The Haua Fteah Fossil Jaw

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PART I. THE EXCAVATIONS (C. B. M. McB.)

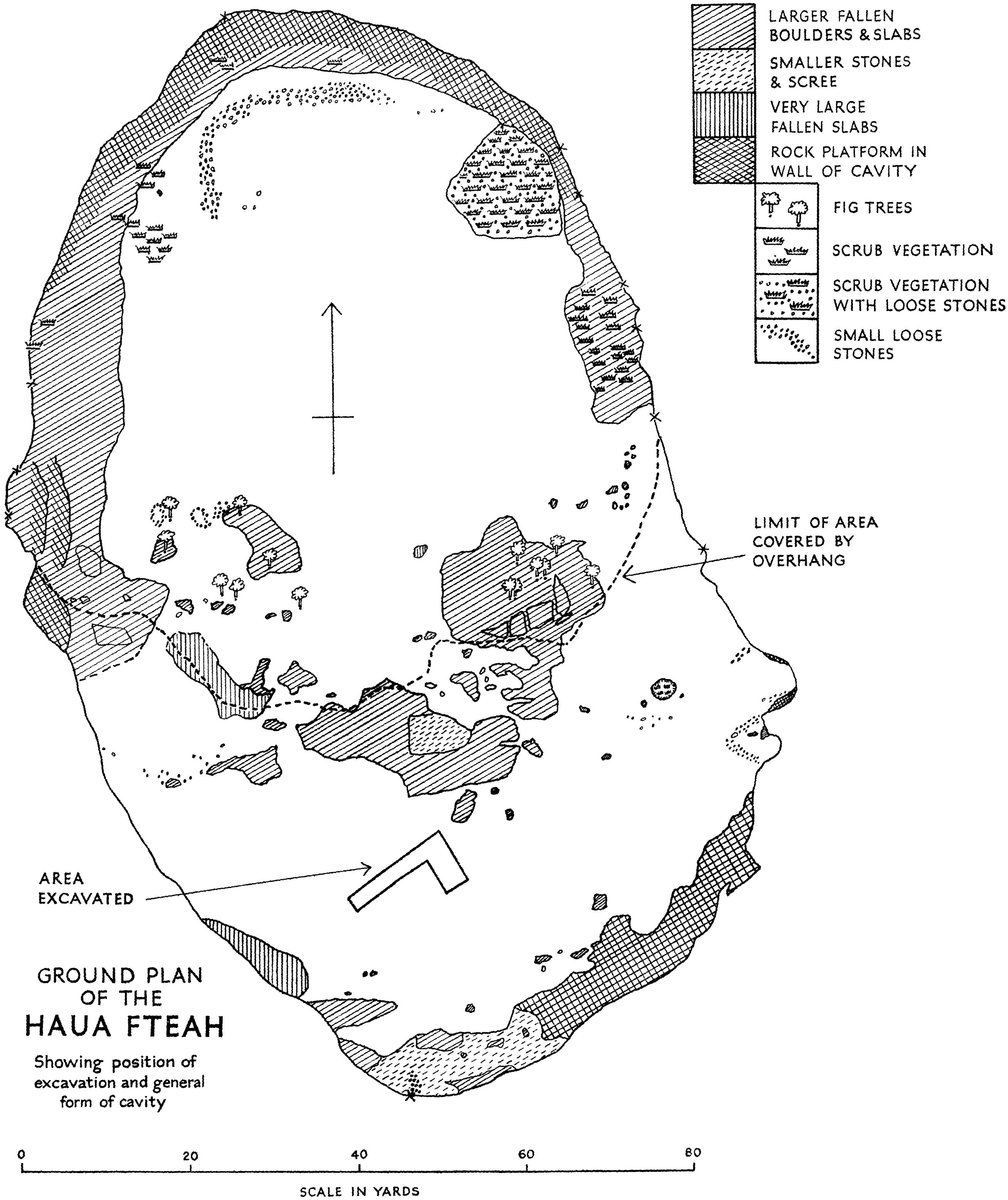
IN 1947 AND 1948, and again in 1951 and 1952, parties of undergraduates and members of the teaching staff of the Departments of Geology and of Archaeology and Anthropology at Cambridge visited the hilly northern coastal district of Cyrenaica, which takes its name from the Jebel el Akhdar, or Green Mountain range. The object of these expeditions was to carry out field work on the Pleistocene geology and prehistoric archaeology of the area and, more particularly, to investigate the possibilities of geological and climatic correlation with other regions of the Mediterranean Basin. Both the solid geology and the topography appeared to favour preservation of evidence regarding past changes of sea-levels which could prove useful in such a connexion. On the other hand, the ecology of the region at the present day suggested that it might be a key area in which to study processes of biological and cultural intercourse along the North African coast.

A glance at the vegetation and rainfall maps of Africa shows that the fertile areas north of the Sahara are three in number, namely, the Atlas, the Jebel el Akhdar, and the Nile Delta. Much the most important of these is the general region of the Atlas, some 1000 by 250 miles in extent, which throughout the Pleistocene undoubtedly provided the main reservoir of animal and human activity in the northern part of the continent. Intermittent intercourse across the Sahara to the south is certainly attested for this region, and probably also to the north with Europe. The much smaller fertile area of the Jebel el Akhdar, now measuring some 200 by 100 miles, lies 800 miles to the east. Cut off from the south by the Libyan Desert, it is mainly of interest as a staging-post between the Atlas and western Asia. As such, the Jebel el Akhdar possesses one most important advantage over the Nile Delta – the solid geology favours the formation of caves in which clear stratified sequences may be expected. In this respect no comparable conditions occur to the east nearer than Mount Carmel in Palestine. Four stratified sites of some importance have so far been found in Cyrenaica, the Haqfat et Tera near Benghazi discovered by C. Petrocchi (1940) in 1938, the Haqfat ed Dabba between Cyrene and Barce discovered by the author in 1947, the Hajj Creiem in the Wadi Derna rediscovered by R. W. Hey also in 1947, and finally the Haua Fteah on the coast west of Derna discovered by the author in 1948.

THE HAUA FTEAH

The term *haua,* instead of the more usual *haqfat,* is applied locally to cavities of a somewhat peculiar kind characteristic of the region. In their most typical form these are very large vertical shafts, ranging from 50 to 100 yards in diameter and often as much as several hundred feet in depth. A further peculiarity is that the orifice at the top is frequently small in diameter than the main part of the shaft, so that a broad, overhanging lip is formed, providing an incomplete dome-shaped roof. The majority of such cavities occur in the high plateau area of the Jebel;

*We wish to thank Dr R. W. Hey, Department of Geology, University of Cambridge, for leave to mention, in advance of publication, certain of his findings in *Prehistory and the Pleistocene in Eastern Lybia* (Cambridge University Press) by C. B. M. McBurney and himself; Messrs A. E. Rixon and M. G. Sawyers, British Museum (Natural History), for help in developing the fossil and for photographing it; and Mr J. A. F. Fozzard, Department of Anatomy, University of Cambridge, for his X-ray examination of the teeth and radiograph of the jaw.



GROUND PLAN OF THE
HAUA FTEAH
Showing position of excavation and general form of cavity

the Haua Fteah, however, formed near the northern margin of the plateau, where the coastal escarpment was in process of erosion by the sea. As erosion advanced, the seaward wall of the cavity was truncated, leaving an overhanging roof on the landward side only. Patches of beach conglomerate on the slope to seaward of the opening appear to date this process to an early stage of the Pleistocene. Subsequently the cavity seems to have been gradually filled with sediments brought in through the enlarged opening (*a*) by hill-wash from the plateau above, and (*b*) by windborne material transported by the prevailing on-shore wind. Judged by their slope, these sediments seem to have accumulated first in the seaward (unroofed) portion and then to have been carried back under the overhang by occasional floods or spring rain. The same process can be seen at work at the present day on a smaller scale, although the infilling is now nearly complete.

As a result of this double process, the sediments in the roofed portion revealed by a sounding trench, assume a typically fine-grained and evenly-bedded character, sloping very gently towards the interior of the cave. The strata are generally thin and appear to represent very flat extensive lenses, distinguishable from one another by slight variations in colour. The sequence is further varied by discontinuous zones of stalagmitic concretion, very thin sheets of stalagmite, and spreads of rock-waste derived from the roof and walls of the cave. Cultural material occurs in the form of fairly frequent hearths – occasionally with slight depressions, which may be cooking-holes – and lenses of concentrated midden-accumulation. The total depth of these deposits is unknown; the lowest point reached by the sounding was 28 ft from the surface, but, judging by similar cavities elsewhere, there would be nothing surprising in a full depth ten or even twenty times as great. There is, of course, no certainty that the cave was inhabited throughout the great period represented by such an accumulation; all that one can say as yet is that it is a favourite camping-spot at the present time and was so in the past, at least as far back as the 28 ft level.

