

EXCAVATION IN THE FRANCHTHI CAVE, 1969-1971, PART I

(PLATES 13-17)

THE third and fourth seasons of excavation in the Franchthi Cave were conducted during the summers of 1969 and 1971.¹ (The alternate seasons, 1970 and 1972, have been devoted to continued study of the finds and surface exploration in the vicinity of the site.) As in the past, these excavations are part of investigations being undertaken by Indiana University and the University of Pennsylvania—Dr. M. H. Jameson of the University of Pennsylvania is co-director of the project—in the neighborhood of Porto Cheli (Fig. 1).²

¹ A complex set of circumstances has necessitated that this report—originally intended to appear in one issue of this journal—be divided into two parts, appearing in separate issues. This initial installment, therefore, will be primarily concerned with a brief description of the progress of the excavations themselves since 1968, the results of continued study of the environmental material and most of the pre-Neolithic remains, and a survey of the evidence bearing upon the absolute chronology of the site. “Part II” will deal largely with the Neolithic remains.

A preliminary report summarizing the results of the 1967 and 1968 seasons appeared in *Hesperia*, XXXVIII, 1969, pp. 343-381. (N. B. Hereafter that report will be referred to as *Franchthi*, I.) In addition to the bibliography cited there (p. 343, n. 1), further notes have appeared annually in *Χρονικά, Δελτ.*; “Chronique des fouilles,” *B.C.H.*; “Archaeological Reports,” *J.H.S.*; and “News Letter from Greece,” *A.J.A.* See also T. W. Jacobsen and J. S. Kopper, “The Franchthi Cave, Greece: A Preliminary Geological Survey,” *Premier Colloque international de Spéléologie en Grèce* (1971)—in press at the time of this writing.

² Financial support for the project has again been provided by the Indiana University Foundation (Edward A. Schrader Fund for Classical Archaeology) and the University of Pennsylvania (Ford Foundation Traineeships in Archaeology). We should also like to thank the Esso-Pappas Company of Greece for its continued interest in our program.

The excavations have been conducted under the auspices of the American School of Classical Studies in Athens in cooperation with the Greek Archaeological Service. Therefore we wish to express our gratitude to Dr. James R. McCredie, Director of the American School, and Mrs. Evangelia Protonotariou-Deilaki, Ephor of Antiquities for the Argolid-Corinthia, for their cooperation and assistance.

A special note of gratitude is owed to the members of our staff and colleagues who have given such dedicated service to the recovery and study of the finds during the past four years. They include: Mr. Vasileios Anagnostopoulos (1969); Dr. J. L. Angel (1969, 1972); Mr. Thomas Boyd (1969, 1971); Mr. Donald Burhans (1971); Mr. and Mrs. Steven Diamant (1969-1972); Mr. Donald Dupont (1969); Mr. and Mrs. Hamish Forbes (1971); Dr. R. J. Giegengack (1970); Miss Mary Immerwahr (1969); Mr. Yaşar Işcan (1971); Mr. James Jackson (1969); Dr. J. H. Kellar (1971); Mr. Jay Kellar (1971); Mr. and Mrs. J. S. Kopper (1971); Mr. and Mrs. Brian Legakis (1971); Mrs. Marian H. McAllister (1969-1972); Mr. and Mrs. Sebastian Payne (1969, 1972); Miss Sarah Peirce (1971); Miss Catherine Perlès (1971-1972); Mr. Karl Petruso (1969, 1972); Mr. Nicholas J. S. Price (1971); Dr. and Mrs. R. Schaeffer (1971-1972); Dr. and Mrs.

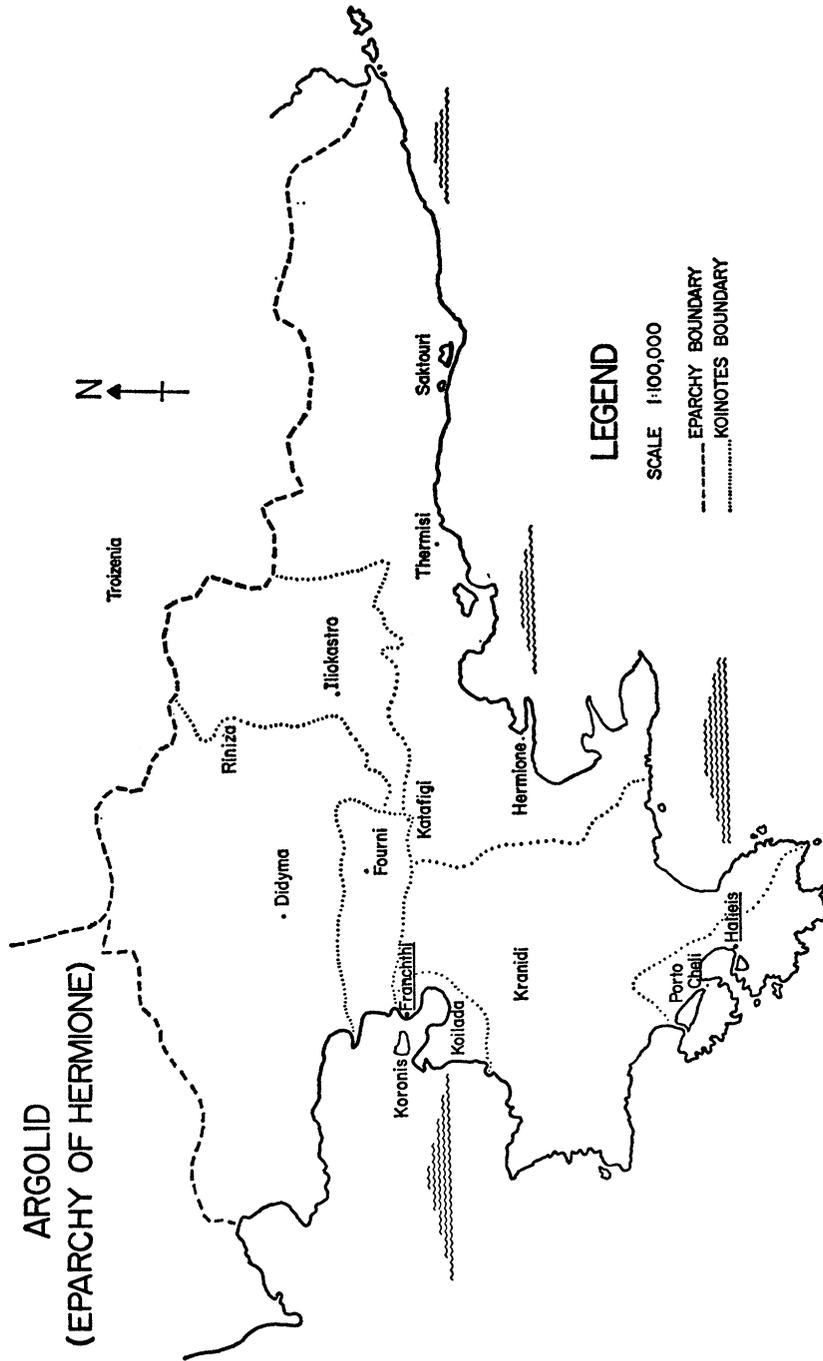


FIG. 1. Map of Hermionid.

The headland of Franchthi, nearly 1.5 km. in length from east to west (maximum elevation *ca.* 112.50 m.), forms the northern arm of what is now the Bay of Koilada (Pl. 13, a, b). Our site lies at its western extremity, but it is only one manifestation of what seems to be a rather complex system of caverns in the headland.³ Indeed caves and sinkholes—a number of which have provided surface indications of prehistoric occupation—are plentiful in the typical karst topography of the region.

Although the date of its formation is still uncertain, the cave was probably formed by solution at a time when the water table in the headland was considerably lower than it is now.⁴ Thereafter, the conformation of the site seems to have changed markedly with the passage of time, as the evidence of varying degrees of breakdown throughout the stratigraphy at least partially suggests. The fault or slump opening at the rear of the cavern and the great breakout dome (“window”) near the center appear to have occurred—possibly as a result of seismic activity—well after the first occupation of the site by man. Likewise, there is good reason to believe that the brow and the mouth of the cave have been gradually retreating throughout the history of the site; that which we see today is probably the result of a fairly recent breakdown (Fig. 2 and Pl. 13, c).

THE EXCAVATIONS

As in the first two years, most of our effort during the past two seasons has been devoted to continued excavation in the forepart of the cave (Fig. 3). Work has been confined in large part to two areas, F/A Balk and H/H-1. No further investigations have been undertaken in G/G-1.

N. J. Shackleton (1969); Mr. Mark Sheehan (1971); Mr. Jeffry Soles (1969); Miss Lauren Talalay (1971-1972); Miss Ritsa Tsifaki (1969, 1971); Miss Karen Vitelli (1970-1972); Dr. P. D. Wallace (1971); Mr. David Walton (1971-1972); Mr. and Mrs. Vance Watrous (1971-1972); Mr. John Watson (1969, 1971); Miss Wendy Watson (1969); Dr. D. R. Whitehead (1971); Mr. Frederick Winter (1969). Mr. N. Didaskalou and Miss Chr. Souyouleoglou served as conservators for parts of the 1969 and 1971 seasons, and Mr. M. Schinas (1969) and Mr. P. Yannakopoulos (1971) have represented the Ephor. The drawings appearing in this report were done by Mr. Boyd, Mrs. McAllister, Miss Perlès, Miss Talalay, Miss Vitelli, and Mrs. Watrous. A special word of thanks is owed to Mrs. Marguerite Schaeffer for her valuable assistance in maintaining the excavation records during the off-seasons and the preparation of this manuscript.

³ For a general survey of the geology of the cave and its environs, see T. W. Jacobsen and J. S. Kopper, *op. cit.*

A vast cavern whose depth is said to exceed 100 m. below present sea level has been exposed by quarrying operations at the southeastern end of the headland. A small pothole near the crest of the headland also seems to be part of this system, while another sinkhole is to be found on the small offshore island of Koronis. Koronis would certainly have been connected with the headland during periods of lower sea level.

⁴ The suggestion (*Archaeology*, XXII, 1969, p. 4) that this may have been a sea-cave appears unlikely.

