PUBLICATIONS OF THE CARLSBERG EXPEDITION TO PHOENICIA 6

SŪKĀS V

A Study of Teeth and Jaws from a Middle Bronze Age Collective Grave on Tall Sūkās

By VERNER ALEXANDERSEN

Det Kongelige Danske Videnskabernes Selskab
Biologiske Skrifter **22**:2

Kommissionær: Munksgaard
København 1978

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Synopsis

Teeth and *jaws* excavated from the *Middle Bronze Age* town in the mound *Tall Sūkās* in *Syria* were examined; see: *Henrik Thrane:* Sūkās IV, Tall Sūkās (Publications ... 5 = Hist. Filos. Skr. Dan. Vid. Selsk. 10:1, 1978). The number of individuals and the age distribution in grave T IV (dating from approx. 1900-1700 B. C.) were estimated from the dentitions. Examination of the jaws showed *agenesis of premolars and third molars*, malpositioned teeth and various pathological changes of the bones. *Dental caries* and minor *structural defects of the teeth* were observed. The conditions in *Tall Sūkās* were similar to the dental conditions in other contemporary populations from the Near East.

The *morphology of deciduous and permanent teeth* was described as well as the *odontometrical variation*. *Smith's distance statistics* was used on selected *non-metric dental traits* to demonstrate population affinities among ancient and recent populations from the Near East. The teeth from *Tall Sūkās* show a great similarity in shape to the teeth from Mesopotamian Kish and similarity in size to the teeth from Byblos. Compared with modern Israelic populations the teeth from *Tall Sūkās* are relatively large with the same trend to weak expression of *shovel-shape of the incisors* and marked *reduction of* the distal *cusps on the molars*, while the *premolars* are not reduced in shape or size.

The concept of an *Eastern Mediterranean dentition* is discussed. The *Eastern Mediterranean dentition* is found to be more variable than previously assumed and the diagnostic traits are in need of reevaluation.

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Printed in Denmark by Bianco Lunos Bogtrykkeri. ISBN 87-7304-057-6

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Introduction

In the years 1958–1963 the Danish Expedition to Phoenicia excavated parts of the mound Tall Sūkās in Syria, under the leadership of Professor *P. J. Riis*. In cultural deposits of the Bronze Age town the expedition un-earthed skeletal remains in an often used grave belonging to the Middle Bronze Age II period (approx. 1900–1700 B.C.). This grave was numbered T IV (*Riis* 1958–60), and its excavation was entrusted to Dr. *Henrik Thrane*.

The bones were studied in the Anthropological Laboratory of the Copenhagen University. They consisted of fragments of crania impossible to assemble into measurable skulls, as well as a quantity of isolated teeth. Their examination therefore took the form of an odontological study.

The deciduous and permanent teeth form a small part of the human skeleton but they contain a wealth of information about the possessor of the teeth.

As the teeth develop and erupt throughout the entire period of childhood and adolescence, they represent a reliable indicator of the physiologic age of young individuals.

Teeth are variable structures and much of the anatomical variation in size and shape is under genetic control. The anatomical variation is therefore useful in attempts to assess population affinities on the basis of genetic similarities.

The dentition is a part of the masticatory apparatus. The teeth have a functional period in which they become more or less worn. They are at the same time exposed to a variety of pathological factors and the impact of functional and pathological influences become permanently stamped on the teeth and jawbones. Such changes of the teeth and jaws reflect to some extent the living conditions of the individuals in the society.

Composition of the Material

Table 1 shows the dental material examined. It was not possible to work out the exact number of individuals represented by the teeth. According to the archaeological diaries there could be no more than 40 shattered skulls. The minimum number was found by counting the first molars of the right and left sides of the mandibles respectively. These teeth could be definitively determined as belonging to right or left side and they formed the largest group of teeth, with 29 right first molars and 31 left first molars.

The first molars were found among the remains of the youngest children aged about 4 years, but were missing – having been lost *ante mortem* – from two of the adult individuals examined. Accordingly, the teeth to be studied are those of between 33 and 40 individuals.

Based upon the stages of dental development it was possible to determine the age of skeletal remains of children. There were no infants. Three children were of about 4 years, whilst 4, 1 and 2 children were 6, 7 and 8 years old. One was about 11 years. Children represented about 30 per cent of the Phoenician material examined. Comparable data are available from *Senyürek* (quoted from *Vallois*, 1960) regarding Anatolian finds. For the Copper Age 31.7 per cent of 104 individuals were found to have been from 0 to 12 years; for the period between Chalcolithic Age (ca. 4000–3000 B.C.) and the Byzantine Period (11th century) 20.4 per cent of 122 individuals (Table 2). Among the skeletal remains of 53 individuals from Chalcolithic Byblos 30 per cent belonged to children (*Özbek*, 1975).

For estimating the age of adult individuals by their teeth the occlusal attrition can be utilized.

Table 1.
Number of teeth examined

Deciduous teeth Maxilla	*Deciduous teeth* Mandible	*Permanent teeth* Maxilla	*Permanent teeth* Mandible
di^1 3	$di_{1,2}$ 5	I^1 36	$I_{1,2}$ 58
di^2 3		I^2 34	
dc 7	dc 8	C 46	C 52
dm^1 11	dm_1 15	P^1 38	P_1 38
dm^2 17	dm_2 19	P^2 46	P_2 41
		M^1 52	M_1 60
		M^2 46	M_2 37
		M^3 14	M_3 37
41	47	312	323

This, however, requires the previous establishment of norms for the population concerned as regards progression of wear in the early years. Until the complete dentition is fully developed, the cutting of the molars indicates ages for comparison with the degree of attrition. In the Tall Sūkās material the number of suitable individuals of known dental age was too low to permit of establishing of norms. The progress of attrition in most children and adults seemed slower than in the Anglo-Saxon population studied by *Miles* (1963), to judge from his diagram showing the systematic use of molar wear for age assessment in pre-mediaeval British skulls. In the Phoenician population most young individuals took more years to expose the dentine of the occlusal surfaces of the molars than did the Anglo-Saxon population. This was particularly so as regards the second and third molars, and more so in the upper than in the lower jaw.

Table 2.

Age distribution in populations from ancient Anatolia, Iran and Tall Sūkās.

	Age				
	(0-12)	(13-20)	(21-40)	(41-60)	(61-x)
Ancient Anatolia (*Senyürek*, 1951) Copper Age	33 (31.7 %)	13 (12.5 %)	36 (36.6 %)	18 (17.3 %)	4 (3.8 %)
Chalcolithic to Byzantine period	25 (20.4 %)	16 (13.1 %)	50 (40.9 %)	24 (19.6 %)	7 (5.7 %)
Ancient Iran (*Vallois*, 1940) Sialk (Eneolithic to beginning of Iron Age)	5 (12.8 %)	2 (5.2 %)	21 (53.8 %)	11 (28.2 %)	
Tall Sūkās (Middle Bronze Age)	11 (33.3 %)	0	17 (51.5 %)	5 (15.2 %)	

Data from Anatolia and Iran were obtained from *Vallois* (1960), table 9. Data from Tall Sūkās represent an estimate based on the assumption that all mature individuals had severely worn teeth. N assumed to be 33.

Examination of the degree of first molar attrition by *Murphy*'s method (*Murphy*, 1959) showed that the adult individuals in the present material were distributed as in Figure 1. In that figure the letters a–d indicate the number of exposed dentine islets on occlusal surfaces with 1 to 4 islets. Letters e–h indicate the progressive merging of the dentine islets with total removal of the occlusal enamel. It transpires that excessive wear was scarcely ever present in the Phoenician material, and in only three jaws were either M^1 or M_1 lost *ante mortem*.

In large Anatolian finds dated to the period Chalcolithic/Roman-Byzantine *Senyürek* (1949) made a study of the extent of dental attrition in relation to the age of the individuals which was determined by the usual anthropological criteria. From his results it appears that in the age group 21–40 years the first molars in the majority of cases showed the cusps worn to the extent of exposing some islets of dentine (a–d). In the age group 41–60 years the majority of the first molars had the occlusal dentine completely exposed and the height of the crowns was much reduced (e to h).

Fig. 1. The degree of attrition of mandibular and maxillary first molars.

The age distribution in Eastern Mediterranean populations in early historic time was discussed by *Howells* (1960) and *Vallois* (1960). In Table 2 the age distributions in ancient Anatolia and Iran are shown. The older individuals (41–60, 61–x) were represented by 20 % to 30 % of the skeletons found. In the Phoenician grave T IV with few individuals showing severe attrition of the first molars there were probably fewer old individuals and more skeletal remains of young persons. The difference between the sample from Tall Sūkās and the other ancient populations mentioned in Table 2 is not statistically significant, however, by the χ^2 test.

Examination of Jaws

a: Variation in number of teeth

No supernumerary teeth were found in the skull fragments unearthed. Hypodontia occurred in the premolar regions of the mandibles, and in the molar regions of both maxillae and mandibles.

In one mandible there was retention of the second deciduous molar, there being no evidence of the premolar that should have replaced it. The anterior premolar was present. The premolar regions in the opposite side of the mandible as well as the upper jaw were missing.

In another skull there was hypodontia of the mandibular second premolars and, to judge from the shape of the alveolar socket of P^2 sin. this tooth – lost *post mortem* – was undersized. The other premolars belonging to the skull were examined and found normal.

Regions of the jaws where third molars were not present but could be anticipated were examined roentgenologically in order to confirm the diagnosis of agenesia. These examinations were confined to children of over eight years, as roentgenological traces of mineralized third molar crowns could scarcely be expected prior to that age.

Thirty-two out of 52 possible third molar regions in 13 individuals were examined. All four third molars were congenitally missing in one skull and in another there was unilateral agenesia of an upper third molar whereas the homologous tooth was markedly reduced in size.

Hypodontia in the permanent dentition most often involves the third molars. The frequency distribution of third molar agenesia in various populations is shown in Table 3. In the fragmentary material from Tall Sūkās the frequency is fairly high.

In a study of third molar agenesia in seven Natufian sites *Smith* (1973) noticed that the frequency in the sample from Hayonim was significantly higher than in the other samples. Congenital absence of teeth is often a hereditary condition and the exceptionally high frequency of third molar agenesia found at Hayonim indicates to *Patricia Smith* that the site was used by members of the same family group throughout the entire period represented.

Excluding third molars the mandibular second premolars showed the highest frequency of hypodontia (2.8 per cent.) of any tooth group in a large sample of recent Swedes (*Grahnén*, 1956). In the material from Tall Sūkās the only congenitally missing teeth besides the third molars were the mandibular second premolars. They were missing in at least 2 cases out of 33 (6 per cent.).

The overall frequency of hypodontia in the skeletal remains from Tall Sūkās might indicate the presence of a family group, but the evidence is not conclusive because hypodontia in the permanent dentition is common in ancient populations from the Near East.

b: Malposition of teeth

There was malalignment of single teeth within all groups of teeth. It was possible to examine a total of ten maxillary fragments with the anterior part preserved. There was rotation of the lateral

Table 3.

Frequency of third molar agenesis in various populations

Population	Number of specimens	Number with 3rd molar agenesis	Percentage	Source
Hayonim				
(Natufians)	17 m.	8 m.	47.0	*P. Smith* (1973)
Erq el Ahmar				
(Natufians)	17 m.	1 m.	5.8	*P. Smith* (1973)
Byblos	19 max.	1 max.	5.3	*Özbek* (1975)
(Chalcolithic)	21 m.	8 m.	38.0	
Kish				
(ca. 3000 B.C.)	36 m.	1 m.	2.7	*Carbonell* (1963 & 1965)
Greece				
(ca. 3300–ca. 2000 B.C.)	28 sk.	5 sk.	17.9	*Angel* (1944)
(ca. 2000–1400 B.C.)	31 sk.	9 sk.	29.0	*Angel* (1944)
Tall Sūkās				
(ca. 1900–1700 B.C.)	13 sk.	2 sk.	15.4	Present Study
Cyprus				
(ca. 1600–1000 B.C.)	21 max.	7 max.	33.3	*Fürst* (1933)
Recent Swedes	1064	262	24.6	*Grahnén* (1956)

m. = mandibles only, max. = maxillae only, sk. = skulls.

incisors in one jaw and of the right lateral incisor in another. The mesial surfaces of the teeth were rotated facially.

Crowding of the teeth was particularly pronounced anteriorly in the mandible. In five of 11 examined mandibles there was crowding with irregular tooth positions. This was especially the case with the mandible of Skeleton V, where two incisors – rotated 90° – formed a row behind the other incisors and the canines. In all, four premolars in the jaw fragments were malposed, i.e. rotated or tilted. In the molar regions the faulty position of several teeth was caused by the loss of adjacent or opposing teeth giving rise to tilting or elongation. This was true of the first molars of the mandible with congenital absence of second premolars. In Skeleton I, the lower third molar on the left side was rotated about 45°, despite spacious accommodation.

The occlusion of teeth in fragments and jaws belonging together could not be determined with requisite certainty. The placing of the attritional facets on the incisal edges suggested horizontal overbite frontally. In the lateral segments the tilt of the attritional facets corresponded to normal transversal relations between upper and lower jaws.

c: Pathological changes in marginal alveolar bone

On the teeth examined there were frequent instances of tartar, both the yellowish, voluminous, supragingival kind and the darker, "gritty", subgingival tartar. The presence of tartar is evidence of an inflammatory condition of the gums. After persisting for a longer or shorter period the inflammatory condition leads to pathological changes in the alveolar bone. In some cases bone thickening appeared along the alveolar crest. In mandibles this phenomenon was present in the form of a uniform marginal

Fig. 2. The mandible belonging to Skeleton I showing generalized marginal bone loss as evidence of periodontal disease.

thickening facially to the premolars and molars of two jaws, and as a localized solid thickening lingually to the second and third molars in one fragment. Frequently chronical pathological conditions in the gums lead to marginal bone resorption. A number of uncertain factors are inherent in the registration of incipient degrees of marginal bone resorption (discussed by *Alexandersen*, 1967). Accurate differentiation between normal bone level and slight bone loss could not be made, the Phoenician material being so fragmentary with *post mortem* changes and with no possibility of accurate individual age determination. In the jaws of Skeleton I a pronounced generalized marginal bone loss was observed (Fig. 2). The pattern of resorption was horizontal in type with exposure of from a third to half of the root lengths, particularly pronounced at the mandibular incisors and molars. Obvious bone resorptions of the alveolar crest around remaining teeth was also found in jaws with *ante mortem* loss of one or more teeth. The remaining teeth had tartar localized up to 2 mm from the lowered alveolar crest, i.e. the tartar extended onto the root surfaces. In the mandible of Skeleton II the alveolar bone loss with exposure of half the root length was localized to the two remaining posterior molars; the first molars and the premolars were lost *ante mortem*. Around the anterior teeth the bone resorption was less extensive. In the maxilla No. 371 all molars had been lost *ante mortem* and premolars, canines and incisors were surrounded by moderate atrophy. Loss of alveolar bone was also pronounced in the molar segments of maxilla and mandible No. 42, mandible No. 58 and fragment No. 459.

It was impossible to determine whether the *ante mortem* loss of teeth in the individual cases was the result of excessive wear, of caries or of progressive marginal bone resorption (periodontal disease) as the initial factor. Teeth lost *ante mortem* were distributable by group as follows: Incisors: 2; First and second premolars: 5; and first and second molars: 14.

d: Caries dentium and periapical osseous changes

Table 4.

Dental caries in permanent teeth

Number of teeth examined	with caries	I1	I2	C	P1	P2	M1	M2	M3	
576	45		3	2	2	1	6	3	4	maxilla
	(7.8 %)	1			2	2	6	5	8	mandible

Table 5.

Localization and degree of caries in permanent teeth

		Number of teeth
Occlusal surfaces		6
	in enamel	11
Proximal surfaces	in enamel and cementum	6
	in cementum	6
Proximal involving also the occlusal surfaces		10
Facial surfaces		1
Carious roots		5
Carious teeth with pulp exposure		14

Caries dentium was found in both deciduous and permanent teeth. Conclusive indications for the diagnosis of caries were: cavities in the enamel and/or cementum and in the underlying dentine. Besides inspection of all teeth roentgenological examination was performed of teeth found *in situ*. Root stumps with concave, irregular occlusal surfaces were assumed to be carious. Teeth lost *ante mortem* were not included in Tables 4 and 5.

Five of 89 deciduous teeth examined were carious. They originated from three children aged 6–7 years. In one of the skulls three of the upper deciduous molars were affected with caries; in the other two, one deciduous molar in the maxilla and one in the mandible were carious. There were no carious permanent teeth in the children. The percentage of carious deciduous teeth (5,7 %) must be viewed with the reservation that not all teeth of the 9 children examined were available for inspection.

Of 576 permanent teeth of adults, 45 had caries. This corresponds to 7.8 %. The percentage given must be viewed in the light of the heavy *post mortem* loss of teeth in the present material. As Table 4 shows, most carious teeth were found among the molars and the fewest among the incisors and canines, the premolars occupying an intermediate position. Table 5 conveys an impression of the caries intensity. Caries on single surfaces were in the majority. Fissure caries includes caries in occlusal pits in the sulci. On several molars pits were observed in relation to grooves occlusally and facially, but indubitable caries occurred solely in occlusal pits. On proximal surfaces several attacks of caries were localized partly or wholly in the cementum. This localization presupposes gingival retraction with exposure of the cementum. These carious defects were found in skeletal remains with widespread caries in the teeth generally, with *ante mortem* loss of teeth and with evidence of periodontal disease, i.e. in the oldest individuals in the Phoenician material.

Large proximal carious lesions involving parts of the occlusal surfaces of the crowns occurred in 10 teeth. Most of these, together with the carious roots, had pulp complications, indicated by visible perforations to the pulp cavities and/or by periapical osseous changes in teeth found *in situ*.