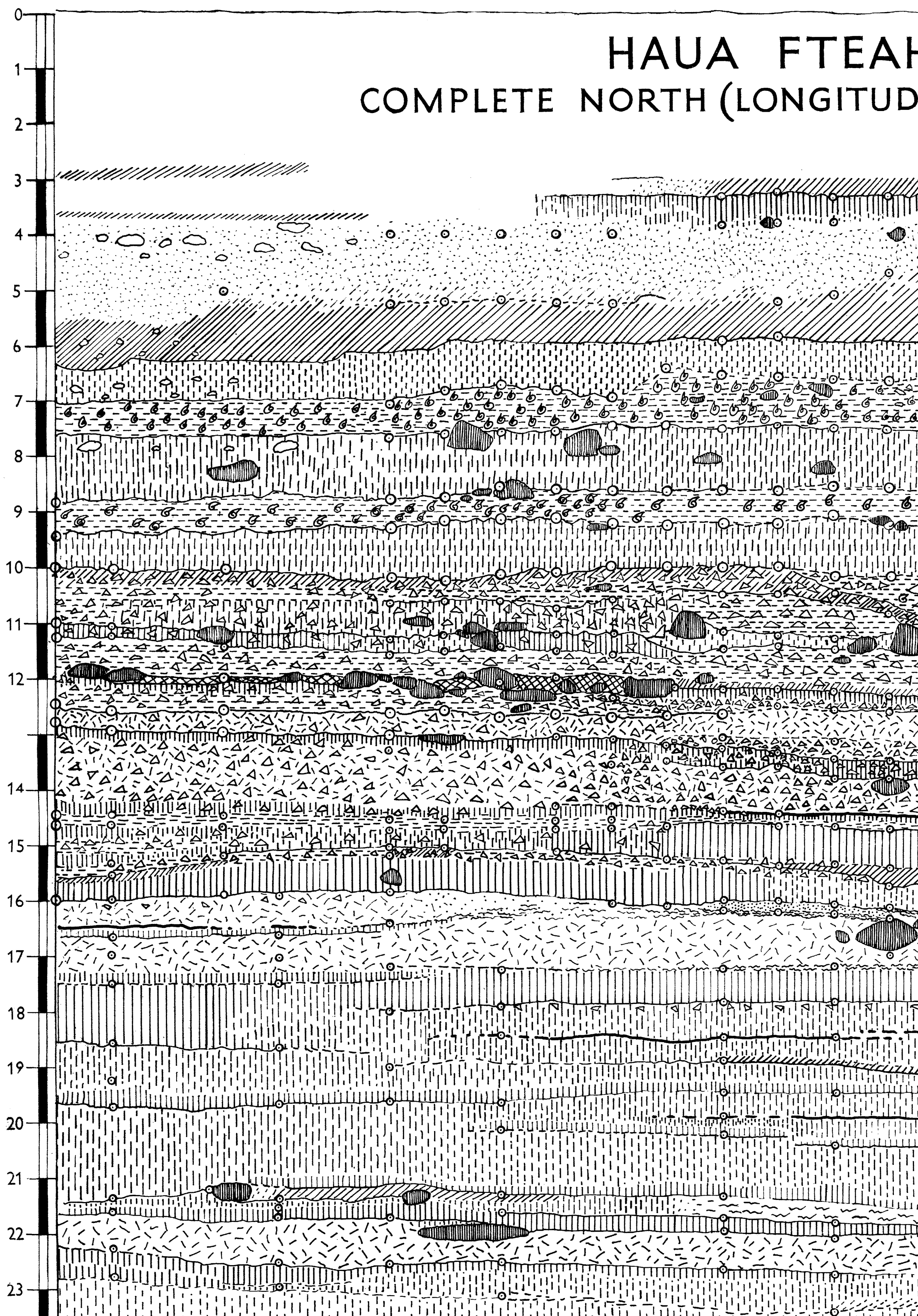
Investigation of the site was begun in the second half of the 1951 season – the main objective was the collection of carbon samples for Carbon-14 dating from previously explored sites elsewhere – and continued throughout the season of 1952. The first operation was the excavation of a sounding trench (corresponding to the western portion of the Ground-Plan) 5 by 8 ft in plan and 25 ft deep, the deposits being removed in six-inch spits more or less adjusted to correspond with the limits of natural stratigraphical units weherever these could be recognized. In 1952 the sounding was extended horizontally to expose a face 20 ft 6 in. long by 25 ft deep as shown in the folding Section-Plan. This extension not only gave a clearer idea of the stratification in general but enabled a detailed subdivision in terms of thin natural layers to be made. At the same time, an increase in the number of specimens by a factor of four or five led to a much more complete picture of the industrial traditions represented. Detailed analysis of the archaeological material is still in progress, while that of the equally abundant palaeontological collection has scarcely begun. The results achieved so far are summarized below, but they will certainly require amplification at a later date. It is already clear, however, that excavation on a much larger scale will be needed before anything like the full information has been extracted from the layers already exposed, to say nothing of the desirability of extending the sounding in depth.

Owing mainly to the great size of the habitable portion of the Haua Fteah – a roughly semicircular area some 80 yds in diameter – the deposits are exceptional for Cyrenaica, and indeed for most other regions also, in a number of respects. Rock-falls from the roof, though individually large, have done little to break up the general regularity and horizontality of the surface presented by the deposits at the present time. As far as can be ascertained from our sounding, the same was true in the past, and nowhere can a gradient of more than a few degrees be detected. Such irregularities as can be observed in the section are of small extent and may be explained in part as artificial excavations, e.g. cooking-holes and the like. No traces have been detected of more serious excavations for post-holes, graves, or the extraction of phosphatic earths, such as disturbed to some extent the deposits at Haqfat ed Dabba and Haqfat et Tera. A single burial, of recent historic times, was dug down a few feet from the surface and disturbed a small area of deposits of Roman date. Elsewhere traces of horizontal stratification can be observed almost up to the present.

The outstanding archaeological and geological observations, then, are as follows. From 0 to −4 ft from the surface traces of hearths can be seen, and occasional sherds of pottery occur. These appear to be of local manufacture and are similar to hand-made wares still used in the region. Towards the bottom of this spit Roman pottery begins to appear fairly frequently. From −4 to −5 ft wheel-made Roman pottery increases in quantity and occasional flint flakes are found. In the foot of deposit below this Roman pottery is reduced to extremely rare scraps that may well be mere accidental intrusions, for large numbers of worked flints occur, including considerable numbers of finished tools. Among the last are numerous burins and large end- and flake-scrapers, together with tanged arrow-heads, a large bifacial knife or spearhead, flaked adzes similar to those of the Neolithic cultures of the Faiyum, and small trihedral pressure-flaked rods and drill-heads. Sherds of a characteristic coarse hand-made ware are not uncommon and appear to represent wall-fragments of globular vessels of considerable size. They are black in colour, occasionally burnished, and tempered with ground shell. While not unlike a coarse ware sometimes found on Roman sites in the area, they appear on the average to be very much thicker and to represent larger vessels. Fragments of decorated ostrich-egg and pierced sea-shells are also not uncommon.

Geologically, the spit comprises mainly hearth and midden deposit; it is fine-grained and somewhat firmer in texture than the overlying sediments. The same distinction is still more noticeable in the underlying zone from −6 to −7 ft, where the trench seems just to have missed a midden concentration, which, to judge by the abundance of artifacts, cannot have been far away. No Roman pottery is found as low as this but sherds of the same coarse ware are still present, mostly towards the top. The other elements of the overlying industry are also represented. No important change in industry can be detected before the next layer,, extending roughly from −7 to −8 ft or a little lower. Here there is a second midden patch, which, however, tails out in the eastern part of the trench. Prominent among the contents of this midden, apart from the ubiquitous split mammal-bones and teeth, are very great quantities of limpet and cockle shells, together with a fair proporttion of land-snails. The distinctive characters of the industry are the absence of (*a*) pressure-flaking and (*b*) some of the larger-scale tools such as flaked adzes and large flake scrapers, coupled with a greater prominence of microlithic and very small tool-forms such as minute backed-blades. Trapezes are unknown and geometric forms such as true lunates and scalene triangles are rare or atypical. Very small double-backed blades or drills and trihedral rods, however, remain relatively common. Both the last mentioned classes of tool disappear below the −9 ft level, and from then on down to −16 ft 6 in. the cultural material shows little obvious change and maintains the general character of a typical blade-and-burin industry, dominated by medium to small sized backed-blades.