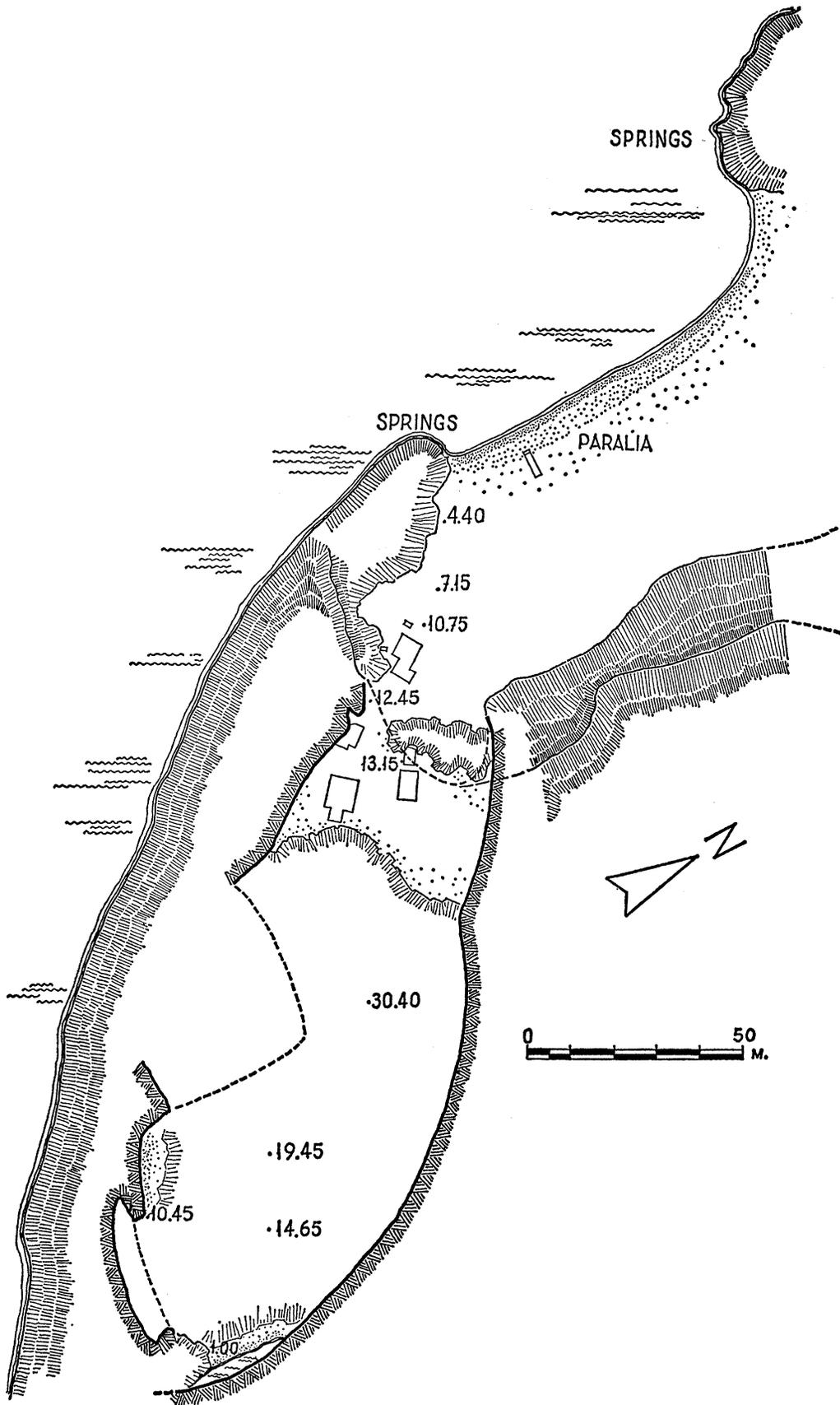
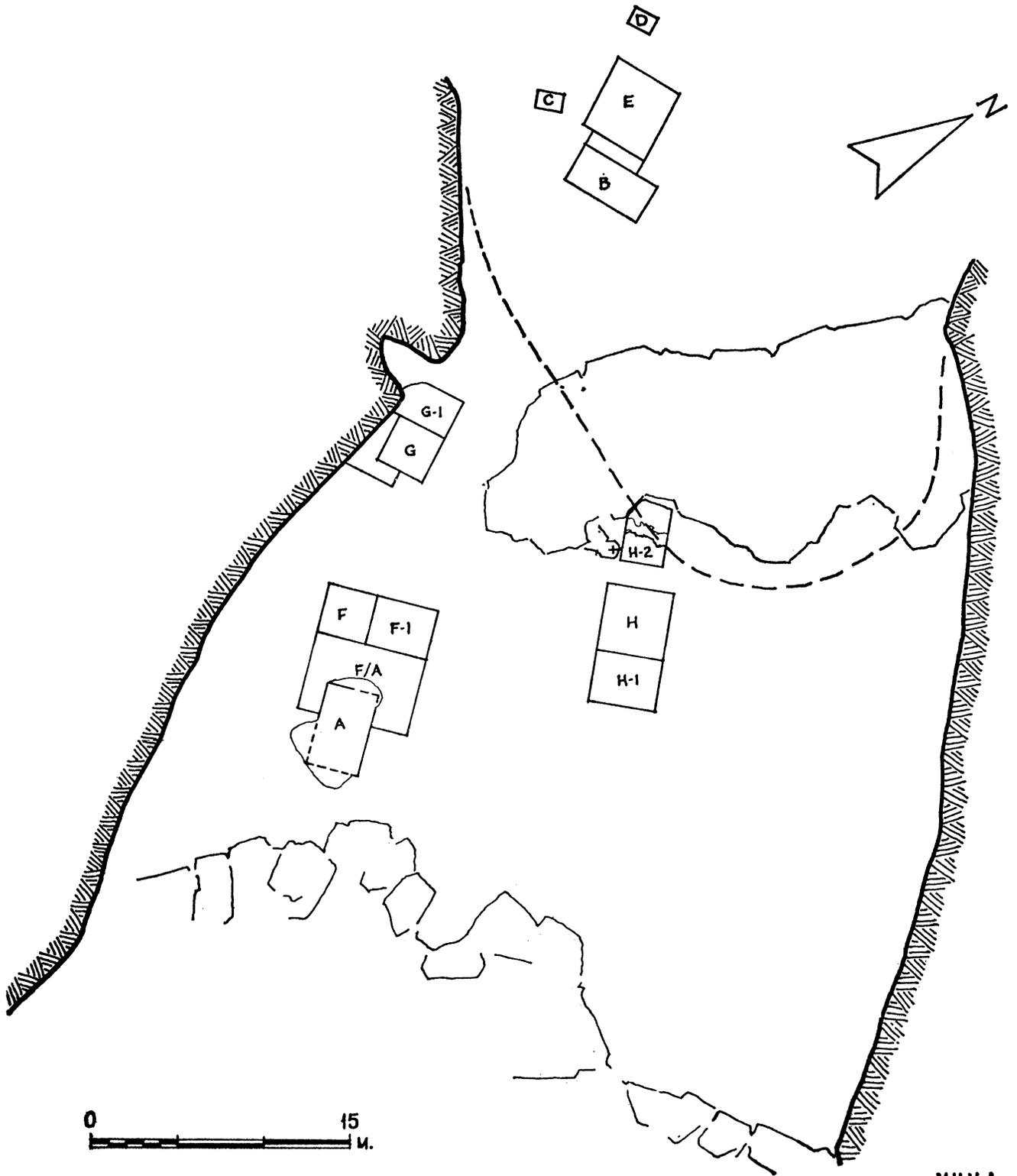


FIG. 2. Plan of Franchthi Cave and Immediate Environs.



M.H. McA.
1971

FIG. 3. Plan of Excavated Portion of Franchthi Cave.

The primary objective of the excavations in F/A Balk was to correlate and isolate as accurately as possible the excellent stratigraphic sequence revealed in Pits A and F/F-1, the only excavated area at the site where Late Neolithic stratigraphy is fully represented. This was accomplished by laying out a rectangular area measuring 6.50 m. (arbitrary east-west) \times 7.50 m. (arbitrary north-south), which included the full extent of old area F/F-1 and approximately the northernmost 2.00 m. of old Pit A.⁵ After clearing the southeastern corner of the rectangle to a depth of nearly 3.00 m. below the modern surface (*ca.* 8.15 MASL),⁶ it could then be used as a working terrace from which we could more readily examine the balk between F/F-1 and Pit A.⁷ The balk thus isolated measured *ca.* 2.00 m. (E-W) \times *ca.* 3.50 m. (N-S, along the W. scarp) (Pl. 13, d). An uncontaminated Neolithic surface representing the latest stratified prehistoric level at the site was exposed at a depth of *ca.* 9.50 MASL. The balk was then divided into two parts ("North" and "South") and each half was excavated separately. By the end of the 1971 season, F/A Balk had been carried down to a depth of *ca.* 7.25 MASL, thus exposing an apparently unbroken stratigraphic sequence from very near the end of the Neolithic period down to the transition from Middle to Early Neolithic (Fig. 4 and Pl. 14, a). Charcoal from the remains of fireplaces was so plentiful throughout the stratigraphy here that we had no trouble collecting samples for radiocarbon analysis. Ten samples have now been submitted to the Radiocarbon Laboratory at the University of Pennsylvania (see below), and the results of eight of them (the stratigraphic positions of seven of them are indicated on the sectional drawing, Fig. 4) have been received. Excavation will be resumed in F/A Balk in 1973 in order to (1) clarify the critical transition from Neolithic to Mesolithic first exposed in Pit A in 1967 and (2) to attempt

⁵ *N. B.* For convenience of recording during the course of our excavations, we have regarded the cave mouth as representing arbitrary north. This convention will also be followed in this report. Reference to direction in areas outside the cave, however, will be made in terms of the true cardinal points.

⁶ MASL = "meters above (1968) sea level."

⁷ The deposit cleared from this area as well as from the surface directly above the balk consisted largely of boulders of various sizes (many fist-sized or only slightly larger) loosely mixed with comparatively small quantities of cave earth. Although excavation was made difficult by pit walls collapsing from the looseness of this deposit, a careful attempt was made to dig the area in thin spits in order to determine whether any stratigraphy existed within it. Although some of the stones from this deposit may well be breakdown from the ceiling, much of it appears to be of secondary origin and probably the result of fairly recent human deposition. Charcoal from a hearth *within* this fill indicated a date of the mid-nineteenth century after Christ (P-1658).

It is clear from this as well as other excavated areas in the cave that there has been considerable disturbance of the surface of the cave in recent times. As an indication of an inflationary trend now existing in Greece, it is worth noting that the price of dung still being excavated in the cave for local use as fertilizer has increased by 20% during the last three years. (Cf. *Franchthi*, I, p. 367, note 29.)

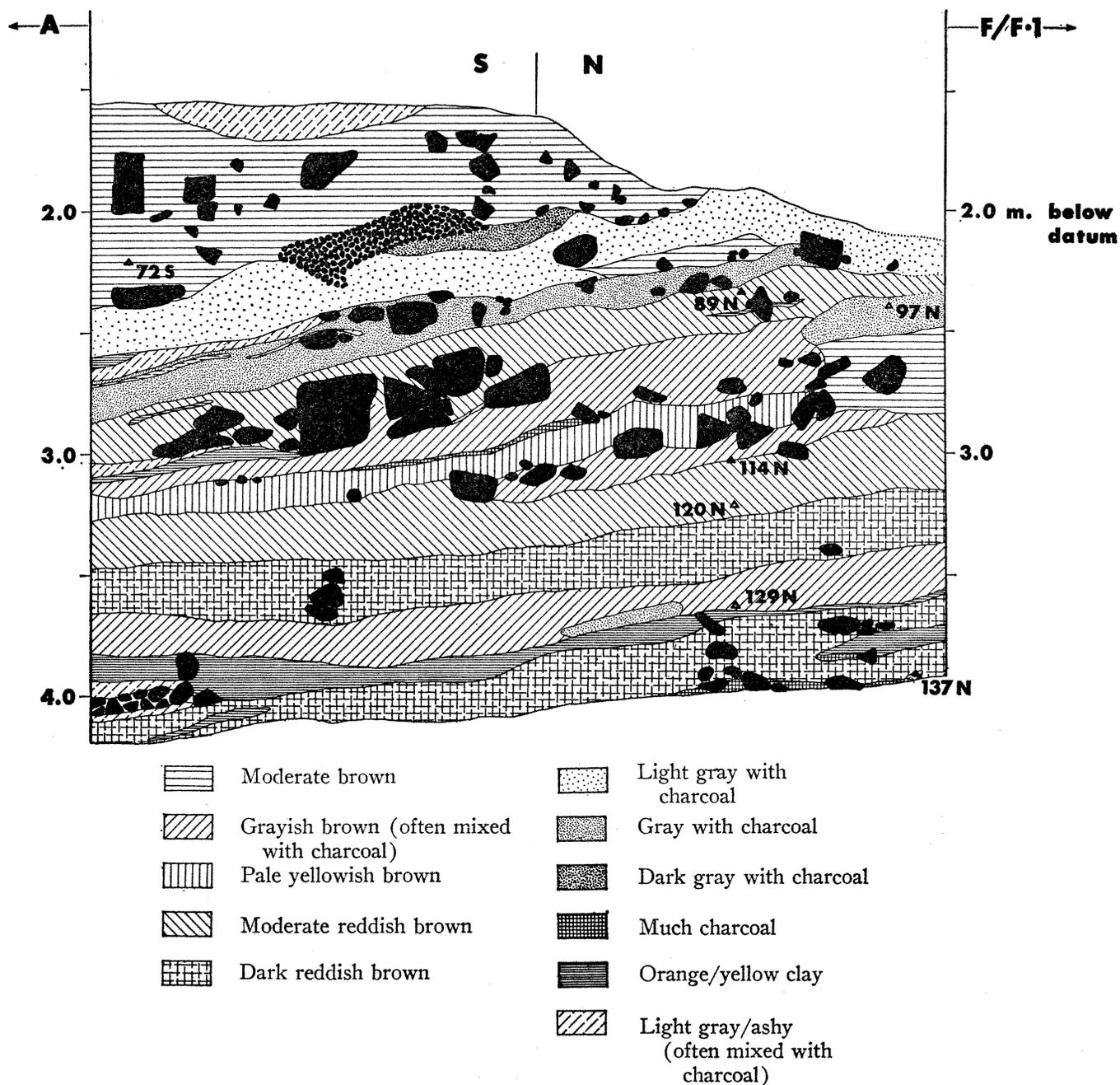


FIG. 4. Section of "West" Face of F/A Balk. Locations of Radiocarbon Dates Indicated by Open Triangles with Appropriate Unit Numbers.