In the deciduous dentitions of early human populations carious teeth were rarely found. In Epipaleolithic Taforalt and in Chalcolithic Byblos all the deciduous teeth were sound (*Ferembach et al.* 1962; *Özbek*, 1975). In fact, there is even today a low prevalence of dental caries in children living in the Near East. According to *Nevitt* (1961) the prevalence of dental caries in 12 year old school children was low in Egypt and Iran – 1,9 per cent. and somewhat higher in Syria – 2.5 per cent. Similar results have been obtained from Greece and Israel (*Russell*, 1966; *Rosenzweig et al.* 1969).

In the permanent dentition the number of individuals with carious teeth will increase from juvenile to adult age-groups. In mature and senile individuals some teeth with dental caries have been lost and the prevalence of dental caries will decrease. In the Natufian samples shown in Table 6 the difference in prevalence of dental caries between Kebara and the other sites is not due to a difference in age composition of the samples. Kebara is placed within the framework of a hunting and gathering economy, as opposed to the remaining sites with an increased reliance on vegetable resources, presumably cereals (*Smith*, 1972, p. 237). It is known that dietary changes may alter the prevalence of dental caries in a population. A high carbohydrate content in the diet is likely to increase the prevalence. During the Metal Ages many populations in the Near East reached a relatively high prevalence of dental caries. In the Eastern Mediterranean area today the prevalence of dental caries has not increased very much since the Metal Ages.

An oral health survey of 4324 residents of three villages near Cairo, Egypt, revealed that the number of carious teeth per individual was 2.3, which is considerably lower than that re-

Table 6.

Incidence of dental caries in various populations from the Near East (permanent dentition).

Population	No. of indiv.	No. of teeth examined	Individuals with caries No.	%	Carious teeth No.	%	Source
Natufian							
Eynan	—	498	—		14	2.8	*Smith* (1973)
El Wad	—	833	—		25	3.0	
Kebara	—	402	—		1	0.2	
Byblos (Chalcolithic)	—	701	—		28	4.0	*Özbek* (1975)
Anatolia (Chalc.-early Bronze Age)	17	—	6	35.3			*Senyürek* (1952)
Kish (3000 B.C.)	45	—	6	13.3			*Carbonell* (1965)
Greece (3000-1000 B.C.)	52	1404	26	50.0	116	12.1	*Angel* (1944)
Tall Sūkās (1900–1700 B.C.)	—	576	—		45	7.8	Present study
Crete (1750–1550 B.C.)	—	1498	—		135	9.0	*Carr* (1960)
Anatolia (1700–1400 B.C.)	21	258	7	33.3	9	3.5	*Schaeuble* (1958)

ported for the over-all population of the United States (*Wheatcroft and Klimt*, 1959). In a number of Israelic populations the mean numbers of decayed, missing or filled permanent teeth (DMF) per person were low to moderate compared with the United States (*Rosenzweig et al.* 1969; *Russell*, 1966). In the age-group 25-44 the DMF value for Samaritans was 6.8 for males and 8.7 for females. This is similar to the frequency in Tall Sūkās.

Periapical bone resorption caused by infection from necrotic pulp tissue was by no means always visible on the outer surface of the bone and in some cases the diagnosis had to be made roentgenologically. Where the inflammatory process round the apex of the root had sought an outlet to an outer surface the fistula sometimes ran vertically along the root, as in the case of a third lower molar in the mandible of Skeleton II. More often, however, the fistula was observed directly opposite the root end which was visible in the bone cavity. In the jaws of No. 42 there was some bone neoformation peripherally around the openings of the fistula opposite M_1 dext. and I^2 sin. In the maxilla there was a pea-sized bone defect around the apex of the left lateral incisor, which was worn with the dentine but not the pulp exposed and had a lingual pit with a lingual groove continuing along the lingual surface of the root. Roentgenologically no "dens in dente" (invagination) could be recognized nor was the tooth carious. As a consequence the cause of the pulp necrosis and subsequent osseous changes is not definitely assignable.

Fig. 3. Occlusal view of mandible No. 47 showing unilateral enlargement of the left side of the mandibular corpus. The incisors, canine, premolars and first molar in the left side were presumably lost *ante mortem*.

Fig. 4. Basal view of mandible No. 47 showing the basal osseous enlargement of unknown cause.

e: Other pathological bone changes

In mandible No. 47 there was unilateral thickening of the corpus. (Fig. 3 and 4). The third molars on both sides were preserved *in situ*. On the right side were sockets for one molar, two premolars, canine and the lateral incisor; thereafter no trace of alveolar sockets as far as to the left second molar. It is noteworthy that the lingual wall of the alveolar process was retained in the left side of the mandible. It was in fact thicker than on the right side, but still no trace was observable of sockets except of M_2 sin. The facial wall of the alveolar process was missing on the left side of the jaw. The mandibular base was very massive on the left side. Viewed basally the base was almost twice as wide on the left as on the right side. At the same time the left side was more prominent in the lateral direction. Roentgenologically there was a fine network of spongiosa trabeculae in the thickened part of the base. The cause of this thickening is unknown.

f: Torus palatinus and torus mandibularis

No tori were observed on 12 mandible and 6 maxilla fragments examined. All the fragments came from adult individuals.

Developmental Disturbances in the Structure of Teeth

It was possible to examine teeth from 28 skulls (containing teeth of each morphological group in the dentition) for enamel hypoplasia. In only one set of teeth the enamel surfaces were affected in the form of distinct grooves horizontally around crowns of inciors, canines and premolars. The position of the constriction on the crowns corresponded, according to the mineralization times stated by *Massler, Schour & Poncher* (1941), to the age of three years. In teeth from 21 of the 28 skulls a feature of the enamel surfaces, especially of canines and premolars, was one or several linear depressions in the facial surfaces (Fig. 5). Macroscopically there was no defect of the enamel surface. Similar horizontal lines occurred on some molars, but much more rarely. No more than two third molars had horizontal lines. In some permanent canines there were more generalized irregularities of the enamel in the gingival third of the facial surface, but without having the degree of defects. The aforesaid changes in the enamel are interpreted by the writer as the results of minor disturbances of tooth formation. Their appearance in different localizations on the individual teeth is evidence of chronological differences. Judging from *Massler, Schour & Poncher*'s diagram showing the chronological development of the permanent teeth the disturbances may be put at between the 2nd–3rd and 6th years. In addition, we have the two third molars whose mineralization times are much later, i.e. 8–14 years; on these teeth the lines occurred about 1 mm from the cemento-enamel junction on the facial surfaces of the crowns.

Numerous nutritional disturbances and diseases may affect tooth formation and cause mineralization disturbances. In the Phoenician material minor disturbances are common and largely associated with the supposed post-weaning period; but the specific cause in each instance of defective mineralization is unknown.

Six of 15 deciduous canines had enamel dysplasia in the facial surfaces. On three lower canines the enamel was rough and uneven in the cervical parts of the facial surfaces mesially or distally. On the three upper canines enamel dysplasia was more pronounced than on the lower canines. In teeth belonging to one child the enamel defects were found solely on the one upper canine examined and not on the lower canines. In another child the dysplasia was situated on one and not on the other lower canine.

This type of enamel dysplasia on deciduous canines was described by *Jørgensen* (1956) who examined 870 medieval and recent deciduous canines from a Danish collection. The frequencies of enamel dysplasia were 17 per cent. and 34 per cent. for upper and lower canines. This type of macroscopic defect of the enamel was also observed in the Epipaleolithic population from Taforalt by *Poitrat-Targowla* (1963). It is possible that these defects are due to local disturbances of the growing tooth germs because of insufficient space in the jaws.

Enamel dysplasia of permanent teeth have been found in Chalcolithic Byblos (four of 46 specimens) and in Neolithic Müreybet by *Özbek* (1975), in Alaca Höyük in two out of 17 cases by *Senyürek* (1952) and in Epipaleolithic Taforalt in about 9 per cent. of the teeth (*Poitrat-Targowla*, 1963).

Odontomorphological Description

Deciduous Teeth

Maxillary and mandibular incisors

Three di^1 from two upper jaws were examined. The teeth from the two jaws resembled one another in all details, such as in having distinct protuberant zones of enamel near the cervical enamel lines along their facial surfaces. The lingual surfaces of the crowns had faint but distinct lateral marginal ridges which continued into the lingual tubercle. The latter occupied part of the central fossa of the lingual surfaces extending farthest in incisal direction in the mesial part of the fossae.

Four di^2 from three jaws were examined. Teeth from two jaws were narrower in proportion to the central incisors, had more cervically converging proximal surfaces and more rounded disto-incisal corners. On the other hand, the facial surface of a right lateral incisor from a third jaw was very similar to that of the central incisor. The lingual surfaces had lateral marginal ridges and a lingual tubercle which, especially on one tooth, was particularly prominent in the lingual direction.

Incisors from three mandibles were examined. Where the central and lateral incisors were present in the same jaw they were clearly distinguishable. The lateral incisor for example had a distinctly rounded disto-incial corner.

Morphologically the incisors were similar to the incisors found in ancient Anatolia (*Senyürek*, 1952), Chalcolithic Byblos and Neolithic Mürey-bet (*Özbek*, 1975). Characteristic is the absence of shovel-shape. The incisors correspond to the textbook descriptions based upon teeth of European origin.

Fig. 5 Horisontal linear depressions in the facial surfaces of the teeth interpreted as the result of minor disturbances of tooth formation.

Maxillary and mandibular canines

Seven maxillary canines from six jaws agreed morphologically with the description of deciduous canines given by *Jørgensen* (1956) of Danish and Dutch medieval and recent teeth. Among the Phoenician teeth there were variations in shape and prominence of the lingual tubercle; for example the two finger-shaped processes directed incisally from the lingual tubercle were missing in some cases.

Eight mandibular canines from five mandibles were examined. They were morphologically in close agreement. Three had the lingual ridge extending from the cusp to the lingual tubercle.

The others, however, had a continuous marginal ridge – U-shaped – the tubercle being part of it and the central fossa was not filled up by any lingual ridge. The distal marginal ridge was usually the widest and the most distinct.

Maxillary molars

It was possible to describe deciduous maxillary first molars from eight jaws. The number of cusps varied. Whereas the paracone and the protocone were present on all the teeth, the metacone on the teeth of seven jaws could be recognized in the form of a central ridge (type b, according to *Jørgensen*, 1956), while the metacone was absent from the teeth of the eighth jaw (type c, according to *Jørgensen*, 1956). On no tooth was there any groove separating paracone and metacone, but faint grooves may have been blurred by attrition. A hypocone in well-developed form was not present. In three jaws the conditions disto-lingually were like *Jørgensen*'s type b: The lingual segment of the oblique ridge is separated from the distal marginal ridge by a transverse groove, which extends to, but never intersects, the lingual margin of the occlusal surface. In four jaws complete absence of the hypocone region was found.

In seven jaws the maxillary first molars had 3 cusps and in the eighth jaw the first molars had two cusps. In a study of Chalcolithic teeth from Byblos *Özbek* (1975) examined deciduous maxillary first molars of 10 individuals. In seven jaws the metacone was developed to the same degree as in seven Phoenician jaws. In the final three jaws the metacone was fully differentiated and well-separated from the paracone. In four skulls from ancient Anatolia *Senyürek* (1952) found first molars with 3 cusps as is usually the case in modern man. The variable hypocone was present in one of the jaws from Byblos, the intermediate type was found in two jaws and absence of hypocone was noticed in 7 jaws. In a larger Anatolian sample examined by *Senyürek* (1959) consisting of 19 skulls one showed a well-differentiated hypocone.

One tooth from jaw No. 63 had a parastyle. The parastyle was observed in two individuals from Byblos and among the Anatolian skulls studied by *Senyürek* (1959) this structure was found more or less developed in 79.6 % of the first molars examined. *Chiavaro* (1914) investigated the frequency with which a parastyle or paramolar tubercle occurs on dm^1. Among 1000 Italian children a well-developed parastyle was observed in 5.0 per cent. In modern and medieval Danish children the frequency of the paramolar tubercle was 8.2 and 9.6 per cent. on the left and right sides respectively (*Jørgensen*, 1956).

The molar tubercle was observable on the facial surfaces of the crowns and this was correlated to the course of the facial enamel line. Thus differences between the most occlusal and the most apical levels of the facial enamel margin were 1 mm in six jaws, while in two the level difference was less than $^1/_2$ mm. In the sample of teeth from Chalcolithic Byblos the mean difference was 1.3 mm with a range of variation from 0.8 mm to 1.7 mm (*Özbek*, 1975). Lingually the cervical enamel margins were horizontal.

One dm^1 had three well-separated roots; three teeth had fused roots distally. It was impossible to examine the roots of the other teeth. There was no partial taurodontism.

The second upper deciduous molars could be described from 9 jaws. All these teeth had four cusps. The hypocone was well developed in all cases. On several teeth there was a distinct interruption of sulcus obliquus – i.e. the sulcus separating crista obliqua from the hypocone – produced by a crest from hypocone to the distal surface of protocone. The presence of four cusps on dm^2 was observed in the teeth from Neolithic Müreybet, Chalcolithic Byblos (*Özbek*, 1975) as well as in the Anatolian teeth from the Metal Ages (*Senyürek*, 1952).

The occurrence of the tubercle of Carabelli was examined by *Jørgensen*'s method (1956). Type a indicates the presence of a well developed

Carabelli structure. On the lingual surface of the protocone is found an occlusally convex, well-developed furrow. The area of the lingual surface gingival to the furrow is strongly developed in the occlusal direction and rises, at least opposite the occlusal part of the furrow, to a higher occlusal level than the bottom of the furrow. This type a was not found among the Phoenician teeth but among the Chalcolithic teeth from Byblos (12 out of 20 teeth), the Neolithic teeth from Müreybet (*Özbek*, 1975) and the Anatolian teeth described by *Senyürek*, (1952).

Type b of the Carabelli structure is defined as follows: The convex furrow is more or less strongly developed. The area gingival to the furrow does not rise so far occlusally as the bottom of the occlusal part of the furrow. The teeth of six jaws from Tall Sūkās presented this type with a faintly developed tubercle of Carabelli.

Type c indicates the absence of the tubercle of Carabelli. There is no trace of a convex furrow; but on the lingual surface of the protocone is found a vertical protoconule groove shallow and with a gently rounded fundus. The teeth of three jaws from Tall Sūkās were of type c. This type also occurred in Byblos and in Anatolia but more rarely than type a (*Özbek*, 1975).

The enamel margin ran fairly uniformly around the cervical part of the teeth, no enamel extensions being found.

The height of the root stem exceeded 4 mm on dm^2 from two jaws. This limit was set as the criterion for the presence of partial taurodontism by *Brabant & Kovacs* (1964). In the same jaws the permanent first molars also had partial taurodontism of the same degree (Fig. 6).

Despite *post mortem* changes and root resorptions on some of the second deciduous molars it was possible to determine that teeth from five jaws had well-separated roots and that teeth from three jaws had fused disto-facial and palatinal roots.

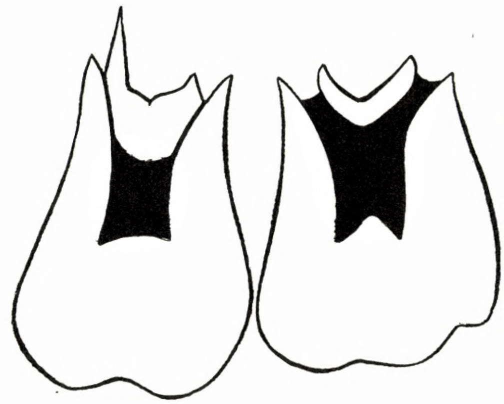

Fig. 6. Drawings from radiographs of the maxillary deciduous second and permanent first molar from the same jaw (No. 285). The teeth show partial taurodontism.

Mandibular molars

Some of the first deciduous mandibular molars were so worn that the number of cusps could not be determined. Teeth from eight jaws were inspected. In five jaws the teeth had five cusps, in two jaws the teeth had four cusps and particular interest attaches to the first molars of jaw No. 468 (Fig. 7). On the right side metaconid was fused with entoconid. On the left side there was no entoconid on the first deciduous molar. The left-side tooth had the triangular, delta-formed crown described by *Jørgensen* (1956). This tooth also had a supernumerary lingual root.

Özbek (1975) reported that the frequency of deciduous first molars with five cusps was high in Lebanese Byblos (57 % and 71 % for teeth from the right and left sides of the jaws). In Anatolia the frequency was 35 % to 38 % according to *Senyürek* (1959). The Phoenician first molars are most similar to the teeth from Byblos. *Jørgensen* observed the delta-formed crowns on five of 160 dm_1 (3.1 per cent.) from the Danish Middle Ages. He found this anomaly most pronounced on the left side.

The lingual part of the mesial marginal ridge

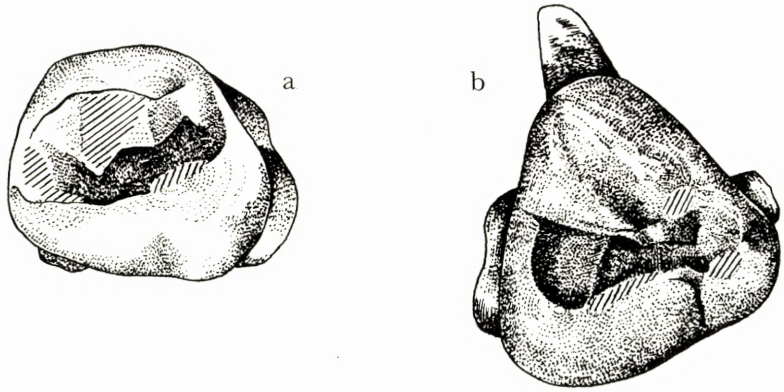

Fig. 7. The mandibular deciduous first molars from jaw No. 468. The tooth from the right side (a) is normal, but the tooth from the left side (b) has a triangular crown and a supernumerary lingual root. Attritional facets are indicated by dross hatching.

was completely separated from the metaconed on teeth from three jaws, but fused with metaconid on teeth from five jaws.

