most heavily worn. The result of this unevenness of attrition was to produce a sloping occlusal surface. The degree of angulation of the worn occlusal surfaces varied considerably from one individual to another: it was sometimes very slight, and in a few cases so marked that the buccal side of a mandibular molar had been worn down to the amelo-cemental junction, while more than half of the original height of the lingual side of the crown still remained. The angle at which the crown was worn was usually sufficient to convert the normal concave (Monson) curve of the unworn occlusal surfaces into an anti-Monson convex curve (Fig. 62).

The occlusal surface of worn molars was not always completely flat. Attrition of dentine and enamel sometimes had proceeded at the same rate and the occlusal surface was then almost plane. Sometimes more rapid wearing away of dentine occurred, with the production of saucer-shaped depressions in the dentine and an outer rim of enamel.

In one Mediaeval skull an unusual type of attrition was seen (Fig./

Fig. 63. Unusual type of attrition, resulting in an uneven occlusal plane, in a Mediaeval skull from Arbroath.

(Fig. 63). Wear had taken place on the mesial and distal faces of the cusps, thereby increasing the pointed appearance of the teeth instead of flattening them, and producing an irregular occlusal plane.

As a result of rapid attrition, a gradually increasing area of dentine was exposed in the mouth during a considerable period of an individual's life. Caries was never observed to have attacked these exposed areas of dentine, and it may be concluded that, as with the slower attrition seen at the present time, an adequate defence was provided by sclerosis of the dentine or the formation of a dead tract. In advanced stages of attrition, where the original limit of the roof of the pulp chamber had been exposed, deposition of secondary dentine had usually been sufficient to prevent pulp exposure. The few cases of pulp exposure observed will be discussed in the chapter dealing with pathological conditions.

The degree of attrition was estimated according to the long established classification by Broca (1879). Five stages can be recognised in individual teeth:-

0. No wear.

1. No dentine visible, cusps distinct, enamel only is worn.

2./

2. Dentine visible, forming one or more spots of a darker colour in the middle of the white enamel.
3. A large amount of dentine exposed, little or no enamel remaining on the occlusal surface.
4. Crown worn completely to the neck of the tooth.

In any dentition, the teeth which showed the greatest degree of attrition were, as would be expected, those which had been the first to erupt, i.e. the first molars and all the incisors. Next in order were the canines, first and second premolars, and second molars. Individuals occasionally showed markedly greater wear of one or another of these teeth, but frequently they could all be classified as showing the same degree of attrition. The third molars were always least worn. As a result of the varying amounts of wear of different teeth, the dentition as a whole was distributed between two classes of attrition.

It had been hoped that it would be possible to estimate the age of individuals by study of the crania, and subsequently by correlation of age and degree of attrition to estimate differences in the rate of wear in Scottish skulls from the various periods. There does not, however, seem to be any possibility at present of assessing the age of crania sufficiently accurately, since there/

there appears to be wide individual variation in the times and order of closure of the cranial sutures (Ashley-Montagu, 1938). The degree of wear shown by skulls of the various groups, irrespective of individual age, has therefore been shown in Table 118.

TABLE 118. DEGREE OF ATTRITION.

	0-1	1-2	2-3	3-4	4
Neolithic	4	24	14	0	2
Bronze Age	4	24	19	5	1
Long Cist	6	19	21	7	0
Viking	0	5	9	2	1
Mediaeval	2	4	11	1	0

As far as the three main racial groups are concerned, there is a fairly similar distribution of individuals with the various degrees of attrition. The slightly smaller proportion of Neolithic individuals with advanced attrition is probably the result, not of more gradual attrition, but of a shorter life. According to calculations of life expectancy made by Atkinson, Piggott and Sandars (1951) on the skeletal material from excavations at Dorchester, only 30% of the Neolithic population had an expectation of life of 40 years.

Fig. 64. Angle class 2 malocclusion in a Long Cist skull from Kintradwell. The photograph shows the forward position of the upper first molar, and the marked overjet in the incisor region.

Fig. 65. Crowding of incisors in a Long Cist skull from Nunraw.

B. Occlusion.

Accurate information regarding the occlusion was impossible to obtain from most of the skulls examined. Even when both maxilla and mandible were present, loss of teeth and damage to condyles prevented accurate observations on the relationship of the jaws from being made. Where it was possible to relate the jaws, an Angle class 1 relationship was most usually found, with an edge-to-edge incisor relationship in skulls with marked attrition. It is generally believed that attrition of the molars allows the mandible to slide forward very slightly and thereby establish the edge-to-edge bite. Moorrees (1957) considered that attrition was an essential factor in the change to this type of incisor occlusion.

In two Long Cist skulls and one Viking an Angle class 2 or post-normal occlusion was found. The incisor overjet of 10 m.m. in the Long Cist skull illustrated (Fig. 64) was relatively much greater than would have been expected from the slight abnormality in the molar relationship.

Only one mild degree of Angle class 3 or pre-normal occlusion was observed in a Viking.

Minor abnormalities, usually crowding of the lower anterior teeth were seen occasionally, e.g. in a Long Cist skull (Fig. 65), and in a Mediaeval skull (Fig. 66). In no case was the abnormality sufficiently severe to alter the shape of the arches.

Fig. 66. Marked narrowing in the incisor area of a Mediaeval mandible from Eyemouth, with crowding of the anterior teeth.

PATHOLOGICAL CONDITIONS.

Apart from attrition, which was so general as to be considered a normal process, the teeth of the prehistoric Scottish skulls were in most cases sound and strong. A number of pathological conditions were, however, noted. Of these, the most interesting was dental caries, on account of the controversy which has raged concerning the aetiology and even the distribution of this disease.

Caries was present in very few skulls and in these there were usually only one or two cavities. No cases of extensive destruction of numerous teeth were observed. It is unfortunately quite impossible to give a properly detailed account of the numbers of caries-free individuals, since there had been a high _post mortem_ loss of teeth. A few teeth had also been lost before death, but this was not necessarily the result of caries: in fact, in many cases it could more probably be ascribed to periodontal disease. A description of the teeth affected by caries follows.

