

## Notes on some Human Teeth from a Neolithic Burial Cave in Malta

BY E. K. TRATMAN, M.D.S.

It is now several years since Sir Arthur Keith sent me a collection of human teeth from a cave in Malta. The excavator, Mr. G. G. Sinclair, recovered them from a fissure cave, which had been exposed by quarrying, near Casal Luca, Malta. The cave had been used as a burial place in Neolithic times, when burial was by inhumation as against cremation in the succeeding Bronze age. The actual date must be determined from the archæological remains.

At the present time there is no generally recognized method of recording the measurements of individual teeth, and this is a handicap when comparisons are to be made, especially as fossil material often consists very largely of teeth no longer in their jaws. The investigators of both fossil and recent material need a common basis on which to record their measurements so that any one set of such measurements can be compared with any other set. In both recent and fossil material, investigators will encounter teeth showing all degrees of wear, so that any system of measurements that may be adopted must avoid the complications introduced by this variation.

Thus the only possible base line from which measurements can be taken is the line of junction between the enamel of the crown on one hand and the cementum of the root on the other; from this base line measurements of the crowns and roots can be taken in all specimens that are not so far worn as to have lost the whole of their crowns.

In the premolar and molar teeth, the base line is very nearly at a constant distance from the apex of the root round the whole circumference of the tooth; in the incisor and canines this is not the case, for the base line is often markedly contoured. Thus measurements taken from the base line to the apex of the root on the labial and palatal and lingual surfaces will differ from those taken from the mesial<sup>1</sup> and distal<sup>1</sup> surfaces.

---

<sup>1</sup> As some confusion may arise, through a difference in terminology, over the terms *mesial* and *distal*, it will be as well to describe these terms as they are used throughout this paper. The *mesial* surface of a tooth is that surface adjoining, and normally in actual contact with, the tooth next in the series towards the front of the mouth; the *distal* surface is that adjoining, and normally in actual contact with, the tooth next in series towards the back of the mouth. Thus the *distal* surface of the tooth in front adjoins the *mesial* surface of the tooth behind. This is the usual dental usage.

Now as in the case of molars and premolars the best way of arriving at the root length is to measure from the mid-points of the enamel-cemental junction on the mesial and distal surfaces to the apex of the root, in the incisors and canines the measurements were made from the same surfaces and not from the labial or palatal or lingual surfaces.

In the first place, these teeth from Malta that were examined were brittle, well mineralized and usually had the roots coated with a film of rust-red earth which did not appear to adhere well to the enamel of the crowns, which were usually free of it; the earth would often peel off quite readily and leave the tooth surface beneath clean and smooth. Owing to their brittleness, many of the teeth were broken, and this applied particularly to the roots of the upper and lower molars; the teeth were therefore divided into complete and incomplete specimens.

The teeth represent persons of all ages, including many young adults and a number of children, as quite a number of deciduous teeth were present in the collection and many of the second molars showed only slight signs of attrition from use. Other molars, especially the firsts, were well worn, but seldom so far as to expose the pulp chamber or the secondary dentine that normally fills that cavity, as wear of the original dentine proceeds after the enamel has been worn away. The measurements taken were all to the nearest half millimetre.

At the outset of the examination the writer had hoped to find some feature or features that would enable him to distinguish without fail these prehistoric teeth from those of modern man. Such a feature or features he could not find, and in order to make certain that he had not overlooked them, the teeth were put aside for several years so that the writer might have time to enlarge his knowledge of the modern types of teeth. In 1929 the examination was continued, but the writer is compelled to admit that he failed to find any feature that would enable him to distinguish readily the Malta teeth from those of the average modern Englishman.