to correlate the underlying Mesolithic with the sequences revealed in areas G/G-1 and H/H-1.⁸

Little work was carried out in Pit H in 1969 and 1971.⁹ Some cleaning was done in the Palaeolithic deposit at the base of sounding B—enough to secure a radiocarbon date (P-1668)—but excavation was soon suspended because of the small size of the work-space and the difficulty of access to it. Additional clearing was also conducted in a balk (*ca.* 1.65 m. \times *ca.* 1.35 m.) left in 1968 at the northern end of Pit H. The excavation, which was primarily concerned with clarifying the transition from Neolithic to Mesolithic, revealed a substantial deposit of pure Early Neolithic remains (C-14 date, P-1667) lying upon the stratigraphically distinct Mesolithic deposit. It seems very likely that there is a hiatus in the sequence at this point.¹⁰

The main objective during the past two seasons, however, has been to enlarge this area so as to permit safer and easier access to the deposits exposed here in 1968. Therefore an extension (H-1), measuring 3.00 m. (N-S) \times 4.00 m. (E-W), was opened up in 1969 to the south of and contiguous with the southern flank of Pit H (Fig. 3 and Pl. 14, c). A deep deposit of disturbed surface accumulation was again removed in shallow spits. Although it bears witness to a good deal of post-Neolithic human activity in the cave, very little evidence of reliable stratigraphy was recovered.¹¹ At a depth of *ca.* 3.50 m. (*ca.* 9.90 MASL), the area was divided into quadrants (A-D) of only roughly equal size. Quadrant A (1.50 m. \times 1.65 m.) has now been carried down through a stratigraphic column encompassing both the transition from Neolithic to Mesolithic and that from Mesolithic to Palaeolithic, a sequence covering more than 5.00 m. of stratified sediments and some 15,000 (radiocarbon) years or more (Fig. 5).¹² Undoubtedly the most significant result of this undertaking was the exposure of the deepest (some 2.00 m. or more, bearing evidence of human occupation throughout) and most carefully excavated Palaeolithic deposit from this site. At the base of this deposit was a layer of bright red (sample Munsell reading for unit A 218: 2.5 YR 4/6, "red") sediment mixed with large rocks and boulders, which made deeper excavation difficult at this point.¹³ Nevertheless, there is good evidence

⁸ It has become clear, as one might expect from any archaeological site but perhaps from caves in particular, that there has been considerable variation from time to time and area to area in the intensity of human occupation within the cave. Thus the depth of deposit and the level of any given phase in the cave's history are not uniform throughout the site. There are many possible explanations of this phenomenon, from the point of view of both natural and human activity.

⁹ Cf. *Franchthi*, I, pp. 346 and 348.

¹⁰ Cf. *Franchthi*, I, p. 348, for the situation in G/G-1.

¹¹ A charcoal sample from a hearth deposit at a depth of *ca.* 2.00 m. (*ca.* 11.40 MASL) produced an early twentieth century date (P-1663). For comments about the surface disturbance, see above, note 7.

¹² Quadrant B was also begun in 1969 and carried down to very near the Neolithic-Mesolithic interface, but work was discontinued at that point and may be resumed in 1973.

¹³ Cf. *Franchthi*, I, p. 348, for a comparable deposit. The maximum depth reached in H-1, Quadrant A, is *ca.* 4.50 MASL, as compared to *ca.* 3.00 MASL in G/G-1.

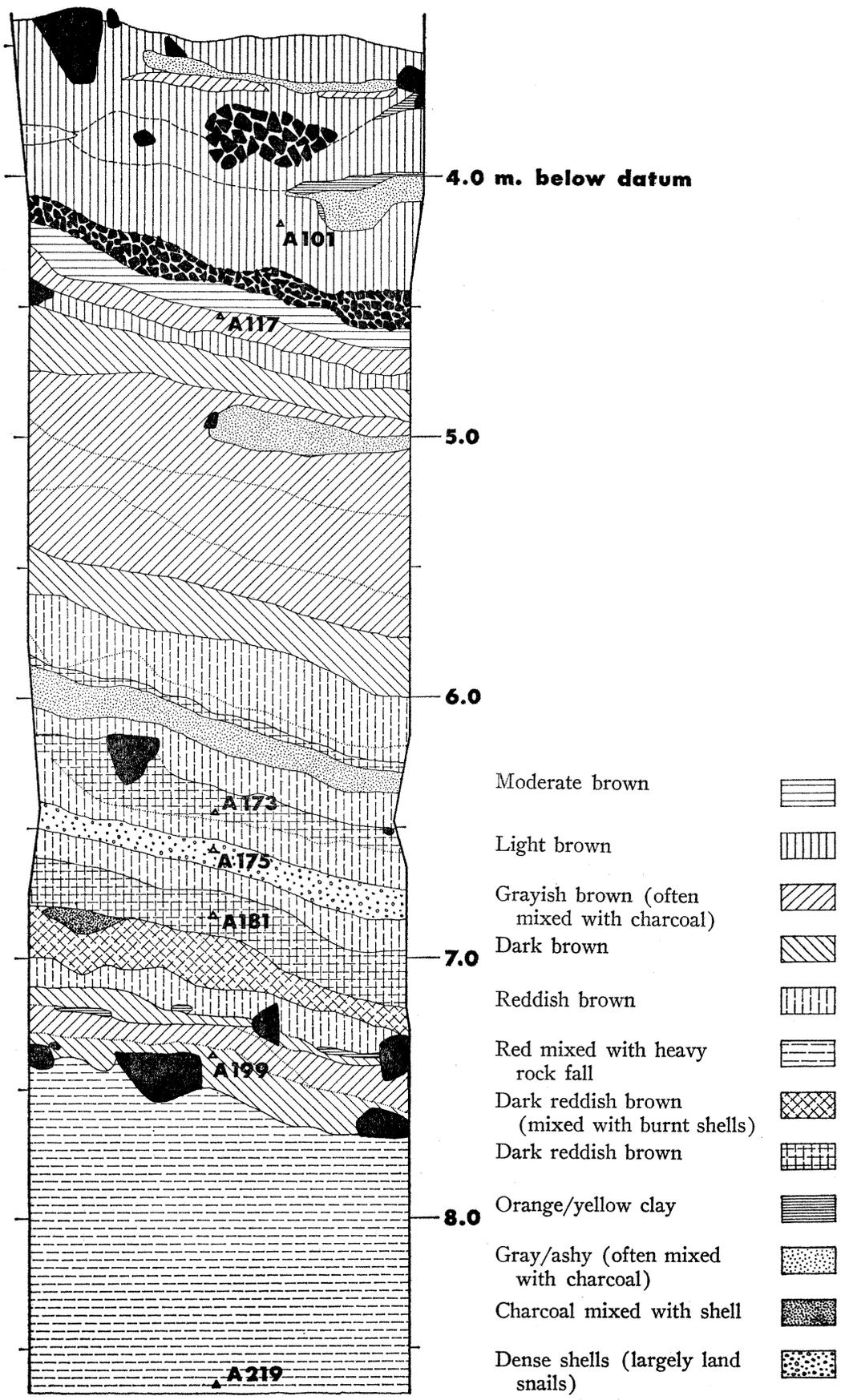


FIG. 5. Section of "South" Face of H-1, Quadrant A. Locations of Radiocarbon Dates Indicated by Open Triangles with Appropriate Unit Numbers.

to indicate that the sediments continue to a much greater depth and therefore human occupation of the site goes back to periods earlier than anything yet exposed.¹⁴ The transition from Palaeolithic to Mesolithic is marked by a relatively thick stratum (*ca.* 0.10 m.) of densely accumulated landsnail shells.¹⁵ Although only a provisional interpretation, it seems more likely that this is a midden representing the debris resulting from human activity rather than a break in the stratigraphic sequence brought about by an absence of human occupation. Radiocarbon dates (I-6129 and I-6139) of charcoal samples from within the midden (Unit A 175) and just above it (Unit A 173) suggest a gradual transition from Palaeolithic to Mesolithic at this point. Further clarification of the Mesolithic sequence—already fairly well known from previous excavation—is also provided by some 2.50 m. of well-stratified sediments in H-1, Quadrant A. The transition to the Neolithic remains to be fully explained, but there are a number of indicators pointing to the existence of a hiatus in the sequence at the end of the Mesolithic.¹⁶ It is hoped that future excavation in F/A Balk—where past experience suggests that the Mesolithic-Neolithic interface is without major interruption—will contribute to an explanation of this point in H/H-1.

The only other new area of excavation within the cave itself is Pit H-2, opened in 1971 just to the north of Pit H and separated from it by a balk 1.50 m. wide (Pl. 14, c). The pit—measuring 2.50 m. (E-W) × max. 3.85 m. (N-S, along W. scarp)—was laid out against the great rockfall beneath the present brow of the cave in order to determine its chronology if possible. Excavation was carried down to a maximum depth of slightly over 2.00 m. (*ca.* 11.00 m. MASL) and produced evidence of at least two major breakdowns from the brow: (1) sometime after (probably well after) the Neolithic (apparently when the cave was no longer heavily occupied), and (2) sometime during the Neolithic, probably in the Middle Neolithic period. Work in H-2 provided a number of surprises, not the least of which was the first significant evidence of structural features at the site. A substantial yet partially collapsed wall (max. pres. ht. *ca.* 0.80 m., w. *ca.* 0.65 m.) roughly bisecting the excavated area from east to west was exposed (Pl. 14, b, d). It consisted of large stones (some of which may have been in place as a result of a previous rockfall) filled in with smaller stones. Its exposed length (the full width of the pit) is *ca.* 2.50 m., but resistivity soundings made by Professor Kopper indicate that it continues eastward for another six to seven meters. Unfortunately, we have not been able to ascertain its westward exten-

¹⁴ Cf. T. W. Jacobsen and J. S. Kopper, *op. cit.* Resistivity soundings made by Professor Kopper with the aid of Bison Instruments, Inc., 2350 A meter indicated an additional depth of at least 8.00 m., thus more than 3.00 m. below sea level.

The combination of the presence of heavy breakdown and the proximity of ground water will make deeper penetration of the Palaeolithic very difficult if not economically impracticable. Nevertheless, means of overcoming these obstacles are being considered at the time of this writing.