No evidence of caries was found in any of the 390 Neolithic teeth examined.

Carious cavities were present in three Bronze Age skulls, all from the Southern sub-group. In two of these skulls ~~a~~ single tooth only was affected. One of these was an upper first molar which/

Fig. 67. A large proximal cavity in a maxillary second premolar of a Long Cist skull from Lundin Links. The adjacent molar also showed a large cavity.

which had a small occlusal pit, and the other was a lower third molar presenting a cavity on the mesiobuccal cusp, a situation which suggests fracture of the cusp prior to caries. The third skull showed a more advanced stage of the disease: the crowns of the upper left first and second molars had been almost completely destroyed and apical abscesses had resulted; in addition there was a small proximal cavity in the lower first molar. Thus 5 teeth of the Bronze Age total of 920 were carious, i.e. 0.5%.

In the Long Cist group, approximately twice as much caries was found, involving seven individuals. Three of these had a proximal cavity in one molar only, while in another, caries of a lower molar had been so extensive that the mesial and distal sides of the crown had collapsed upon one another. Depressions on the occlusal surfaces of two molars in the fifth skull had the appearance of arrested caries; this was the only case noted of this condition. The remaining two skulls showed severe proximal caries of several adjacent teeth. In one case, two upper molars were affected, one so badly that the palatal root was lying free; and in the other case, two premolars and one molar were involved (Fig. 67). The proportion of carious teeth in the Long Cist group was 11 in 925, i.e. 1.2%.

Only one Viking skull showed a doubtful cavity in a lower third/

a.

b.

Fig. 68. a. Extensive carious destruction of a lower first molar in a Mediaeval skull from Seacliff.
b. Abscess formation has occurred at the root of this tooth.

third molar. Diagnosis here was difficult because a large part of the crown was covered by calculus. In all, 283 teeth were examined.

Four Mediaeval skulls all showed multiple cavities, and in two of these individuals abscess formation had occurred at the roots of some of the teeth (Fig. 68). The teeth involved in these two skulls were (a) two lower molars from opposite sides and a premolar adjacent to one of them, and (b) two upper and two lower molars. Another skull showed proximal caries of three upper molars, and the fourth presented the only example of gingival caries, on the buccal side of two lower molars. Of 316 teeth in the Mediaeval group of skulls, 12 were carious, i.e. 3.8%.

It can be seen that the incidence of caries rises from Bronze Age Group to Long Cist group, and that there is a further marked increase in the Mediaeval group, though the latter still shows a considerably lower incidence than is seen in the modern British population.

It should also be noted that all carious teeth observed were premolars or molars. It cannot, however, be concluded that all incisors and canines were caries-free, since <u>post mortem</u> loss of these teeth was very high.

It has for long been known that peoples living on a primitive diet/

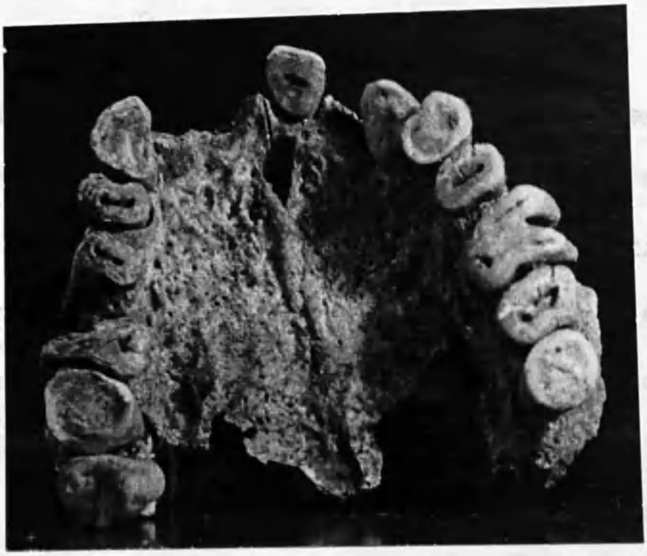
diet have a low incidence of caries compared to civilized races whose diet consists largely of highly refined carbohydrates. Mummery (1869) found that both prehistoric British skulls and those of a number of coloured races presented a low incidence of caries. The importance of diet in producing these results was stressed by the fact that members of a population with access to a modern refined diet have a higher caries incidence than members of the same population living on the primitive diet. This was shown by Pedersen (1947) to be true for the East Greenland Eskimos, and by Price (1933) for children from several islands in the Hebrides. It is therefore not surprising that a low incidence of caries should be found among the prehistoric Scottish skulls. Unfortunately too little is known concerning variations in diet between one group and another to allow the rise in caries incidence in the later periods to be explained as the result of such variations. A correlation between caries incidence and the nature of the diet of the prehistoric Scottish races would have been extremely interesting.

The relative frequency of occurrence of caries in Scottish skulls of successive groups agrees to a certain extent with the results obtained for prehistoric races in other countries. Dascoulis (1956) found no caries in Greek skulls of the Stone or early/

early Bronze periods; caries appeared first in the later Bronze Age and has gradually increased up to the present day. In a study of children's skulls from Hungary, Schranz and Huszar (1958) also found no cases of caries in small series of skulls from Palaeolithic or Neolithic periods. Caries appeared first in the Copper Age (2 cases in 40 skulls), and 2 of 12 Bronze Age skulls showed early cavity formation. No caries was evident however in 10 Iron Age skulls. In these two works and in the present study, the earliest period in which caries was found to appear was the Copper or Bronze Age. Mummery (1869), however, found two instances of caries in 68 Neolithic skulls from English long barrows. Von Lenhossek (1919), on the basis of evidence from a single skull, claimed that caries appeared in Europe in the Mesolithic period, and that it was introduced by brachycephalic invaders from Asia. He therefore suggested that caries should be considered as an Asiatic epidemic, comparable to cholera or plague. The dating of the skull upon which von Lenhossek's entire theory depends is not wholly satisfactory, and the problem of the period during which caries appeared in Europe is still unsolved.

Apical abscesses or dental cysts were observed in a number of skulls, and those cases which were clearly due to caries have already been mentioned.

The/



a.