Abnormalities there certainly were amongst the Malta teeth, but these were not constant and fell within the range, which is a very wide one, of those that may be observed in any similar large, random collection of English teeth. So wide are these variations that the writer would hesitate to identify even Neanderthal man on the sole evidence of one or two teeth, for the feature of taurodontism can be found to exist even in modern dentitions, and may even exist on one side of the jaw and not on the other. It is true that the tendency to taurodontism is manifested chiefly in the third molars in modern

man and occurs but rarely in the first molar, so that if a series of human molars are found, all showing a strong tendency to taurodontism, it might be reasonable to assume the presence of Neanderthal man, and his presence might be definitely asserted if this evidence were borne out by other factors; here, however, it would be well to remember that not all the specimens of undoubted Neanderthal man show this special feature of the teeth in a fully developed form.<sup>2</sup>

It may be argued that taurodontism in the third molars of modern man is the result of the degenerative diminution of the tooth leading to the close approximation of the roots and their subsequent fusion into one, whereas in Neanderthal man the taurodontism is the result of specialization; on the other hand it may equally well be argued that this is also a degenerative change. At all events it is interesting to note that the teeth of Neanderthal man showing the greatest degree of taurodontism belong to the deposits that can be dated by other means as belonging to the later portion of the Middle Palæolithic period in western Europe, a time when the reign of this type of man was drawing rapidly to a close.

In the process of sorting out the Malta teeth into their individual categories certain difficulties were encountered. It was difficult, as is always the case in collections of odd teeth, to distinguish between the lower central and lateral incisors. Upper and lower canines when extensively worn proved to be similar. The lower premolars at times presented difficulties of distinction. In the molar region the frequent absence of the roots of the teeth made it difficult to distinguish between the first and second and between the second and third molars.

The individual teeth were examined and measured as follows:—

UPPER CENTRAL INCISORS (Number of teeth measured, 93).

The following measurements were taken in each case to the nearest half millimetre.

The length of the root was measured on the mesial surface from the junction of the enamel and cementum to the tip of the root; this was repeated on the distal surface. In each case these measurements were taken from the lowest point to which the cementum reached on these surfaces; the difference between them amounted to as much as two millimetres in two cases and nothing in others, the average being 0.5 mm. The average of these measurements is taken as the root length.

The measurements for the crowns were between (1) the mid-points

---

<sup>2</sup> Keith, Sir Arthur, *Antiquity of Man*, 2nd ed., Vol. I, p. 210, Fig. 75, C.

on the mesial and distal surfaces, and (2) the mid-points on the labial and palatal surfaces at the enamel margins; the average of these two has been taken as giving the crown factor; this factor multiplied by 100 and divided by the root length gives the index for the tooth.

In three cases the cingulum on the palatine aspect of the crown was elevated in the mid-line to form a pronounced tubercle, which was accompanied by a groove down the disto-palatal aspect of the root and thus showed a tendency towards the formation of two roots. In one further example, which, however, had no tubercle, this groove was so marked as to make the tooth partially two-rooted, the second root being formed in the manner described by Tomes<sup>3</sup> in the case of lower premolars.

There were six examples, or 6.4 per cent, of curved roots suggesting the presence, in some cases, of alveolar prognathism; in addition only two cases of caries were present, or a fraction under 2.2 per cent, and in both the cavity was situated at the cervical margin on the mesial side.

One other abnormality occurred on the labial surface of a single tooth where a deep fissure was present in the mid-line at the incisal edge; this fissure became shallower as it ascended over the labial surface and disappeared after covering two-thirds of the labial surface.

Further, a number of the teeth gave the impression that the labial surface of the crown was bent inwards from the line of the axis of the root, as if a natural attempt had been made by this means to correct the overbite due, possibly, to the alveolar prognathism, and so to bring the upper incisors into an edge-to-edge contact with the lower incisors.

#### UPPER LATERAL INCISORS (Number of teeth measured, 91).

The measurements taken for these teeth were the same as those taken for the upper central incisors.

In general the form of these teeth did not differ from those of modern man; there was a tendency for the distal angle of the crown to be so rounded off as to give the tooth rather the appearance of a canine, but this is a feature that is of quite common occurrence in modern dentitions. It was markedly pronounced in six cases, or 6.6 per cent.

There were sixteen cases, or 17.5 per cent, of excessive flattening of the root, this being very marked in two of the specimens; in all

---

<sup>3</sup> Tomes, *Dental Anatomy*, p. 575 and Fig. 287.

it was accompanied by a groove along the length of the root, marking a tendency towards the formation of two roots, labial and palatal.

In thirteen cases, or 14.3 per cent, the cingulum was considerably more elevated than is normally the case, thus leaving a deep pit on the palatal surface; this pit was replaced in three specimens by a well-marked median tubercle.