The molar tubercle was present on the facial surfaces of all the teeth examined. As a consequence the facial enamel margin had a curve convex in the apical direction on the mesial root. This form of enamel margin was named type 7 by *Pedersen & Thyssen* (1942) and it was further graduated by *Jørgensen* (1956) into three types. Type a was found in three Phoenician jaws. The difference between the highest and lowest points on the enamel line did not exceed $^1/_2$ mm. Type b, which occurred in five jaws showed a level difference between $^1/_2$ mm and $1^1/_2$ mm. Finally, a type c was set up, represented by two Phoenician jaws, where the level difference exceeded $1^1/_2$ mm.

The lingual enamel margin was either faintly curved in the apical direction or showed faintly developed enamel extensions.

Five cups were present on all second deciduous mandibular molars. Hypoconulid was well developed and situated facially in line with protoconid and hypocone. Metaconid and entoconid were large pointed cusps. On the lingual surfaces of several teeth traces of the supernumerary cusp c_7 were found. Distally of the apex of metaconid a bulge was found assuming the shape of an accessory crest which was separated by a groove from the central cone of metaconid when the teeth were seen in an occlusal view. The teeth in six of 11 jaws showed traces of c_7. There was no sign of other supernumerary cusps.

In Chalcolithic Byblos the 21 second deciduous molars had five cusps but two of them also showed the distally located supernumerary cusp c_6. In the Anatolian sample of 42 second deciduous molars from the Metal Ages both supernumerary cusps, c_6 and c_7, were found. The distal supernumerary cusp in one case, the lingual supernumerary cusp in 19.2 per cent. of the teeth. With regard to the number of cusps the Phoenician teeth are more similar to the Anatolian than to the Lebanese teeth.

In all cases the anterior fossa was closed lingually. Teeth in seven jaws had a faint groove more or less midway on the mesial marginal ridge, while the teeth of three jaws had the groove lingually immediately adjacent to the metaconid.

No cingulum structures were observed on the facial surfaces. There were no enamel extensions on either facial or lingual surfaces. The enamel margin varied facially between an apically convex line and a line consisting of two occlusally convex portions which merged over the bifurcation in a faint enamel extension. On the lingual surfaces there was also a form with a horizontal enamel margin.

All teeth examined had two roots. Partial taurodontism was observed in teeth from two jaws. Partial taurodontism was found in Anatolian teeth studied by *Senyürek* (1949). This aspect of dental morphology was not studied by *Özbek*.

Permanent Teeth

The maxillary central incisor

A total of 70 upper incisors were examined, their distribution being: I^1 dext. 16 teeth, I^1 sin. 20 teeth, I^2 dext. 18 teeth and I^2 sin. 16 teeth. Quite a large proportion of these teeth had pronounced incisal wear facets as well as wear of the lingual surfaces. Description of the morphological details of lingual-surface reliefs is based upon unworn teeth of 13 individuals, whilst the worn teeth provided supplementary information on morphological details that were unchanged.

Some of the upper central incisors had highly convex facial surfaces with the maximum curvatures situated in the gingival thirds of their crowns. On the majority of the teeth the proximal surfaces converged distinctly in the gingival direction – the teeth being viewed facially. On the whole the lingual surfaces showed little disposition for shovel-shape. One tooth was judged as being shovel shaped and another five showed traces of that form. *Dahlberg*'s Plaque P 1. was used for evaluation of shovel shape*. The shovel-shaped central incisor had pronounced marginal ridges which merged gingivally, thus delimiting the central fossa. A pit had formed just incisally of the junction of the marginal ridges. On teeth with traces of shovel shape the ridges were clearly marked, but the depth of the lingual fossa was less than 1 mm. These teeth had a faint lingual tubercle which prevented the lateral ridges from uniting.

On teeth with no signs of attrition indistinct grooves were observed on the lingual surfaces, running in the longitudinal direction of the crowns, separating the marginal ridges from the central fossa and delimiting a median ridge. On most of the incisors it was the grooves at least as much as the ridges that permitted identification of morphological details on the lingual surfaces. The lingual tubercle was usually little prominent from the lingual surface. Its boundary against the marginal ridges was not marked by grooves. The tubercle's boundary against the central fossa was given by finger-shaped processes lying either medially and distally, distally or centrally. In the lateral direction the processes occasionally merged with the marginal ridges. The tubercular extensions were most distinct when situated centrally on the lingual surface.

The enamel margin followed a course winding around the neck of the tooth, facially in an apically convex arch, on which in two instances there were notches. On one of the incisors with this indentation there was a shallow facial groove as a continuation on the root. The mesial curvature reached a more incisal point than did the distal curvature. The lingual enamel line was either curved or horizontal.

Radicular grooves were present on several central incisors. On two teeth the grooves were visible only on the root surfaces; on two others the root grooves continued on the crowns (Fig. 8). Three teeth had coronal grooves alone (facially, distolingually or mesially).

The maxillary lateral incisor

The lateral incisors were smaller than the central incisors. Where length differences of the crowns were measurable between I^1 and I^2 from the same individuals they were found to vary between 1.4 and 2.3 mm (six jaws). In some cases there was close similarity in the shape of lateral and central incisors, not only as regards the shape of the facial surfaces but also in the presence of the lingual tubercle with or without finger-shaped processes well separated from the marginal ridges. The lateral incisors from one jaw had the

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*) Prepared by *A.A.Dahlberg*, Models of Teeth. Materials for the establishment of standards for the classification of tooth characters, attributes and techniques in Morphological Studies of the dentition.

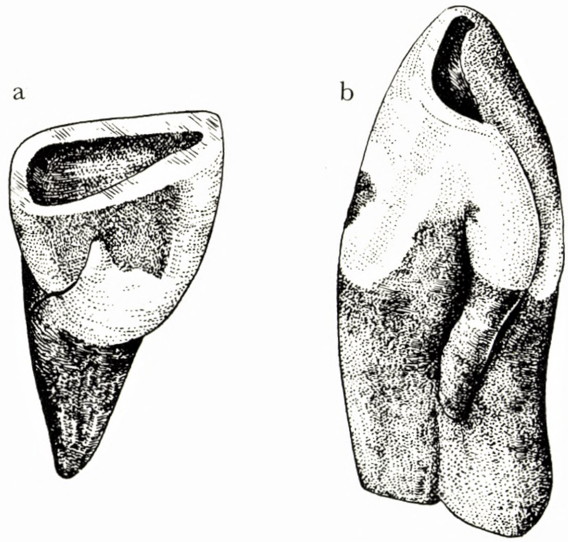

Fig. 8. Maxillary central incisor with a corono-radicular groove on the distal surface of the tooth (a); maxillary lateral incisor with a corono-radicular groove and an accessory root developed mesially of the root (b).

incisal edges more rounded than ususal, so the edge resembled a cusp.

A feature of the lingual surfaces was lateral ridges, which imparted a faintly developed shovel shape to the teeth. Due to attrition the number of teeth with trace of shovel shape cannot be stated with certainty, but at any rate two cases were found. In some cases the marginal ridges terminated at the tubercle; in some others they united in an arch over the gingival eminence, or they approximated but remained parted by a groove midway on the tubercle. In such cases a lingual pit had often formed. The pits were found on ten teeth from seven jaws. The lingual tubercle was well developed on only two I^2, with cusp-like formations prominent in the incisal direction.

A single tooth differed from the others by lacking the mesial marginal ridge, whilst the distal ridge was well developed.

As with the central incisors the lateral incisors also included some specimens with grooves on crowns and roots. Six of 33 inspected I^2 had root grooves emanating lingually either from the lingual pit or disto-lingually or mesio-lingually. The grooves were visible on at least a third of the root lengths and in some cases continued all the way to the apices. The grooves occurred unilaterally. A lateral incisor had an accessory root developed mesially of the root (Fig. 8).

Mandibular incisors

It was possible to study morphological details on 25 unworn incisors. Among these a distinction could be made between I_1 and I_2, the central incisor having a more symmetrical structure than the lateral incisor. The incisal edge on central incisors had three mammelons of equal size. On I_2 the central one was very faintly developed but nevertheless formed an incisal cusplike point which did not occur on I_1, where all three mammelons reached the same incisal level. On the central incisor the disto-incisal corner was just as pronounced as the mesio-incisal. On the lateral incisor the disto-incisal corner was clearly rounded. The facial surfaces were often highly curved in the inciso-gingival direction. The lingual surfaces had extremely faintly developed marginal ridges. On all the teeth the lingual tubercle had developed in the form of a gingival eminence continuing smoothly into the midmost third of the lingual surface. On I_2 the eminence was often displaced a little distally of the crown axis, viewing the tooth from the lingual side.

Few roots of the mandibular incisors were intact if the teeth had been found *ex situ*. Root deflections in the facial direction were found apically on two I_1, and from another jaw the roots of both lateral incisors were evenly curved in the distal direction.

Discussion of the incisors

The frequency of shovel-shaped incisors has been studied in several ancient and recent populations from the Middle East. Shovel-shape is a characteristic trait in Mongoloid populations.

In Asiatic or North American Mongoloids the lingual marginal ridges of the incisors are well developed. In maxillary incisors they surround a lingual central fossa which is often as deep as 1 mm or more. In European populations the slight degrees of shovel-shape are most common. The distinct shovel-shape is rarely found.

Distinct shovel-shape of the maxillary incisors was neither found in Neolithic Jarmo or Müreybet (*Dahlberg*, 1960; *Özbek*, 1975) nor in the Natufian teeth from Hayonim (*Smith*, 1973). Only slight to moderate degrees of shovel were observed in Anatolian teeth dating from the Metal Ages or in the Kish population (*Senyürek*, 1952; *Carbonell*, 1963). The maxillary incisors from Chalcolithic Byblos were similar to the Phoenician teeth. In Byblos shovel-shaped incisors were found in 4 individuals (7.4 %), in Tall Sukas in maxillary central incisors in one out of 13 individuals (7.7 %) and in two lateral incisors out of 18 (11 %). In contrast to these observations is the frequency of shovelshaped maxillary incisors in Middle Minoan Knossos. According to *Carr* (1960) distinct shovelshape was found in 27 % of the teeth examined.

In small samples of recent populations from the Negev desert, Yemen and Afghanistan shovel-shape is rarely found but slighter degrees of shovel, i.e. trace of shovel or semi-shovel, are more common (*Rosenzweig & Zilberman*, 1967, 1969; *Beynon*, 1971).

Prominent lingual tubercles on maxillary lateral incisors were found on a few teeth from Tall Sūkās. Such tubercles were observed by *Carbonell* (1963) in the Kish population and in a sample of 28 undated skulls of Palestinian Arabs with the frequencies of 26 % and 21 %. In Tall Sūkās the frequency was 6 %.

Corono-radicular grooves were common in the maxillary incisors from Tall Sūkās. In lateral incisors the frequency was 18 % which is similar to the frequency of such grooves on the maxillary incisors from Chalcolithic Byblos (12.9 % according to *Özbek*, 1975). In a recent Dutch population the frequency among 2147 maxillary lateral incisors was 2.2 % (*Visser*, 1948).

Maxillary canines

As illustrated by 17 unworn teeth the canines had one cusp from which emanated a shorter mesial and a longer distal ridge. The facial surfaces were evenly convex; in some instances a ridge from the cusp continued cervically. This ridge was delimited in the occlusal part of the tooth by a mesial or by a mesial and a distal groove.

Like the incisors, the canines showed much variation with regard to the shape of their lingual surfaces. Viewed lingually the cusp would appear as a vertical oval prominence – almost guttiform, as on three unworn C sup. – or the cusp formed the starting point of a ridge which continued right to the basal tubercle.

On all the teeth was a mesial marginal ridge on the lingual surface of the crown that differed from the likewise commonly occurring distal marginal ridge in being longer and more parallel to the axis of the crown. Between the lingual marginal ridges and the median lingual ridge was a short ridge mesial to the median ridge on two teeth and distal to it on six. The distal accessory ridge seems to have been formed by the bending of the posterior part of the incisal edge up on to the lingual surface.

The lingual tubercle sometimes formed a faint elevation basally on the lingual surface (9 teeth), or it was furnished with one or two finger-shaped processes (8 teeth). On two other teeth no tubercle was formed and the marginal ridges united in a U-shaped figure cervically on the lingual surface. On seven teeth a cusp-like tubercle stood out from the lingual surface separated from it by grooves. The distal parts of the grooves were particularly marked.

On the canines there were no narrow, distinct furrows on the crowns such as those found on incisors. On the roots only shallow mesial and distal root grooves were observable and none corresponding to those described on the incisors.

Cervically on the mesial surface of one tooth there was a median root ridge.

Mandibular canines

On account of the copious occurrence of tartar only 30 unworn and slightly worn teeth were available for detail inspection. Viewed facially the crowns had their most incisally situated point in the cusp. On two teeth the cusp was placed in the axis of the crown, but on the others it was more or less shifted in the mesial direction. Such teeth appeared more incisiform than caniniform.

Regarded incisally the most prominent part of the facial surface was in a position corresponding to a ridge prolongation in cervical direction from the cusp. This ridge, however, was distinctly marked by lateral grooves on only two teeth. On the other teeth the facial surfaces were evenly domed.

The lingual structures were faintly developed, sometimes wholly obliterated as on the lower incisors. On the lingual surfaces the cusp had a guttiform development which in most cases continued in a median ridge. This ridge was variable with regard to mesio-distal extent, prominence and length. Peripherally the ridge was delimited from the ever-present marginal ridges by faint grooves, of which the distal one was the more constant and distinct. In the cervical direction the ridge somtimes became lost in the central fossa, but generally it reached the region of the basal domed eminence. The marginal ridges were also delimited cervically by the tubercle if present, or they merged into a U-shaped encirclement of a central fossa when the tubercle was absent.

Only two teeth found *ex situ* had intact roots. They were straight and had single roots.

Discussion of the canines

The unworn maxillary canines all had a distinct cusp while the mandibular canines showed either a pointed cusp or an incisiform type with a mesially displaced small tip of the cusp. The incisiform type of C inf. was also observed by *Senyürek* (1952) in Anatolian teeth from the Metal Ages and it was the dominating type among the mandibular canines from Chalcolithic Byblos studied by *Özbek*, (1975).

The distal acessory ridge located distally to the median ridge on the lingual surfaces of C sup. was found on six of 17 teeth from Tall Sūkās. This structure was also observed by *Özbek* on one of the teeth from Byblos.

The basal tubercle on the lingual surfaces of C sup. was developed into a cusp-like tubercle on seven out of 26 teeth from Tall Sūkās (27 %). In Anatolian teeth from the Metal Ages such a tubercle was observed in 34 % of the teeth. It was also observed in Natufian teeth from Hayonim, according to *Smith* (1973) but it was found with a low frequency among the Chalcolithic teeth from Byblos (4 %).

The corono-radicular grooves did not occur on the canines. Such grooves were not mentioned in the relevant literature on ancient populations in the Near East. This agrees very well with the observations by *Visser* (1948). In the large collection of recent Dutch teeth a corono-radicular groove was found in one out of 3114 C sup. and not in any of the 2488 C inf. examined.

Maxillary premolars

A large proportion of the premolars inspected were not *in situ* in their sockets. Determination of the teeth as to first and second premolars before measuring and describing was based upon criteria and characters applying to European teeth. There was no difficulty in distinguishing between first and second premolars.

All teeth had two cusps. In one jaw the facial cusps on both P^1 were atypically enlarged, so that the contours of the facial and lingual surfaces, when the teeth were viewed proximally, diverged occlusally from the cervical third of the crown. For this reason the facial surfaces presented their greatest prominences in the occlusal thirds of these two P^1. In one jaw with widespread enamel hypoplasia there was a hypoplastic line along the base of the facial cusp of P^1; the cusp was also smaller than normally. On the same tooth the lingual cusp had an uneven surface due to hypoplastic enamel.

The first premolar had a more asymmetrical crown than that of the second premolar. Its greatest mesio-distal diameter was located well facially in the crown. The crown of the second premolar was oval in contour, seen occlusally.

A mesial shifting of the lingual cusp was of such regularity in its occurrence that it was used as a suitable criterion for separating teeth from the two sides of the jaws. On P^1 there was often a prolongation of the mesio-distal sulcus beyond the mesial marginal ridge.

In addition to the central cone, accessory ridges were sometimes seen on premolar cusps mesially and distally of the cone. In most cases the distal ridges were better developed than the mesial. Six unworn first premolars had no accessory ridges; three had distal accessory ridges, one also had a mesial ridge on the facial cusp. Accessory ridges on P^2 were more frequent and distinct. One tooth had none, but five had ridges on the lingual cusp and eight on the facial cusp, more often distally alone than both mesially and distally.

Marginal ridges were especially wide on upper second premolars, and as a rule mesial marginal ridges were seen to be the highest. Cervically on the first premolars there was often a mesial concavity, but it was never very marked.

The few premolars with intact roots showed that four P^1 had one root, two P^1 had one root which was bifid apically, five P^1 had two roots and three P^2 had one root.