An important geological distinction, however, is observable in this zone, namely a very high proportion of small angular rock-waste closely comparable to the *éboulis sec,* well known in European sites. This element is maintained with remarkable consistency from side to side and end to end of the trench, and it contrasts in this respect (as likewise in the degree of angularity and density of the fragments) with discontinuous patches of stones in overlaying layers. Dr R. W. Hey, who kindly examined the section in the course of excavation, considers that



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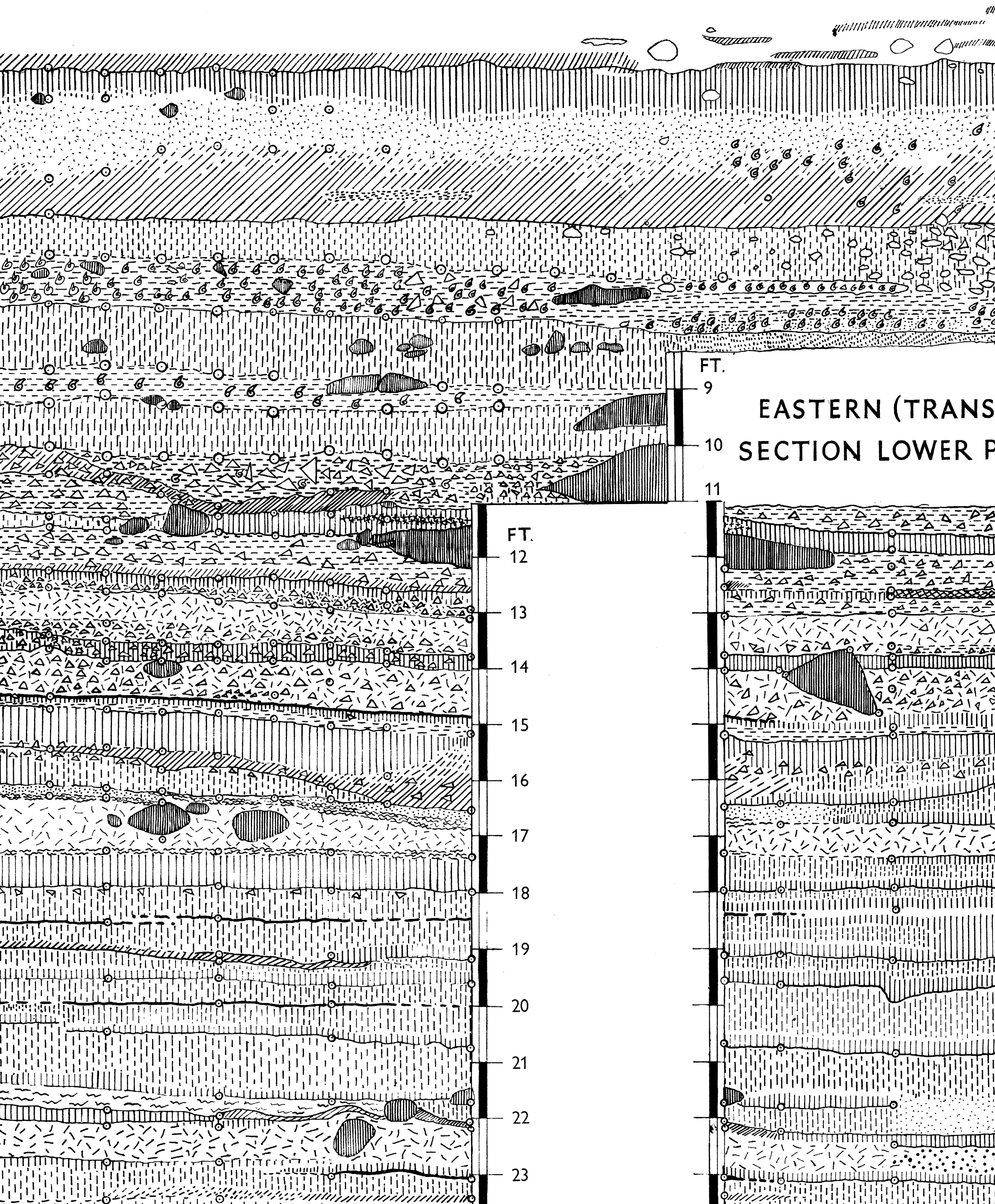
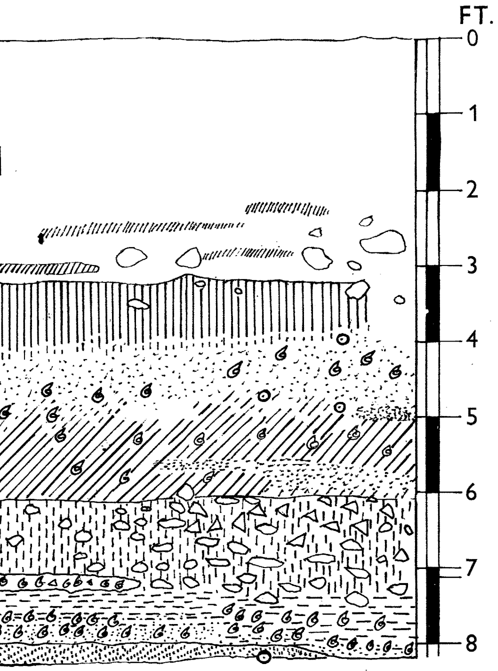
A FTEAH (CYRENAICA)

(LONGITUDINAL) SECTION OF MAIN TRENCH





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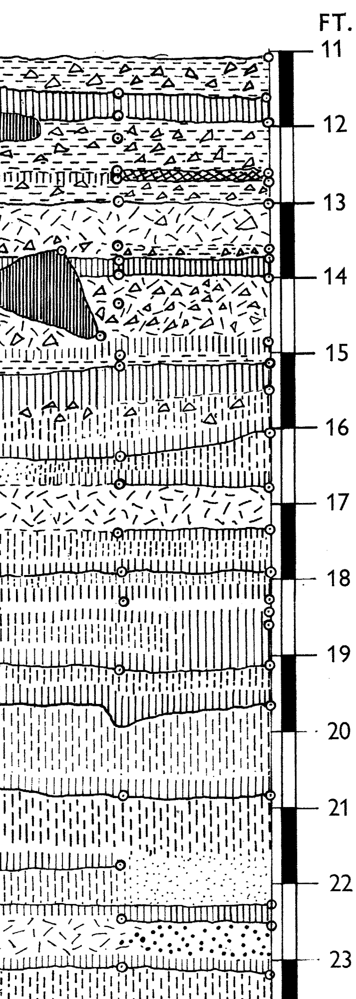