Three teeth showed marked curving of the apical third of the root, while two others were almost peg-shaped in form, thereby marking a tendency towards the loss of these teeth from these series.

Dental caries was present in only two specimens, or 2.2 per cent, and both cavities were situated at the cervical margin on the distal surface.

In both the central and lateral incisors the nature of the wear of the teeth suggests that the bite was normally overlapping, but that in a very considerable number of cases it must have been edge to edge. It would be interesting to see which bite is the case in any articulated jaws that may be recoverable from the deposits.

Finally one tooth showed an erosion of the root, thus suggesting the presence of a chronic abscess or possibly a dental cyst.

#### UPPER CANINES (Number of teeth measured, 55.)

The same measurements were taken for these teeth as for the central incisors.

In two exceptionally massive specimens the root was very flat, while two other teeth showed very extensive wear facets due to occlusion with the lower premolar and canine. There were four examples, or 7.3 per cent, of caries, and of these no less than three of the cavities were situated at the cervical margin. In the fourth example the caries had penetrated from the palatal surface, forming a large cavity. In one specimen there was also an erosion cavity, as distinct from caries, at the neck of the tooth.

#### UPPER FIRST PREMOLARS (Number of teeth measured, 50).

The following measurements were taken for these teeth. The roots were each measured from the mid-point on the mesial and distal surfaces of the junction of the enamel and cementum to the tips of the roots. The crown measurements were taken between the mid-points on the mesial and distal surfaces at the junction of the enamel and cementum and at the same level between the buccal and palatal surfaces.

Most of the teeth showed a marked tendency towards the formation of two roots, which were actually completely formed in

thirty-three examples, or 66 per cent. In seven cases, or 14 per cent, the two roots were distinguishable by a very marked constriction of the single root on the mesial and distal aspects, and this constriction was marked along the whole length of the root. In ten cases, or 20 per cent, there was either no attempt at all towards the formation of two roots, or the constriction of the single root, marking the first stage of such an attempt, was so slight that it could be ignored. There were no examples of three-rooted first premolars in the collection.

Caries was present in five cases, or 10 per cent, and of these teeth one of them had two cavities, making a total of six. In all of the teeth the cavities were situated interstitially at the gum margin, an area that is so often the starting point for caries at the present day. In three cases the crown of the tooth had been fractured and subsequently worn smooth, while yet another tooth showed a much greater degree of wear of the palatal cusp than the buccal. One tooth showed an exostosis around part of its root, possibly the end-result of a healed fracture.

#### UPPER SECOND PREMOLAR (Number of teeth measured, 42).

The same measurements were taken for these teeth as for the upper first premolars; but in this case, with the exception of two teeth, or 4.8 per cent, two roots were not present. At the same time, though, there was a decided tendency towards the formation of two roots as indicated by the grooving of the root, this being well marked in no less than fifteen examples, or 35.7 per cent.

The incidence of caries in these teeth was greater than in the first premolars, there being eight examples, 19.1 per cent, of which six were placed at the cervical margin interstitially; the other two cavities were large and both involved the pulp chamber, one of them being so large as to involve almost the whole crown and part of the coronal end of the root as well.

Exostosis of the root of the irregular type was present in three cases, of which two were probably due to the chronic irritation of the pulp through slowly advancing caries. There was one example of a fractured crown subsequently worn smooth by mastication.

#### UPPER FIRST MOLARS (Number of teeth measured, 19).

It is unfortunate that only nineteen of these teeth were sufficiently complete for measurements to be taken out of the total number of seventy-four teeth present; this is due to the brittleness of the teeth,

**TABLES OF MEASUREMENTS**  
**Table I. UPPER INCISORS AND CANINES**

TOOTH	No. EXAM.	ROOT LENGTH IN MILLIMETRES						CROWN IN MILLIMETRES						INDEX	PER-CENTAGE OF CARIOUS TEETH
		Buccal			Palatine			Mes.-dist.		Lab.-pal.		Average			
		Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Max.	Min.				
Cent. Incis. . .	93	20.5	11.9	15.9	7.5	5.0	8.5	5.5	6.5	0.5	2.2				
Lat. Incis. . .	91	20.0	11.0	15.9	6.0	4.0	8.0	4.5	5.0	5.0	2.2				
Canines . . .	55	24.0	13.5	18.7	7.0	5.0	10.0	6.5	6.8	6.8	7.3				