Mandibular premolars

Most of the first premolars examined had one lingual cusp besides the facial larger and dominating cusp (36 of 45). Marginal ridges running mesially and distally could be followed from the apex of the facial cusp (protoconid). The distal ridge continued into the distal marginal ridge of the occlusal surface and from there round the disto-lingual corner continuing in a lingual marginal ridge separated more or less from the base of the central cone of the protoconid. The mesial protoconid marginal ridge continued into the mesial marginal ridge of the occlusal surface and approached the lingual marginal ridge at the mesio-lingual corner of the tooth. The relation between the mesial marginal ridge and the lingual marginal ridge will be described later. The lingual cusp – metaconid – was situated on the lingual marginal ridge. On those teeth where the metaconid was absent the lingual marginal ridge was increased in its faciolingual dimension in the mesial part towards the mesial marginal ridge, from which it was separated by a distinct groove. On most of the teeth the metaconid formed a visible elevation directly in front of or just mesially of the lingual ridge of the protoconid. On some teeth this elevation was delimited mesially and distally by grooves across the marginal ridge. One ridge generally appeared from the apex of the metaconid elevation and extended facially towards the protoconid. As the elevation of the metaconid lay peripherally upon the lingual marginal ridge the facial ridge assumed one of the following variations, (1) its length equal to the width of the marginal ridge, (2) a narrow crest across the mesio-distal sulcus and terminating on a level with or lower than the apex of the metaconid, (3) a wide ridge drawing the apex of the metaconid facially on to the protoconid, causing a more or less complete interruption of the mesio-distal sulcus. The latter variation was much the more frequent, whereas the first was the most uncommon.

On unworn teeth three ridges were sometimes observable on the metaconid. The facial ridge has already been mentioned. There was always a distal ridge extending from the apex but a mesial ridge was occasionally present too. Where distal and facial ridges continued one another the lingual marginal ridge seemed to bend facially just distally of the mesial groove between the mesial marginal ridge of the occlusal surface and the metaconid.

On the protoconid of some teeth there was a distal accessory ridge starting from the distal marginal ridge of the protoconid. The wear of many of the teeth prevented a satisfactory statistical review of this variation.

As the case with the first deciduous molar, it was possible to see on the successors to the deciduous teeth, i.e. first premolars, the same variation as regards the relation of the mesial marginal ridge to the metaconid. Using the subdivision given by *Jørgensen* (1956: 101) it was found that 24 P_1 were of type a and 17 of types b and c combined. It was difficult to distinguish one of the last mentioned types from the other. In type a the anterior fovea is not closed by any ridge in the lingual direction while in types b and c the anterior fossa is closed in the lingual direction.

Three of the first premolars inspected had two lingual cusps. In one case the cusps were widely separated; in the other two it was the question of small juxtaposed elevations centrally on the lingual marginal ridge, devoid of any detail structures and relations across the mesio-distal sulcus to the protoconid.

Most second premolars had two lingual cusps or one lingual cusp situated on the mesiolingual corner of the occlusal surface with a marked marginal ridge distolingually. Two lingual cusps were always found to be situated each on its lingual corner. On three teeth one lingual cusp was central vis-a-vis the protoconid. With this metaconid position too the entoconid may be present, as shown by another tooth in the collection. In the absence of the metaconid the lingual marginal ridge in one instance was continuous and in another consisted of a longer mesial and a shorter distal part. Where two cusps were found lingually the mesial cusp was usually the larger and higher; on one tooth, however, the reverse was the case. The protoconid had a central cone which basally was sometimes divided like a fork. As most of the teeth had been functioning the frequency of such details could not be determined. This is also true of mesial and distal accessory ridges on the protoconid, which were observed on six teeth but may have been more common. In two cases the distal accessory ridges had occasioned the formation of a hypoconid-like cusplet.

The metaconid was drop-shaped or had a triangular plateau extending from the peripheral apex towards the mesio-distal sulcus, which was more rarely exceeded on P_2 than on P_1. Finally, one metaconid form was marked by a narrow triangular ridge across the marginal ridge. Marginal ridges ran mesially and distally from the apex of the metaconid.

The entoconid presented structural details similar to those of the metaconid; but as this cusp was rarely well developed there was only little chance of observing any variations. If this cusp is present it should show a palpable elevation from the marginal ridge.

The shape of the root was examined on eleven P_1 and nine P_2. All P_2 were single-rooted. This also applied to the majority of the P_1, but two teeth from two jaws had Tomes' root, i.e. it was possible to recognize a root bifurcation caused by the deepening of a mesio-orally-placed root groove. One of these teeth had two apices. Four other first premolars had narrow mesio-orally-placed root grooves, but no bifurcation. On one P_2 there was a disto-orally situated root groove. No root grooves were observed on other six first premolars or seven second premolars.

Discussion of premolars

The number of cusps is constant on the maxillary premolars. There is a facial and a lingual cusp. On the mandibular premolars there is always a facial cusp but the number of lingual cusps varies from zero to two or more. In the teeth from Tall Sūkās the first mandibular premolar had one lingual cusp in 36 out of 45 teeth (80 %), two lingual cusps in five teeth (11 %) and no well-defined cusp in four teeth (9 %). *Özbek* (1975) remarked that the size of the lingual cusp on P_1 inf. in Chalcolithic Byblos was very variable, but gave no figures to document his statement.

In mandibular second premolars from Tall Sūkās two lingual cusps were observed in 17 out of 40 teeth examined (42.5 %), one lingual cusp was found in 21 teeth (52.5 %), while two teeth were without a distinct lingual cusp (5 %). P_2 inf. with two lingual cusps were found in 35 % of the Natufian teeth studied by *Smith* (1973) and in 29.1 % of 24 individuals from Chalcolithic Byblos (*Özbek*, 1975). In North Western Europe the frequency of P_2 inf. with two lingual cusps tends to be lower than in the populations from the Near East. In a paper on the evolution of the dentition in Western Europe *Brabant & Twiesselmann*, (1964) mention the tendency to molarization of P_2, i.e. the formation of two lingual cusps, which was found in 25 % of the teeth from their more recent samples. In an early study of European skulls the frequency of P_2 with two lingual cusps was 16.6 % (*M. de Terra*, 1905) and in modern Finns the frequency was found to be 26 % and 32 % by (*Becker*, 1936) and (*Hjelmman*, 1929).

The number of roots on maxillary premolars varies from three to one. In the small sample from Tall Sūkās no three-rooted specimens were found. Seven of the 11 P^1 sup. studied showed either two roots or a subdivision of the single root with formation of two apices (63.6 %). The few remaining teeth had one root. This marked tendency to formation of two roots was also found in nine of 12 ancient Anatolian teeth (75 %) and in seventeen of 18 teeth from Byblos (94 %). In the large collection of recent Dutch teeth *Visser* (1948) observed 3 % three-rooted P^1 sup., 41 % with two roots or subdivision of a single root and 56 % with a single root.

In second maxillary premolars there is most often a single root. This was found in 91 % of 4000 Dutch P^2 sup. The three teeth from Tall Sūkās with intact roots had single roots, but the tendency to formation of two roots was evident in the sample of teeth from Byblos, where 53 % of 17 teeth showed subdivision of the root and in Anatolia, where 14 % of the 14 teeth showed the same tendency (*Visser*, 1948; *Özbek*, 1975).

The mandibular premolars have one root but P_1 inf. occasionally shows a deep groove mesio-lingually on the root surface. This indicates a beginning subdivision of the single root into a separate mesial and a separate distal root. An incipient division of the root was noticed in two out of 11 P_1 inf. from Tall Sūkās (18 %), in 15.3 % of the Anatolian teeth studied by *Senyürek*, 1952, 1959, and in 17 % of the 12 teeth from Byblos (*Özbek*, 1975).

Maxillary molars

There were 52 M^1, 46 M^2 and 14 M^3 for examination. Because of attrition, tartar, *post mortem* changes, caries etc. some of these teeth could be studied only as regards certain morphological characters. For the same reasons all the teeth could not be measured for maximum crown diameters.

In every case the first molars had four cusps (Fig. 9). On the unworn specimens where morphological details were observable (eleven in all) the paracone had a central cone extending from the apex towards the central sulcus system in the direction of the middle of the crown, as was also the case with central cones on the other cusps. From the apex extended a distal and a mesial ridge. The distal ridge was sometimes bent inwards just mesially of the sulcus separating it from the metacone. The protocone too had a central cone as well as mesial and distal marginal ridges. Mesio-lingually the mesial protocone-ridge formed a bend towards the middle of the occlusal surface. In this bend there was a reminiscence of the protoconule. Without employing this term other than in a descriptive sense the protoconular ridge is less pronounced than a corresponding ridge from the marginal ridge

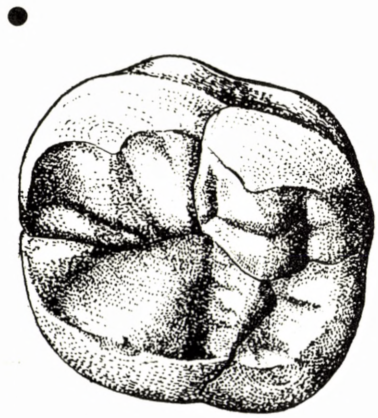

Fig. 9. Maxillary right first molar with four well-developed cusps. The black dot indicates the mesio-facial corner of the occlusal surface. Terminology: Paracone = mesio-facial cusp; protocone = mesio-lingual cusp; metacone = disto-facial cusp and hypocone = disto-lingual cusp.

basally of the paracone (crista nova according to *Remane*, (1960). Fig. 9. The distal marginal ridge of the protocone curved towards the centre of the crown and formed part of the oblique ridge. The latter ridge was distinct in all cases. Where the oblique ridge was interrupted by a groove the marginal protocone ridge might split in two ridges of which the longer prong ran mesially basally of the central cone.

On three teeth the mesial marginal ridge had an interstitial tubercle between the ever-present crista nova and the protoconule. On other teeth the marginal ridge of the occlusal surface was unbroken by grooves and tubercles between crista nova and the protoconule ridge.

The metacone was situated distally of the paracone in such a manner that an angle between the mesial marginal crest (the occlusal third of the mesial surface of the crown) and a line along the facial surface on the facial slopes of the cusps measured about 75°. Measurements were taken of nine and eight M^1 respectively from the two sides. The angle variation extended from 79° to 71°. The central cone of the metacone was part of the oblique ridge. Just facially of the groove between the metacone and the protocone there was sometimes a guttiform expansion of the metacone ridge (one tooth), a bifurcation of the ridge (four teeth) or distally directed ridges like barbs of a feather (three teeth).

The hypocone was a well-developed cusp. It was sometimes associated with a faint mesial ridge or a – usually faint – centrally directed ridge (central cone) and there was in every case a more pronounced distal marginal ridge.

Transverse grooves were occasionally present on the distal marginal ridge of the crown and in two cases there were transverse crests.

The second molar in the upper jaw showed greater variation in number and shape of the cusps than did M^1. Fourteen of the examined second molars were unworn. Twelve M^2 had four cusps whereas six had three. The hypocone was regarded an independent cusp when it was separated from the distal surface of the crown by a continuous groove.

The tricuspidate type lacked the hypocone. The metacone too was sometimes reduced in size, especially in its mesio-distal dimension, as well as being situated on the crown in such a manner that the angle between the mesial surface and the buccal surface occlusally became more acute than on M^1. For ten right second molars this angle was 61°, and for five left second molars it was 64°. The minimum value was 54.5° and the maximum 71.5°. Measurements were taken of both tri-and quadricuspidate teeth. Where first and second molars from the same jaw were measured the angle was found to be more acute on the second molar.

In the mesial part of the crown the difference between M^1 and M^2 was merely that M^2 had a narrow marginal ridge which often had no transverse ridges (crista nova and protoconule ridge). The metacone was relatively smaller. The connection of the oblique ridge with the protocone was rarely achieved, it being completely interrupted by the essential sulcus between the cusps. A distal accessory ridge on the metacone of a few teeth was situated opposite the distal marginal ridge of the protocone. Occasionally they were united across the sulcus.

Reduction of the size of the hypocone was accompanied by the disappearance of morphological details like ridges on this cusp. Connection with the distal slope of the protocone by means of a ridge was one of the faintest traces of the cusp before it disappeared completely. More often than on M^1 the distal marginal ridges of the crowns had transverse grooves that could be followed down on to the distal surfaces.

Three teeth presented a form variation that is characteristic of M^2. The crown was oval with its long axis oriented mesiofacially to distolingually. Four cusps were recognizable. The metacone and protocone were placed opposite each other with a wide basal connection (Fig. 10).

The quadricuspidate M^2 had the proximal surfaces converging lingually in contrast to M^1, on which the hypocone was prominent distolingually. There was a smooth transition from quadricuspidate M^2 to tricuspidate ones.

The third upper molars were the most variable of the molars. Five were quadricuspidate, eight were tricuspidate, one had several supernumerary tubercles distally on its crown and one was considerably reduced in size. It came from a jaw with congenital absence of the other M^3.

Pronounced reduction of the metacone was found on two teeth from two jaws. Moderate reduction in size of the metacone was accompanied by some rotation of its central cone and distal marginal ridge in the mesial direction. This brought the distal marginal ridge of the metacone opposite the distal marginal ridge of the protocone, and a crestal connection had sometimes been set up. Sometimes the protocone was united with the distomolar tubercle. This was found well-developed on three teeth. Two distal marginal tubercles were found on three teeth.

Occurrences of the tubercle of Carabelli on the lingual surfaces of the molars were registered by

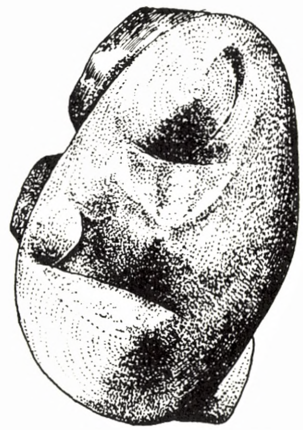

Fig. 10. Maxillary left second molar with the crown markedly compressed mesio-distally. The cusps are named from the top of the photo: paracone, protocone and hypocone. Metacone is very reduced in size and situated opposite the protocone.

Jørgensen's method. No well-developed tubercles were found. On first molars from six jaws a mesio-occlusal groove, occlusally convex, was found on the lingual surface of the protocone. Cervically from the groove a faint convexity had formed without rising above the floor of the groove. This type was named type b (*Jørgensen*, 1956: 133). On the teeth from four jaws the sole trace of a tubercle was a faint groove – a faint protoconule groove – here referred to as type c. The two teeth in another jaw had a type b and a type c groove. No second and third molars revealed a sign of Carabelli's tubercle.

There was no trace of cingulum or buccostyle on the facial surfaces of the molars.

The curvature of the enamel margin presented small irregularities, visible as faint extensions towards the occlusal surfaces. Enamel extensions of more than 1 mm of length were found only on three teeth. It must be recalled that owing to tartar and *post mortem* changes many teeth were unsuitable for examination.

On all M^1 the number of root was three. On teeth from 16 jaws the distance between the enamel line facially and the bifurcation was 4 mm or more. According to *Brabant & Kovacs* (1964) who studied the deciduous teeth this limit may be set for partial taurodontism. Applying this limit to permanent teeth widespread partial taurodontism occurred in first molars. For second and third molars an arbitrary limit was no reliable criterion as the roots usually were incompletely divided or fused. Where the roots of M^2 were well separated there was also partial taurodontism. The presence of partial taurodontism was verified with the aid of radiographs of the teeth.

Like the third molars, the second molars presented various forms of root fusion. Whereas six M^2 and three M^3 had three free roots, five M^2 had fusions of two or three roots. Five M^3 had fusions similar to those of M^2. One third molar had a supernumerary palatal root.

Discussion of maxillary molars

Among the upper molars the first molar is the best developed with regard to number of cusps and roots. All the basic structures of a molariform tooth are distinctly developed on the first molars. The maxillary first molars have four cusps and three well separated roots. This applies to the teeth from Tall Sūkās, Kish, Byblos and ancient Anatolia. There is some variation as to minor ridges and grooves on the occlusal surfaces. In 37 % of 100 M^1 sup. from Kish *Carbonell* (1958) noticed some reduction in size of the disto-lingual cusp, the hypocone. On the lingual surfaces of the crowns the Carabelli's structure is visible on many of the first molars. Among the teeth from Tall Sūkās no well-developed Carabelli's cusps were found but the weaker expressions of the structure (cusp and/or grooves and pit) were observed. Complete absence of the Carabelli's structure occurred in 57.7 % of the teeth from Tall Sūkās. In Kish only one dentition showed a well-developed Carabelli's tubercle, intermediate forms were found and complets absence of the structure was found as often as in 77 % of the teeth. In ancient Anatolia the conditions were the same: Few dentitions had first molars with large tubercles, many intermediate forms were found and complete absence was recorded in 54 % of the dentitions. In contrast to these observations the 20 specimens from Chalcolithic Byblos in all but one case showed some evidence of the Carabelli's structure. In recent European populations Carabelli's cusp is often well-developed. The total frequency of the strong and weak expressions of the Carabelli' structure does not differ from the ancient populations in the Middle East. According to *Kallay* (1957) the percentage of occurrence of the Carabelli's structure in 2978 Yugoslavian children is 51.05 per cent. In the *Bolk's* collection of recent Dutch teeth the Carabelli's structure was found in 61.6 % of 2325 first molars.

The maxillary second molars show a certain reduction in the size and number of the cusps. The disto-lingual cusp, the hypocone may be absent as the case was in 33 % of the teeth from Tall Sūkās, in 31 % of the teeth from Kish (N: 91) and in a fourth of the teeth from Byblos. In Anatolia a further reduction has occurred because 60 % of a small sample of M^2 sup. were without a hypocone.

Reduction in size of the disto-facial cusp, the metacone, was noticed in the sample from Tall Sūkās. The shape of the crown became oblongated with a long axis oriented from the mesio-facial to the disto-lingual corner of the crown. A similar reduction was observed by *Dahlberg* (1962) in a specimen from Sialk, Iran.

In recent European populations the reduction in number of cusps is also noticed in maxillary second molars. From a review by *Brabant & Twiesselmann* (1964) the following observations of Italians by *Piersanti* can be quoted: Frequency of M^2 sup. with reduced or missing hypocones: 52 % in recent Italians and the frequency of M^2 sup. without hypocone in medieval Italians: 45 %.