¹⁵ Cf. *Franchthi*, I, pp. 348 and 380.

¹⁶ See above, p. 52, and note 10.

sion because of the presence of breakdown from the brow.¹⁷ The purpose of this wall is still uncertain, but it is possible that it served as a windbreak against the very strong northwesterly winds which—when at their worst—can make working in the cave extremely difficult.¹⁸ A small stone fireplace was built against the inner (southern) face of the wall (removed before photographs, Pl. 14, b and d, were taken). In the same general area, moreover, numerous lumps of clay daub bearing clear impressions of reeds were found (Pl. 15, a). It is not as yet apparent whether these lumps of clay were once part of a wattle-and-daub superstructure belonging to the wall or represent the remains of a small lean-to built against the inner face of the wall. A preliminary examination of the pottery associated with these finds suggests that the wall is to be dated to the early Middle Neolithic period. Finally, provisional reference must be made to a most unexpected find made during the last days of the excavation. In the course of cleaning around the wall preparatory to closing up the excavations at the end of the season, traces of a human skull were recognized beneath the base of the wall. Additional cleaning¹⁹ revealed the *upper* half, almost fully articulated, of a human skeleton (31 *Fr*, Pl. 15, b). Subsequent analysis by Dr. Angel has suggested that these are the remains of a teenage girl, but neither he nor the excavators are as yet prepared to explain the absence of the vertebrae and the lower portion of the skeleton.²⁰ There is no evidence to indicate that the burial had been disturbed by a later pit. Perhaps additional light will be shed upon the problem when excavation is resumed in this area in 1973.

Although most of our investigations have been confined to the interior of the cave, some work has continued to be conducted outside the shelter. A final enterprise of the 1969 season was the removal of the small balk (3.35 m. × 0.75 m.) left between Trenches B and E on the terrace in front of the cave (Fig. 3).²¹ Excavation reached a depth of about 0.80 m. below the present surface (*ca.* 11.50 MASL), being forced

¹⁷ It should be noted that a small bit of what appeared to be a double-faced wall turned up in the excavations in G/G-1 in 1968. Although on approximately the same orientation, the differences in construction and the date of the finds associated with the two stretches of wall tentatively suggest that they are not to be regarded as one.

Excavation behind (i.e. to the north of) the wall in H-2 produced evidence of unstratified fill, possibly deposited there at the time of construction. If this fill served as packing within a double-faced wall (which is perhaps possible), the second "face" must lie beneath the breakdown in the mouth of the cave.

¹⁸ It must be borne in mind, however, that the effect of a wind-tunnel that now exists on occasion is greatly facilitated by the presence of the huge window near the center of the cave. We can not say as yet whether or not the breakdown that created this feature had occurred by the time the wall was in use.

¹⁹ This required an extension of the season by several days.

²⁰ For a discussion of these and other Neolithic skeletal remains from the site, see Angel's report in Part II.

²¹ Cf. *Franchthi*, I, pp. 344-347.

to stop at that point because of an impenetrable mass of brecciated rockfall, much of which shows evidence of water-smoothing (Pl. 15, c). Beneath a mixed surface deposit, we came upon a thin stratum of uncontaminated Early Neolithic material, not recognized in earlier excavations in this area.²² Since the rockfall beneath this Early Neolithic stratum seems to be the result of a major breakdown, that breakdown must have occurred prior to the Early Neolithic and—in the light of the evidence from Pit H-2—may be associated with the collapse of the brow at a time when it was farther forward than it is now. Systematic study of the findings from B/E Balk may well contribute to the interpretation of the sequences exposed in the forepart of the cave.²³

Excavation was undertaken for the first time in 1971 on the slopes below the cave, just above the present shore, where a grid of five meter squares was set out along a baseline oriented approximately north-south (Fig. 2).²⁴ A trench measuring 1.50 m. (N-S) × 5.00 m. (E-W) was opened within square Q 5 in order to investigate the circumstances and environs of a fragmentary human skull seen protruding from the eroded scarp above the beach.²⁵ Excavation indicated that the skull belonged to an only partially preserved but reasonably well articulated human burial (18 *Fr*), oriented east-west (with the head toward the east). This seems to have been a primary burial of an adult female laid out in a flexed position.²⁶ Further excavation brought to light the remains of what may have been another burial (19 *Fr*)—indeed only a few scattered bones, possibly of an adult female—a short distance to the east (fully within square Q 5). Because of the incomplete state of the remains, this may well have been a secondary burial. Neither of these burials can be dated earlier and, provisionally, not later than the Middle Neolithic period. Apart from a heavily worn clay spindle whorl (FC 121) found near the secondary burial, neither of these burials provided evidence of associated grave goods. Further probing in a small test pit (1.40 m. × 1.50 m.) at the eastern end of the trial trench in square Q 5 produced valuable preliminary information about the stratigraphy of the slopes in front of and below the cave. Beneath a disturbed surface stratum, layers containing pure M. N. and an

²² Our inability to isolate this stratum in Trenches B and E in 1967 was doubtless due in part to improper excavation techniques but also perhaps to disturbance resulting from a modern burial (21 *Fr*) found in Trench E. An interesting story is told locally about the circumstances of this burial. In brief, the man (age 50, according to Dr. Angel) is said to have been an Italian soldier murdered by Nazi soldiers during the Second World War. Shortly thereafter he was buried here by the inhabitants of Koilada.

²³ Such as the possible hiatus near the Mesolithic-Neolithic interface in H/H-1 and G/G-1 (but not as yet observed in A or F/F-1).

²⁴ This area is identified in the excavation records by the Greek word for "shore", *Paralia*. The grid covers a total area of 5200 sq. m., 130 m. from north to south (A-Z) and 40 m. from east to west (1-8).

²⁵ The skull was in fact located just within square Q 6.

²⁶ For a discussion of the skeletal remains, see Part II.

even more substantial quantity of pure Early Neolithic material overlay what appeared to be a sterile deposit of reddish brown earth and partially brecciated stones.²⁷ There were no indications of structural features here, nor did evidence of an undisturbed Late Neolithic deposit come to light. More extensive excavation in this area is being planned for the 1973 season.

One might characterize the first two seasons of work at Franchthi (1967-1968) as ones largely of exploration and testing. These were also years of experimentation in terms of field techniques and methods of recovery and analysis of the excavated remains. Although such experimentation must always take place if field archaeology is to develop and progress, it is safe to say that our retrieval-efficiency has improved markedly during the past two seasons—indeed we trust that it will continue to improve with each passing season.²⁸ This improvement is in part due to a slower but more effective pace of excavation (trowels have largely replaced small picks as the standard excavation implement, so that excavated units are now normally spits of 0.05 m. or less), but recovery has of course been greatly facilitated by visual access to the stratigraphy exposed in previous seasons. Yet there are a number of other reasons for improved retrieval during the past two seasons, and probably the most important of them is the practice of wet-sieving.

We first undertook to experiment with wet-sieving during the 1969 season in response to the urging of Mr. Payne, under whose supervision it was carried out.²⁹ Excavated earth from selected units in F/A Balk and H-1, Quadrant A, which had passed through the normal dry-sieving process, was brought back to the dig house where it was water-washed in smaller sieves and carefully sorted by hand.³⁰ But this proved to be tedious, and it was not until 1971 that the procedure came to be at least partially mechanized. The wet-sieving process that we chose to adopt is one devised for D. H. French to be used on his excavations in Turkey and fully described by him elsewhere.³¹ Suffice it to say that our system departed from that described there in

²⁷ The top of the brecciated basal deposit lay at a depth of only *ca.* 1.75 m. below the present surface (*ca.* 2.25 MASL), but lack of time prevented us from penetrating it to a depth of more than *ca.* 0.20 m.

²⁸ Many aspects of our operation have, however, remained roughly the same since the early years of the excavation. The size of the Greek work-crew—nine or ten men who do most of the excavating, sieving and heavy labor—has not changed, but it has been a pleasure to witness the improving skills of some of these men as they have returned from year to year. Likewise, we have found that the demanding tasks involved in maintaining the field records require two student supervisors per excavated area. Although most of the students are with us for only one season, we are fortunate to have had some for a second and even a third year.

²⁹ For which we are very much indebted to Mr. Payne, whose wisdom and considerable field experience have contributed in no small measure to whatever success these excavations have achieved.

³⁰ For a description of the dry-sieve in use at the site (the three-part "shaker"), see *Franchthi*, I, p. 350, note 13.

³¹ D. H. French, "An Experiment in Water-sieving," *Anatolian Studies*, XXI, 1971, pp. 59-64.

only one major respect: we chose not to use the "elutriator".³² Our equipment was set up on a platform projecting into the sea at a point on the northwestern tip of the headland in order to take fullest advantage of the fresh water emanating from a sub-marine spring along the shore (Pl. 15, d). A hose was inserted in the mouth of the spring, and the water was drawn into two 1.00 m.³ reservoir tanks by means of a two hp. gasoline-driven pump. Although the entire process proved to be rather more expensive in Greece than it was in Turkey, it also proved to be of enormous value in the recovery of all kinds of material remains.³³ It was particularly useful in improving the recovery-rate of tiny objects such as beads and microscale implements, but it also expedited immeasurably the collection of carbonized plant remains. Once our equipment had been installed and was operative, all excavated earth (excluding only the largest stones, which were discarded in the trenches) from F/A Balk and H-1, Quadrant A, passed through the water-sieve.³⁴ We fully expect to resume this operation in 1973.

* * * * *

For the subsequent sections dealing with the environmental remains and some of the finds from the last two seasons of excavation, the reader should note that the following are responsible: Mr. Sebastian Payne (S. P.), British Institute of Archaeology at Ankara (fauna); Dr. Jane Renfrew (J. R.), University of Southampton, England (carbonized plant remains); Mr. Mark C. Sheehan (M. S.) and Dr. Donald R. Whitehead (D. W.), Indiana University (pollen); Miss Catherine Perlès (C. P.), Laboratoire de Préhistoire du Muséum National d'Histoire Naturelle, Paris (chipped stone tools); and Dr. Colin Renfrew (C. R.), University of Southampton, England, and Mr. J. E. Dixon (J. D.), University of Edinburgh, Scotland (obsidian analyses).

We should like to express our gratitude to Dr. French who helped to supervise the construction of our equipment. A special word of thanks is also due to Mr. Steven Diamant who—with the valuable advice and assistance of Messrs. Eugene Vanderpool, Jr., and Spiros Spiropoulos of the staff of the American excavations in the Agora at Athens—saw the development of this equipment through to its installation and ultimate use at the site.

³² For a description of this device, see French, *loc. cit.*, and M. E. Weaver, "A New Water Separation Process for Soil from Archaeological Excavations," *Anatolian Studies*, XXI, 1971, pp. 65-68.

³³ It should be noted that it is increasingly difficult in our part of Greece to find labor willing to do the demanding kind of work involved in sorting "residue" by hand. We employed six teenage girls (@ \$1.50 per day) in 1971 and learned that we will need perhaps three times that number to keep up with the work in the future. This is undoubtedly the major obstacle to the success of such a water-sieving operation.

³⁴ Since our equipment could only conveniently accommodate material from two trenches without introducing the possibility of contamination, the remaining areas of excavation continued to use only the dry-sieves. For an indication of the effectiveness of the water-sieving process, see Mr. Payne's comments below.

ANIMAL BONES

As previously reported (Payne in *Franchthi*, I, pp. 350-354), three main faunal phases have been distinguished at Franchthi Cave. The earliest (Palaeolithic) phase, whose date has now been confirmed by several C-14 determinations, is characterized by the presence of *Equus* and *Capra*. These are absent in the second (Mesolithic) phase, in which the bone samples are dominated by red deer. The beginning of the third (Neolithic) phase is marked by the appearance of sheep and goat, which dominate the bone samples from this point on.