**Table II. UPPER PREMOLARS**

TOOTH	No. EXAM.	ROOT LENGTH IN MILLIMETRES						CROWN IN MILLIMETRES						INDEX	PER-CENTAGE OF CARIOUS TEETH
		Buccal			Palatine			Mes.-dist.		Buc.-pal.		Average			
		Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Max.	Min.				
First . . .	50	19.5	11.0	19.5	10.5	14.3	5.5	4.0	9.5	7.0	6.3	45.00			
Second . . .	42	19.5	11.0	*	*	15.3	6.0	4.0	9.0	7.0	6.9	43.30			

\* Only two specimens had two roots and so for record purposes the single root has been termed the buccal root.

**Table III. UPPER MOLARS**

TOOTH	No. EXAM.	ROOT LENGTH IN MILLIMETRES												INDEX	PER-CENTAGE OF CARIOUS TEETH								
		Ant. Buc.				Post. Buc.				Palatine						Mes.-dist.				Buc.-pal.			
		Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average			Max.	Min.	Average	Max.	Min.	Average		
First . . .	19	15.0	10.0	13.0	10.0	15.0	10.0	13.0	10.5	7.0	8.0	11.5	8.0	9.4	68.79								
Second . . .	22	14.0	10.0	14.0	10.0	15.0	11.5	12.4	8.5	7.0	11.0	9.0	9.2	73.86									
Third . . .	32	13.0	8.0	13.0	8.0	14.5	9.0	11.5	8.0	5.0	10.5	8.0	7.8	67.61									

which has caused the loss by fracture of portions of one or more of the relatively slender roots.

The measurements taken for these teeth were five in number :—

1 and 2. The anterior and posterior buccal root lengths from the mid-point of the line of junction to the enamel and cementum on the buccal surface to the tips of the respective roots.

3. The palatine root length from the junction of the enamel and cementum at the base of the root to the apex of the root.

4 and 5. The crown was measured between the enamel margins between the points used in 1 and 3, and between the mid-points at the enamel margin on the mesial and distal surfaces.

The teeth showed a distinct tendency towards the so-called oblique-rooted type, in which the posterior palatine cusp is much reduced and may be almost absent. This, as is usual in modern man, is accompanied by an over-development of the anterior palatine cusp, which must be looked upon as a degenerative change towards a simple bicuspid type of crown.

In many cases the teeth bore small oval or saucer-shaped shallow depressions near the occlusal surface on the mesial and distal surfaces, that is, near the contact points. These are all due in these specimens to the very slight movements of the teeth in their sockets under the stresses of mastication ;<sup>4</sup> the facets were observable in all the molars, both upper and lower, and also in the premolars, though in these the facets were not so well marked.

Two specimens, 10.5 per cent, had enamel tubercles on the palatine surface of the anterior palatine cusp. In four cases, 21.0 per cent, the fissure between the anterior and posterior palatine cusps was continued in the form of a shallow groove well on to the palatine root. In seven cases, 36.8 per cent, the palatine root was deeply grooved along its whole length as if for division into two. Of the three roots of the teeth the anterior buccal root was generally the largest.

There were only three cases of caries, 15.8 per cent. In two of these the cavities were small and multiple and situated all round the neck of the tooth at the gum margin ; an extension of these often leads to the breaking away of the whole of the upper part of the crown from the roots, thus leaving a series of the occlusal parts of the crowns of molars lying free in the cave deposits and undestroyed by caries. Examples can be found in the mouths of modern man, and a number of specimens are to be found amongst the teeth from

---

<sup>4</sup> Cf. Goadby, K., *Diseases of the Gums and Oral Mucous Membrane*, p. 16.



the late Upper Palæolithic site of Aveline's Hole in Somerset.<sup>5</sup> The third carious cavity was large, involving the whole of one of the interstitial surfaces from the cervical margin to the occlusal surface, thereby so weakening the crown that it had fractured under mastication and had been subsequently worn smooth.