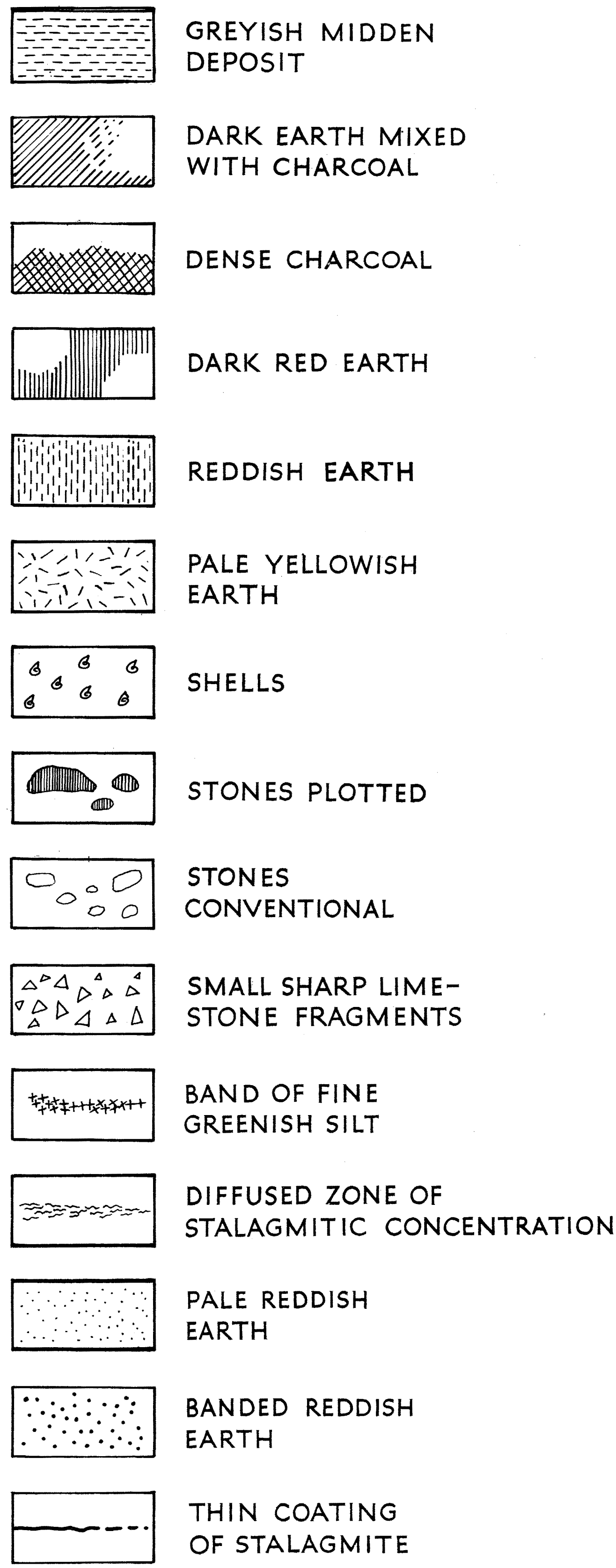

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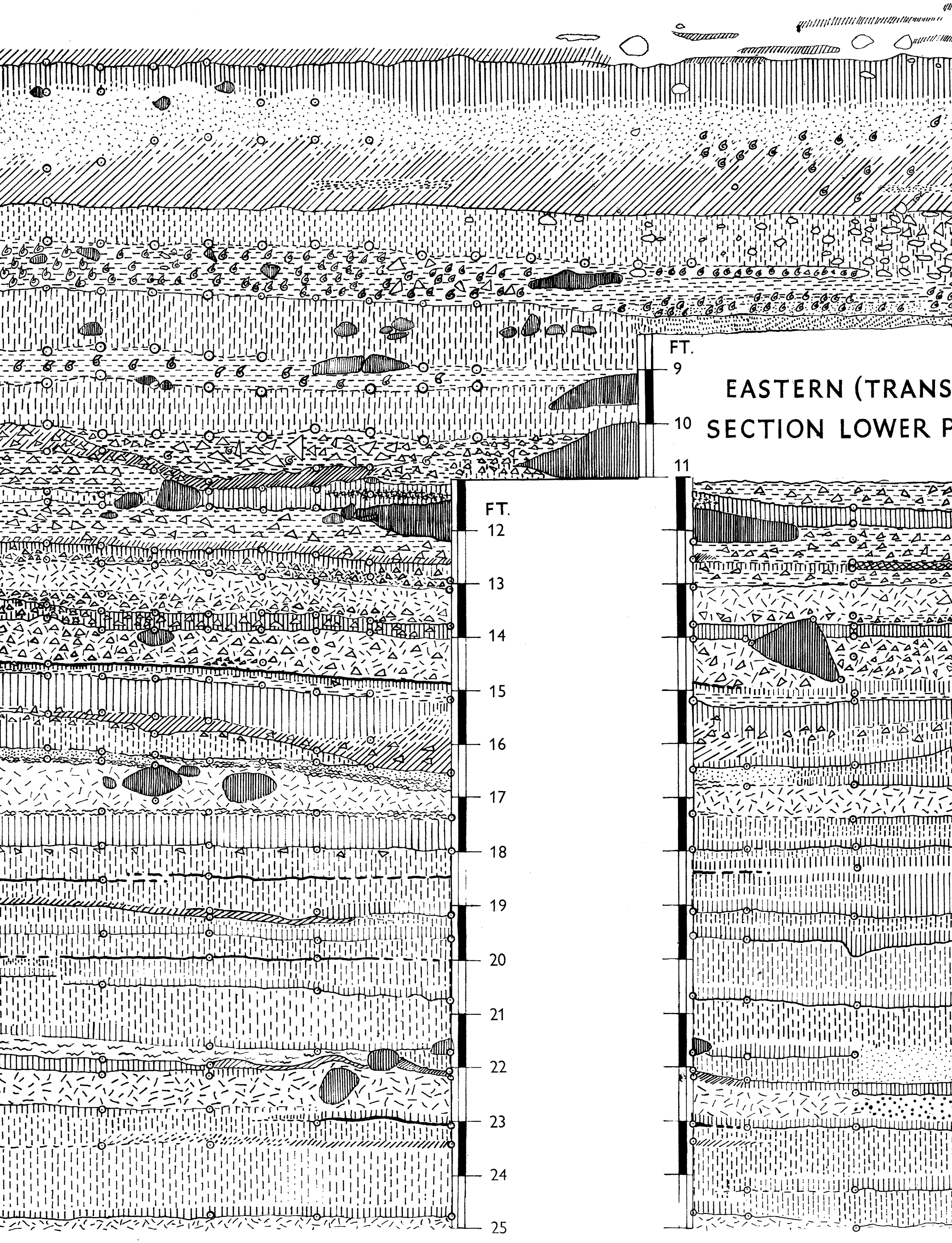

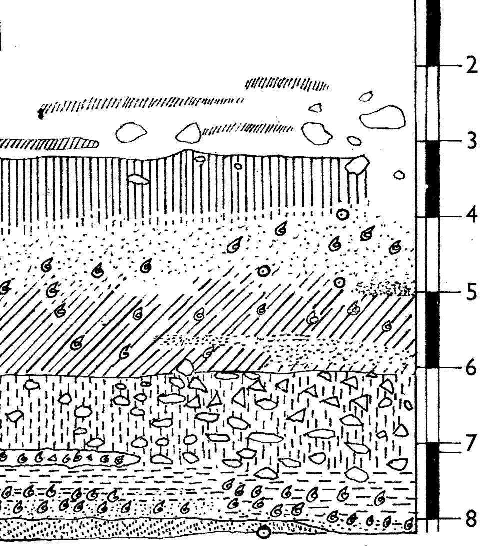

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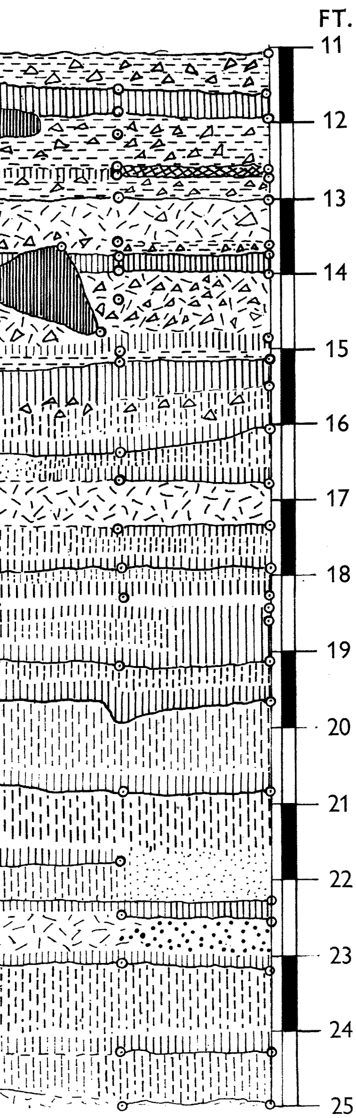

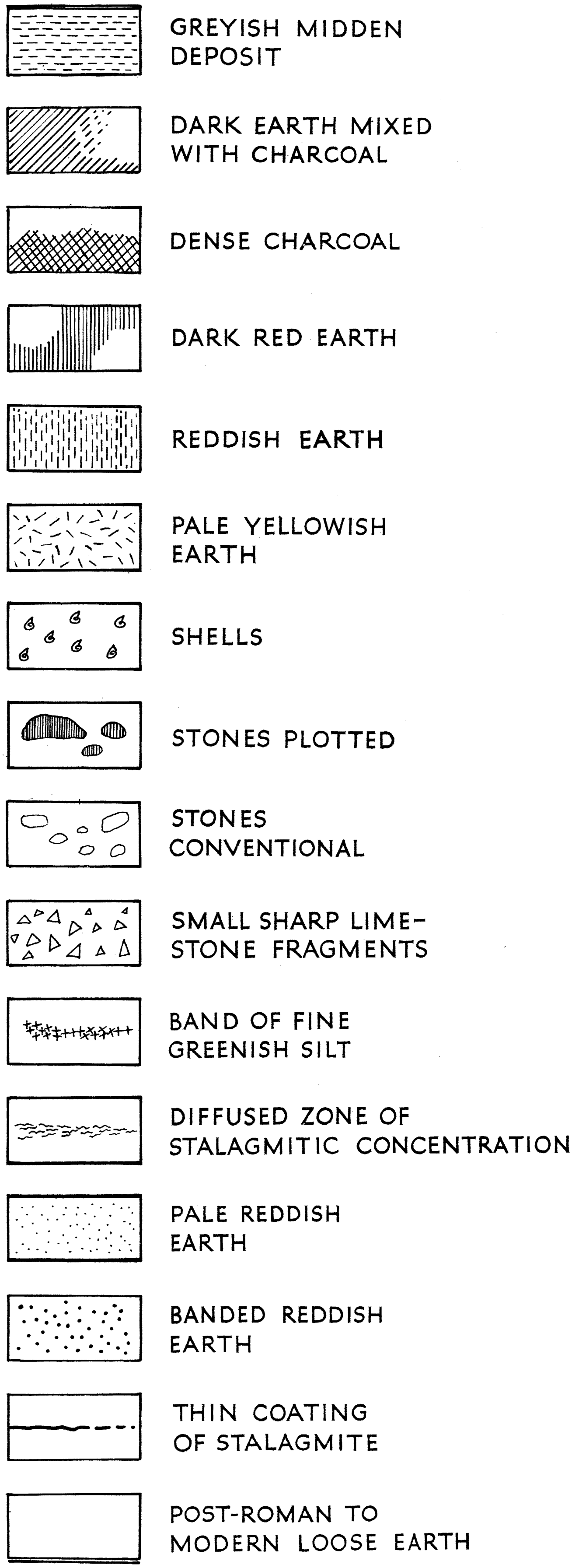

climatic factors are required to account for this feature, and that it is best explained in terms of a marked increase in the number and intensity of winter frosts (not wholly unknown in the area at the present time). Towards the base of the zone, from −14 ft 6 in. to −15 ft, the first trace of stalagmite can be observed. Below −16 ft such traces become relatively frequent, resulting at several stages in the formation of firmly consolidated zones 5 or 6 in. deep. This, together with the almost complete absence of the characteristic *éboulis* just described, suggests an important difference in the climatic regimen of the cave, with virtual absence of winter frosts and considerably greater precipitation than anything experienced since.