Within each of these main phases, evidence is now emerging of significant faunal changes.

PALAEOLOGICAL AND MESOLITHIC

The best sequence through the Palaeolithic and Mesolithic deposits is given by Pit H-1: A, though the top of the Mesolithic is probably missing. Figure 6 presents a preliminary⁸⁵ picture of faunal change through this sequence, together with the available C-14 dates.

Five phases can tentatively be recognized, characterized as follows:

- | | |
|--|---|
| <p>A Units A 220-215, Palaeolithic. Equid dominant (<i>ca.</i> 70%). Red deer <i>ca.</i> 30%. Pig, hare, tortoise and birds present. Probably distinct from B, though samples rather small.</p> <p>B Units A 206-191, Palaeolithic. Equid down to <i>ca.</i> 40%, red deer <i>ca.</i> 25%. Large bovid and <i>Capra</i> appear (<i>ca.</i> 25% and <i>ca.</i> 10% respectively). Small fish bones appear, though rather scarce. Fox and mole rat appear about half-way through (198, 199).</p> <p>C Units A 187-175, Palaeolithic. Red deer now dominant (<i>ca.</i> 70%). Equid down to <i>ca.</i> 20% at base, decreasing above. Pig increased to <i>ca.</i> 10%. Large bovid absent. <i>Capra</i> sporadic, averaging <i>ca.</i> 10%. Voles appear.</p> | <p>D Units A 166-101, Mesolithic. Equid and <i>Capra</i> have disappeared. Red deer dominant (<i>ca.</i> 70% at base, increasing above). Pig <i>ca.</i> 30% at base, decreasing above. Large bovid scarce. Fox abundant, hare and birds common. Hedgehog appears (160). Mole rat has disappeared.</p> <p>D1 Units A 166-127. As in B and C, small fish bones are present, but rather scarce; they are notably scarce between 160 and 175.</p> <p>D2 Units A 119-101. Fish bones increase to 20-40% of the total bulk of bone; even more in some units. Mainly large fish bones (vertebrae 2-4 cm. in diameter).</p> |
|--|---|

These changes suggest that open rather dry conditions in A slowly gave way to more wooded conditions through B, C and D.⁸⁶ As temperatures were increasing,

⁸⁵ Preliminary not only because time and available comparative specimens were limited, but also because these results are based either on the bones collected in the pit (H-1: A 162, 164-220), or on the bones recovered by dry-sieving (H-1: A 101-161, 163). Most of the units were water-sieved, but many of the residues have not yet been sorted, so that the animal bones are not yet available. Sample results from water-sieved units are described below (pp. 64-65, Table 1, Pl. 16).

⁸⁶ Much the same picture is indicated by recent palynological evidence from Northern Greece

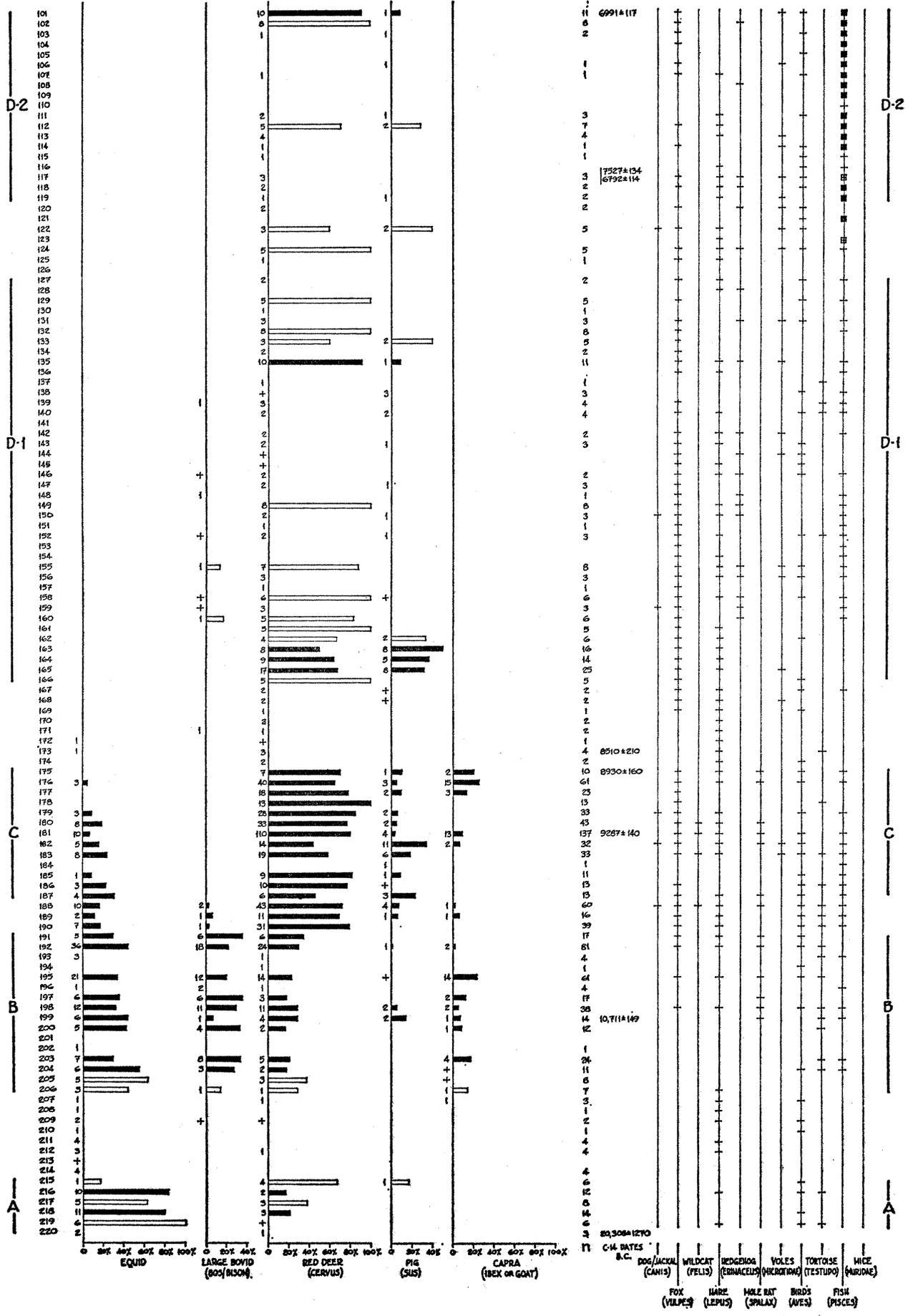


FIG. 6. Faunal Change through Palaeolithic and Mesolithic Deposits in H-1, Quadrant A. The units are arranged in numerical order, which corresponds fairly closely but not exactly to their relative stratigraphic position. For the larger mammals, the following were counted: jaws only with at least one tooth of which more than half is present; single teeth when more than half is present; and the following only when some part of the articular surface (or, in the case of an unfused shaft, the fusion surface) is present: scapula, glenoid or coracoid; distal humerus; proximal ulna; proximal or distal radius; distal tibia; proximal or distal metapodial; astragalus; calcaneum; all phalanges. Percentages are calculated for each unit on the basis of the number of counted bones of the larger mammals, which is also given in the figure (n). When n is less than 5, no percentage is plotted; when n is 5-9, percentages are plotted as open bars; when n is 10 or more, percentages are plotted as solid bars. Smaller mammals and other animals are not treated numerically: + = present. In the case of fish, the amount of fish bone was estimated visually as a percentage of the total bulk of animal bone in each unit: + = present but less than 10%; ☒ = 10% to 20%; ■ = 20% or more. Other species present in small numbers have not been included.

this would imply that rainfall in this area in the early Holocene was substantially higher than in the last part of the last glaciation. At the same time heavy tree cover is not indicated even in D, and the steeper rockier slopes were probably still unwooded. Work on the smaller mammals and bird bones from the cave will play an important part in confirming or changing this picture; it is also to be hoped that additional palynological evidence will be available.

Economically, a striking feature is the change in the abundance and size of fish bones between D1 and D2. Small mammals and birds are relatively commoner in D than in the earlier phases, but this needs fuller documentation when water-sieved samples become available. Also noteworthy is the abundance of animal bones in B and C; the excavators describe much of these deposits as bone middens. The following interpretation is tentatively put forward—not as a final product, but as something to be considered and tested in future work.

Increase in temperature and rainfall in late A and B combined to produce a considerable improvement in grazing conditions in B, with large areas of good open grazing, indicated by the peak in large bovids. Conditions were very favorable for man's exploitation of the large herbivores, whose biomass was at a much higher level than in A. Through C and into D, expansion of tree cover, combined perhaps with the rise in sea level, slowly reduced the amount of good grazing. Under these less favorable conditions, exploitation shifted first to make more use of the smaller mammals and birds, and then to an increased use of fishing, probably using boats.

MESOLITHIC/NEOLITHIC CHANGE

One of the most interesting and important parts of the Franchthi Cave sequence is that covering the change between the Mesolithic and the Neolithic. Unfortunately it appears that the deposits of this period have been particularly subject to disturbance and local erosion, so that in the trenches at the front of the cave there is a hiatus at this point. The available evidence was discussed in the first preliminary report; there is little to add to this at present. One of the main aims of the next season of excavation will be to examine this change with great care in F/A Balk. This lies toward the back of the cave between Pits F and A, which have given the best evidence so far.

NEOLITHIC

F/A South Balk provides the best available sequence from Middle through Late Neolithic. Figure 7 presents a preliminary³⁷ picture of the fauna through these deposits. Four phases can tentatively be distinguished, though the differences between them are much smaller than those between the earlier phases.

and in other parts of the Eastern Mediterranean. Cf. T. A. Wijmstra, "Palynology of the First 30 Metres of a 120 m. Deep Section in Northern Greece," *Acta Bot. Neerl.*, XVIII (4), 1969, pp. 511-527.

³⁷ See footnote 35 above. F/A 39, 45 and 59S-72S were recovered by dry-sieving; F/A 73S-126S are trench-collected samples.