The tendency to reduction in size and shape increases from the first to the third molar in the upper jaw. The frequency of three-cusped M^3 sup. i.e. molars without a hypocone was 57 % in Tall Sūkās, 51 % in Kish, 45 % in Byblos, while the frequency was even higher in the very small sample from ancient Anatolia consisting of 7 teeth out of which 5 were without a hypocone. In recent European populations the frequency of three-cusped third molars vary from 47 % to 80 %. In medieval Italians *Piersanti* reported a frequency of 80.5 %. (*Brabant & Twiesselmann*, 1964).

Mandibular molars

A number of the molars in the collection could not be examined in great detail because occlusal attrition prevented evaluation of the groove pattern and the number of cusps, whilst *post mortem* changes made it impossible to determine the number of roots. Table 7 shows the number of teeth inspected as regards cusp number and groove pattern. It is noteworthy that a relatively large number of M_1 had four cusps. In every case the missing cusp was the hypoconulid. The frequency of third molars with four cusps placed the third molar in an intermediate position between that of the first and second molars.

Table 7.

Number of cusps and groove patterns of mandibular molars

	M_3sin.	M_2sin.	M_1sin.	M_1dext.	M_2dext.	M_3dext.
No. of cusps						
5	4	1	13	13	1	2
4	7	18	9	9	16	11
3	–	–	–	–	1	–
Groove pattern						
Y	2	3	10	14	4	3
+	2	3	3	3	6	4
X	9	13	4	3	9	5

The sulcus pattern was judged according to directions given by *Remane* (1960) and *Jørgensen* (1955). Y-form signifies that the Dryopithecus pattern originally described by *Gregory* is present. It means contact between the metaconid and the hypoconid along a line which is considered larger than a point, if the sulcus – separating the cusps – is more than 0.2 mm. Only on first molars the Y-form was most frequent. M_1 preserved the original sulcus pattern better than the original number of cusps, i.e. five cusps. On many of the posterior molars there was line contact between the distal accessory ridge of the protoconid and the entoconid. An intermediate position was held by the + configuration of the grooves, which represents a punctiform contact between four cusps. The most modified from the ancestral pattern was the X-pattern which in its details varied as shown by *Remane* (1960, Fig. 44). The variation corresponded in frequency to the observed reduction of the entoconid, of the hypoconid which often had shifted facially and become isolated, and of the hypoconulid.

Supernumerary cusps were found on two M_3. On one tooth there was a c_7 and on another two distal accessory cusps. Reduction forms of M_3 in some instances evaded analysis owing to reduction of parts of the crowns or to attrition (three teeth). On three M_3 there was a well-developed buccal cingulum with incipient cusp formation on the facial slope of the protoconid or a protuberant zone of enamel below a groove, sometimes with a pit (Fig. 12b). On M_1 there was a corresponding mesial protuberant zone or a groove on two teeth, on M_2 on one tooth.

Facial pits as terminals of the grooves between protoconid and hypoconid were of common occurrence and particularly pronounces on second and third molars. Moreover, on a few M_2 and M_3 a pit occurred on the facial surface mesially vis-a-vis the protoconid (Fig. 12b).

Fifteen unworn, mostly quadricuspidate M_1 were examined as regards the configuration of

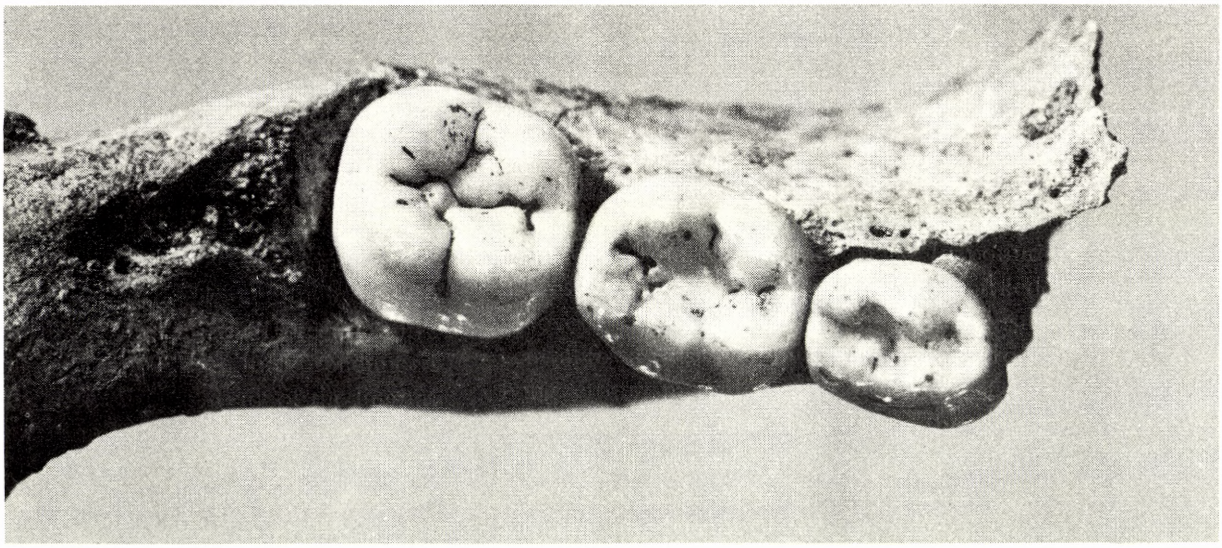

Fig. 11. Mandibular fragment with the left first and second deciduous molars and the permanent first molar in situ. The second deciduous molar shows five cusps: protoconid = located mesio-facially (cf. the black dot); metaconed = mesio-lingually; hypoconid = centro-facially; entoconid = disto-lingually and hypoconulid = disto-facially. The permanent first molar has four cusps, the hypoconulid is missing.

the occlusal surfaces (cf. fig. 11). On all these teeth the protoconid had an accessory ridge on the distal slope of the central cone. In a single instance it was bifurcated.

The metaconid, which was a large, dominating cusp with a pointed apex, had its central cone directed mesio-facially. The central cone sometimes had a thickness basally which curved distalward. This deflecting wrinkle (*Weidenreich*, 1937) was found on teeth from three jaws. The marginal ridges of the metaconid curved facially. This was found most constantly on the distal side of the central cone, but occasionally the mesial variety was also distinct.

The hypoconid had either a long, narrow central cone or a distinct ridge formed by the distal marginal ridge of which the central part was constricted by a groove, whereby it formed an isolated enamel island.

On the few teeth having a hypoconulid this cusp was the smallest. It was located nearer the line of the largest mesio-distal diameter of the tooth crown than the other facial cusps. Besides

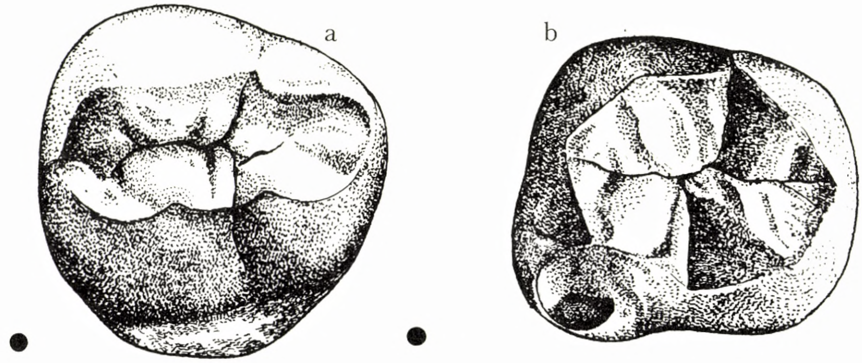

Fig. 12. Mandibular left second molar with reduction in size of the distal cusps (a); mandibular left third molar showing a well-developed facial cingulum (b). Black dots indicate the mesio-facial corners of the occlusal surfaces.

the central cone a distally deflected marginal ridge was occasionally observed.

Both mesially and distally the entoconid had accessory ridges around its central cone.

Mesially and distally on the marginal ridges of the crown there were one or two transverse grooves. Small tubercles between two grooves were seen on two teeth, one mesially and one distally.

Compared with M_1, the second molars showed certain differences (cf. fig. 12a). Sometimes the various cusps retained their mutual size relations, but in three jaws the entoconid alone was reduced in size. In two jaws the hypoconid and the entoconid were reduced in size in relation to the corresponding cusps on M_1 in the same jaws, and in one jaw the metaconid was also reduced as well as the hypoconid. Absence of the hypoconulid seemed to have no influence on the size of the other cusps. Changes in the sulcus pattern have been referred to.

The protoconid on M_2 was of the same shape as on M_1. The metaconid had its central cone situated more transversally than on M_1. Accessory ridges were occasionally present. Sometimes they were united basally around the cone. On the teeth from one jaw the metaconid increased in size distally at the expense of the entoconid (seen in relation to M_1 from the same jaw). On the entoconid the central cone and especially the mesial accessory ridge were well-developed. The mesial accessory ridge was thickened basally. The hypoconid had a cone and a distinct mesial accessory ridge, in constrast to M_1. Transverse grooves across marginal ridges mesially and distally on the occlusal surfaces were observed occasionally.

In two jaws M_3 was much reduced in size. The shape of the crowns was impossible to describe in detail. Reduction of the cusp size was observed of the entoconid alone on teeth from two jaws and of entoconid and hypoconid in two jaws. On M_3 from one jaw the hypoconid was enlarged, and in other cases the size of the cusps mutually and absolutely was as on the anterior molars. It seemed that M_1 and M_3 bore the greatest resemblance in the size of the metaconid and in the orientation of the central cone of the metaconid.

A feature of the enamel line was a tendency to extensions towards facial and lingual bifurcations; pronounced enamel extensions were not observed, however.

On all M_1 the number of roots was two. There was partial taurodontism in 11 teeth out of 25. In the majority of cases M_2 had two roots. They were fused on three teeth and partially taurodontic in 12 of 22 teeth. Seventeen M_3 had roots capable of being analyzed. Four teeth had two fused roots; one tooth had a bifurcated mesial root and ten had two roots. Of these, six had partial taurodontism, which in this paper signifies a root stem height facially of 4 mm or more. Two M_3 had one root.

Discussion of mandibular molars

In table 8 the number of cusps and the groove patterns of mandibular first molars from Tall Sūkās are compared with those of other ancient populations from the Middle East. There is apparently a difference between Tall Sūkās and Kish on one side and Byblos and Anatolia on the other side. There is a very high frequency of four-cusped M_1 inf. in the Tall Sūkās and Kish populations. This is a change from the more conservative or primitive condition with mostly five-cusped M_1, a change which is often found in European populations (*Brabant & Twiesselmann*, 1964). At the same time also the groove patterns have changed from the original Y-pattern to a high frequency of the + and X-patterns.

In the more conservative samples from Byblos and Anatolia a few M_1 inf. showed supernumerary cusps. Such cusps were not found in the sample from Tall Sūkās and no information is available from Kish.

Table 8.

Number of cusps and groove patterns of mandibular first molars.

Population	N	5 cusps	4 cusps	Groove patterns		
				Y	+	X
Tall Sūkās	44	26 (59 %)	18 (41 %)	–	–	–
	37	–	–	24 (65 %)	6 (16 %)	7 (19 %)
Kish (3000 B.C.)	93	51 (55 %)	42 (45 %)	20 (21.5 %)		73 (78.5 %)
Byblos (Chalcolith.)	18	17 (94 %)	1 (6 %)	15 (83 %)	0	3 (17 %)
Anatolia (Chalc. Copper)	88	86 (88 %)	2 (2 %)	–	–	–
	72	–	–	61 (85 %)	9 (14 %)	2 (2 %)

Data from both sexes and from both sides of the jaws are combined.

Some recent populations in the Middle East show a very high frequency of five-cusped M_1 so that the frequency of four-cusped M_1 is less than 10 %. In living Samaritans only 5.7 % of their M_1 are four-cusped (*Rosenzweig & Smith*, 1971) and in Tajiks from Afghanistan 6 % of 43 M_1 inf. were found to be four-cusped by *Beynon* (1971). Other populations show a lower frequency of five-cusped M_1 and a frequency of four-cusped M_1 higher than 10 %. Among the Bedouins from the Negev desert 16.4 % had four-cusped M_1 and among Yemenite Jews 15 % had four-cusped M_1 inf. (*Rosenzweig & Zilbermann*, 1967 and 1969).

In the comprehensive dental study of dentitions from the Nubian cemeteries 6-B-16, NAX, and 6-K-3 (Meroitic, X-Group and Christian cultures) *Greene* (1967) found no significant differences between the populations, but the frequencies of four-cusped M_1 inf. varied between 5 % and 23 %.

Mandibular second molars usually have four cusps (Table 9), the disto-facial cusp is missing in about 90 % of the teeth. The sample from Kish differs from the other samples having a high frequency of five-cusped M_2 inf. It is tempting to assume that some loose first and second molars were mixed up during the study. This critical comment may also apply to the sample from Tall Sūkās, where the same tendency to a low frequency of five-cusped M_1 existed.

In medieval and recent Italians the frequency of four-cusped M_2 vary between 82.4 % and 91 %, the remaining teeth being five-cusped (*Piersanti* and *Taviani*, quoted from *Brabant & Twiesselmann*, 1964).

The third molars develop late in childhood after the tooth crowns of the other molars are fully formed. The cusp number and groove patterns of the third molars show a certain independency of the trend to gradual reduction in size and shape of the molars from the first to the third one. Often there is more space in the mandible than in the maxillae for development of the third molars. The mandibular third molars are therefore capable of a more full expression of the molar pattern. The results presented in Table 10 show that M_3 more often than M_2 is a five-cusped tooth. The results also indicate that reduced forms or aberrant forms

Table 9.

Number of cusps on mandibular second molars

Population	N	5 cusps	4 cusps	3 cusps
Tall Sūkās	37	2 (5 %)	34 (92 %)	1 (3 %)
Kish (3000 B.C.)	91	18 (20 %)	73 (80 %)	–
Byblos (Chalcolithic)	19	2 (11 %)	17 (89 %)	–
Anatolia (Chalc.-Copper)	85	7 (8 %)	78 (92 %)	–

Table 10.

Number of cusps on mandibular third molars

Population	N	5 cusps	4 cusps	3 cusps
Tall Sūkās	24	6 (33 %)	18 (67 %)	–
Kish (3000 B.C.)′	52	9 (17 %)	43 (83 %)	–
Byblos (Chalcolithic)	14	8 (57 %)	4 (29 %)	2 (14 %)
Anatolia (Chalc.-Copper)	60	23 (38 %)	35 (58 %)	2 (3 %)

may occur in this region of the jaws. The reason for this may be that the strict genetical determination of the growth and development of tooth germs is more relaxed on the last tooth germs to form late in childhood and environmental factors have a greater influence upon the final result.

In Italian teeth from the Middle Ages the frequency of four-cusped M_3 was 47,7 %, and in recent Italians the frequency was found to be 46.5 %. (*Piersanti* and *Taviani* quted from *Brabant & Twiesselmann*, 1964).

In the morphological study of the permanent mandibular molars of the Chalcolithic and Copper Age inhabitants of Anatolia *Senyürek* (1952), observed a relatively high proportion of wrinkled lower molars. Such wrinkles were also very characteristic for the teeth from Tall Sūkās. The cervical enamel extensions occurred less frequently in Anatolians than in modern Danes. This also applies to the molars from Tall Sūkās. Finally *Senyürek* (1952) observed moderate taurodontism and a frequency of fused roots which did not differ much from modern Europeans. Again the teeth from Tall Sūkās are similar to the Anatolian teeth.

Population affinities based on non-metric dental traits

The description of the teeth showed that there exists a multitude of variable dental traits. There is reason to believe that most of these traits are genetically controlled and little influenced by environmental factors (*Greene*, 1967; *Schulze*, 1964; *Krogman*, 1967 and other reviews on dental genetics). It is therefore a rational procedure to assess biological relationships of populations by means of inherited dental traits. First an exemple:

Greene, (1967) studied ancient Nubians from the Meroitic, X-Group and Christian cultures. Sixteen dental characters were analyzed. The various populations from the three cultural periods shared a large number of traits. Significant differences were only found in mandibular first molar groove patterns and maxillary first molar cusp patterns. *Greene* concluded that the three successive populations belonged to the same breeding population. This result is supported by *Mukherjee* (1955) who applied *Mahalanobis*'s D^2 function, using cranial chords and angles, to Nubian populations, and compared them with West African populations and with

Table 11.

Frequency of selected non-metric dental traits in ancient populations.

Population	Tall Sūkās		Byblos		Anatolia		Kish		Bedouins Negev desert		Samaritans Tel Aviv		Jews from Yemen	
Trait	N	%	N	%	N	%	N	%	N	%	N	%	N	%
I^1 shovel*	26	(7.7)	23	(7.4)	20	(10.0)	23	(0)	137	(6.8)	219	(0)	60	(7)
M_1 5 cusps	44	(59.1)	18	(94.5)	72	(97.2)	94	(54.2)	129	(81.6)	167	(94.3)	60	(83)
M_2 5 cusps	37	(5.4)	19	(10.5)	82	(8.5)	91	(19.8)	79	(7.0)	139	(5.8)	41	(0)
M_1 Y-pattern	47	(51.1)	18	(72.3)	72	(84.7)	94	(21.3)	129	(70.4)	132	(87.1)	60	(53)
M_2 Y-pattern	38	(18.4)	19	(0)	82	(6.1)	91	(14.3)	79	(7.0)	127	(12.6)	41	(9)
$M^1 \div$ Carab.c.	52	(57.7)	20	(5.0)	26	(53.8)	47	(77.0)	131	(27.7)	169	(92.9)	60	(7)
M^2 Hypocone abs.	18	(33.3)	33	(24.2)	20	(60.0)	91	(30.8)	73	(69.5)	157	(54.2)	31	(36)

* Includes shovel and semi-shovel shape

Data from *Özbek*, 1975; *Senyürek*, 1952; *Carleonell*, 1958, 1960, 1963; *Rosenzweig et. al.* 1967 and 1969.

ancient Northern Egyptian populations. The Nubian populations were closely clustered and were almost equal distances from the West African and Egyptian populations. *Vagn Nielsen* (1970) studying the same Nubian populations as *Greene* but using other samples, also found great homogeneity on the basis of D^2-statistics and non-metric anatomical variation of the skulls. It is important here to emphasize that the use of different samples, different morphological and genetic systems by different workers all agree with regard to the biological relationships of the Nubian populations.