Fig. 69a. Severe attrition of all the teeth in a Long Cist skull from Camptown, Drem. In many of the teeth the pulp has been exposed.

b.

c.

Fig. 69b. right side and 69c. left side of the same skull, to show the numerous alveolar abscesses which have resulted from pulp exposure.

The secondary dentine reaction to attrition was usually very good, but occasionally insufficient tissue had been formed, resulting in pulp exposure and leading to abscess or cyst formation at the apex. This was observed in two Bronze Age and two Long Cist skulls. Usually only one or two teeth were affected, but in one of the Long Cist skulls there were numerous pulp exposures and multiple abscesses, one of which had penetrated the maxillary sinus (Fig. 69). In addition to these skulls, in which the teeth were present and thus the cause of the abscesses could be determined, there were two Bronze Age, three Long Cist and one Viking skull which presented abscess or cyst cavities (Fig. 70); but since the teeth involved had been lost post mortem it was impossible to determine whether the lesions were the result of caries or of pulp exposure.

Two probable abscess cavities were noted in Neolithic skulls. One of them was associated with the crown of an embedded upper third molar, and may in fact have been a dentigerous cyst. The other was related to the root of a lower incisor and may have been traumatic in origin, since the tooth appeared to be normal.

An assessment was made of the amount of calculus adhering to the teeth. The calculus was of the light coloured supragingival type, and the areas of heaviest deposition were usually the lingual surfaces/

d.

Fig. 69d. View of the (damaged) maxilla from above showing the opening of one of the abscesses into the maxillary air sinus.

Fig. 70. A large cavity in the palate of a Long Cist skull from Lundin Links, due to an abscess, or more probably to a dental cyst.

surfaces of lower incisors and molars, and the buccal surfaces of upper molars. The amount of calculus present in general in a dentition was classified under the headings heavy, moderate, slight or none. Localized heavy deposits round individual teeth were disregarded. Table 119 shows the percentage distribution of the degrees of calculus deposition in the various groups.

TABLE 119. CALCULUS DEPOSITION

	Heavy		Moderate		Slight		None	
	No.	%	No.	%	No.	%	No.	%
Neolithic	3	6.4	10	21.3	14	29.8	20	42.5
Bronze Age	4	9.8	5	12.2	18	43.9	14	34.1
Long Cist	10	24.4	10	24.4	6	14.6	15	36.6
Viking	3	18.7	6	37.7	5	31.3	2	12.5
Mediaeval	3	21.4	4	28.6	5	35.7	2	14.3

The Long Cist, Viking and Mediaeval groups have a markedly higher incidence of the heavy and moderate grades of calculus than do the Neolithic and Bronze Age groups. This may perhaps indicate that the diet in these later periods was becoming softer; and this could also be correlated with the increase in caries noted in the same periods. However, bacterial action, precipitation/

precipitation of calcium salts from the saliva, C-hypovitaminosis and constitutional predisposition have all been suggested as aetiological factors in calculus deposition (Thoma, 1954), and it is impossible to estimate variations in these factors between one group and another.

Picton (1957) found supragingival calculus in 19 of 40 Jutes of the 6th century A.D. This is a somewhat lower incidence than was observed for the Scottish Long Cist and Viking skulls.

As a result of frequent post mortem fracture or crumbling of the alveolar process, it was not possible to carry out a detailed investigation of minor degrees of alveolar bone resorption due to periodontal disease. Notes were, however, made of gross periodontal pocket formation and bone loss, and this was found to occur in one Neolithic, two Bronze Age, three Long Cist, four Viking and three Mediaeval skulls, usually round the molars.

Periodontal disease has already been recorded in English Neolithic skulls by Cave (1938) who observed evidence of severe pyorrhoea in two of the seven skulls from Lanhill long barrow.

An enamel pearl was seen on the distal surface of the root of an upper second molar in a Long Cist skull, but no odontomes of any kind were observed. There were a few cases of abnormal crown/

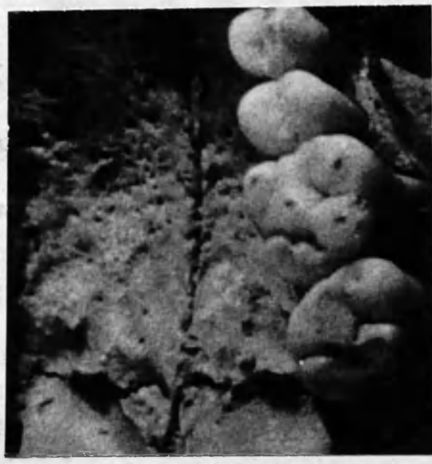


Fig. 71. The first maxillary molars of this Mediaeval skull from Seacliff present unusually large tubercles of Carabelli. The normal four cusps of the tooth have been distorted, so that the mesiolingual cusp now occupies a position in the centre of the crown.

crown shape, but none of these was sufficiently severe to be classed as an odontome. Probably the most interesting abnormality was an enlargement of the cusp of Carabelli in the maxillary first molars of a Mediaeval skull, to such an extent that the mesiolingual cusp had been pushed into the centre of the crown (Fig. 71).

A number of skulls was seen in which one or several teeth were embedded within the jaw in such a way that it was unlikely that they could ever erupt. The account which follows does not, of course, include cases of adolescents or young adults in whom there was still a possibility of eruption of teeth lying in a normal position within the crypts.

The most remarkable case of embedded teeth was a Neolithic skull from the Knowe of Yarso, Orkney. The skull showed marked asymmetry associated with premature closure of the sutures, and the maxillary dental arch was narrow and deformed. The upper canines and third molars on both sides and the premolars on one side were completely embedded and the premolars on the other side were partially embedded - a total of eight teeth in the maxilla alone. It is unfortunate that the mandible had been lost, as it would have been interesting to discover whether the mandible had developed normally, or whether it also contained a number of embedded teeth. In two other Neolithic skulls both maxillary third molars/

molars were embedded and in another two a maxillary third molar from one side was embedded: the opposing tooth had been lost after death, but from the position of the socket it seemed likely that it too had been embedded. One complete Neolithic mandible was seen in which both third molars were embedded, one of them in mesio-oblique impaction against the second molar. A small fragment of another mandible contained an embedded third molar in horizontal impaction against its neighbour. In none of these instances were both jaws present.