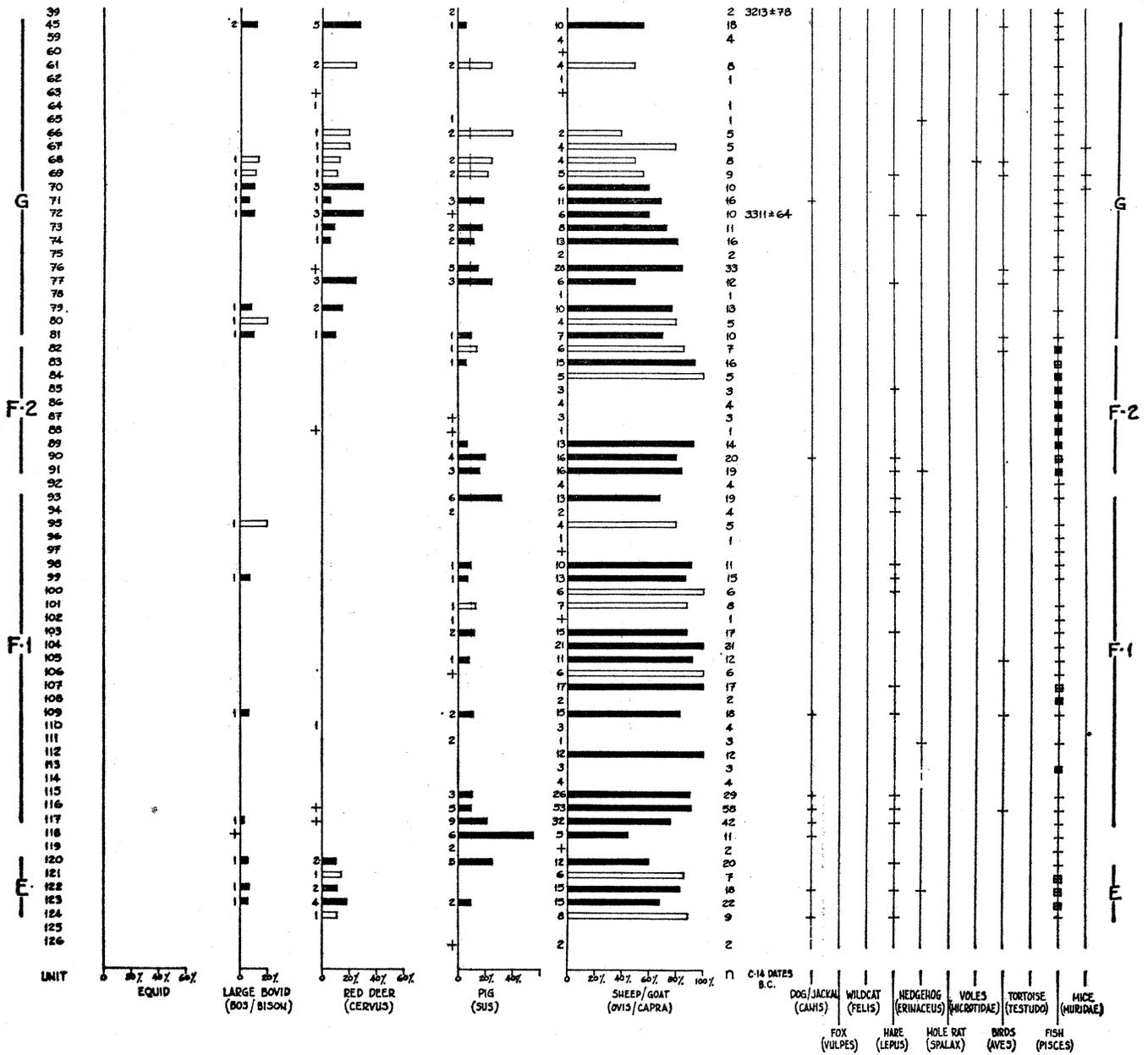


FIG. 7. Faunal Change through Middle and Late Neolithic Deposits in F/A South Balk. See Comments in Caption of Figure 6.

TABLE 1. SAMPLE RESULTS OF WATER-SIEVING.

	Red deer (Cervus)	Pig (Sus)	Sheep/goat (Ovis/Capra)	Carnivora	Hare (Lepus)	Hedgehog (Erinaceus)	Bird (Aves)
F/A 76 S Late Neolithic	+	5	28	1 cf. <u>Meles</u>			1
	1	2	34	1 <u>Meles</u> 4 <u>Vulpes/Canis</u> 1 unid. small	5		7 2 pieces of eggshell
H-1: A 111 Mesolithic	2	1			5		3
	1	2		5 cf. <u>Vulpes</u>	13	1	2
H-1: A 131 Mesolithic	3			13 cf. <u>Vulpes</u>		1	1
	1			12 cf. <u>Vulpes</u> 1 cf. <u>Meles</u>	3		1

Fish (Pisces)	Snakes (Ophidia)	Mice (Muridae)	Voles (Microtidae)	Bats (Chiroptera) and shrews (Soricidae)	Amphibia
Fragments include 1 vertebra, 1 jaw					
Many fragments, including ca. 75 small vertebrae and 7 jaws	ca. 25 vertebrae	4 jaws, many teeth	2 jaws, teeth	2 jaws, tooth	+
Fragments include 10 large vertebrae					
Fragments include 2 vertebrae	1 vertebra	1 jaw	1 jaw, teeth	1 jaw	
1 small vertebra			1 jaw		
Fragments include 11 small vertebrae, 2 jaws	+		1 tooth	4 jaws	

- E Units 124-120 S, Middle Neolithic. Sheep/goat *ca.* 70-75%, pig *ca.* 10%, red deer *ca.* 15%, cow *ca.* 5%. Fish around 10% of the total bulk of animal bone; large fish present. Though the samples are rather small, they so closely resemble the Middle Neolithic samples from Pit G-1 described in the first preliminary report that it seems reasonable to recognize this as a distinct phase.
- F Units 117-82 S, Middle/Late Neolithic and Late Neolithic. Sheep/goat increase to *ca.* 90%, pig still *ca.* 10%, cow and red deer very scarce.
- F1 Units 117-93 S. Fish around 5% of the total bulk of animal bone.
- F2 Units 91-82 S. Fish increase to 20-40% of the total bulk of animal bone.
- G Units 81-59 S and 45, Late Neolithic. Sheep/goat down to *ca.* 70%, pig *ca.* 10-15%, red deer and cow increase to *ca.* 10-15% and *ca.* 5% respectively. Fish usually less than 5% of the total bulk of animal bone; nearly all small fish, unlike earlier phases.

The most striking feature is the dominance throughout of sheep/goat. The scarcity of cow and red deer in F is interesting, but difficult to interpret at this stage.

WATER-SIEVING

The results presented above are based on the animal bone samples recovered either in the trench, or by dry-sieving. As a result of water-sieving experiments carried out at Franchthi Cave and other sites,⁸⁸ water-sieving on a large scale has started at the cave, but only a small proportion of the resulting residues has as yet been sorted. In order to give some indication of how this will change and amplify the results given above, preliminary results for three sample units are given in Table 1; some of the smaller bones recovered by water-sieving are illustrated in Plate 16.

S. P.

PLANT REMAINS: AN INTERIM REPORT

Seeds and nutshells have been recovered from Palaeolithic, Mesolithic and Neolithic levels in the Franchthi Cave by sieving and by flotation. The identification of the material is in progress. The following results obtained so far give an indication in outline of the general results; the presence of species should be regarded as more important than their absence in interpreting these figures. An illustrated and much more detailed discussion will be presented in the final report.

Findings from the Palaeolithic levels include both carbonized seeds of lentils (*lens* sp.) and vetch (*vicia* sp.) and calcified seeds of gromwell (*lithospermum*) and alkanet (*anchusa*) and were recovered by flotation.

A number of samples have been examined from the Mesolithic levels in the cave and with only two exceptions they have yielded only the shells of *pistacia atlantica* nutlets and almonds.

⁸⁸ S. Payne, "Partial Recovery and Sample Bias: The Results of Some Sieving Experiments," in E. S. Higgs, *Papers in Economic Prehistory*, Cambridge, 1972.

TABLE 2. SEEDS FROM PALAEO-LITHIC LEVELS.

LEVEL	GROMWELL (<i>Lithospermum arvense</i>)	LENTIL (<i>Lens</i> sp.)	VETCH (<i>Vicia</i> sp.)	ALKANET (? <i>Anchusa</i> sp.)
H-1: A 193	—	1	—	—
H-1: A 200	—	1	—	—
H-1: A 203	4	4	1	—
H-1: A 205	4	—	—	—
H-1: A 209	110	—	—	—
H-1: A 213	43	—	—	—
H-1: A 217	—	—	—	5

The Mesolithic levels have yielded material from both flotation and sieving. Many of the samples containing nut shells were recovered from the sieves, but those which were floated have so far not added to the species list for the Mesolithic levels.

The first indications of agriculture occur in the Neolithic deposits, previously indicated by the appearance of the bones of domestic animals. It is significant that

TABLE 3. SEEDS FROM MESOLITHIC LEVELS.

LEVEL	PEA	VETCH	PISTACHIO	ALMOND
H-1: A 99	—	—	—	2
H-1: A 101	—	—	—	3
H-1: A 106	—	—	—	3
H-1: A 109	—	—	—	1
H-1: A 111	—	—	—	1
H-1: A 117	—	—	5	14
H-1: A 126	—	—	3	19
H-1: A 127	2	1	35	54
H-1: A 128	—	—	10	23
H-1: A 129	2	—	55	157
H-1: A 130	—	—	1	1
H-1: A 131	—	—	72	175
H-1: A 144	—	—	—	+
H-1: A 145	—	—	—	+
H-1: A 159	—	—	+	+
H-1: A 160	—	—	—	+
H: 61 (1968)	—	—	22	2
H-1: A 163	—	—	+	+
H-1: A 167	—	—	2	—

none of the cultivated plants occur in their wild forms in earlier levels, with the exception of the lentil.

Both wheat and barley were cultivated as cereal crops and lentil is so far the only pulse crop found. Almonds and pistachios were still collected.

TABLE 4. SEEDS FROM NEOLITHIC LEVELS.

LEVEL	EMMER WHEAT	6 ROW BARLEY	BARLEY	LENTIL	PISTACHIO	ALMOND
<i>Late Neolithic</i>						
F/A 104 S	—	—	1	—	—	—
F/A 106 N	—	—	—	—	—	1
F/A 107 N	—	—	—	—	2	—
<i>Middle / Late Neolithic</i>						
A 52 (1968)	1	—	—	—	—	—
<i>Early / Middle Neolithic</i>						
H-1: A 88-9	—	—	4	2	—	—
H-1: A 89	3	4	—	2	—	3
H-1: A 92	—	—	—	—	—	1
H-1: A 93	—	3	—	—	—	—
H-1: A 93 (R)	—	—	4	1	—	—
H-1: A 94	—	—	—	—	—	1
H-1: A 95	—	—	1	—	—	—
<i>Early Neolithic</i>						
H-1: A 97	—	—	1	—	1	2

CONCLUSIONS

The results of analyses made so far indicate that there is, for the first time in Greece, evidence for the utilization of plants in Palaeolithic deposits. They also indicate, so far, that the progenitors of the cereal crops, or other forms of grass seeds were not much valued, but the completion of the analyses will give more weight to negative conclusions of this sort.

The Mesolithic levels are chiefly typified by the regular presence of almond nuts and pistachios, and these continue to be in evidence in the Neolithic levels where they may have been brought into the cave by shepherds who collected them while tending their flocks.

The Neolithic levels are the first ones to give evidence of domesticated plants, and these crops at least are represented: emmer wheat (*Triticum dicoccum*), six-row barley (*Hordeum vulgare*) and lentil (*Lens esculenta*).

J. R.

POLLEN ANALYSIS OF FRANCHTHI CAVE SEDIMENTS: PRELIMINARY RESULTS

Franchthi Cave's long and essentially unbroken cultural sequence plus its morphology (broad entrances permitting pollen influx) make it potentially interesting from a palynological point of view. The obvious importance of the site warranted the initiation of a palynological investigation, despite the fact that the cave's environment is not ideal for pollen preservation due to alkaline sediments and periodic wetting

TABLE 5. PRELIMINARY TABLE OF POLLEN TYPES, OCTOBER, 1972.

Sample Number	Associated Level (Unit No.)	Phase	Pinus	Juniperus	Tiliaceae	Gramineae	Quercus	Pistacia	Cistaceae	Oleaceae	Dipsacaceae	Compositae Cynareae	Compositae Cichoreae
A - 17a	F/A 73s	L. N.	-	-	-	1	1	-	-	1	-	-	-
A - 16	F/A 78-79S	L. N.	-	-	1	-	-	-	-	-	-	1	-
A - 15	F/A 90-92S	L. N.	-	-	-	1	1	-	-	1	-	1	-
A - 13b	F/A 113S	L. N.	-	2	1	5	3	-	-	1	-	2	1
A - 11	F/A 116-117S	L. N./M. N.	-	-	-	1	-	-	-	-	-	-	-
A - 7b	F/A 122S	M. N.	-	-	6	3	-	-	-	-	-	1	-
A - 6	A 56*	M. N./E. N.	-	-	-	-	-	-	-	-	1	-	-
A - 5	A 63-65*	Aceramic N.	-	1	-	2	-	1	-	-	4	3	-
A - 4	A 66*	A. N./Mesol.	-	1	-	-	-	-	-	-	-	-	1
A - 2	A 67*	Mesolithic	-	-	-	-	-	-	-	-	-	1	5
G-1 - 2	G-1 66	Palaeolithic	-	-	-	1	-	-	-	-	-	1	-
G-1 - 1	G-1 67	Palaeolithic	1	-	-	-	-	-	-	11	1	10	4

* Only approximate correlations with excavated stratigraphic units.

and drying. The study was begun in the summer of 1969 on a suite of 15 samples collected by Dr. T. W. Jacobsen and associates from the freshly exposed scarps of Pits G-1 and H. We found pollen to be present, but in extremely low concentrations. Nevertheless, there was sufficient pollen to suggest the desirability of further study.