This striking climatic evolution is paralleled by an equally significant change in industry. From −16 ft 6 in. down to −18 ft only the most meagre traces of human activity can be discerned. Below this and down to −28 ft, however, a consistent succession of small hearth-sites and food-bone accumulations occurs, regularly associated with flints worked in the Levalloiso-Mousterian tradition. Typical Levalloiso-Mousterian assemblages have already been reported for other sites in the region such as Hajj Creiem, and are considered by Professor Garrod to resemble closely the Lower Levalloiso-Mousterian stage identified by her at Mount Carmel in Palestine. It is interesting to note that the new assemblages from the Hauh Fteah correspond more nearly to the Upper Levalloiso-Mousterian of Palestine and include the feature of well-characterized angle-burins which are absent from previous Middle Palaeolothic finds in Cyrenaica. However, I do not consider that any convincing signs of true blade manufacture, in the Upper Palaeolithic sense, have yet come to light at this horizon, and the contrast between it and the very completely evolved blade tradition, which appears abruptly at −16 ft 6in., is striking. There is no sign here of anything resembling the hypothetical transitional-stage postulated by Petrocchi for the Haqfat et Tera. The human mandibular fragment described later in this paper occurred among a scatter of miscellaneous food-bones at between −23 ft and −23 ft 3 in., that is to say, some 5 ft below the latest recognizable Levalloiso-Mousterian horizon and approximately 7 ft below the level of climatic change.

GEOCHRONOLOGY

It remains to compare these results with those previously obtained in the area. It is true that, until Carbon-14 tests have been completed, no comparative chronology can be regarded as proved; nevertheless the evidence as it stands suggests certain conclusions with a high degree of probability. The work of the two earlier expeditions in 1947 and 1948 was mainly directed to establishing, as far as possible, the broad outline of human and natural events in the area during the Pleistocene. A detailed report on this work is due to appear shortly in book form, but the following points may be mentioned in anticipation as particularly relevant to chronological problems at the Haua Fteah.

Three major geological and climatic stages can be recognized towards the end of the Pleistocene. The first is represented by a raised shore-line traceable for over 150 miles along the north Cyrenaican coast and maintained throughout at a constant level of five to six metres above present sea-level. The constancy of this level would appear to indicate unequivocally a true fluctuation in the level of the Mediterranean and not to be due merely to local tectonic movement. Such a level is widely accepted by students of sea-level change as belonging to the final stage of the last or Riss-Würm Interglacial. In Cyrenaica it can be shown that the initial period of marine regression from this high level was accompanied by the formation, in coastal wadis, of a high terrace pointing, both by its geological character and by its palaeontological content, to a temperate climate with a very much greater rainfall than now obtains. Following this first stage of regression, and accompanying one in which the sea fell at least twenty metres below its present level, was a second phase of terrestrial deposition in the coastal area, separated from the first by a brief period of erosion. The deposits of this second stage indicate a sharp drop in rainfall together with a prolonged increase in the thermoclastic weathering of the wadi walls by winter frost-action.

Apart from detailed evidence (which is not lacking), there are good general grounds for correlating these two phases in Cyrenaica with similar phases observed to accompany the last marine regression in Italy and widely accepted as representing the first and second advances respectively of the final (Würmian) glacial maximum. If so, there is little reason to deny a similar date to the two stages observed in Cyrenaica. At first sight it might seem reasonable to correlate the two newly-discovered stages in the infilling of the Haua Fteah – a damp and temperate phase, followed by a cold and dry one – with the damp-temperate and cold-dry stages of the coastal series, and hence by implication with Würm I and II respectively. This cannot be, however, for the convincing industrial reasons that follow. While the cold-dry phase of the cave is associated with an abundant and evolved blade-and-burin industry, that of the coastal series is equally clearly associated with Levalloisian remains that, both by their character and by their abundance, exclude the possibility of a contemporary tradition of true blades and burins in the same area.

Unless, therefore, an error occurs in the proposed correlations, it would follow that the fossil mandible and the associated Levalloiso-Mousterian industry at the Haua Fteah belong at earliest to the Würm II–III Interstadial; and further that the change from a Middle to an Upper Palaeolithic type of industry in this part of the North African coast took place no earlier than Würm III. The bearing of this last conclusion on the question of origin of the North African blade-and-burin industries and their relation to those of Palestine is again dependent on the establishment of reliable Carbon-14 readings in both areas. Nevertheless it is interesting to recall that dominance of the blunted-back knife-blade element to the degree observed at the Haua Fteah only appears in the final stage of the Palestinian blade-and-burin sequence. From the earlier stages of the Palestinian Upper Palaeolithic it is characteristically absent.

Part II. The Human Mandible (J. C. T. & L. H. W.)

The mandibular fragment was found during August 1952 and has been prepared at South Kensington and Cambridge for study by means of the acetic acid process (Rixon 1949). It consists of the left ascending ramus and a portion of the body, with two teeth of the permanent dentition – the second and the third molars – still in place. The medial surface of the specimen is intact but the lateral surface has been badly crushed. With the exception of about a fifth of the condylar process, which has been broken off at its lateral extremity and lost, the ramus is complete. The body tapers forward and upwards from a point on the inferior border below the third molar to about the position once occupied by the missing second premolar. Regrettably, no part of the symphysis was recovered. Although the bases of the cusps are preserved, the occlusal surface of the second molar has been subjected to a great deal of wear, the degree of attrition corresponding to Weidenreich's (1937, p. 5) No. 4. The wisdom tooth has not been long erupted and only the anterior margin of the crown is worn, presumably as the result of contact with the second upper molar. This suggests that its fellow in the maxilla had been in occlusion with it very slightly, if at all. The subject, therefore, would appear to have been adult but still quite young at the time of death – on the basis of modern western European standards of eruption, perhaps between eighteen and twenty-five years of age.

Metrical features of the teeth and jaw

While the dental evidence furnishes a more or less reliable estimate of individual age, the incompleteness of the Haua Fteah fossil does not permit an equally straightforward assessment of sex by anatomical appreciation. In any case, it might be asked what the relevant criteria were for this. It seems unlikely, for example, that they would be provided ideally by modern teeth and jaws. On the other hand, the fact that the Levalloiso-Mousterian assemblages in the cave-sites of Cyrenaica resemble those of Palestine suggests that a comparison between the metrical features of the north African specimen and of the fossils from Mount Carmel studied by McCown & Keith (1939) might prove more profitable on the not unreasonable grounds that here, as elsewhere, a distinctive archaic human form could well be associated with similarities in culture. Certain measurements these authors had taken were consequently repeated on the new find. In general, however, the teeth were measured according to the technique of Remane (1927) and the mandibular characters according to biometric methods, since the last alone have been adequately described and tested (Morant 1923, 1936) and more extensive comparative data are available for them than for any others.

In a recent memoir on the dentition of East Greenland Eskimos, Pedersen (1949, p. 76) comments on the lack of well-established standards and definitions of tooth measurements and adds: 'Although many studies have been made in this field for more than half a century, discrepancies still prevail as to the technique which should be employed.' With some notable exceptions (e.g. Remane 1927; Ashton & Zuckerman 1950; Senyürek 1951), many recognized authorities give surprisingly ambiguous accounts of their procedures, unaccompanied by diagrams. Pedersen states that he has employed Martin's methods rather than those of Hrdlička (1923, 199–200; 1924, p. 110), since the first are more widely accepted by students of dental anatomy. But two investigators mentioned by him, Shaw (1931, p. 11) and Nelson (1938, p. 263), appear to follow Hrdlička closely in measuring the mesio-distal diameters of molars not as maxima but between the contact-points of adjoining teeth. Gregory and Hellman (1926*a*, pp. 55*n.*, 74*n.*), and McCown & Keith (1939, p. 209*n.*) do likewise, despite the fact that elsewhere Hrdlička (1947, p. 155*n.*) says that Gregory & Hellman prefer the maximum mesio-distal diameter. The last is the practice of Martin (1928, p. 670), of Weidenreich (1937, p. 5), of Senyürek (1940, p. 10*n.*), and of Pedersen (1949, pp. 46–7) himself.