One other tooth showed a very much worn crown with an irregular exostosis of the middle third of the anterior buccal root.

Amongst the unmeasurable specimens were four examples in which the anterior buccal cusp was reduced somewhat, but accompanying this condition there was a small additional cusp present on the buccal surface. There were also seven specimens with tubercles on the palatine aspect of the anterior palatine cusp, and two specimens in which the crown had been fractured and subsequently worn smooth.

#### UPPER SECOND MOLARS (Number of teeth measured, 22).

These teeth, like the first upper molars, had suffered badly from breakages, which had reduced the number available for measurement to rather a small total. The actual measurements taken were the same as those for the first upper molars.

The so-called oblique rootedness noticeable in the first molars was accentuated in these teeth, where the posterior buccal cusp, instead of being in line with the anterior buccal cusp, was displaced towards the palate, being at the same time a little reduced in size; this reduction appeared to be due in part to the enlargement of the anterior buccal cusp. The posterior palatine cusp was still further reduced and was often practically absent, being accompanied by a very large anterior palatine cusp.

The fissure between the palatine cusps was continued down on to the palatine root in three cases, while the unmeasurable specimens showed five more examples.

There were no less than nine teeth showing caries, 40·9 per cent; of these six showed cavities placed interstitially at the gum margin, one tooth having two cavities. One cavity was a shallow fissure—one on the occlusal surface—while the remaining two cavities were very large, involving the whole of one of the interstitial surfaces, the pulp chamber, and the major part of the occlusal surface.

One of the carious teeth showed an irregular exostosis on the anterior buccal root, and another showed a healed fracture of the palatine root with considerable exostosis. Two of the crowns had

---

<sup>5</sup> See collection of teeth in the museum of the Spelæological Society, University of Bristol.

been fractured and subsequently worn smooth, while one other tooth showed a tendency towards the formation of four roots.

#### UPPER THIRD MOLARS (Number of teeth measured, 32).

The measurements taken for these teeth were the same as those for the first and second molars.

Generally these third molars were reduced in size compared with the first and second molars and were also irregular in form, the cusps of the crowns often appearing to follow no regular plan but to lie round a single central sulcus, faintly reminiscent of the multi-tubercular molars of the *Ursidae*, and the likeness was helped by the presence of minor fissures breaking up the surface of the individual cusps.

The antero-internal or anterior palatine cusp was generally the most prominent one and was, compared with the actual size of the crown, larger than in either of the other two molars, the enlargement being, as before, at the expense of the postero-internal or posterior palatine cusp. This was often so much reduced in size as to be, for all practical purposes, absent or fused with the anterior palatine cusp; when this occurred the line of fusion was marked by the commencement of a fissure branching from the central sulcus.

The posterior buccal cusp was more reduced in size than the anterior buccal and tended to be completely absent, thereby reducing the crown to a rather flat bicuspid form with the roots more or less fused into one to form a taurodont type of tooth.

The fusion of the roots varied from a stage in which the division into three separate roots was marked by a deep groove to one in which the line of division was scarcely perceptible. In all there were only six specimens, 18·8 per cent, that showed separate roots, and one of these bore a fourth root. In a second the posterior buccal and the palatine roots were joined by a large irregular exostosis, while the anterior buccal root was also affected.

Caries was present in twelve specimens, 37·6 per cent, representing thirteen cavities; of these cavities no less than twelve had started interstitially at the gum margin. Three of the cavities were large.

#### LOWER CENTRAL INCISORS (Number of teeth measured, 73).

These teeth and the lower lateral incisors are perhaps the most difficult to identify in a mixed collection of teeth, such as those from the Ghar Dalam Cave.

— The measurements taken for these teeth were the same as those for the upper central incisors.

In most cases the roots were normal in form, but there were

seven examples in which the roots were rounded at the apex, though the writer is not of the opinion that this was due to chronic periodontal disease, as other signs of the disease were absent, such as irregular deposits of cementum near the apex. In several cases the roots were very flat and grooved as if for bifurcation, but such a condition can quite often be observed in modern teeth.

Two examples showed tartar still adherent to the necks of the teeth, but this would not represent the percentage of persons with tartar on their teeth during life, for the tartar may easily have become detached under the *post-mortem* conditions. The serual type of calculus appeared to be absent unless it was masked by the prevailing coating of red earth; its absence is in keeping with the lack of evidence of the presence of periodontal disease.