During the summer of 1971 we collected a suite of 15 samples from Pit H-1, including samples from the deepest Palaeolithic levels excavated that year. In addition, 20 samples representing 17 stratigraphic levels were collected from Pit A. These have been processed and preliminary analysis completed.

Initially all samples were processed using the standard HF-acetolysis technique of Faegri and Iversen.³⁹ This method yielded pollen from only a few levels. In an attempt to increase the pollen yield, other techniques were attempted: (1) an oil flotation technique,⁴⁰ and (2) a heavy-liquid separation.⁴¹ Both of these methods failed to yield greater pollen numbers. The results to date are presented below and in Table 5.

PIT G-1

*Sample G-1-1.*⁴² This sample represents the deepest level excavated from Pit G-1 and dates from the later Palaeolithic.⁴³ The pollen included 15 Compositae (sunflower family) grains of which four are of the tribe Cichoreae and 11 from the tribe Cynareae. Species of both of these tribes are well represented in the modern flora of the Argolid. Virtually all are spiny, thistle-like plants. One of the Cynareae grains can be assigned to the genus *Echinops*. Also found were 11 Oleaceae (olive family) grains, one of which could be identified as *Olea* (olive). The other ten were too poorly preserved to permit generic identification. A single Dipsacaceae grain (teasel family) and a single Juniperus (juniper) were also identified.

Sample G-1-2. From the Palaeolithic directly above sample G-1-1. It contained but a single *Quercus* (oak) grain and a single Dipsacaceae.

PIT A

Samples were taken from the north face of the pit which later became the south face of F/A Balk. Hence our sample numbers for those levels in F/A which were excavated in 1971 can be correlated with F/A unit numbers. For pollen from the lower levels the only correlations possible at present are with the units excavated in Pit A in 1967. Therefore the correlations are (temporarily) less accurate than they will be when deeper excavation takes place in F/A in 1973.

³⁹ K. Faegri and J. Iversen, *Textbook of Pollen Analysis*, Munksgaard, Copenhagen, 1964.

⁴⁰ E. B. Kurtz and R. M. Turner, "An Oil Flotation Method for the Recovery of Pollen from Organic Sediments," *Micropaleontology*, III, 1957, pp. 67-68.

⁴¹ D. G. Frey, "A Differential Flotation Technique for Recovering Microfossils from Inorganic Sediments," *The New Phytologist*, LIV, 1955, pp. 257-258.

⁴² All "sample numbers" in this report are our pollen sample numbers and are not to be confused with the archeologists' stratigraphic unit numbers.

⁴³ Cf. *Franchthi*, I, pp. 353-354.

- Sample A-1.* Mesolithic, 5.30 m. below the F/A datum point. No pollen.
- Sample A-2.* Mesolithic, 5.05 m. below the F/A datum point. Sample contained 1½ *Pinus* (pine) and 6 composites (five Cichoreae, one Cynareae).
- Sample A-4.* Aceramic Neolithic-Mesolithic transition zone, 4.70 m. below datum point. Sample contained one composite (Cichoreae) and one Liliaceae (lily family) grain. The Liliaceae grain was quite large.
- Sample A-5.* Roughly correlated with the Aceramic Neolithic level, 4.40 m. below datum point. Sample yielded four Dipsacaceae, three Cynarean composites, two oaks, one Liliaceae, and one *Cistus* (rockrose, family Cistaceae).
- Sample A-6.* Can be only very approximately correlated with Unit 56 of Pit A which is radiocarbon dated at 5244 ± 122 years B.C., 4.10 m. below datum point. It has yielded only a single Dipsacaceae grain.
- Sample A-7b.* Middle Neolithic (F/A 122 S), 3.85 m. below datum point. Sample contained three oaks, one badly corroded composite, and six grass pollen (family Gramineae). Of the grasses, three are of the "*Festuca*-type" (characteristic of non-cultivated grasslands, thus non-agricultural), while three are clearly cereal types, probably *Triticum*.
- Sample A-11.* Middle Neolithic to Late Neolithic transition zone (F/A 116-117 S), 3.50 m. below datum point. It yielded but a single oak pollen.
- Sample A-13b.* Late Neolithic (F/A 113 S), 3.20 m. below datum point. Sample contained one *Festuca*-type grass pollen, five oaks, one Cichorean composite, two Cynarean composites (one of which was an *Echinops*), three *Pistacia* (pistachio), and two Liliaceae.
- Sample A-15.* Late Neolithic (F/A 90-92 S), 2.65 m. below datum point. Sample yielded one Cynarean composite, one *Olea*-type, and one oak.
- Sample A-16.* Late Neolithic (F/A 78-79 S), 2.30 m. below datum point. Sample contained only one *Festuca*-type and one Cynarean composite.
- Sample A-17a.* Uppermost Neolithic level sampled (F/A 73 S), 2.10 m. below datum point. Contained only one *Olea*-type and one oak pollen.

PITS H AND H-1

All efforts have failed to produce any pollen from the samples collected from Pits H or H-1. The position of these pits in the cave (higher and more central) suggests conditions less favorable for pollen preservation in the sediments (due to more oxidation and more extreme drying).

DISCUSSION

Although an approximately equal volume of sediment from each level was prepared, there are obvious differences in the numbers of grains found. These differences probably reflect both differing rates of sedimentation and pollen decomposition through time.

Nearly all of the levels which bore pollen contained several grains which have not yet been identified. Work toward identifying these grains is now in progress.

Obviously it is too early to draw any paleoecological conclusions from the sparse data presented above. Many hours of extremely tedious microscopy will be necessary to expand this preliminary report into one of significance. The fact that F/A Balk

contains pollen in its upper, more oxidized levels whereas similar levels in G-1 are barren leads us to hope that as F/A is excavated through Mesolithic and into Palaeolithic sediments it will provide a more meaningful and abundant pollen spectrum than has hitherto been encountered.

To supplement the data from the cave sediments, cores of sediment for pollen analysis were extracted from two salt lagoons on the eastern coast of the Hermionid (Fig. 1: Thermisi and Saktouri), from a salt lagoon northwest of Porto Cheli and from the harbor at ancient Halieis. The cores ranged in length from 2.00 m. to 5.30 m. and indications at present are that their basal sediments will date from about 4,000-5,000 years B.P.⁴⁴ Preliminary analyses have shown pollen preservation to be moderately good so it is predicted that these cores will provide important information concerning the environment of the area from the Bronze Age to the present.

M. S. AND D. W.

THE CHIPPED STONE INDUSTRIES

PALAEOLITHIC

Late Pleistocene industries were found in Pit H-1 in Units A 220 to A 175. These units gave from one to 200 artifacts each, with up to 35 retouched pieces per unit; although larger samples would be desirable, the importance of this well-stratified and dated Upper Palaeolithic is considerable, especially in a country where so little is known about it.

Every unit has been water-sieved, but the residues have not been sorted out yet. The industry being small in size, one can expect the amount of retouched pieces to be in fact more substantial than stated here. Consequently, all the numbers or percentages given here are strictly provisional, and some observations might be contradicted by further studies.

Raw Material. The raw material picked up and brought into the cave by Palaeolithic people is rather varied. It consists mainly of flint (pale and dark green, red and chocolate) and chert (yellow, brown, green or mixed) with, in lesser quantity, shale, limestone, marble, siltstone and some crystalized rocks. The flaking quality is very poor, since even the flint often has limestone inclusions. Only the red and brown flints show better qualities, and it is significant that they have been chosen preferentially for the preparation of backed bladelets. Most of this material, if not all, must have been found locally, as either land stones or sea and river pebbles.

Debitage. Flakes are largely dominant. Of the five larger units (A 190, A 195,

⁴⁴ Cf. H. E. Wright in W. A. McDonald and G. R. Rapp, Jr., *The Minnesota Messenia Expedition*, Minneapolis, 1972, pp. 188-199.

A 197-199), the relative percentages are the following: flakes, between 65.86% and 78.97%; blades, between 4.54% and 9.67%; bladelets, between 20.96% and 26.47%. The high proportion of bladelets compared to blades can be explained by the small size and bad quality of the cores, which do not easily allow the striking of blades from them. Thus, the high amount of flakes and bladelets in this industry must be considered more as a technical constraint than a cultural characteristic. The products of debitage are all of small size; although one blade with a length of 8 cm. is found in A 199, the average is about 4 cm. for the blades and 3.5 cm. for the flakes.

The butts are mainly unfaceted and cortical, with still a fairly large amount of punctiform. This corresponds to the general use of soft hammer percussion for flakes and punch percussion for blades and bladelets. Cores and core rebutes (as well as some unstruck pieces) are very abundant. In many cases they were discarded after a few flaking attempts, when of too poor quality. Quite a number show clear evidence of heating, as if thrown into fire-places, a common Upper Palaeolithic practice. The real cores present a great variety in shape and technique, depending on the raw piece; most of them are irregular with no preferential striking directions, others are polyhedral, subconical, cubical, or flat with opposite or perpendicular striking directions.

Retouched Pieces. The proportion of retouched pieces, compared with the totality of intentional products of debitage (i.e. flakes, blades and bladelets, retouched or not), is surprisingly high; in the five larger units, it is between 18.56% and 24.38%. This cannot be explained by the scarcity of good raw material, since in the Mesolithic, when exactly the same raw material was used, this percentage drops to a mean of 4%. It is thus a characteristic of this Upper Palaeolithic industry. Steep and short marginal retouch are both very common, and exclusive of long flat retouch.

(1) By far the dominant tools are the backed bladelets (Pl. 17, a); nearly a hundred have been already recovered, and this number will undoubtedly increase notably with the water-sieving residues. They are usually small (often fragmentary) and relatively narrow; the longest intact example does not exceed 3.05 cm.^{44a} Most of them are prepared by direct retouch, a few by direct and inverse retouch (*sur enclume*) and none of the analyzable ones by inverse retouch.⁴⁵ It is noteworthy, too, that most of the pieces about which it can be determined with some certainty present a left back.⁴⁶ By their morphology, they can be divided into two main categories, unpointed and pointed. Sub-groups can be distinguished in each: bladelets with intact

^{44a} Length usually between 1.3 and 1.9 cm. Width usually between 0.6 and 0.9 cm. Thickness usually between 0.25 and 0.4 cm.

⁴⁵ Direct retouch, 97.7%; inverse and direct retouch, 2.3%. This difference is statistically significant at $\alpha > 0.001$.

⁴⁶ Left back, 75.32%; right back, 24.67%. The difference is statistically significant at $\alpha > 0.01$.