In the present investigation only seven variable dental traits were used. (Table 11). The reason is that few characters were described in a similar way in all the populations compared with the sample from Tall Sūkās. The following traits were analyzed: The prevalence of shovel and semi-shoveled maxillary central incisors, the frequency of five-cusped mandibular first molars and second molars, the frequency of first and second mandibular molars showing the Y-pattern on the occlusal surfaces, the frequency of maxillary first molars without any trace of the Carabelli's structure and finally the frequency of maxillary second molars showing absence of the disto-lingual cusp, the hypocone.

There is no possibility of testing the sample from Tall Sūkās with regard to sex or age differences in the frequencies of the traits mentioned. The young individuals with relatively unworn teeth were used in the skeletal samples and young individuals were examined in the recent populations studied by *Rosenzweig & Zilberman*. The differences among the samples are not due to age differences.

Greene, (1967), found no sex differences in the expression of the following traits: the cusp patterns of M^2, the Carabelli's trait on M^1, the cusp and groove patterns on M_1 and M_2. *Greene* studied Nubian populations. *Berry* (1976) came to the same conclusion and showed furthermore that no significant association existed between the variants used in a study of ancient and modern North West European samples. *Garn* (1966) was able to show that the cusp number and groove pattern of M_1 varied independently of each other in North American Whites and *Greene* (1967) found no significant association between the cusp and groove patterns of either M_1 or M_2 or between M_1 and M_2 when the cusp number or the groove pattern were considered one at the time.

Table 12.

Smith's distance between populations based on non-metric dental traits in the permanent dentition

Population	Tall Sūkās	Byblos	Anatolia	Kish
Tall Sūkās	–	0.3323 0.1306	0.7021 * 0.1196	0.1063 0.0241
Byblos		–	0.2333 0.0514	0.7961 0.2206
Anatolia			–	0.6179 * 0.0835
Kish				–

Upper rows show distances and lower rows variances.
* Indicates that the distance coefficient is significantly different from zero at the 5 % level.

The degree of affinity between populations compared are different from character to character and it is important to consider several traits provided they are largely genetically determined, their occurence independent of age and sex and that the variants are not correlated one with another (*Berry*, 1976). These assumptions appear to be fulfilled in the present study.

Among several methods available to assess the biological distance based on non-metric characters the one by *C.A.B.Smith* was used. The original equation for calculating the distance coefficient (D) and its variance (V) given by *Smith* are:

$$D = [\sum_{i=1}^{N} (\Theta_{Ii} - \Theta_{IIi})^2/N] - (1/n_{Ii} + 1/n_{IIi})$$

and

$$V = [4(1/n_I + 1/n_{II}) \sum_{i=1}^{N} (\Theta_{Ii} - \Theta_{IIi})^2/N] - 4(1/n_I + 1/n_{II})$$

where $\Theta_{Ii} = sin^{-1}(1\text{–}2p_{Ii})$, p_{Ii} is frequency of i-th characters in population I, and N stands for the number of characters involved.

Table 13.

Smith's distance between Tall Sūkās and recent populations in the Middle East based on non-metric dental traits

Tall Sūkās – Beduoins (Negev Desert)	0.1697 0.0304
Tall Sūkās – Samaritans	0.3597 0.0440
Tall Sūkās – Yemenite Jews	0.2597 0.0406

Upper rows show distances and lower rows variances.

However, these forms do not allow the use of sample numbers which differ for each trait under consideration. To obtain distance coefficients and their variances based on different sample numbers the above formulae should be modified as follows (*Hanihara et. al.*, 1974, *Hanihara*, 1976):

$$D = \sum_{i=1}^{N} [(\Theta_{Ii} - \Theta_{IIi})^2 - (1/n_{Ii} + 1/n_{IIi})]/N$$

and

$$V = \sum_{i=1}^{N} [4(1/n_{Ii} + 1/n_{IIi}) ((\Theta_{Ii} - \Theta_{II}«)^2 - (1/n_{Ii} + 1/n_{IIi}))]/N$$

The distances and variances computed by the modified *C.A.B. Smith* equations are shown in Tables 12 and 13. Every distance coefficient larger than two standard deviations indicates that the distance is significantly different from zero at the 5 % level. Most of the distance coefficients are non significant, i.e. the distances from Tall Sūkās to older and younger populations. The only significant distances are found between Tall Sūkās and Anatolia and between Kish and Anatolia. The general impression is that of great similarity among the populations compared. This interesting result will be discussed in relation to the odontometric study on page 44.

Odontometry

The maximum mesiodistal and labiolingual crown diameters were measured with a sliding caliper with sharpened points and a scale reading to 0.05 mm. Teeth with severe attrition, with dental caries or calculus were excluded from the study. A few maxillary second molars with atypical shape of the tooth crowns were also excluded because it was impossible to find the correct points of measurements (cf. Fig. 10).

The maximum mesiodistal diameter was measured on all the loose teeth while the greatest distance between the normal mesial and distal contact areas on the proximal surfaces was measured on the teeth *in situ* in the jaws. The labiolingual diameter of a tooth crown was measured as the largest diameter in the labiolingual direction, in a plane at right angles to that of the mesiodistal diameter (*Lunt*, 1969).

The error of the method was rested by double determination of both dimensions on 50 maxillary anterior teeth. The error was then calculated form the formula:

$$\delta_i = \sqrt{\frac{d^2}{2n}}$$

where d is the difference between measurements of the same tooth, and n is the number of teeth measured. The result of this test was 0.1 mm which is comparable to the results of other investigators, according to *Lunt* (1969).

The data from right and left sides of the jaws are presented separately. There is a high degree of correlation between corresponding dimensions of antimere teeth and no systematic difference in size was noticed between the two sides. Both sexes were combined of necessity because the loose teeth could not be determined safely with regard to sex.

The method chosen for analysis of the tooth measurements is that of the Student's t-test, by means of which the significance of differences between mean values may be estimated. The variability was estimated from the coefficient of variation.

The calculations were performed on a programmed SR-1800 calculator. The variance and standard deviation were calculated if more than five observations were made of a tooth dimension.

The size of the deciduous teeth

In Tables 14 to 17 the mean values for mesiodistal and labiolingual crown diameters of teeth from Tall Sūkās are presented. The sample sizes were small and the standard deviations were only calculated for deciduous canines and deciduous molars.

In Tables 18 and 19 the deciduous teeth from Tall Sūkās are compared with some older Eastern Mediterranean populations. As mentioned previously, the teeth from Tall Sūkās are dating from the Middle Bronze Age (approx. 1900–1700 B.C.), the teeth from Byblos are dating from the Chalcolithic Period (approx. 4000 – 3000 B.C.) and the few Anatolian teeth from the Chalcolithic and Copper Ages (approx. 4000 – 2350 B.C.). Two neolithic groups are included. Tell Mürey-bet is claimed to be one of the oldest villages in the Near East. It is situated near the river of Eufrates about 80 km south-east of Aleppo. It is probably contemporary with the village of Jarmo. Accord-

Table 14.

Mesiodistal crown diameters of deciduous maxillary teeth

Tooth	No.	Mean	S.D.
di^1	1	6.70	–
di^2	2	5.55	–
dc	7	7.34	0.19
dm^1	8	7.03	0.21
dm^2	10	8.93	0.41

Table 15.

Labiolingual crown diameters of deciduous maxillary teeth

Tooth	No.	Mean	S.D.
di^1	3	5.5	–
di^2	4	5.1	–
dc	6	6.48	0.32
dm^1	8	8.67	0.39
dm^2	10	9.39	0.36

Table 16.

Mesiodistal crown diameters of deciduous mandibular teeth.

Tooth	No.	Mean	S.D.
di_1	3	4.70	–
di_2	2	5.20	–
dc	7	6.28	0.16
dm_1	8	7.87	0.50
dm_2	10	9.96	0.52

Table 17.

Labiolingual crown diameters of deciduous mandibular teeth.

Tooth	No.	Mean	S.D.
di_1	3	4.30	–
di_2	2	4.70	–
dc	5	5.82	0.34
dm_1	7	7.22	0.44
dm_2	11	9.06	0.47

ing to *Dahlberg* (1960) the sample from Jarmo is dating from about 6750 B.C.

The deciduous canines from Tall Sūkās are significantly larger that the canines from Byblos. In fact, the deciduous canines are as large as those of modern Australian aborigines, known to have very large teeth (*Hanihara*, 1966, 1976).

The deciduous molars from Tall Sūkās are similar in size to those from Byblos. There are no significant differences between the means in seven out of eight possible tests. The labiolingual diameter of the first maxillary molar is significantly larger in the sample from Tall Sūkās, this being the only significant difference. It is evident from the data in Tables 18 and 19 that there is a tendency for the older Neolithic teeth to be larger than the younger teeth from the Metal Ages. This point was clarified by *Özbek*, (1975), who presented the relation of mesiodistal and labiolingual crown diameters graphically, indicating in ellipses 70, 95 and 99.9 per cent of the results. Ellipses were computed on the basis of the deciduous teeth from Byblos. On the graphs were plotted the means for Medieval and Neolithic Belgian populations, Natufians and Anatolians as well as data from children of Neandertals. For the first and second maxillary molars all the population-means fell within the smallest two ellipses with exception of the means for Natufians and children from Skhul (dm^1) and Tabun (dm^2). In the mandible the deciduous first and second molars for all the populations compared were plotted within the smallest of the three ellipses. Again the Neandertals had the largest means, but only m_1 from Skhul X was significantly larger than the mean for Byblos.

In conclusion, the deciduous molars from ancient Near Eastern populations are not significantly different from each other but there is a tendency for the oldest samples to show the larger teeth.

Table 18.

Mesiodistal and labiolingual crown diameters of deciduous anterior teeth in ancient populations from the Middle East.

		Mesiodistal				Labiolingual			
Tooth	Population	N	Mean	S.D.	t	N	Mean	S.D.	t
di^1	Tall Sūkās	1	6.70	–		3	5.50	–	
	Byblos	5	7.00	0.52		5	5.40	0.45	
	Anatolia	1	6.50	–		1	5.10	–	
	Müreybet	2	7.00	–		2	5.20	–	
	Jarmo	2	6.30	–		2	4.80	–	
di^2	Tall Sūkās	2	5.55	–		4	5.10	–	
	Byblos	7	5.50	0.41		7	5.20	0.43	
	Anatolia	1	5.50	–		1	4.80	–	
	Müreybet	2	5.70	–		2	4.70	–	
	Jarmo	1	4.90	–		1	5.00	–	
dc^1	Tall Sūkās	7	7.34	0.19		6	6.48	0.32	
	Byblos	8	6.60	0.50	3.67**	8	6.00	0.39	2.45*
	Anatolia	2	6.60	–		2	5.85	–	
	Müreybet	3	7.20	–		3	6.80	–	
	Jarmo	4	6.80	–		4	6.10	–	
dc_1	Tall Sūkās	7	6.28	0.16		5	5.82	0.34	
	Byblos	8	5.80	0.44	2.72*	8	5.70	0.73	n.s.
	Anatolia	2	5.85	–		2	5.50	–	
	Müreybet	1	6.40	–		1	5.50	–	
	Jarmo	3	6.40	–		3	5.90	–	

Dating of the samples: Tall Sūkās: Middle Bronze Age; Byblos: Chalcolithic (*Özbek*, 1975); Anatolia: Chalcolithic-Copper Age (*Senyürek*, 1952); Müreybet: Neolithic (*Özbek*, 1975); Jarmo: Neolithic (*Dahlberg*, 1960).
Differences between the samples from Tall Sūkās and Byblos were tested by Student's t-test. n.s. = non significant difference, * = significance at the 5 % level, ** = significance at the 1 % level.

The size of the permanent teeth

In Tables 20 to 23 the means, standard deviations and coefficients of variation for the crown diameters of teeth from Tall Sūkās are presented.

It is known that local populations within the same geographical race differ with regard to tooth size. There are European populations with large teeth and European populations with small teeth. Tooth size may also fluctuate with time in a given geographical region. In Europe large teeth were common before the Neolithic Period and they are common again today, but in the Middle Ages several European populations had small teeth. The teeth from Tall Sūkās were compared with ancient and modern European data compiled by *Brabant*, 1971; *Lavergne*, 1974; *Lunt*, 1969 and they were found to be of medium size. The Phoenician crown diameters were in general larger than those of medieval European teeth but they did not quite reach the size of living Europeans.

Table 19.

Mesiodistal and labiolingual crown diameters of deciduous molars in ancient populations from the Middle East.

		Mesiodistal				Labiolingual			
Tooth	Population	N	Mean	S.D.	t	N	Mean	S.D.	t
dm^1	Tall Sūkās	8	7.03	0.21		8	8.67	0.39	
	Byblos	17	6.80	0.36	n.s.	17	8.00	0.43	3.73**
	Anatolia	4	7.20	–		4	8.27	–	
	Müreybet	2	7.10	–		2	8.40	–	
	Jarmo	5	7.60	–		5	9.00	–	
dm^2	Tall Sūkās	10	8.93	0.41		10	9.39	0.36	
	Byblos	19	8.80	0.50	n.s.	19	9.40	0.60	n.s.
	Anatolia	3	8.90	–		3	10.06	–	
	Müreybet	2	9.15	–		2	10.10	–	
	Jarmo	5	9.70	–		5	10.50	–	
dm_1	Tall Sūkās	8	7.87	0.50		7	7.22	0.44	
	Byblos	16	8.10	0.59	n.s.	16	7.00	0.91	n.s.
	Anatolia	3	8.06	–		3	6.93	–	
	Müreybet	2	8.45	–		2	6.70	–	
	Jarmo	5	8.10	–		5	7.50	–	
dm_2	Tall Sūkās	10	9.96	0.52		11	9.06	0.47	
	Byblos	18	9.90	0.82	n.s.	18	9.00	0.50	n.s.
	Anatolia	4	9.85	–		4	8.57	–	
	Müreybet	2	10.40	–		2	9.15	–	
	Jarmo	5	10.60	–		5	9.80	–	

Dating of the samples: Tall Sūkās: Middle Bronze Age; Byblos: Chalcolithic (*Özbek*, 1975); Anatolia: Chalcolithic-Copper Age (*Senyürek*, 1952); Müreybet: Neolithic (*Özbek*, 1975); Jarmo: Neolithic (*Dahlberg*, 1960).
Differences between the samples from Tall Sūkās and Byblos were tested by Student's t-test. n.s. = non significant difference, * = significance at the 5 % level, ** = significance at the 1 % level.

The mesiodistal crown diameters of teeth from Tall Sūkās were compared with those from Chalcolithic Byblos by means of t-tests and no significant differences were found (Table 24 and 25). Comparisons with tooth diameters from Kish (*Carbonell*, 1958) showed that the maxillary canines and first premolars were significantly larger in the sample from Tall Sūkās and the mandibular lateral incisor, canine, second premolar and second molar likewise significantly larger in the sample from Tall Sūkās. It is possible that the proportion of males and females differed in the samples from Tall Sūkās and Kish and it is of interest to compare the data from Tall Sūkās with a modern Eastern Mediterranean population where the males and females are described separately. The population of modern Bedouins from the Negev desert was chosen because this population shows a marked sexual dimorphism (*Rosenzweig & Zilberman*, 1969). In Tables 24 and 25 are demonstrated that a few of the Phoenician mesiodistal crown diameters

Table 20.

Mesiodistal crown diameters of permanent maxillary teeth.

Tooth		No.	Mean	S.D.	V
I^1	right	11	8.60	0.43	5.00
	left	16	8.59	0.45	5.24
I^2	right	10	6.63	0.44	6.64
	left	14	6.59	0.43	6.53
C	right	13	7.74	0.41	5.30
	left	21	7.72	0.48	6.22
P^1	right	20	6.98	0.33	4.73
	left	15	6.97	0.37	5.31
P^2	right	14	6.87	0.34	4.95
	left	11	6.82	0.29	4.25
M^1	right	18	10.42	0.59	5.66
	left	17	10.39	0.51	4.91
M^2	right	15	9.34	0.70	7.49
	left	15	9.32	0.52	5.58
M^3	right	11	9.06	0.46	5.08
	left	8	8.94	1.04	11.63

Table 21.

Labiolingual crown diameters of permanent maxillary teeth

Tooth		No.	Mean	S.D.	V
I^1	right	15	7.24	0.36	4.97
	left	17	7.23	0.37	5.12
I^2	right	13	6.39	0.42	6.57
	left	17	6.31	0.33	5.23
C	right	20	8.38	0.60	7.16
	left	25	8.44	0.61	7.23
P^1	right	25	9.16	0.55	6.00
	left	17	9.16	0.48	5.24
P^2	right	14	9.44	0.39	4.18
	left	12	9.33	0.39	4.18
M^1	right	17	11.55	0.59	5.11
	left	17	11.58	0.68	5.87
M^2	right	8	11.84	0.64	5.41
	left	15	11.41	0.74	6.49
M^3	right	10	11.23	0.57	5.08
	left	5	11.44	0.48	4.20

Table 22.

Mesiodistal crown diameters of permanent mandibular teeth.