Six Bronze Age skulls contained embedded teeth and in two of these, from Broomend and Strathnaver, it seemed probable that all four third molars had been embedded. In the Broomend skull, one mandibular third molar was embedded below the ramus of the mandible, and one maxillary third molar was embedded with the crown facing buccally. The remaining third molars had been lost <u>post mortem</u>, but the position of their sockets suggested that they had also failed to erupt. Both the mandibular third molars of the Strathnaver skull had become impacted in the mesio-oblique position against the second molars. One upper third molar of of this skull was in vertical impaction against the second molar and it appeared that the other had been in a similar position. In another Bronze Age skull both maxillary third molars were unerupted/

Fig. 72. The maxillary left canine of this Long Cist skull from Camptown has been partially embedded. Although the crown is completely uncovered in the photograph, a comparison of the levels of the amelocemental junctions of this tooth and of its neighbours shows that only a very small part of the canine could have been exposed during life.

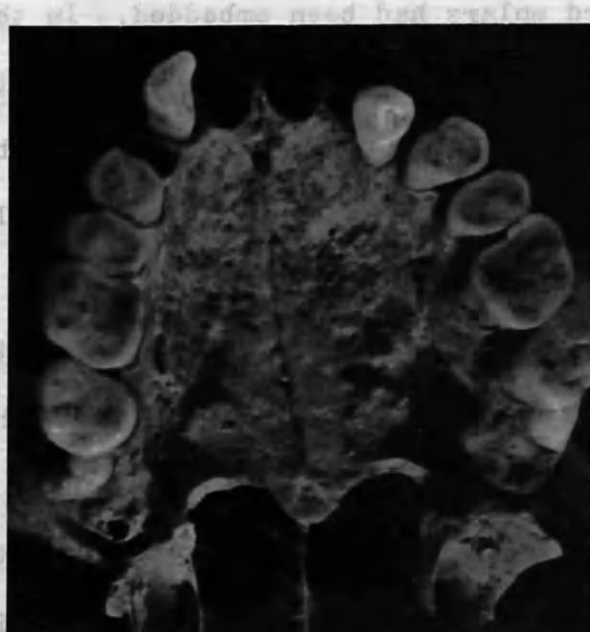


Fig. 73. Embedded third maxillary molars in a skull from a stone cist of indeterminate type at Dounreay. There is ample room in the alveolar process for the teeth to have erupted in the normal position.

erupted, while the mandibular third molars were in normal positions. The fourth case exhibited a deeply embedded third molar on one side; the other lower molar segment was missing. There was no trace of the maxillary third molars of this skull and they have already been included under the heading of missing teeth, but it is possible that they may have been deeply embedded. The remaining two Bronze Age skulls both lacked mandibles. In one of them, both maxillary third molars and one maxillary canine were embedded. The other showed impaction of one third molar against the second molar, while the molar on the opposite side had erupted normally.

Embedded teeth were observed in only two Long Cist skulls, and in both of these the teeth involved were a mandibular third molar from one side and the maxillary canine on the opposite side (Fig. 72). In one of these skulls none of the other third molars was visible, and they have been classified as missing. In the other skull the remaining third molars had all erupted normally.

No skull from the small Viking and Mediaeval groups showed any embedded teeth.

It seems probable that the failure of these teeth to erupt was due as much to faulty positioning of the tooth germ, as to lack of space resulting from insufficient development of the jaws. In some instances there appeared to be adequate space in the jaw to/

Fig. 74. A Long Cist skull from Kintradwell in which an upper third molar is congenitally missing, and the opposing lower molar has over-erupted well above the occlusal plane of the other teeth.

Fig. 75. Considerable resorption of a lower second molar has been caused by impaction of the third molar in this Long Cist skull from Camptown, Drem.

to accomodate the embedded tooth (Fig. 73).

When teeth were missing or embedded in one jaw only, the opposing tooth was unworn, and very often stood above the plane of occlusion of its neighbours (Fig. 74).

In one of the Long Cist skulls, impaction of a lower third molar had caused extensive resorption of the second molar upon which it had rested (Fig. 75). A smaller degree of resorption may also have been present in some other cases of impacted teeth, and have remained undetected because of the close approximation of the teeth.

Although cases of the commonest modern dental disease, caries, are infrequent, a number of pathological conditions have been found to exist in the jaws of prehistoric Scottish skulls. Advanced attrition leading to exposure of the pulp and abscess formation, heavy deposition of calculus, periodontal disease and bone loss, and embedded and impacted teeth have all been observed, and in some cases, notably the adult Long Cist skull from Camptoun, Drem, several of these conditions have been present in the same skull (Figs. 69, 72 and 75). In such cases dental pain must have been severe.

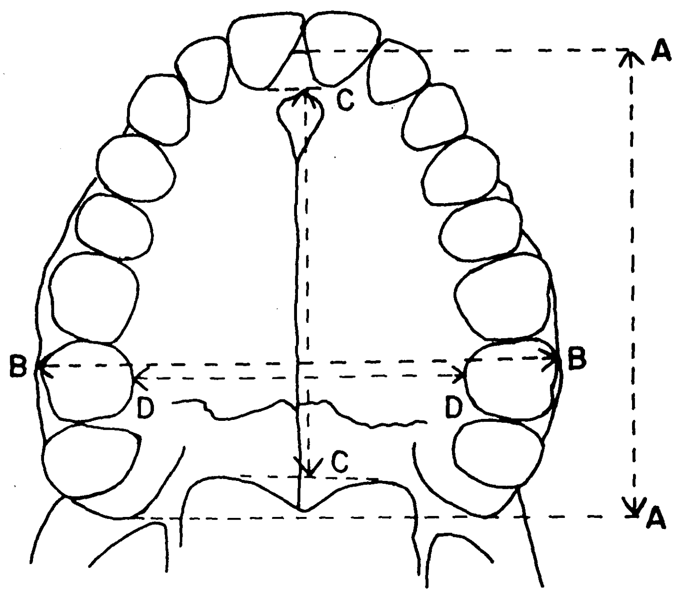


Fig. 76. Diagram of the palate and alveolar arch measurements used in the present study.