There were no specimens showing dental caries.

#### LOWER LATERAL INCISORS (Number of teeth measured, 40).

The measurements taken were the same as those for the upper central incisors.

There were four specimens showing grooving of the roots marking a tendency towards bifurcation, while salivary calculus was still adherent in two cases; caries was present in only one specimen, 2.5 per cent, interstitially at the gum margin.

#### LOWER CANINES (Number of teeth measured, 47).

The measurements taken were the same as those for the upper central incisors.

Caries was present in only one specimen, 2.1 per cent, at the cervical margin interstitially; there were, however, fifteen specimens, 31.9 per cent, which showed a grooving of the root marking a tendency to division, and in three cases out of these actual division had occurred at the apex.

Tartar was still adherent in five specimens, and one specimen showed a large enamel tubercle on the cingulum.

A study of the marks of attrition due to mastication suggests that in thirty-four cases, or 72.3 per cent, the bite was edge to edge; in six cases, or 12.8 per cent, the bite was the modern overhung type; in seven cases, or 14.9 per cent, the nature of the bite was uncertain but was probably edge to edge.

These figures contradict the impression given by the upper central and lateral incisors that the bite was of the modern overhung type in many cases. The figures obtained by this examination of the

lower canines are to be more relied upon than the *impression* gained by an examination of the upper incisors.

#### LOWER FIRST PREMOLARS (Number of teeth measured, 47).

The measurements taken were the same as for the upper central incisors.

In five specimens, 10.6 per cent, the roots showed a marked groove, thus indicating a tendency towards the division into two roots, one anterior and one posterior,<sup>6</sup> but in none of these examples had the process gone so far as to form two separate roots.

Caries was present in ten specimens, 21.3 per cent, and of these five of the cavities had commenced interstitially at the gum margin and three at the gum margin on the labial surface.

Irregular deposits of cementum were present near the apices in three specimens, in two of which these deposits were associated with caries at the gum margin. Tartar was adherent to the lingual surface in two specimens.

#### LOWER SECOND PREMOLARS (Number of teeth measured, 41).

The measurements taken were the same as those for the upper central incisors.

One specimen showed anterior and posterior roots, and a second tooth showed a groove on the root marking the commencement of such a division.

Caries was present in ten specimens, 24.4 per cent, in nine of which the carious process had started interstitially at the gum margin. Three of the cavities were large, and one tooth showed multiple small cavities all round the neck.

Tartar was still adherent on the lingual surface in four specimens, and irregular deposits of secondary cementum in the apical region were present in one specimen only.

#### LOWER FIRST MOLARS (Number of teeth measured, 24).

The following measurements were taken for these teeth:—

1. The length of the anterior root from the mid-point on the mesial surface of the line of junction between the enamel and the cementum to the tip of the root.

2. The length of the posterior root from the mid-point on the distal surface of the line of junction of the enamel and cementum to the apex of the root.

---

<sup>6</sup> Tomes, *Ibid.*, p. 375.

TABLES OF MEASUREMENTS

Table IV. LOWER INCISORS, CANINES, AND PREMOLARS

Tooth	No. Meas.	ROOT LENGTH IN MILLIMETRES			CROWN IN MILLIMETRES						INDEX	PER-CENTAGE OF CARIOUS TEETH
		Anterior		Average	Mes.-dist.		Lab.-ling.		Average			
		Max.	Min.		Max.	Min.	Max.	Min.				
Cent. Incis.	73	19.0	13.5	14.4	5.0	3.0	7.0	5.0	4.9	34.20	Nil	
Lat. Incis.	40	18.0	12.0	13.6	5.0	4.0	7.5	4.5	5.3	39.04	2.5	
Canines	47	16.0	11.0	13.6	6.5	5.0	9.5	6.0	6.7	36.40	2.1	
P.M. 1	47	19.0	12.5	15.7	6.0	4.5	8.0	6.0	6.1	39.96	21.3	
P.M. 2	41	18.5	14.0	16.3	8.0	4.5	9.5	6.0	6.5	39.91	24.4	