Most authors recommend that the facio-lingual diameter – the term used by Pedersen is adopted here in the place of 'bucco-lingual', 'labio-lingual', or the inelegant 'vestibulo-lingual' – should be taken perpendicular to the mesio-distal diameter, but agreement seems to go no further than this. Gregory & Hellman (1926*a*, p. 55*n.*) say that their facio-lingual diameter is perpendicular to a base-line in its turn tangential to 'the lingual convexities' of the lower molars. For upper molars, Remane (1927, pp. 617–18) defines two facio-lingual diameters, one being in a plane that bisects the projective mesio-distal diameter of the tooth and the other being the projective maximum facio-lingual diameter. For lower molars, only the second of these is retained (Remane 1927, p. 622). His trigone and talon, or trigonid and talonid, diameters are not necessarily parallel to his 'standard' facio-lingual diameter (see Remane 1927, Figs. 302, 304, pp. 618, 622). Ashton & Zuckerman (1950, p. 473) measure the maximum trigone and talon, or trigonid and talonid, diameters perpendicular to the mesio-distal diameter and accept whichever value is the greater in each pair as the maximum facio-lingual diameter. In general, it seems likely that most workers have taken a projective maximum facio-lingual diameter. Hrdlička (1924, p. 111) advises that this character should be measured with the 'blunt extremities' of a sliding caliper, which suggests that he meant a projective diameter, since his preference for the Broca-type of instrument, which would give it, to the Martin-type, which might not, is well known. Although Martin (1928, p. 670) is hardly precise, it may be inferred that he, too, had projection in mind; and probably the same may be said of Weidenreich (1937, p. 5), who remarks that his practice was to place a tooth between the two 'broadened legs' of a gauge and measure it perpendicular to its 'respective main axes'.

This somewhat tedious digression has been necessary in order to indicate some of the difficulties encountered by the anthropologist who professes no familiarity with or special competence in odontometry. It also illustrates how easily reliance on textual descriptions alone can invite disaster, even when what appear to be the simplest and most direct measurements of a molar tooth are involved. In the case of the Haua Fteah teeth, the mesio-distal diameter of M_2, whether taken as a maximum or from the mid-point of the superior border of the mesial articular facet to the point of contact with M_3, is the same. Comparison can safely be made, therefore, with the technique McCown & Keith use to measure this character on the Mount Carmel lower second molars, but the mesio-distal diameter of the Haua Fteah M_3, being a true maximum, is less certain to correspond to theirs. The facio-lingual diameter taken by them may or may not be a projective, or for that matter a maximum, measurement. It is merely said to be perpendicular to the mesio-distal diameter (McCown & Keith 1939, p. 209*n*.).

The dimensions of the two Haua Fteah molars were obtained by means of an engineers' gauge of 'Columbus' pattern fitted with a vernier, ordinary dividers being used to verify doubtful readings. The characters considered relate solely to the crown and no attempt has been made to measure the roots, although the approximate ratios of these to one or more crown heights can be ascertained from the radiograph in Plate I. Apart from the crown heights, which he illustrates only in the case of the upper molars (although it is clear that the same principles apply to the lower molars), the diameters now taken are shown by Remane in his Fig. 304. For present purposes three lower molar planes, modified from Remane (1927, pp. 614–17), may be defined:

(1) The standard sagittal plane, which passes through the mid-points of the straight lines joining the protoconid and metaconid tips mesially and the hypoconid and entoconid tips distally.

(2) The standard transverse plane, which passes through the mid-points of the straight lines joining the protoconid and hypoconid tips perpendicular to the standard sagittal plane.

(3) The standard occlusal plane, which passes through the deepest point in the space between the metaconid and the hypoconid perpendicular to the standard sagittal and standard transverse planes.

The measurements of the lower molar teeth can be summarized as follows: M_dD maximum mesio-distal diameter parallel to standard sagittal and standard transverse planes; F_lD maximum projective facio-lingual diameter parallel to standard transverse and standard occlusal planes; T_rD maximum trignoid diameter in plane passing through protoconid and metaconid tips parallel to standard occlusal plane; T_aD maximum talonid diameter in plane passing through hypoconid and entoconid tips parallel to standard occlusal plane; M_eH metaconid height from tip to gingival enamel border perpendicular to standard occlusal plane; E_nH entoconid height from tip to gingival enamel border perpendicular to standard occlusal plane. Owing to wear on the occlusal surface of M_2, crown heights have not been taken on that tooth. Since a concretion against the gingival enamel border on the facial surface of M_3 also prevents accurate measurement of the projective protoconid and hypoconid heights (P_rH and H_cH), no comparison with the crown heights of the Mount Carmel lower molars, which were also taken on the facial side, is possible.

Table I gives the absolute measurements of the Haua Fteah teeth and of four indices derived from these. It will be seen that in all its corresponding dimensions M_3 is smaller than M_2 and that the trigonid diameters of both molars exceed their talonid diameters. While recognizing two types of dentition at Mount Carmel, the Tabūn and the Skhūl, McCown & Keith (1929, p. 208) could not find 'any clear-cut line of demarcation between them', Skhūl VII (♀) having teeth of Tabūn type. Certainly there is nothing in the measurements of the ten second molars and the seven third molars that would suggest that they might be divided on metrical

TABLE I. *Measurements of the Haua Fteah Teeth*

Absolute Measurements			Indices		
Character	Tooth		Character	Tooth	
	M_2(L)	M_3(L)		M_2(L)	M_3(L)
Mesio-distal diameter, M_dD	11·7	10·6	100 M_dD/F_lD	102·6	98·1
Facio-lingual diameter, F_lD	11·4	10·8	100 T_rD/M_dD	95·7	100·9
Trigonid diameter, T_rD	11·2	10·7	100 T_aD/M_dD	93·2	96·2
Talonid diameter, T_aD	10·9	10·2	100 E_aD/T_rD	97·3	95·3
Metaconid height, M_eH	—	6·2	100 M_eH/T_rD	—	57·9
Entoconid height, E_nH	—	6·1	100 E_nH/M_eH	—	98·4

grounds, and the situation is not much better in regard to sex. The Mount Carmel ranges of M_dD are from 8·6 (Skhūl VII ♀) to 12·2 (Skhūl II ♀) for M_2 and from 9·0 (Skhūl VII ♀) to 11·5 (Tabūn II ♂) for M_3, and those of F_lD from 10·6 (Tabūn I ♀) to 12·3 (Skhūl VII ♀) for M_2 and from 9·8 (Tabūn I ♀) to 11·8 (Skhūl V ♂) for M_3. Thus, although in all four ranges female subjects have the smallest dimensions, in two of them M_dD and F_lD for M_2, they also have the largest. The measurements of the Haua Fteah teeth fall within the Mount Carmel ranges, but it is evident from what has just been indicated that such a fact can hardly assist in sexing the Haua Fteah specimen. Whether a comparison of the metrical features of the mandible offers more hopeful prospects for this remains to be decided.

In addition to characters which are common to both Rudolf Martin's and the biometric schemes, several unfamiliar measurements have been taken on the Mount Carmel mandibles. Those of concern to the present paper are the area of the ramus and what McCown & Keith (1939, p. 230) have termed the condylar and coronoid heights and the minimum height of the ramus, although the manner in which the last three were obtained would appear to be unique. The first, denoted here by the symbol *RA*, omits the condylar and coronoid processes but 'extends to the lower margin and includes the entire area of masseteric insertion'. It may be determined by tracing the outline of the rameal portion of the mandible on squared paper or, as Keith & McCown suggest, by placing a sheet of glass divided into 0·25 sq. cm. over such an outline drawn on plain paper. The condylar and coronoid heights and the minimum height of the ramus have as a common terminal the 'masseteric marginal point'. This is the inferior limit of a chord 'from the deepest point of the sigmoid notch to the lower margin of the mandible, parallel to the posterior margin of the ascending ramus', and it is marked in pencil on the bone. To avoid confusion with similarly-designated measurements in Martin (1928, p. 663) or their nearest equivalents in the biometric scheme (Morant 1923, p. 257), they will be referred to below as chords from the condylion, the coronion, and the incisura to the masseteric marginal point and the respective symbols denoting them will be 'double-dashed', namely, C_yH'', C_rH'', and IH''.

The rest of the characters employed are the customary biometric ones (Morant 1936, pp. 116–22; Trevor 1950, p. 461), together with the projective height of the condylar process and the breadth and depth of the incisura or sigmoid notch (Morant 1923, pp. 256–60). Apart from subscripts, the lower-case letters previously used to denote these have been capitalized. Since, owing to its incompleteness, the Haua Fteah jaw could be oriented only approximately in the standard horizontal, standard rameal, or standard transverse planes of the mandible,[1] the values

[1]A mandible is oriented in the standard horizontal plane when three or more points on its base are in contact with a flat surface and pressure is applied to the second left molar tooth or its cavity. The standard rameal plane of the mandible is tangential to two points on the posterior border of the left ascending ramus and to one on that of the right. The standard transverse plane of the mandible makes contact with the posterior surface of each condylar process perpendicular to the standard horizontal plane.