PALATE FORM.

The shape of the palate was studied by means of the upper alveolar arch index (palato-maxillary index) and the palatal index. The necessary measurements were made according to the instructions given by Buxton and Morant (1933) and Hrdlicka (1947), i.e.:

Alveolar arch

Length: from the anterior surface of the alveolar border between the central incisors to the midpoint of a transverse line connecting the posterior borders of the alveolar processes. (Fig. 76, line AA).

Breadth: maximum transverse external diameter of the arch, usually found in the second molar region. Buccal exostoses of the alveolar border were disregarded. (Fig. 76, line BB).

Palate

Length: from the median point of a line tangential to the posterior alveolar borders of the central incisors ("orale" of Buxton and Morant, 1933) to the point where the common tangent to the posterior curved borders of the palatine bone crosses the median palatine suture ("staphylion" of Buxton and Morant, 1933).(Fig. 76, line CC).

Breadth/

Breadth: distance between the palatal alveolar borders of the second molars. (Fig. 76, line DD).

For many of the measurements the small sliding caliper (Fig. 20) could be used. Frequently the curved caliper (Fig. 21) was required for measuring alveolar arch length and breadth where the teeth were standing.

Both indices were obtained by the formula: $\frac{\text{Breadth} \times 100}{\text{Length}}$.

It was not possible to carry out a statistical evaluation of the data concerning alveolar arch and palatal indices because of the scarcity of material. The means, ranges and numbers of individuals studied in the various groups have simply been tabulated. It was also found necessary to combine the sexes.

TABLE 120. ALVEOLAR ARCH INDEX.

	No.	Mean	Range
Neolithic	15	114.5	103.0-123.8
Bronze Age	13	112.2	104.1-127.9
Long Cist	17	112.5	96.7-130.2
Viking	6	111.8	103.6-118.1
Mediaeval	7	113.5	104.2-123.2

The mean alveolar arch indices for all five groups are very close and the figures show no evidence of any general upward or downward trend. The means all come within the mesuranic group (index 110-115). The indices for all groups range from dolichouranic (index below 110) to brachyuranic (index above 115).

The indices in Table 120 may be compared with those published for other races. Weidenreich (1943) stated that the range of the alveolar arch index in modern man is 108.2-126.0, but did not give values for individual races. At the lower end of this range are the mean figures of 108.9 for Australian aborigines (Campbell, 1925) and 110.5 for Bantu (Shaw, 1931).

Turner (1915) published indices for a number of prehistoric Scottish skulls, and the mean values derived from these are:-

Neolithic	117.7
Bronze Age	117.8
Long Cist	117.2

These figures are consistently higher than those in Table 120, and it seems probable that this difference is the result of a slight variation in measuring technique.

A mean index of 113.0 is quoted for English Neolithic males by Shaw after Flower. This figure is quite close to those obtained in the present study, but its source is unfortunately dubious/

dubious. The reference given by Shaw is erroneous, and the figure quoted could not be traced by the writer.

TABLE 121. PALATAL INDEX.

	No.	Mean	Range
Neolithic	16	88.0	77.3-98.1
Bronze Age	19	88.8	77.6-104.8
Long Cist	17	89.1	76.8-99.5
Viking	7	91.4	88.2-96.6
Mediaeval	8	93.5	78.1-102.6

A slightly greater range is covered by the mean palatal indices than by the mean alveolar arch indices, and the former show a steadily increasing value from Neolithic to Mediaeval. This suggests that either the palate breadth was increasing, or the length decreasing, or both.

Analysis of the figures for length and breadth of the palate gave the following results:-

TABLE 122. PALATAL LENGTH AND BREADTH.

	Mean Length	Mean Breadth
Neolithic	44.5	38.9
Bronze Age	44.3	39.2
Long Cist	43.4	38.7
Viking	43.2	39.4
Mediaeval	42.9	39.9

The above table does in fact show a very slight gradual decrease in mean length of the palate. At the same time there is an increase in mean breadth in Bronze Age, Viking and Mediaeval groups as compared with Neolithic and Long Cist, which exaggerates the increase in index in the former three groups.

In the case of the alveolar arch index, the inclusion of the teeth and alveolar process with their own variability has probably obscured the minor variations in palate form. It seems that palate size and tooth size vary to some extent independently.

There are very few published figures for palatal index which can be compared with those given for the Scottish groups in Table 121./

121. Weidenreich (1943) gave the range for modern man as 63.0-94.6

A number of results was published for various racial groups by Morant (1923, 1926) and Hooke (1926). These unfortunately cannot be used in comparison with the figures obtained in the present work, since both these authors measured the palatal length to the tip of the posterior nasal spine. This point is not satisfactory, since the spine is extremely variable and also has often suffered _post mortem_ damage. It was replaced for these reasons by the staphylion (Buxton & Morant, 1933). Morant's paper of 1926 did, however, include two indices in which the palatal length had been measured to the base of the posterior nasal spine, a point which probably corresponds fairly closely to that used in the present study. These indices are 88.2 for Anglo-Saxon males and 88.6 for the 17th century English Whitechapel skulls. These figures both fall within the range of mean values for the Scottish groups in Table 121.

The mean palatal indices of the prehistoric Scottish races are thus seen to lie at the upper end of the range given by Weidenreich (1943) for modern man, and to correspond closely to the only two available results for early English skulls.

In view of the small differences and wide, almost coincident/

dent, ranges of variation, it is not possible to use the alveolar arch and palatal indices as a criterion of race, at least in the prehistoric Scottish period.

It must also be pointed out that these indices provide information regarding the relationship of the length of the upper jaw to its width in the molar region only. In the anterior part of the maxilla there may be considerable variation which cannot be reflected in the indices (Robinson, 1956). A more detailed method of metrical study of the palate has been evolved by Lysell (1958), but the Scottish material was too scanty and in too poor condition to allow the use of this method.