Table V. LOWER MOLARS

Tooth	No. Meas.	ROOT LENGTH IN MILLIMETRES			CROWN IN MILLIMETRES						INDEX	PER-CENTAGE OF CARIOUS TEETH				
		Anterior		Average	Mes.-dist.		Buc.-ling.		5TH CUSP							
		Max.	Min.		Max.	Min.	Max.	Min.	Max.	Min.			Average			
First	24	19.0	13.5	16.5	12.5	16.0	10.0	8.0	8.0	10.0	8.0	9.4	0.4	0.75	58.46	29.2
Second	29	18.0	12.0	15.5	12.0	14.3	11.0	8.0	8.0	10.0	8.0	9.1	0.3	0.56	63.74	44.8
Third	29	16.0	11.0	16.0	10.0	13.2	11.0	7.5	7.0	11.0	7.0	8.3	0.0	0.38	62.48	20.7

3. The crown was measured between the first points in 1 and 2 and between the mid-points buccally and lingually at the line of junction of the enamel and cementum.

In these teeth, as in the other lower molars, it was considered desirable to estimate the size of the fifth cusp. Various methods of direct measurements were tried, but found to be impracticable owing to the variations in the degree of wear of the teeth and the nature of the fissures marking the limits of the fifth cusp; therefore an empirical method of measurement had to be adopted by estimating the size of the cusp against a normal calculated as 1.0. It is admittedly a method that allows errors of degree to occur, especially as it is impossible to define the standard used for comparison which may therefore vary with each investigator. In spite of this the method does provide a means for an approximate comparison of the size of the fifth cusp in the three molars.

Caries was present in seven specimens, 29.2 per cent, representing nine cavities; of these seven had commenced interstitially either at the contact points or at the gum margins; one certainly, and one probably, had commenced on the occlusal surface.

The facets worn at the contact points on the mesial and distal surfaces were particularly well marked in these teeth.

There was another feature worthy of notice in these teeth, and that is, the point at which the roots become separate from the body of the tooth. In the average modern Englishman the roots separate a little below the neck of the tooth, but examples are not wanting in which this distance is considerably increased, thereby shortening the actual root length as measured from the external surface of the floor of the pulp chamber to the apex of the root. In other words, there is an enlargement of the pulp chamber marking a tendency towards taurodontism. In these teeth from Malta the same thing occurred, but in a slightly more marked degree and somewhat more frequently both in the upper and lower molars.

Only one specimen showed any exostosis of the roots, and that on the anterior root only.

#### LOWER SECOND MOLARS (Number of teeth measured, 29).

The measurements taken were the same as those for the first molars, and the size of the fifth cusp was estimated in a similar manner, using a standard fifth cusp of a first molar.

Caries was present in thirteen specimens, 44.8 per cent, representing fifteen cavities; of these two were placed interstitially at the gum margin, seven at the gum margins either buccally or lingually, and

six occlusally, including one cavity involving the whole of the distal surface and half of the crown. Several specimens showed varying degrees of taurodontism.

#### LOWER THIRD MOLARS (Number of teeth measured, 29).

The measurements taken were the same as those for the first lower molars.

These teeth were generally smaller and more irregular than the first or second molars, but maintained the general true shape of the crown more so than was the case with the upper third molars; nevertheless the shape of these teeth varied very much. A degree of taurodontism was in evidence in nearly all specimens and a study of these third molars most strongly suggests that this condition is the result of a tendency towards the fusion of the normally separate roots; or to express it in another way, taurodontism represents a retrogression from the normal multiple-rooted teeth and makes itself felt most strongly in those teeth that are degenerate and tending to disappear, such as the third molars, from the human dental series.

The roots of these teeth were fused completely in only eleven specimens, 37.9 per cent, and in these the line of fusion was still marked by a groove. Thus 62.1 per cent had separate roots as against only 18.8 per cent of the upper third molars, which may therefore be regarded as the more degenerate of the two sets of third molars.

The cusps of the crown tended to be subdivided by minor fissures and to lie grouped round a central sulcus reminiscent of the multi-tubercular type of molars seen in the *Ursidae*. This was well marked in eight specimens, or 27.6 per cent.