Table II. *Measurments of the Haua Fteah Mandible**

Absolute Measurements				Indices & Angles	
Character	Value	Character	Value	Character	Value
Area of ramus in sq. cm., *RA*	17·3	Projective height of condylar process, C_yH	55·9?	100 RB'/RL	66·3?
Minimum breadth of ramus, *RB'*	39·6	Chord, condylion–masseteric marginal point, C_yH''	71·5	100 C_yB / C_yL	48·0??
Condylar length, C_yL	20·0??	Projective height of coronoid process, C_rH	57·0?	100 IH'/C_yC_r	28·4
Condylar breadth, C_yB	9·6	Chord, coronion–masseteric marginal point C_rH''	57·0	100 C_yH/C_rH	98·1?
Breadth of incisura, C_yC_r	34·5	Least height of incisura, *IH*	47·1?	100 C_yH''/C_rH''	125·4
Depth of incisura, *IH'*	9·8	Chord, incisura–masseteric marginal point, *IH''*	50·7	$M\angle$	113·2°?
Projective 'length' of ramus, *RL*	59·7?	Projective height of corpus, M_2H	25·3?	$R\angle$	68·1°

*Measurements followed by a single query may be taken as close approximations to the true values. Those followed by a double query are more doubtful.

of all measurements made on it in these planes, of the indices derived from them, and of the mandibular angle have been queried. With the exception of those taken by McCown & Keith, which have already been described, the mandibular measurements are as follows: *RB'* minimum breadth of ramus between anterior and posterior borders in any direction; C_yL condylar length, maximum length between medial and lateral surfaces of condylar process in any direction; C_yB condylar breadth, maximum antero-posterior breadth of condylar process perpendicular to C_yL; C_yC_r breadth of incisura between condylion and coronion; *IH'* greatest depth of incisura from condylion-coronion line; *RL* projective 'length' (height) of radius from zero axis of standard horizontal and standard rameal planes to superior surface of condyle; C_yH projective height of condylar process from zero axis of standard horizontal and standard transverse planes to condylion; C_rH projective height of coronoid process from zero axis of standard horizontal and standard transverse planes to coronion; *IH* least height of incisura perpendicular to standard horizontal plane (scriber); M_2H projective height of corpus at M_2 to ectomolare perpendicular to standard horizontal plane (scriber); $M\angle$ mandibular angle between standard horizontal and standard rameal planes; $R\angle$ rameal angle between condylion–coronion line and plane tangential to posterior border of ramus.

Although the individual measurements of very few long series of modern mandibles have been published, it is clear that no single character of the Haua Fteah mandible included in Table II falls beyond their range. At the same time, it would be rare to find as large a value for *RB'* as 30·6 mm. in conjunction with an unexceptional *RL* of 59·7 in a contemporary European jaw, and values of the resultant index, 100 RB'/RL, over 65·0 would also be unusual.[1] The very low value of the index 100 IH'/C_yC_r, namely 28·4, is again striking, and it is of interest to note that this is identical with the figure recorded for the Le Moustier youth and that the Malarnaud – if credence can be given to the measurements – and Mauer indices are below, and those for the two Krapina and the La Quina H 9 and the La Chapelle-aux-Saints specimens above, it (Weidenreich 1936, p. 94). It is nevertheless still within the limits of modern series of mandibles (Schultz 1933, p. 312). Unfortunately McCown & Keith did not measure the breadth and depth of the incisura in the Mount Carmel jaws.

[1]A very high mean value of this index, 59·9, with a standard error of ±1·05, has been found for a series of forty-seven female 12th–13th-dynasty Nubian mandibles from Kerma (Morant 1936, p. 96). Their mean *RB'* and *RL*, however, are respectively 7·5 and 5·5 mm. less than the corresponding measurements of the Haua Fteah fragment.

TABLE III. *Measurements of Mount Carmel Mandibles**

Character	Tabūn		Skhūl				Range
	I(♀)	II(♂)	IV(♂)	V(♂)	VI(♂)	VII(♀)	
Area of ramus in sq. cm., RA	18·9	24·6	25·5	22·4	24.2??	—	18·9–25·5
Minimum breadth of ramus, RB'	38·0	40·0	42·5	36·2	42·0?	32·0??	36·2–42·5
Condylar length, C_yL	18·0?	25·0?	—	23·0	—	21·2	18·0–25·0
Condylar breadth, C_yB	10·0	11·0	—	9·2	—	13·4	9·2–13·4
Chord, condylion–masseteric marginal point, C_yH''	65·5	79·0	67·0??	78·5	71·0??	73·0??	65·5–79·0
Chord, coronion–masseteric marginal point, C_rH''	57·6	70·0	65·0??	74·0	65·0??	65·0??	57·6–74·0
Chord, incisura–masseteric marginal point, IH''	49·5	56·0	48·0?	60·5	56·0??	54·0??	48·0–60·5
Projective height of corpus, M_2H	26·2	38·5	35·5	34·5	25·7??	30·0?	26·2–38·5
100 C_yB/C_yL	55·6?	44·0?	—	40·0	—	63·2	40·0–63·2
100 C_yH''/C_rH''	113·7?	112·9	103·1??	106·1	109·2??	112·3??	106·1–113·7
$M\angle$	104°	118°	111°	107°	—	—	104°–118°

*The brackets in which McCown & Keith enclose doubtful measurements have been replaced in this table by queries or double queries according to the completeness of each specimen, as shown in their illustrations, for the character concerned. Measurements followed by a double query have been omitted in determining the ranges.

Table III gives for the Mount Carmel series (i) the individual values of eight absolute measurements, two indices, and an angle which are also available for the Haua Fteah jaw, and (ii) the ranges of what seem to be the more accurate of these, judged from the completeness of the particular specimen as shown by photographs. If the indices are omitted on the grounds that they merely show the relations of the absolute measurements, six or two-thirds of the Haua Fteah characters fall within the corresponding Mount Carmel ranges and the remaining third (RA, C_rH'', and M_2H) below them. This result might suggest that, if there is real affinity between the Cyrenaican fossil and the jaws from Palestine, its sex is more likely to be female than male, but such an inference would rest on very slender foundations. Comparison of the sex-ratios – ♂ means divided by ♀ means for the same characters – of several large modern mandibular series suggests that, contrary to the general belief, sexual differences are more marked for the mandible than for the cranium. In the light of such a conclusion, the possibility of sexing mandibles mathematically has been considered more than once (Morant 1936, pp. 95–9; Martin 1936, pp. 150–8; Cleaver 1937, pp. 90–2).

While the methods proposed are not feasible in the present case, the characters that seem to be most effective in discriminating between the sexes are, of course, relevant to it. Morant (1936, p. 99) mentions six of these characters, which Martin (1936, pp. 155–6) and Cleaver (1937, p.90) reduce to four. Two of Morant's six, C_yL and $M\angle$, and the near-equivalent of a third, C_rH'', are available, both for the Mount Carmel mandibles and for the Haua Fteah jaw, All, however, must be rejected but for different reasons. The C_yL of the Haua Fteah jaw is a doubly-queried measurement. Although in long modern series it is almost always found that the female means for $M\angle$ are sensibly greater than the male, in the small Mount Carmel series the reverse is true, a situation which may well be due to chance. Three of the six Mount Carmel values of C_rH'' have been doubly queried in Table III. Apart from the area of the ramus, RA, which is likely to be highly correlated with any of its grosser dimensions, the choice of the most suitable characters for the assessment of sex by size would seem to be limited to RB', IH'', and M_2H. A simple mathematical procedure, which has proved effective in sexing short series (Morant 1926, pp. 67–8) and is described below, was applied to these.

The ranges of RB', IH'', and M_2H for the combined male and female Mount Carmel mandibles having been divided into five histograms with equal bases, 'marks' for sexual discrimination in terms of size were awarded to the Haua Fteah jaw on the following basis: zero if its measurement for the character in question fell within the central histogram; -1 if it fell within the histogram immediately to the left, and $+1$ if it fell within that immediately to the right, of the central one; and -2 if it fell within the extreme left, and $+2$ if it fell within the extreme right, histogram. A positive total for the three characters denotes maleness, a negative total femaleness. From this rough and admittedly far from ideal test, the Haua Fteah jaw emerged with a score of -3 marks, which suggests that its probable sex is female. A similar treatment of the Mount Carmel mandibles confirms the sexes that McCown & Keith assigned to them by the usual anatomical appreciation, although the lower limit of the IH'' range is represented by a male specimen (Skhūl IV).

MORPHOLOGY OF THE TEETH AND MANDIBLE

Owing to the attrition of the occlusal surface, the cusp-pattern of the second molar is obscure. That of the wisdom tooth, however, is well preserved, a fact to be welcomed in view of Weidenreich's (1937, p. 96) remark that data for unworn third molars of Neandertal Man are extremely scarce – and the situation is little altered since he wrote. The Haua Fteah M_3 displays five cusps but the groove system is cruciform rather than Y-shaped as in the *Dryopithecus*-pattern. Quite well-developed crenations also occur. No such 3–2 or hypoconid–metaconid contact exists as that which Gregory & Hellman (1926*a*, p. 105; 1926*b*, p. 305) have described in the permanent lower molars of the Le Moustier youth and in the two erupted in the jaw of the Ehringsdorf child; nor is it replaced by the opposite 1–4 or protoconid–entoconid contact of the kind that Montandon (1943, p. 47) terms '*gabarit en escalier*'. The lower molar pattern of this tooth is, in fact, the '+5' of Hellman (1928, p. 165). No anterior fovea can be discerned, but otherwise the description of the Tabūn lower molars given by McCown & Keith (1949, p. 198), namely, a slightly differentiated hypoconulid and 'the tendency for the furrows behind the two proximal cusps (trigonid) to assume a complete transverse pattern as in modern molars', would fit the Haua Fteah M_3 very well. The largest cusp is the protoconid and the second largest the metaconid, which is usual in *Homo sapiens*. As has already been indicated, the trigonid diameter is greater than the talonid, a condition opposite to that found in the M_3 of Le Moustier (Weidenreich 1937, p. 96).