Tooth		No.	Mean	S.D.	V
I_1	right	6	5.60	0.39	6.96
	left	6	5.40	0.47	8.70
I_2	right	11	6.28	0.36	5.73
	left	11	6.17	0.30	4.86
C	right	19	6.85	0.34	4.96
	left	17	6.76	0.37	5.47
P_1	right	15	6.85	0.32	4.67
	left	15	6.98	0.40	5.73
P_2	right	14	7.19	0.48	6.67
	left	11	7.11	0.28	3.93
M_1	right	11	10.85	0.65	5.99
	left	13	10.86	0.59	5.43
M_2	right	13	10.65	0.71	6.66
	left	13	10.77	0.91	8.44
M_3	right	11	10.76	0.95	8.82
	left	10	10.54	1.13	10.72

Table 23.

Labiolingual crown diameters of permanent mandibular teeth.

Tooth		No.	Mean	S.D.	V
I_1	right+left	7	5.80	0.60	10.34
I_2	right	10	6.40	0.44	6.87
	left	7	6.36	0.29	4.55
C	right	19	7.88	0.51	6.47
	left	20	7.92	0.45	5.68
P_1	right	20	7.70	0.45	5.84
	left	20	7.68	0.54	7.03
P_2	right	19	8.25	0.61	7.39
	left	17	8.11	0.61	7.52
M_1	right	17	10.42	0.43	4.12
	left	21	10.38	0.48	4.62
M_2	right	16	10.09	0.69	6.83
	left	11	10.09	0.66	6.54
M_3	right	22	9.91	0.70	7.06
	left	20	9.93	0.79	7.95

Table 24.

Means and standard deviations of mesiodistal crown diameters in the permanent dentition reported by previous authors

	Byblos[1]		Kish[2]		Bedouins (male and female)[3]			
Tooth	N	M & SD	N	M & SD	N	M & SD	N	M & SD
I^1	25	8.90	26	8.33	83	8.76	54	8.49
		.73		.93		.55		.59
I^2	29	6.80	26	6.58	80	6.89	53	6.79
		.48		.72		.48		.63
C	34	7.70	37	7.28	58	7.80	46	7.46
		.58		.63		.49		.49
P^1	46	6.80	37	6.56	62	7.02	45	6.72
		.53		.74		.46		.39
P^2	40	6.70	38	6.78	60	6.75	46	6.53
		.58		.88		.47		.59
M^1	54	10.20	48	10.44	78	10.63	35	10.03
		.64		.79		.58		.70
M^2	43	9.40	45	9.65	53	10.22	38	9.52
		.56		.88		.62		.57
I_1	30	5.60	23	5.25	75	5.45	51	5.23
		.41		.49		.37		.33
I_2	35	6.20	22	5.74	77	6.09	53	5.88
		.49		.51		.39		.44
C	43	7.00	33	6.47	59	7.03	47	6.52
		.69		.51		.49		.44
P_1	41	6.80	40	6.68	63	7.03	47	6.78
		.65		.49		.46		.40
P_2	39	7.20	36	6.85	51	7.21	46	6.92
		.67		.53		.47		.44
M_1	50	11.00	59	10.65	75	11.27	54	10.76
		.67		.58		.55		.64
M_2	41	10.40	51	10.17	39	10.49	40	10.05
		.78		.62		.69		.50

[1]) Data from *Özbek*, 1975; [2]) *Carbonell*, 1958 and [3]) *Rosenzweig & Zilberman*, 1969.

are significantly smaller than those of male Bedouins – I^2, M^2 and M_1 – while eight of the Phoenician diameters are significantly larger than those of the female Bedouins. It is possible but not at all proven that the sample from Tall Sūkās consisted of more males and fewer females than the sample from Kish. In some Mediterranean populations there is little sexual dimorphism in tooth size as mentioned by *Rosenzweig & Smith* (1971) in their study of Habani Jews. *Rosenzweig & Zilberman*, (1967 and 1969) showed that the Bedouins have larger teeth than three other modern Israelic populations (Samaritans, Jews immigrated from Yemen and Cochin in India). The teeth from Tall Sūkās are comparable to the larger teeth of Bedouins.

Table 25.

T-test for differences in mean mesiodistal crown diameters between Tall Sūkās and other populations.

Tooth	Byblos	Kish	Bedouins	
			males	females
I^1	n.s.	n.s.	n.s.	n.s.
I^2	n.s.	n.s.	B > TS*	n.s.
C	n.s.	TS > K**	n.s.	TS > B*
P^1	n.s.	TS > K*	n.s.	TS > B*
P^2	n.s.	n.s.	n.s.	TS > B*
M^1	n.s.	n.s.	n.s.	TS > B*
M^2	n.s.	n.s.	B > TS***	n.s.
I_1	n.s.	n.s.	n.s.	TS > B*
I_2	n.s.	TS > K***	n.s.	TS > B**
C	n.s.	TS > K**	n.s.	TS > B**
P_1	n.s.	n.s.	n.s.	n.s.
P_2	n.s.	TS > K*	n.s.	n.s.
M_1	n.s.	n.s.	B > TS*	n.s.
M_2	n.s.	TS > K*	n.s.	TS > B**

n.s. = no significant between-group difference.
TS > K = Between-group difference between the samples from Tall Sūkās and Kish is statistically significant at the 5 % level (*), 1 % level (**) or 0.1 % level (***).

Table 26.

T-test for differences in mean labiolingual crown diameters between Tall Sūkās and other populations.

Tooth	Byblos	Bedouins (m)	Bedouins (f)	Yemenite Jews (m)
I^1	n.s.			
I^2	n.s.			
C	n.s.			
P^1	n.s.	n.s.	TS > Be*	TS > Y**
P^2	n.s.	n.s.	TS > Be*	TS > Y**
M^1	TS > B**	n.s.	TS > Be*	TS > Y**
M^2	n.s.	n.s.	TS > Be*	TS > Y***
M^3	TS > B*			
I^1	n.s.			
I^2	n.s.			
C	n.s.			
P_1	n.s.	n.s.	TS > Be*	TS > Y**
P_2	n.s.	n.s.	n.s.	TS > Y*
M_1	n.s.	5 > TS**	n.s.	n.s.
M_2	n.s.	B > TS*	n.s.	TS > Y**
M_3	n.s.			

n.s. = no significant between-group difference.
TS > B = The difference between the samples from Tall Sūkās and Byblos is statistically significant at the 5 % level (*), 1 % level (**) or 0.1 % or 0.1 % level (***).

Table 27.

Mean and standard deviations of labiolingual crown diameters in the permanent dentition reported by previous authors.

Tooth	Byblos[1]		Bedouins (males and females)[2]				Yemenites (m)[3]	
	N	M & SD	N	M & SD	N	M & SD	N	M & SD
I^1	25	7.1						
		.51						
I^2	29	6.3						
		.47						
C	34	8.6						
		.80						
P^1	46	9.0	62	9.20	45	8.87	28	8.69
		.38		.66		.54		.65
P^2	40	9.2	60	9.42	46	9.03	25	8.83
		.95		.63		.58		.61
M^1	54	11.0	78	11.54	53	11.12	30	10.95
		.59		.65		.61		.69
M^2	43	11.1	35	11.55	38	11.03	16	10.34
		.53		.76		.60		.65
M^3	28	10.5						
		1.06						
I_1	30	6.1						
		.41						
I_2	35	6.5						
		.58						
C	43	8.1						
		.90						
P_1	41	7.8	63	7.96	47	7.40	28	7.25
		.79		.48		.49		.50
P_2	39	8.1	51	8.49	46	8.04	25	7.90
		.88		.71		.54		.55
M_1	50	10.4	75	10.77	54	10.34	30	10.20
		.56		.53		.49		.36
M_2	41	9.9	39	10.44	40	10.06	23	9.53
		.64		.61		.52		.58
M_3	28	9.7						
		.82						

[1]) Data from *Özbek*, 1975,[2]) *Rosenzweig & Zilberman*, 1969 and [3]) *Rosenzweig & Zilberman*, 1967.

Regarding the labiolingual crown diameters the means of Phoenician teeth were compared with those from Byblos (Tables 26 and 27). The means for maxillary first and third molars were the only ones with significant differences. The maxillary first and third molars were larger in Tall Sūkās. Comparisons with modern Arabians and Jews showed that the labiolingual diameters of teeth from Tall Sūkās were smaller than those of male Bedouins for the first and second mandibular molars, larger than those of female Bedouins in five of eight comparisons and larger than male

Table 28.

Mean difference of the mesiodistal crown diameters of I^1 and I^2.

Eastern Mediterranean Populations		European Populations		Mongoloid Populations	
Population	*Diff.*	*Population*	*Diff.*	*Population*	*Diff.*
Tall Sūkās	2.0	French Neol.	1.72	Aleuts	1.10
Byblos	2.1	Belgian Neol.	1.82	Chinese (m)	1.70
Kish	1.7	Megalithic	1.63	Japanese	1.40
Müreybet	2.3	Belgian M.A.	1.87	Javanese	1.58
Jarmo	2.1	Danish M.A. (m)	2.02	Pecos Indian	1.61
Natufians	2.2	Danish M.A. (f)	1.91	Eskimos	1.36
Middle Minoan	2.4	Swedish M.A.	1.94	Pima Indian (m)	1.46
Bedouins (m)	1.9	French Rec.	1.9	Pima Indian (f)	1.25
Bedouins (f)	1.7	Swedes Rec. (m)	2.02	Ainu (m)	1.20
Habani Jews (m) 2.1	2.1	Swedes Rec. (f)	2.08	Ainu (f)	1.40
Habani Jews (f)	2.1	Swedes Rec. (m)	2.03	Japanese (m)	1.52
Yemenites (m)	1.6	Swedes Rec. (f)	1.98	Japanese (f)	1.50
Yemenites (f)	2.2	Swiss Rec.	1.86		
Cochin Jews (m)	1.8	Amer. Whites	2.6		
Cochin Jews (f)	1.7	Amer. Whites	2.1		
		Amer. Whites	2.0		

Populations	N	$\bar{x}$	SD	t
E. Mediterraneans	15	2.00	.25	
Europeans and North Americans	16	1.85	.52	1.01
Mongoloids	12	1.31	.43	5.22***

Data from *Özbek*, 1975; *Carbonell*, 1958; *Dahlberg*, 1960; *Rosenzweig et al.* 1967, 1969; *Carr*, 1960, *Brabant*, 1971; *Lunt*, 1969; *Moorrees*, 1957; *Pedersen*, 1949.

Yemenite Jews in seven out of eight comparisons.

Özbek, (1975) in his study of Chalcolithic teeth from Byblos made extensive comparisons with the teeth from Anatolia (Chalcolithic – Copper Age), from Israel (Natufians, Yemenites), from Syrian Tell Müreybet and the more Eastern villages Jarmo and Sialk. The method of study was for each tooth the graph of the mean mesiodistal and labiolingual crown diameters from Byblic teeth surrounded by three ellipses indicating the dispersion around the mean of 70%, 95% and 99.9% of the sample. With exception of the small means for the teeth from Müreybet the other populations could be plotted within the two smallest ellipses in all the comparisons, i.e. their means were not significantly different from those of the sample from Byblos.

In conclusion, the crown diameters of the permanent teeth from Tall Sūkās show medium size when compared to a number of European samples and they belong among the large-toothed Eastern Mediterranean populations. The teeth from Tall Sūkās are closely similar to those of Chalcolithic Byblos which are more than a thousand years older and they are also very similar to modern Bedouins who are almost 4000 years younger. There have been too few populations studied to document any fluctuations in tooth size through time in this geographical region.

Turning now to the size pattern within the

Table 29.

The ratio P^2/M^1 of labiolingual crown diameters in various populations

Eastern Mediterranean Populations	Ratio	European Populations	Ratio
Tall Sūkās	82	French Neolithic	76
Kish	80	Belgian Neol.	78
Byblos	84	French Megalith.	75
Natufians	79	Belgian Middle A.	79
Afalou	86	Danish Middle Ages	79
Jarmo	86	French recent	80
Bedouins (m)	82	Swedes recent	66
Bedouins (f)	81	Amer. Whites rec.	82
Habani Jews (m)	80	Amer. Whites rec.	65
Habani Jews (f)	82	Amer. Whites rec.	83
Samaritans (m)	82		
Samaritans (f)	82		
Yemenites (m)	81		
Yemenites (f)	80		

Data from *Özbek*, 1975; *Carbonell*, 1958; *Dahlberg*, 1960, 1963; *Rosenzweig et al.* 1967, 1969, 1971; *Brabant*, 1971; *Lunt*, 1969.

Table 30.

Ranked metric comparisons of the summed mean mesiodistal and labiolingual diameters from the Tall Sūkās sample with those from other populations.

Population	Mmax	Mman	Sum
Middle East			
Byblos (Chalcolithic)	60.5	61.1	121.6
Alaca Höyük (Copper Age)	62.97	60.53	123.5
Tall Sūkās (Bronze Age)	63.01	62.65	125.66
Jarmo (Neolithic)	62.9	64.9	127.8
Natufians (Neolithic)	66.47	65.25	131.72
Europe and North America			
Belgium (Middle Ages)	59.18	60.11	119.29
Belgium (Neolithic)	60.40	60.08	120.48
France (Megalithic)	63.12	61.74	124.86
Denmark (Middle Ages)	62.75	62.83	125.58
Chicago White Males (Modern)	62.90	63.26	126.16

Data from *Özbek*, 1975; *Senyürek*, 1952; *Dahlberg*, 1960; *Brabant*, 1971 and *Lunt*, 1969.

dentition it is of interest to notice the magnitude of the size difference mesiodistally of the central and lateral maxillary incisors. In Tall Sūkās and other Eastern Mediterranean populations the mean difference is 2.0 mm (SD. = 0.25), in 16 European samples the corresponding difference is 1.85 (SD. = 0.52) but in contrast to the Caucasian race are populations belonging to the Mongoloid race. In 12 Mongoloid samples the mean difference is 1.31 mm (SD. = 0.43), which is significantly less than in Europeans and Eastern Mediterraneans (Table 28).

Students of the Eastern Mediterranean dentition have noticed that the premolars often are small compared to the first molars. *Dahlberg* (1960) expressed this observation in the ratio P^2/M^1 for labiolingual crown diameters. Calculation of this ratio for the labiolingual diameters of P^2 and M^1 was done for a number of Eastern Mediterranean and European populations (Table 29). It is obvious from the data, that the Mediterranean populations do not show the expected low values of the ratio. In Fig. 13 the ratios for individual cases from Tall Sūkās are presented. They demonstrate the variability found in an Eastern Mediterranean population. The ratio ranges from 76 to 83.

To test whether the two groups of populations in Table 29 differ in central tendencies the Median test was used (*Siegel*, 1956, p. 111). The Fisher exact test resulted in $p = 0.0001$, which leads to rejection of the null hypothesis that the two groups of populations are drawn from populations with the same mean.

The molars form a large part of the total masticatory surfaces of the dentition. The amount of tooth substance in the molar regions can be documented using crown modules: the sum of the mesiodistal and labiolingual diameters divided by two, or the index of robustness, which is the

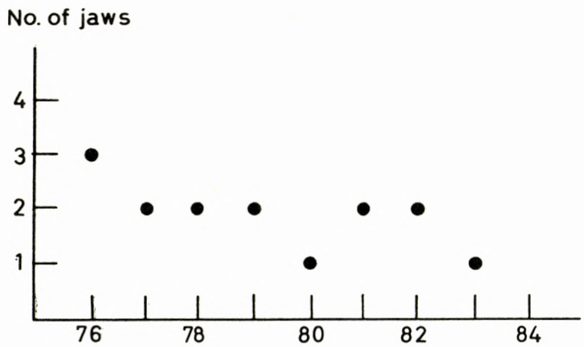

Fig. 13. The labiolingual crown diameter of P^2 shown as a percentage of the labiolingual diameter of M^1 from the same half of the jaw. The ratio P^2/M^1 is shown for all 15 pairs of teeth known from Tall Sūkās.

product of the two diameters. In this paper the summed mesiodistal and labiolingual crown diameters of maxillary and mandibular molars have been calculated for various populations and ranked according to the total sum of the diameters (Table 30).

It has been assumed that the molars in Mediterranean dentitions are much reduced in the size and number of cusps (*Dahlberg*, 1963). The summed mean crown diameters for molars in Middle Eastern populations vary around a mean of 126.05 mm (SD.=3.92) which is numerically larger than the mean for five European and North American populations ($\bar{x}$ = 123.27, SD. 3.15). The difference between the means is not statistically significant by the t-test. It is concluded that the ancient Mediterranean populations did not have very small molars compared with contemporary European populations.

Evolutionary Trends in the Middle East

Cranial variability has been studied more extensively than dental variability in the skeletal materials from the Middle East. For that reason it is of interest to examine the cranial variation during the cultural periods considered in this paper and compare the cranial variation with that of the teeth. First, however, the relationship between linear cranial dimensions and tooth size has to be discussed.

A low degree of correlation between tooth size and skull size was found in dolichocephalic and mesocephalic white British men; a slightly greater order of correlation was found in brachycephalic men. The method was to compare cranial length and breadth with mesiodistal and labiolingual crown diameters of the teeth. The correlation in brachycephalics tended to be of a higher order in relation to skull breadth than length. For the maxillary dentition, tooth size was 1.7 % greater in brachycephalic than in mesocephalic men and 2.7 % greater in brachycephalic than in dolichocephalic men. The respective values for the mandibular dentition were 2.3 and 3.3 % (*Lavelle*, 1974).

In recent Swedes a low correlation, significant at the 5 % level, was found between breadth of the head and the sum of the tooth widths of the maxillary right central incisor and cuspid (*Filipsson & Goldson*, 1963).