An attempt was made to record the shape of the maxillary dental arch, particularly in regard to its anterior portion. This method suffers from the defects common to all subjective methods, in that standards are difficult to establish, there are no clear distinctions between types and there is no method of judging accuracy. Classification was made more difficult by the fact that the material was scattered and direct comparisons could not be made between one skull and another.

The shape of the dental arch has been classified in different ways by several authors. Hrdlicka (1916) enumerated five types of normal arch - elliptic, ovoid, approaching circular, U-shaped and/

Fig. 77. Rounded type of maxillary dental arch.

Fig. 78. Pointed type of maxillary dental arch.

and diverging - but did not define them clearly or illustrate them. Shaw (1931) illustrated four types of dental arch found in the Bantu, and named them hyperbolic, semi-elliptical, elliptical and divergent. According to Carette-Pillot (1947), the elliptical form is that found in monkeys such as the macaque, the U-shaped arch belongs to anthropoid apes, and it is the parabolic or hyperbolic type which occurs most frequently in man and especially in white races. There thus appears to be no general terminology in use for arch shape.

Three main forms of dental arch were noted in the Scottish skulls. These were named and described as follows:-

(a) Rounded - anterior teeth set in a broad curve, arch nearly as broad in the premolar region as in the molar region, and molar segments often curving but sometimes straight. (Fig. 77).

(b) Pointed - arch tapering continuously from molars to incisors, with considerable narrowing in the premolar and canine regions, producing a V-shape (Fig. 78).

(c) Slightly pointed - arch form intermediate in appearance between (a) and (b). The anterior segment is/

Fig. 79. Slightly pointed type of maxillary dental arch.

Fig. 80. Square type of maxillary dental arch.

is curved, but not so broad as in (a), there is slight narrowing in the premolar region, and the molar segments diverge towards the back of the jaw. (Fig. 79).

A fourth type, the square arch (marked by a flattened anterior segment, slightly diverging molar segments and prominent canines) was observed in only three Neolithic and one Long Cist skulls (Fig. 80). Table 123 gives the distribution of the other types in the Scottish racial groups.

TABLE 123. MAXILLARY DENTAL ARCH FORM.

	Rounded	Slightly pointed	Pointed
Neolithic	21	1	1
Bronze Age	25	12	0
Long Cist	20	5	4
Viking	6	4	3
Mediaeval	3	2	2

The rounded arch was the commonest in all groups and the square form the least common. The slightly pointed and pointed forms are almost absent in the Neolithic group, while together they/

they form circa 33% of the total in both Bronze Age and Long Cist groups. However, of this 33%, the Bronze Age group shows exclusively the milder form of compression, while the Long Cist group has nearly equal proportions of the slightly pointed and pointed forms. In the Viking and Mediaeval groups, the slightly pointed and pointed forms together make up just over 50% of the total in each group.

Compression of the arch thus appears to be at its minimum in the Neolithic group, and to become progressively commoner in later groups.

MANDIBLE FORM.

The mandible has not been studied as frequently as the cranium, and consequently there is neither the recognised anthropometric technique nor the vast bulk of published data which exist for cranial measurements. Morant (1936) made a "Study of the human mandible" using large series of Egyptian material, in order to discover which measurements were most useful in racial discrimination. A shorter series of measurements is given by Hrdlicka (1947). The methods used in the present study follow these two authors closely and will be detailed below. Murphy (1957, 1958) in a study of Australian aboriginal mandibles used Morant's measurements and added five more. Since these latter were mainly for the purpose of drawing type contours, which has not been attempted in the present work, they have not been included in the following list.

The following definitions and measurements are exactly according to Morant's (1936) instructions, except where stated.

Standard horizontal plane of mandible (which must be used for all mandibular measurements): the mandible is in the standard horizontal plane when it is placed in the normal horizontal position on a flat surface and pressure is applied to the second left molar.

Coronion:/

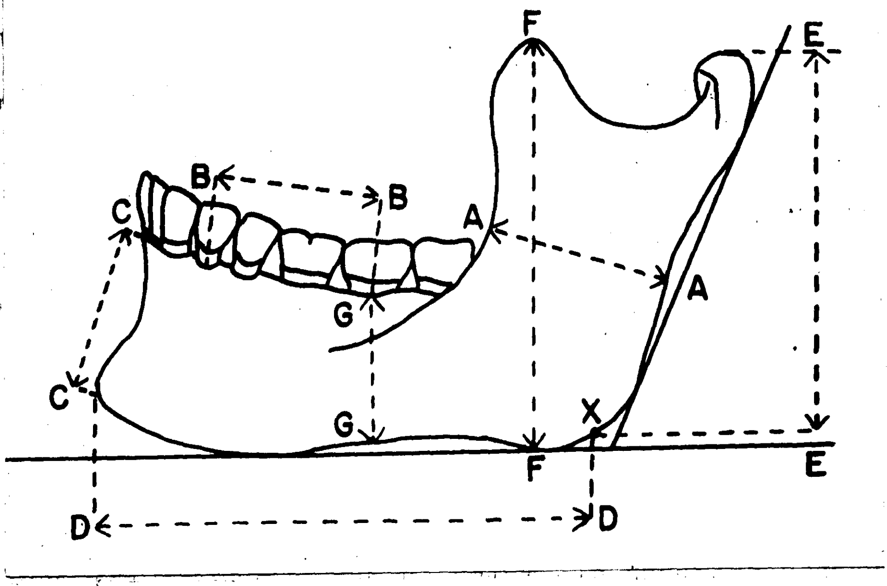


Fig. 81. Diagram of the measurements of the mandible (except transverse measurements) used in the present study.

<u>Coronion</u>: the tip of the coronoid process. To find the exact location of the coronion, the mandible should be turned upside down on a flat surface so that it is balanced on both coronoid processes and one condyle. The points at which the coronoid processes make contact with the surface are the coronia.

<u>Gonion</u>: a point on the angle of the mandible at the junction of the body and the ascending ramus. To find it, the mandible must be placed in the standard horizontal plane. Gonion is located on the border of the mandible, at the point nearest to the intersection of a plane touching the posterior part of the condyle and the ramus above the angle, with the standard horizontal plane. (Fig. 81, point X).