It can be seen from the radiograph that the configuration of the gingival enamel boundary of both the Haua Fteah molars is concave towards their occlusal surfaces and the enamel does not extend between the roots. This is the Type 2 of Pedersen & Thyssen (1942, p. 454), an illustrated account of whose classification has also been given in English by Pedersen (1949, p. 74 and Plate 18). The roots are separate, without facial or lingual fusion, and the X-ray examination kindly made by Mr J. A. F. Fozzard shows that those of M_3 are limited to the normal two. Coincidentally there is an absence of full or true taurodontism according to the criterion of Tratman (1950, p. 45), who distinguishes between this and a pseudo-taurodont or reduction form accompanied by pyramidal roots as follows: 'The true taurodont form shows a slight tapering to the waist of the tooth between the enamel-cemental junction and the root end. If there is no true root the waist is about half way along the length of the body, so that diagramatically the full taurodont form has a faintly hour-glass outline.' He adds: 'Where there is a partial taurodont form the waist is approximately at the level of the commencement of the roots proper and the roots diverge from this level and do not converge as in the pyramidal reduction form', and 'If the simple pyramidal form is taken as a reduction form then many of the teeth described as taurodont cease to be so describable.'

At first sight, the most striking feature of the Haua Fteah mandible is the 'square' appearance of the ascending ramus, emphasized by the shallow incisura or sigmoid notch – No. 2 of Schultz (1933, p. 314) – and low blunt coronoid process, Schultz's (1933, p. 315) Type V.[1] This appearance of the ramus seems to be due chiefly to a building-out of its anterior border, that is, the portion to which the temporal muscle is attached. It is further accentuated by the relative lowness of the mandibular body at its junction with the ramus; the height of the ramus above the alveolar plane is proportionately great. This proportion is noteworthy, since it eliminates comparison with the mandibles of African paedomorphic types, in which the supra-alveolar height is diminished. Despite the shallow sigmoid notch, the articular surface of the condyle is boldly convex. The small portion of the mandibular body that is preserved creates the impression that its superior and inferior borders were nearly parallel, so that the body did not increase abruptly in depth towards the symphysis.

The lateral surface of the fragment is too much corroded to reveal any significant details of modelling. On the medial aspect the Y-shaped rameal bar of McCown & Keith (Weidenreich's *torus triangularis*[2]) is strongly developed. At its lower end it is confluent with the alveolar margin, but there is no sharp crest or *crista pharyngea* upon this junctional region such as is seen in *Sinanthropus* and in the modern great apes. The anterior branch of the Y-shaped bar (*crista endocoronoidea*) is sharply demarcated; its posterior branch (*crista endocondyloidea*) is more diffuse. Between these two crests there is a well-defined depression, the *planum triangulare*. Because of the building-out of the anterior border, the groove or fossa between the border and the rameal stress-bar is unusually broad in the Haua Fteah fossil. (Weidenreich has, rather surprisingly, omitted to name this depression!)

As a further consequence of the building-out, the mandibular foramen, instead of being approximately central, is much closer to the posterior than to the anterior border. This foramen is almost completely concealed by a very large triangular lingula. The mylo-hyoid groove, which has normal human relationships, is narrow and sharply defined; it is uncovered in its upper portion but crossed by a long bridge near its lower end. Although the *area musculi pterygoidei interni* is neither sharply defined nor conspicuously rugose, it appears to extend almost up to the posterior lip of the mylo-hyoid groove. The posterior border of the ramus in its lower portion is somewhat corroded, but the angle seems to have been evenly rounded rather than truncated. On the medial surface of the body the mylo-hyoid line is not strongly marked.

DISCUSSION

The mandibles of Neandertal type previously found in Africa north of the Sahara are limited to the fragments from Rabat in French Morocco (Vallois 1945) and the Porcupine Cave, near Dire Dawa in Abyssinia (Vallois 1951), to which one of us paid a brief visit in 1943. The first consists of a chinless anterior segment; its date is uncertain but probably pre-Würm (Briggs 1948, p.108). The second comprises part of a much-eroded body extending from the third molar to the lateral incisor on the right side, and it also apparently lacked a chin; its association with an evolved Mousterian industry seems well established.

Both these African specimens are thus deficient in the portions that correspond to what is preserved of the Haua Fteah jaw. Effective comparisons must therefore be sought over a wider geographical range. The archaeological context of the new find suggests that it can most profitably be compared with the Mount Carmel fossils, but comparisons with European Neandertal mandibles also appear to be legitimate.

[1]Types II and IV appear to have been reversed in Fig. 66, k–n, of Weidenreich's (1936, p. 74) reproduction of the Schultz scheme.

[2]This and certain of the other italicized anatomical terms given below are those used by Weidenreich (1936) in his study of the *Sinanthropus* mandibles.

Certain aspects of the Haua Fteah teeth in relation to those from Le Moustier, Ehringsdorf, and Mount Carmel were mentioned at the beginning of the last section, and little more need be added here. It may at the same time be noted that the much worn left upper second molar from the Caves of Hercules on the Atlantic coast in the International Zone of Tangier, which is also attributed to a Neandertaloid form, 'was probably taurodont only to a sub-moderate degree' (Senyürek 1940, p. 23). The maxillary and mandibular molars of the young adult male from Rabat are characterized by taurodontism but the teeth in the Dire Dawa mandible are not. In discussing the last fossil, Professor Vallois (1951, p. 237) points out that taurodontism should not be considered as a specific feature of Neandertal Man. He observes further that if some of the Krapina pulp-cavities exhibit hypertrophy, as do a few other Neandertal dentitions, the increase in their volume is due solely to the remarkable size of the teeth since both phenomena are associated, the Ehringsdorf cavities being quite small.

In the mandibles of the best-known European Neandertal specimens (La Chapelle-aux-Saints, La Ferrassie, La Quina, Krapina) the ascending ramus is relatively tall but is narrower in proportion to its height than in the Haua Fteah jaw. Moreover, in all of them the angle is broadly truncated in a manner not clearly shown in the Cyrenaican fragment. The ramus of the presumably female Malarnaud jaw, however, would present a very similar appearance if its anterior border were built out to the same degree and the angle were similarly rounded off. The difference between the Haua Fteah and Malarnaud specimens is indeed very much the same as that between the Mauer ramus and a tall Neandertal ramus. It cannot therefore be said that the Haua Fteah fragment is outside the range of variation of the European Neandertal group.

It has been shown that of nine metrical characters of the Haua Fteah mandible six fall within and three just below the ranges for the Mount Carmel mandibles. Among these the Tabūn specimens, and particularly the female Tabūn I, agree most closely in their morphological features as well as in their proportions with the Haua Fteah jaw. While conclusions drawn from so incomplete a specimen can only be tentative, the indications certainly suggest that the Haua Fteah find may be most closely linked with the Tabūn group of the Mount Carmel Neandertaloids.

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CARBON READINGS: NOTE ADDED IN PROOF

AT THE TIME OF GOING TO PRESS, six preliminary Carbon-14 readings for material from the Haua Fteah obtained by Dr Hans Suess of the U.S. Geological Survey have become available. The bearing of these on the problems discussed above is briefly as follows. All the readings are in correct stratigraphical order. The two lowest come from samples in the fine-grained deposit forming the lower 13 ft of the exposed section. An age of from 30,500 to something over 40,000 years would appear to be clearly demonstrated for this zone. No reading has yet been obtained for the hearth and floor associated with the mandible, but a reading of 34,000 years comes from the hearth at about 19 ft, and this, together with the apparent rate of formation of the extremely homogeneous deposit, suggests a figure not far removed from 40,000 years for the human fossil. As far as we are aware, this is the first reliable estimate of the absolute date of a specimen of such a nature ever obtained. In the course of the excavation, traces of an apparently minor erosional disconformity were noted between 15 ft and 16 ft 6 in.; the Carbon readings now indicate that the interval represented by this disconformity was considerably greater than at first supposed, and was of the order of 15,000 years. Of the four readings above the disconformity, the third from the top, at about 9 ft 6 in., marks the close of the geological evidence of strong frost action. The figure of 10,600 $\pm$ 400 years (before the present) which it yields is in close agreement with the age of the final cold period of the Upper Dryas flora of Europe. The remaining dates are outside the range of the present discussion. In the absence of Carbon-14 dates for the earlier stages of the Würmian glacial maximum, it is not possible to say whether the absolute dates now available for the Haua Fteah confirm, or run contrary to, the correlation proposed on geological grounds.