Solow (1966) studied the pattern of associations in 100 young Danish adults. Direct body measurements, measurements from cephalometric films and measurements on casts of the mesiodistal crown diameters were made. The sums of the tooth widths were studied in relation to 86 other parameters. The correlation analysis showed the body measurements to be positively associated with most of the linear cephalometric measurements. A large proportion of the correlations between the cephalometric variables were significant and often very high. Most of them referred to variables spanning the same area and may be taken as expression of the variability of this topographical area. The association between the jaw and the dentitional measurements constituted the largest set of biological coordination among the variables studied. Tooth size and dental arch length in both jaws were associated with the length and prognathism of the maxilla. Dental arch width in both jaws (correlated also with tooth size) were found to be correlated with the face and jaw widths.

The anthropologists have procured the following information about cranial variation in the Middle East.

Since the mesolithic Natufian it is possible to distinguish the antecedants of the Mediterranean race with the two subdivisions Atlanto-Mediterranean (Euro-African) and Ibero-Insular (Gracile Mediterraneans) and the first indications of the Alpine race may be perceived (*Ferembach*, 1970, 1973). During the Neolithic period, present racial characters establish themselves more firmly as far as the skeletal traits are concerned. The distinction between the Euro-African and gracile Mediterraneans corresponds on the whole to a geographical distribution, which is discussed below, while the Alpine race probably is the result of local evolution of the Mediterranean race. The process of gracilization becomes more

Fig. 14. Maxillary fragments illustrating the range of variation observed in the size of jaws and teeth from Tall Sūkās.

pronounced in the following cultural period, the Bronze Age, and the modern races manifest themselves (*Ferembach*, 1973).

In Israel the gracile proto-Mediterraneans dominated in Chalcolithic and Early Bronze Age in Megiddo, Oum Qatafa, Gat, as-Safadi and Tell al Asawir. In Jericho both varieties of the proto-Mediterranean race were found, the robust and the gracile types (*Ferembach*, 1973, 1974).

In the Mesopotamian region the gracile Mediterraneans are found in Jemdet Nasr, al-Ubaid and Kish according to scholars, who studied the skeletons. *Ferembach* adds, however, that the robust type was also present in Kish (*Özbek*, 1975).

In Lebanese Byblos the cranial variation in skeletons from a Chalcolithic cemetery showed the presence of the gracile type of the proto-Mediterranean race (*Özbek*, 1975).

In Anatolia there is a predominance of the robust proto-Mediterraneans during the Chalcolithic and Early Bronze Age. From sites near the Turkish-Syrian border, both the robust and the gracile types have been recovered (*Krogman*, 1937).

Turning now to the Middle and Late Bronze Age the previously rare brachycephalic Alpine race becomes more common. In Turkey the increase in frequency is from 16 % in Chalcolithic and Early Bronze Age to 42–50 % in the Middle and Late Bronze Age in Alishar, Kusura, Hissarlik III and Arslantepe during the Hettite Empire.

In some Israelic sites there is an increase in number of brachycephalics (Megiddo), but this change does not occur in Jericho where the gracile Mediterraneans remain the dominating element of the population.

In Syrian Ras Shamra the gracile variety dominates, while the robust and alpine types are rare (*Vallois & Ferembach*, 1962). In Minet-el Beida, situated near Ras Shamra, the three types are equally well represented. In Tall Sūkās gracile and robust jaws were found (Fig. 14). The prevalence of each type cannot be determined because the material is too fragmentary.

Following a different methodology *Özbek* (1975) in a craniometric study compared the male skulls of gracile Mediterranean type from Chalcolithic Byblos with composite samples from Anatolia and

Mesopotamia dating from late Neolithic up to the beginning of the Iron Age. The composite samples of individuals from several sites were primarily formed and studied by *Cappieri* (1972, 1970). Seven cranial dimensions were compared, i.e. cranial length and breadth, height of the skull (basion-bregma; porion-bregma), upper facial height and nasal height and breadth. Mean values were compared by means of the Student t-test and no significant differences were found among the samples. In spite of marked individual differences in cranial size and shape, there is nevertheless a certain homogeneity among skulls from Anatolia, Byblos and Mesopotamia dating from the Chalcolithic period and the Bronze Age.

The trend to gracilization of the Eastern Mediterranean skulls from mesolithic Natufian to the Bronze Age is only to some extent visible in the dentition. Reduction in tooth size with younger cultural age is apparent in the deciduous dention as discussed on p. 37. In the permanent dentition on the contrary, the younger teeth from Tall Sūkās tend to be larger than the chronologically older teeth from Kish, being of the same size as the much older teeth from Chalcolithic Byblos. Further data compiled by *Özbek* (1975) show a trend of diminishing tooth size from mesolithic Natufians over Chalcolithic Byblos to Anatolians from Chalcolithic to Copper Age. It is remarkable, however, that the robust Anatolians – supposed to have large teeth – have slightly smaller teeth than the gracile inhabitants of Byblos dating from the same period.

Previous studies of the relationship between linear cranial dimensions and dental crown diameters have indicated that the correlation is not high enough to be of predictive value. A thorough analysis of the association between selected cranial dimensions and tooth size in skulls from the Middle East is necessary before the trend to gracilization of skulls and teeth can be fully evaluated.

Summary and Conclusions

The present investigation is based on 88 deciduous and 635 permanent teeth as well as fragments of the jaws belonging to 12 individuals. The teeth and jaws belonged to no more than 40 individuals whose skeletal remains were excavated from Tall Sūkās, a mound on the Syrian coast near Ǧabla.

The skeletal remains are dating from the Middle Bronze Age II (appr. 1900–1700 B.C.). They were found under a house in the Bronze Age town. The burial is either a mass burial where the dead persons were simultaneously buried with domestic utensils, tools and weapons or it is a family grave, where men, women and children were buried throughout an extended period of time.

An attempt was made to assess the age distribution in the sample. The age of children could be estimated from developing tooth germs and other dental parameters. The age of adult persons was estimated from the degree of attrition of the first molars. In ancient Anatolia *Senyürek* had studied the progression of molar attrition in individuals whose age was estimated from the usual anthropological criteria. *Senyürek* found that severe attrition of the first molars developed after the age of 40. In the sample from Tall Sūkās few of the first molars were severely worn and few first molars were lost *ante mortem*. It is estimated that 33.3 per cent of the sample were children (0–12 years of age), 51.5 per cent were adults and 15.2 per cent were mature or senile (41–x). This age distribution is similar to that of other ancient Mediterranean populations as shown in Table 2.

The numerical variation in the permanent dentition was studied. Agenesis of third molars was found in two individuals and agenesis of premolars was found in other two dentitions. A survey of the literature showed that agenesis af third molars is a common anomaly in ancient Mediterranean populations (Table 3). Hypodontia is often a genetically determined anomaly and a high frequency in a small sample may suggest genetic relationship.

Examination of the teeth and jaws showed that the inhabitants of the Middle Bronze Age town at Sūkās had many dental problems. Malpositioned teeth were not unusual in cases of agenesis of one or more permanent teeth or in those cases where a discrepancy existed between tooth size and the size of the dental arches. As shown in Fig. 14 there were individuals in the population with small jaws and teeth and other individuals with large teeth and jaws. The tooth size is genetically determined and so is the growth pattern of the jaws. Crowding in the dental arches could arise if these two genetic systems did not match in the growing child or if adverse environmental factors impeded the growth of the jaws.

Dental caries was found in both deciduous and permanent teeth. The frequency of permanent teeth with dental caries corresponds well with contemporary populations from the Eastern Mediterranean region. It is likely that consumption of cereals has increased the risk of developing dental caries. Among hunters and gatherers the frequency is lower than in agriculturists. Even today the caries frequency is low in many villages in Mediterranean countries, where the people adhere to the traditional diet.

The accumulation of soft deposits and tartar on the tooth surfaces invariably led to gingival and periodontal disease in most adult persons. Some evidence of periodontal disease was observed in the jaw fragments and it is likely that the *ante mortem* loss of teeth was partly due to periodontal disease, partly due to dental caries with sequelae and to a small extent due to excessive attrition and traumatic lesions of the teeth.

Even a rare bony overgrowth enlargement of a mandible was found (Fig. 3 and 4). It is not surprising to find such distressing dental conditions in the sample from Tall Sūkās, because similar conditions were found in other Eastern Mediterranean populations reported by previous investigators (*Ruffer*, 1920; *Bolender et al.* 1964 in Egypt. *Grimm*, 1960 in *Mesopotamia*, *Krogman*, 1938, *Senyürek*, 1952 and *Schaeuble*, 1958 in Anatolia, *Angel*, 1944 in Greece and *Carr*, 1960 in Crete).

Formation of the dental hard tissues begins in intrauterine life and continues throughout the entire growth period of the individual. The dental tissues are sensitive during the formative stages. They react to disturbances of the mineral metabolism by development of a defective enamel and dentine structure. Developmental disturbances of the enamel may appear on the outer surfaces of the teeth as irregularities such as pits, linear and band-like depressions and in severe cases the teeth become hypoplastic in shape. The teeth from Tall Sūkās often showed the minor irregularities of the enamel surfaces, but defective structure was found in only one out of 28 individuals, where teeth from all regions of the dentition could be examined.

The incidence of developmental disturbances of the enamel is comparable to those of contemporary populations. The location of the irregularities on the tooth surfaces indicates that they did not develop during the infantile period but later in childhood. A high frequency of facial structural defects on deciduous canines is interpreted as being due to local disturbances of the growing tooth germs in their crowded positions in the small jaws. The minor defects of the permanent teeth in most dentitions cannot be assigned to a definite cause but it is likely that various infections with concomitant high fever or nutritional deficiences are responsible for many of these defects.

This study showed that many different environmental factors influenced the teeth during their formation and later during their functional period. Dental disease and tooth loss were common in ancient Mediterranean populations and it is no wonder that restorative dentistry originated in the Mediterranean area. There is no evidence of dental treatment in any of the jaws from Tall Sūkās, but is is known that Egyptians and Phoenicians used gold wire to fasten loosened anterior teeth and they made bridgework, inserting natural or artificial teeth to replace lost teeth, as early as 2500 B.C. in Egypt and in the sixth to fourth century B.C. in Sidon (*Hoffmann-Axthelm*, 1976; *Edey*, 1974, *Clawson*, 1934).

Dahlberg (1963), *Rosenzweig & Zilbermann* (1969) and *Rosenzweig & Smith* (1971) characterized the Eastern Mediterranean dentition as follows: It is a dentition with small teeth, there is a low prevalence and expression of shovel-shaped incisors, the maxillary second premolar is very small compared with the first molar in labio-lingual dimensions. The metacone on maxillary second and third molars is greatly reduced and lingually positioned. The hypocone is reduced or lost. More than 40 % of the dentitions, however, have the advantage of the Carabelli's cusp in the upper first molars to give additional substance and size to this tooth. In mandibular molars the hypoconulid is reduced or lost, thereby often reducing the number of cusps from five to four. There is almost complete absence of the protostylid, which is formed by the facial cingulum. The small teeth in some Mediterranean populations show little sexual dimorphism, they have a high crown index and a high coefficient of variation.

In some respects the dentitions from Tall Sūkās conform to this pattern, but there are many exceptions: The teeth from Tall Sūkās are not in general very small and the upper second premolars are not reduced in labiolingual dimension. The Carabelli structures including the cusp are not well-developed in the sample from Tall Sūkās. There are the expected reductions of the distal cusps in maxillary and mandibular molars but a low to moderate size of the mesiodistal and labiolingual coefficients of variation.

The odontomorphological and metrical comparisons have shown that the teeth from Tall Sūkās are basically similar to European teeth. In spite of several differences from the hypothetical "Eastern Mediterranean dentition" there appears to be a morphological similarity among various ancient and recent Mediterranean populations including Tall Sūkās. This probably means that Eastern Mediterranean dentitions form a regional type of the Caucasoid or European dentition.

Calculation of Smith's distances between Tall Sūkās, Byblos and Northern Anatolia as well as Mesopotamian Kish suggested a further subdivision in a Northern versus a Southern and Eastern group, but this needs further studies to be substantiated.

Archaeologists and historians have documented the existence of contacts between the cities along the Phoenician coast and surrounding geographical regions during the Bronze Age and the following periods. To demonstrate changes in the populations of these coastal cities over time more complete series of skeletons from different sites are needed. The present investigation of a limited sample of teeth has shown the potential of dental studies in characterizing human populations.

Acknowledgements

I am indebted to Professor, dr. phil. *P.J. Riis* and Head of the Anthropological Laboratory, dr. med. *J. Balslev Jørgensen* for permission to study the skeletal remains from Tall Sūkās. I also wish to express my thanks to Professor *P.O.Pedersen* for constructive criticism and valuable suggestions.

A special thanks to Mr. *E. Leenders* who has drawn the figures, to Mr. *J.V.Holm* and Mrs. *G. Hahn* who made the photographs. A final thank you goes to stud. mag. *Pia Andersen* and Mag. art. *Berit Sellevold*, research associates at the Anthropological Laboratory, for their interest and aid during completion of this study.

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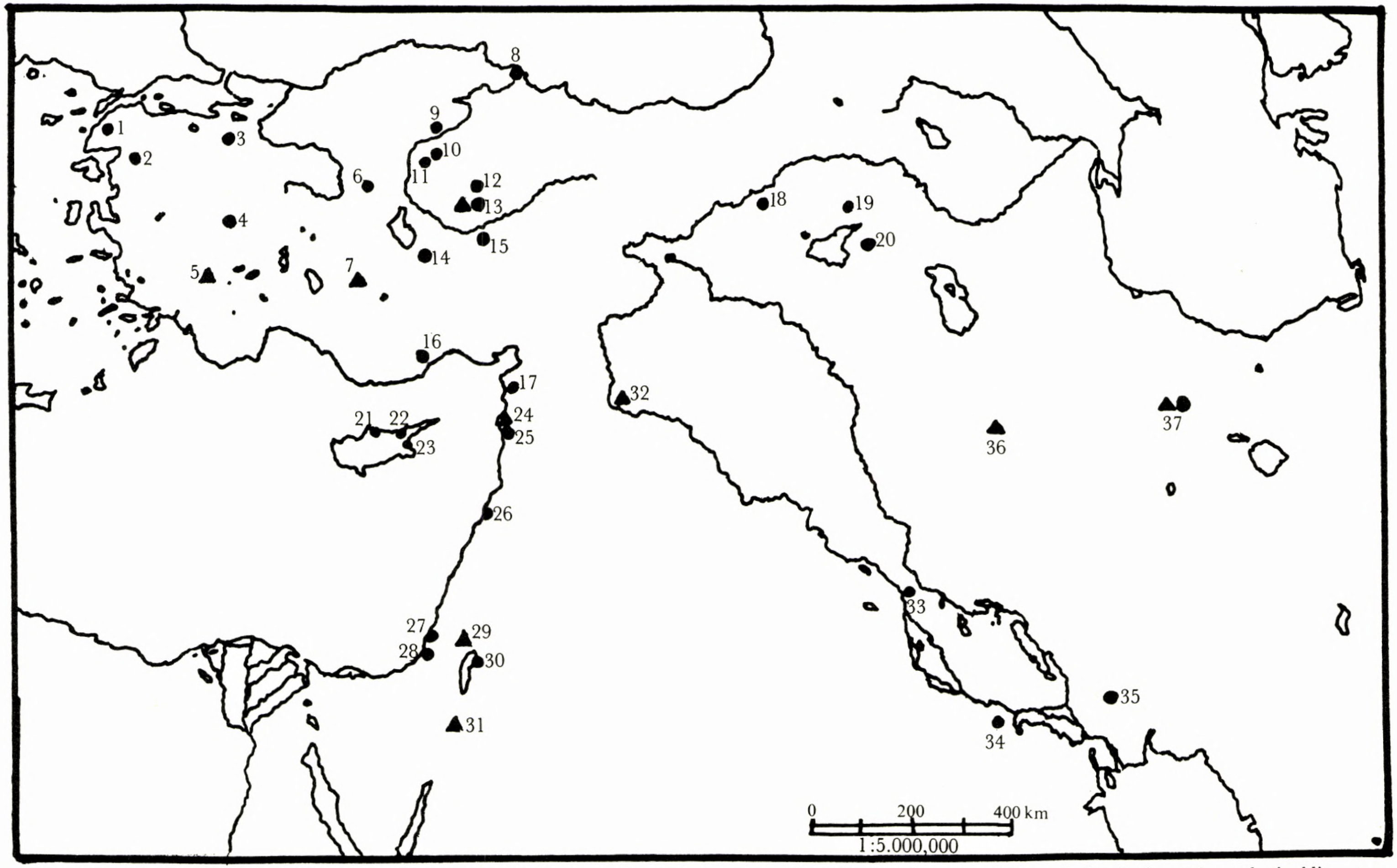
Indleveret til Selskabet september 1977.
Færdig fra trykkeriet juli 1978.



Map illustrating the location of sites from the Neolithic Age (black triangles) and the Metal Ages (black dots) mentioned in the text.

Arabian names are spelled as in the anthropological literature cited.

1. Kum Tepe
2. Hissarlik
3. Babaköy
4. Kusura
5. Hacilar
6. Ahlathbel
7. Catal Höyük
8. Samsum
9. Büyük Gull
10. Alaca Höyük
11. Osmankayasi
12. Masat
13. Alicar Höyük
14. Acem Höyük
15. Kultepe
16. Yümük Tepe
17. Seyh Tepe
18. Altin Tepe
19. Evdi Tepesi
20. Tilki Tepe
21. Lapithos
22. Melia
23. Enkomi
24. Ras Shamra
25. Tall Sūkās
26. Byblos
27. Megiddo
28. Gata
29. Jericho
30. Qatafa el Khiam
31. Beidha
32. Tell Müreybet
33. Jemdet Nasr
34. Ubaid
35. Kish
36. Jarmo
37. Sialk

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Printed in Denmark by Bianco Lunos Bogtrykkeri A/S. ISBN 87-7304-057-6