The following measurements were made with the sliding caliper, as recommended by Morant (1936). These have been illustrated in Fig. 81, with the exception of the transverse measurements.

w_1 - maximum breadth outside the condyles, avoiding excrescences.

$c_y l$ - maximum breadth (in the coronal plane) of the left condyle, avoiding excrescences.

rb - minimum antero-posterior breadth of left ascending ramus. This may be at any angle to the horizontal, and is usually/

- usually situated just above the occlusal plane of the molars (Fig. 81, line A-A).

m_2p_1 - chord between central points on the outer alveolar margins of the sockets of left first premolar and second molar. (Fig. 81, line B-B).

h_1 - symphyseal height from the intradental (tip of bony crest between the lower central incisors) to the furthest point in the symphyseal plane. (Fig. 81, line C-C).

zz - minimum chord between anterior margins of mental foramina.

c_rc_r - maximum breadth between coronia.

Morant (1936) recommended that the following measurements be made by means of a mandible board. This was not available, and therefore the sliding caliper was used with slight modifications in method. The chief difference in technique was the choice of gonion as a terminal point in measuring the lengths of the body and ramus.

c_pl - length of body of mandible, measured from gonion to the most advanced point of the chin. (Fig. 81, line D-D).

rl - length of ascending ramus, from gonion to the top of the condyle. (Fig. 81, line E-E).

Morant (1936) also recommended that the remaining three measurements/

measurements should be made using a mandible board. In the present study, the sliding caliper was used and the points from which the measurements were made correspond exactly to those described by Morant (1936). There was thus no major difference in technique.

g_og_o - maximum breadth between gonia.

c_rh - maximum height of left coronoid process (Fig. 81, line F-F).

m_2h - vertical height of body of mandible at the mid point of the outer alveolar border of the second left molar (Fig. 81, line G-G).

A mandible board and goniometer are essential for measurement of the maximum projective length of the mandible, and for measurement of the several angles included in the mandible. These measurements have therefore not been made on the Scottish mandibles.

The small straight caliper (Fig. 20) was found to be suitable for all mandible measurements. It should be mentioned that Hrdlicka (1947) also recommended that mandible measurements should be made with the sliding caliper, and preferred the latter to the mandible board in taking the length of the body.

The following tables show the mean values obtained for the measurements/

measurements listed, in the Scottish groups. Results obtained by Morant (1926) for Anglo-Saxon males and females have also been included, except in the case of $c_p l$ and rl, for which Morant used a different technique, as has been explained above. Many of the Scottish mandibles had suffered severe post mortem damage, and the numbers of measurements obtained were in most cases too small to permit sex differentiation in the results.

TABLE 126. rb.

	Mean	No.	Range
Neolithic	37.7	10	33.2-42.0
Bronze Age	34.1	21	29.7-39.2
Long Cist	32.2	27	26.1-39.4
Viking	32.7	12	30.0-35.9
Mediaeval	31.7	11	27.4-35.4
Anglo-Saxon male (Morant)	36.4		
Anglo-Saxon female (Morant)	34.6		

TABLE 127. m_2p_1

	Mean	No.	Range
Neolithic	28.5	7	26.2-30.5
Bronze Age	28.5	23	25.2-31.0
Long Cist	27.4	26	23.5-29.9
Viking	27.8	13	24.2-30.2
Mediaeval	27.4	10	26.4-28.3
Anglo-Saxon male (Morant)	28.1		
Anglo-Saxon female (Morant)	27.6		

TABLE 128. h_1

	Mean	No.	Range
Neolithic	34.7	9	30.0-39.9
Bronze Age	31.7	21	28.6-35.0
Long Cist	32.6	28	25.0-38.6
Viking	31.9	11	27.2-36.1
Mediaeval	33.6	11	30.5-39.9
Anglo-Saxon Male (Morant)	33.1		
Anglo-Saxon female (Morant)	30.5		

TABLE 129. zz.

	Mean	No.	Range
Neolithic	45.4	10	40.6-48.0
Bronze Age	43.9	20	40.6-48.0
Long Cist	43.8	29	35.5-50.2
Viking	44.3	12	40.5-48.7
Mediaeval	43.2	11	39.1-45.7
Anglo-Saxon male (Morant)	45.3		
Anglo-Saxon female (Morant)	44.1		

TABLE 130. $c_r c_r$

	Mean	No.	Range
Neolithic	97.3	3	92.0-100.3
Bronze Age	97.9	8	90.7-106.0
Long Cist	95.3	15	77.0-114.3
Viking	94.8	8	84.8-111.2
Mediaeval	97.3	6	92.6-103.3
Anglo-Saxon male (Morant)	100.3		
Anglo-Saxon female (Morant)	93.2		

TABLE 131. $c_p l$

	Mean	No.	Range
Neolithic	89.2	9	83.4-93.9
Bronze Age	89.1	10	81.2-97.7
Long Cist	86.7	18	80.0-94.0
Viking	88.8	11	85.6-97.2
Mediaeval	86.1	9	74.9-95.0

TABLE 132. rl

	Mean	No.	Range
Neolithic	58.8	8	54.3-63.4
Bronze Age	61.8	9	49.6-74.8
Long Cist	59.3	17	53.8-65.4
Viking	61.2	11	49.0-72.5
Mediaeval	61.3	8	55.3-67.6

TABLE 133. g_og_o

Neolithic	92.2	5	87.0-100.7
Bronze Age	91.6	4	88.6-95.0
Long Cist	96.1	11	86.2-108.6
Viking	94.8	7	80.9-104.3
Mediaeval	90.8	7	84.8-99.7
Anglo-Saxon male (Morant)	100.4		
Anglo-Saxon female (Morant)	92.9		

TABLE 134. $c_r h$

	Mean	No.	Range
Neolithic	66.9	9	56.9-75.9
Bronze Age	63.0	17	50.6-72.7
Long Cist.	64.7	28	55.0-75.8
Viking	64.7	12	55.0-74.6
Mediaeval	65.2	10	57.0-79.4
Anglo-Saxon male (Morant)	65.7		
Anglo-Saxon female (Morant)	59.2		

TABLE 135. $m_2 h$

	Mean	No.	Range
Neolithic	30.4	12	25.8-33.8
Bronze Age	28.3	28	20.1-34.5
Long Cist	27.7	31	18.4-33.3
Viking	27.4	12	22.6-30.6
Mediaeval	27.6	11	23.5-34.0
Anglo-Saxon male (Morant)	27.2		
Anglo-Saxon female (Morant)	24.4		

For all the mandibular measurements, the mean values obtained are similar in all the Scottish groups. In fact, the difference between the greatest and smallest mean value recorded for any particular measurement was never greater than 6.0 m.m. The mean measurements for Scottish mandibles also agree well with the figures for Anglo-Saxons published by Morant (1926).