Caries was present in six examples, or 20.7 per cent, in three of which it appeared as cavities placed interstitially; two cavities had started from the occlusal surface, and one which involved almost the whole of the crown probably started from this area as well.

#### SUMMARY AND CONCLUSIONS.

The detailed examinations outlined above show that there is no feature by which these teeth from Malta of Neolithic times may be distinguished from those of modern man save by the state of their preservation and their superficial appearance due to their long burial in the material of the cave floor.

The percentage of caries is interesting and is displayed graphically in Table 1. As in modern man the lower incisors and canines are

practically immune, but it is a little surprising to find the upper incisors and canines following suit. From the canines backwards to the second molars the percentage of teeth affected with caries increases, save for a slight drop in the case of the upper first molars, till it suddenly increases to the high maximum of the second molars. The third molars show a decrease, which is probably largely accounted for by their shortened time of exposure to the chances of decay; and this shortened time is due to the late date of their eruption, coupled with the fact that the whole of the teeth represent a very high percentage of young adults.

But if these are the true reasons for the decrease in the percentage of caries in the third molars, then, arguing in the reverse direction, the peak of the incidence of caries should come in the first molars and not in the second. Here, though, other factors come into play.

In the first place the attrition of the first molars would lead in time to the exposure of the dentine underlying the enamel, with the complete obliteration of the natural fissures in that substance. These fissures are very often the first places to be attacked by dental caries. The exposure of the dentine would stimulate the production of secondary dentine, and the hyper-calcification of the normal dentine; thus there would be an increase in immunity to caries.

It may well be asked, however, why the first molars did not become subject to caries prior to the wearing away of the enamel and the eruption of the second molars, and this is a question not easily answered in the limited state of our knowledge of the people.

Secondly, it is probable that diet was a factor in the relative immunity to caries in the first molars; in other words, the young were brought up on a more natural diet than their elders, and it was not until they were fairly well grown, say in their teens, that they were allowed to consume the more refined diet; and by that time the fissures in the crowns of the first molars would have been very largely obliterated even if the dentine were not exposed; such a degree of wear so early is normally excessive for the average Englishman, but it is by no means uncommon to find such a degree of wear of the teeth at that early age in races living on a largely vegetable diet of a fairly coarse nature.

Thirdly, oral hygiene probably plays an important part in the lessened amount of caries in the first than in the second molars. Where relatively primitive methods of cleaning teeth, such as the use of the finger dipped in charcoal or ashes, are in vogue, the teeth as far back as the first molars are easy to cleanse over their main



surfaces, but it is not so easy to cleanse the second molar thoroughly unless extra care is taken to ensure this.

These three factors between them account, in the writer's opinion, for the higher percentage of caries in the second molars compared with the first, and this percentage is remarkably high for such early times.

Out of a total of 100 carious cavities, no less than 72 had started at the gum margin, and of these 65 were cavities placed interstitially, thus giving a picture of inefficient oral hygiene leaving food debris round the necks of, and between, the teeth.

Another point of interest is the absence of roughening of the roots due to the irregular deposition of secondary cementum. This absence of increase in the amount of the cementum, either regular or irregular, is in striking contrast with the conditions found in the human teeth from the late Upper Palaeolithic station of Aveline's Hole in Somerset, where chronic periodontal disease was apparently rife. Thus the inhabitants of Malta in Neolithic times as represented by these teeth were susceptible to caries but not apparently to periodontal disease.

On the other hand, the presence of tartar round the necks of a number of the teeth makes it obvious that a number of the population must have suffered from some degree of marginal gingivitis, which, in an average Englishman, would progress to a very definite periodontal disease if left untreated; but this does not seem to have been the case in these teeth, for there is none of the roughening of the roots of the teeth that is associated with this condition. Again the youth of the individuals represented might account, in part at least, for the absence of evidence of periodontal disease.

The degree of wear of the molars in a number of cases suggests that the people lived on a gritty vegetarian diet rather than one consisting largely of meat. The tendency of some of the molars to assume a taurodont form is worthy of note.

Thus though these results and figures may be regarded as inconclusive, they do show that the modern tooth form has not changed perceptibly over a long period of time, a period which is probably not less than 5,000 years and is almost certainly considerably more.