With the small numbers of mandibles available, slight differences between the racial groups cannot be detected. This was to be expected, since Cleaver (1937) stated that no information regarding racial differences could be gained from mandibular measurements, unless the series contained more than 40, and preferably more than 50, individuals. He made the comment, "We can assert that series made up by 40 or fewer individuals will not give the information required, and for such the lack of statistical distinction between two types cannot be supposed sufficient evidence of racial identity".

No useful purpose can thus be served by further discussion of the mandibular measurements of the Scottish groups.

SUMMARY.

The object of the present work was to study the teeth and jaws of prehistoric Scottish skulls, and to evaluate such differences as might exist between the races who inhabited Scotland from the Neolithic period to Mediaeval times.

A brief description has been given of the archaeological features of the different periods, with particular reference to the burial customs of the various races.

The anthropological features by which these races may be distinguished have also been described.

The main part of the work consisted of an odontometrical study of the Scottish material. A preliminary survey has been made of previous studies of tooth measurements in various different races.

The methods used in the present study for measurement of teeth have been described in detail, and an account has also been given of the method used in statistical preparation of the results.

The material fell into four main groups - Neolithic, Bronze Age, Iron Age and Mediaeval. The first three of these groups were each subdivided into two sections. In dealing with the results of tooth measurement, the main groups were first discussed separately, and the sections were compared. An analysis of sex differences/

differences within each main group was also made.

Too little material was available in the Neolithic group for differences in tooth size between the Western and Northern subgroups to be apparent. The few measurements obtained from the teeth of females were with one exception smaller than the mean measurements of the male teeth. This finding could not be subjected to statistical evaluation, but may be suggestive.

The Bronze Age group contained sufficient material to permit a fairly complete statistical comparison to be made between Southern and Northern subgroups. As far as tooth size was concerned, these subgroups appeared to form a homogeneous population. This agrees with the current anthropological opinion. No sex difference could be observed in Bronze Age teeth, and in a number of instances, the mean diameters of the teeth of the females were even found to exceed those of the males.

There appeared to be some differences between the Long Cist and Viking subgroups of the Iron Age population, and these were most clearly marked in the males. Unfortunately, the quantity of Viking material was too small to allow more than tentative conclusions to be drawn from these results. In the Iron Age group there was a distinct sex difference in tooth size, the teeth of the males always being larger than the corresponding teeth

of/

of the females. The sex differences were found to be most highly significant for the canines of both jaws.

The Mediaeval group was not subdivided on archaeological grounds. Since there were no known female skulls in this group, no sex comparison could be made.

Sufficient material was available in the Bronze Age and Iron Age groups to permit a statistical comparison of the tooth measurements to be carried out. Unsexed material was excluded from this comparison. In general, Bronze Age teeth were found to be larger in both dimensions than those of Iron Age individuals. This racial difference was more marked in the females than in the males.

The mean values obtained for tooth measurements of the Neolithic and Mediaeval groups could only be compared with the values recorded for the Bronze Age and Iron Age groups by using the combined sex groups. Figures published for 5th-10th century Alamanni, modern American Whites and modern Norwegian Lapps were also compared with those obtained for the Scottish groups. Tooth size was similar in the Neolithic and Bronze Age groups; and also in the Iron Age and Mediaeval groups. The figures for the Alamanni were closest to those for the Scottish Neolithic and Bronze Age groups. The American teeth tended to be rather larger and the Lapp teeth rather smaller than those of the Scottish groups./

groups. It was not possible to evaluate the statistical significance of these results.

Throughout the odontometric survey, comparisons were carried out using the crown indices as well as the absolute mean diameters. The crown indices, however, appeared to be of little value and in very few instances could a difference in crown index be shown to be statistically significant.

A discussion of the odontometric investigation followed, in which the results obtained for the Scottish groups were compared with those published for a number of other races.

Variation in certain morphological characteristics of the teeth was then discussed. The most interesting of these characteristics was the number of cusps of the maxillary molars. It appeared that progressive stages of cusp reduction could be demonstrated in the Scottish groups, and that these stages could be related to the degree of cusp reduction reached by certain modern coloured races. Reduction of cusps of the mandibular molars appeared to be a more complicated process, and no straightforward progression of reduction from one Scottish group to another could be shown. Nor could cusp reduction of the mandibular molars in the Scottish groups be related to that occurring in modern coloured races. The Neolithic group showed the least degree of cusp reduction in/

in all the molars. This group also showed the highest incidence of the accessory tubercle of Carabelli and of supernumerary cusps.

Brief accounts have been given of the distribution and severity of attrition of the teeth, and of irregularities of the occlusion.

A description has also been given of the pathological conditions which were noted in the Scottish skulls. Caries was rare in all groups but became a little more frequent in the later groups. Calculus deposition was widespread, and the heaviest deposits were found in the Long Cist, Viking and Mediaeval groups. A few cases were noted of exposure of the pulp, resulting from severe attrition and leading to the formation of apical abscesses. Embedded third molars were frequently seen.

Finally, an attempt was made to evaluate differences in the shape of the palate and mandible. The alveolar arch index gave no indication of differences in shape of the maxillary arch in the various Scottish groups, but the palatal index provided some evidence of a progressive slight shortening of the palate from Neolithic to Mediaeval times. None of the mandibular measurements showed any difference between the Scottish groups.

A complete bibliography has been appended.

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