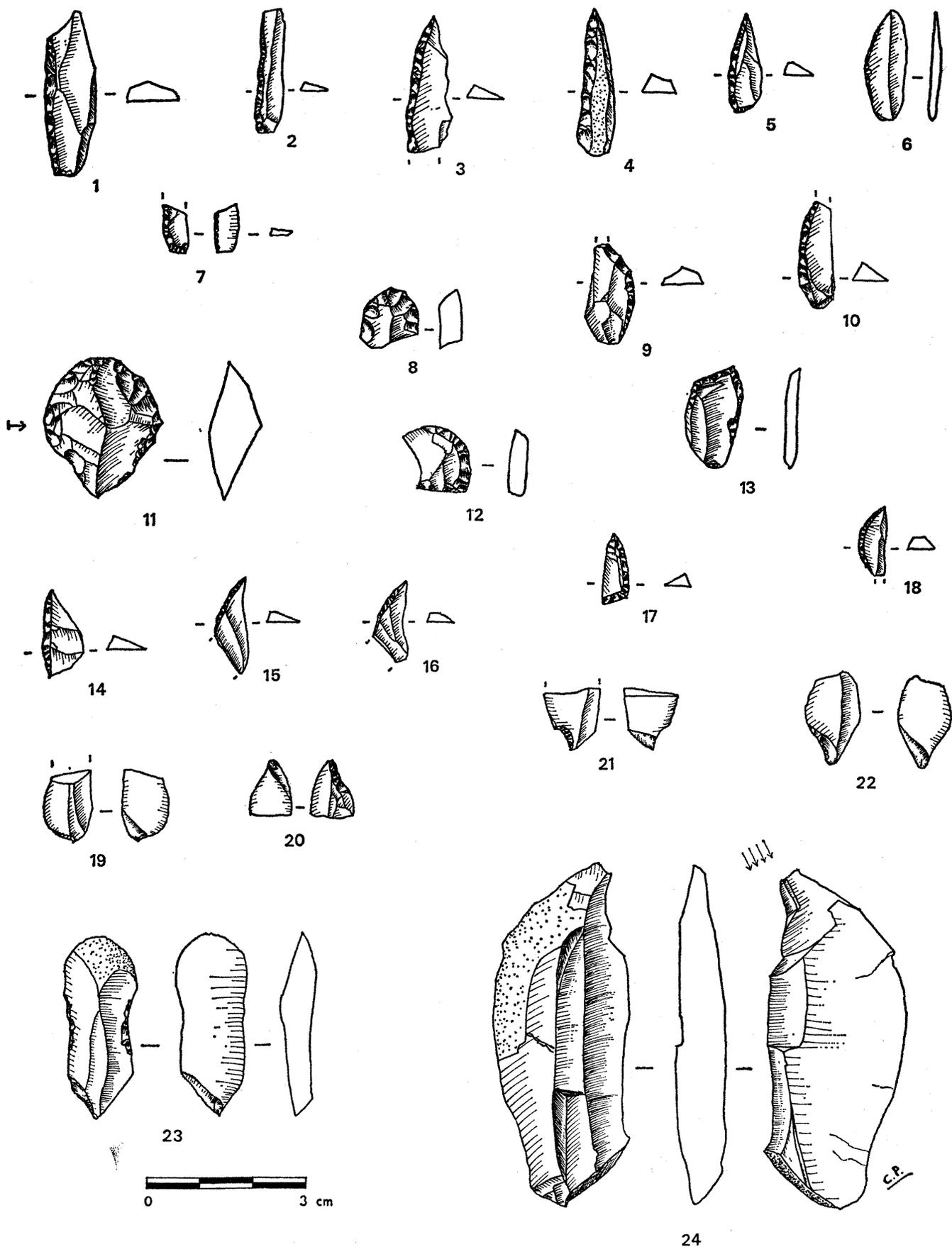


FIG. 8. Upper Palaeolithic tools. 1, backed blade; 2-5, 7, 9, 10, backed bladelets; 8, 11, 12, end-scrapers; 13, truncated blade; 14-16, microlithic tools of geometric shape; 17, 18, geometrics; 19-23, microburins; 24, multi-faceted burin.

proximal end and bladelets with retouched proximal end. Furthermore, the backs can be straight or curved, or straight and curved at the distal end (Fig. 8, Nos. 1-5, 7, 9, 10). These distinctions appear to be chronologically significant (see below).

(2) End-scrapers. Eight times less abundant, they constitute nevertheless an interesting group for the chronological attribution of this industry. End-scrapers on blades are rare, and most of them belong to two types: small scrapers on flakes, tending to the circular scraper, or thick steep end-scrapers (Fig. 8, Nos. 8, 11, 12).

(3) Burins. Rare but typical, they are always angle multi-faceted burins (Fig. 8, No. 24). Other typical Upper Palaeolithic tools, such as notched blades or truncated pieces, are present, as well as flakes or blades with continuous retouch on one or two edges.

(4) Microburins. A most important feature of this industry is the presence of microliths associated with the use of the microburin technique. Thirty microburins, plus four Krukowski microburins have already been found; they show an unusually high proportion of left distal microburins. The right ones are rarer, but they tend on the contrary to be proximal (Fig. 8, Nos. 19-23).⁴⁷

(5) Geometric microliths. Although very few true geometrics have been discovered, their presence is important and one may hope that the water-sieving residues will show more of them. For the moment, the only ones are two lunates, two elongated scalene triangles and one isosceles triangle (Fig. 8, Nos. 17 and 18). Some other microliths of geometric shape should be noted as well, though by their technique they cannot be considered as pure geometrics: for example, two triangular tools with a fractured edge instead of truncation and a trapezoidal tool with the long edge retouched (Fig. 8, Nos. 14-16).

Stratigraphic Distribution. As far as the number of retouched tools in these units allows reliable stratigraphic observations, three groups of units can be distinguished.

(1) A 220 to A 204: units rather poor, containing almost entirely backed bladelets (apart from the blanks). These backed bladelets are mostly unpointed with a straight and high back. Unit A 219 was dated $22,330 \pm 1270$ B.P. (I-6140), and, both from the date and from the analysis of the implements, it seems that these levels can be compared to levels 6 to 9 of Asprochaliko.⁴⁸

(2) A 203 to A 190-188: appearance of microburins, microlithic tools, small circular scrapers, pointed backed bladelets and bladelets with curved back. These levels are richer, and the tools more diversified. Unit A 199 was dated $12,543 \pm 176$ B.P.

⁴⁷ The distribution of the microburins is as follows:

Left, 64.29%; right, 35.71% (statistically insignificant). Proximal, 25.00%; mesial, 7.13%; distal, 67.85% (statistically significant at $a > 0.001$).

⁴⁸ E. S. Higgs and C. Vita-Finzi, "The Climate, Environment and Industries of Stone Age Greece: Part II," *Proceedings of the Prehistoric Society*, XXXII, 1966, pp. 1-29.

(P-1827). Although geometric microliths seem to be less abundant, certain affinities can be seen between these levels and the upper levels from Asprochaliko.⁴⁹ On the other hand, the levels from Kastritsa which can be dated from the same period completely lack the geometric element.⁵⁰

(3) A 187 to A 175: all of these types disappear, and the proportion of retouched pieces decreases. Denticulates, notches and marginally retouched flakes constitute the basis of the industry. This group corresponds to the very end of the Palaeolithic (dated $10,880 \pm 160$ B.P. [I-6129] in Unit A 175), and probably relates at least in part to Units H 57A2-59A3, described in the previous report.⁵¹ It seems that no equivalent of this final Palaeolithic has been discovered so far in Epirus, but, on the contrary, some of the implements discovered on the Kastron sites in the western Peloponnese might be related to this industry.⁵²

MESOLITHIC

Mesolithic has been studied in Pit H-1 in Units A 174 to A 99. This pit is not as rich as those studied previously, but it is of great interest since it is in stratigraphic continuity with the Palaeolithic levels. Neither the dates nor the material shows any break between these two periods. The H-1 sequence covers most of the Mesolithic, with a possible interruption at the very end.

The samples are reasonably large (usually from 50 to 100 pieces in each unit), but with a very low percentage of retouched pieces.⁵³ For this reason we shall add only a few observations to what was said in the previous report, which was based on richer material.

Raw Material. Although nothing has to be added about flint and chert (the highly dominant raw material) except that no difference in its choice can be seen from Palaeolithic to Mesolithic, new information is now available about obsidian. The analysis having shown that Franchthi's obsidian was imported from Melos,⁵⁴

⁴⁹ *Ibid.*

⁵⁰ A radiocarbon date of $13,000 \pm 210$ B.P. (I-1960) was obtained from these levels. E. S. Higgs, C. Vita-Finzi, D. R. Harris and A. E. Fagg, "The Climate, Environment and Industries of Stone Age Greece: Part III," *Proceedings of the Prehistoric Society*, XXXIII, 1967, pp. 1-29.

⁵¹ *Franchthi*, I, p. 358.

⁵² A. Leroi-Gourhan and N. and J. Chavaillon, "Premiers résultats d'une prospection de divers sites préhistoriques en Elide Occidentale," *Annales Géologiques des Pays Helléniques*, XIV, 1963, pp. 324-329; J. and N. Chavaillon and F. Hours, "Industries palaeolithiques de l'Elide. II. Région du Kastron," *B.C.H.*, XCIII, 1969, pp. 97-151.

⁵³ In the four largest units (A 129, 132, 155, 156) there is only between 2% and 4.7% retouched pieces. Yet only some of the units have been water-sieved, and, in the microlithic phase, the percentage of retouched pieces can double or triple depending upon whether the unit has been water-sieved or not.

⁵⁴ Cf. below, pp. 82-85.

its presence implies sea-travel at least by the early seventh millennium.⁵⁵ The first occurrence of obsidian is found indeed in a unit which can be attributed, by the faunal studies, to lower Mesolithic (A 168). It must be stated, however, that obsidian flakes only begin to be common at the very end of the Mesolithic sequence in H-1 (A 110), and it is at this moment only that they begin to be used for retouched tools.

Debitage. It is very similar to the Palaeolithic debitage, but with a much lower percentage of blades and bladelets (between 0% and 8% as a mean). Although often punch-pressed, blades and bladelets are very irregular in shape. Hard hammer was used more than in the Palaeolithic for flakes, but soft hammer remains the most common technique by far. The number of cores and core rebutes is still very high, and no difference in the technique and the products of debitage can be seen from the beginning to the end of the Mesolithic in this sequence.

Retouched Pieces. As already stated, notched flakes and denticulates (i.e. flakes or blades with two or more adjacent notches), constitute the basis of the Mesolithic industry, together with marginally retouched flakes or blades. In most units, they are the only types of tools but tend to be less important towards the end of the sequence (A 125-A 99). End-scrapers of different types are proportionately more abundant than in G-1 (10 scrapers on 185 retouched tools): end-scrapers on blades or flakes, steep end-scrapers and nucleiform end-scrapers but no more of the small circular scrapers. Truncated pieces and backed pieces are very rare in most of the Mesolithic, but in the last phase (A 120-A 99) they become common types, together with the reappearance of microlithic tools: lunates, triangles, trapezes and transverse arrow-heads (Fig. 9, Nos. 1-12). But most of the microlithic tools cannot easily be put into any geometrical category. Furthermore, there is no evidence that any of them was prepared by the microburin technique, as true geometrics are supposed to be (no scar on the pieces themselves and no microburins). Since most of these late units were water-sieved, the absence of microburins must be considered as significant and appears to be one of the characteristics of Franchthi's Mesolithic.

Stratigraphic Distribution. The stratigraphic distribution of tools shows two clearly defined periods:

(1) Units A 174 to A 121, a lower and probably middle Mesolithic, very crude, with marginally retouched flakes, denticulates and notches. Obsidian flakes are very rare and never retouched. The interesting point is that there is no discontinuity, no major change in the lithic assemblage between this Mesolithic and the latest phase of the Palaeolithic. If the climate and the fauna had changed, it seems that it had

⁵⁵ Two radiocarbon dates were obtained from Unit A 117 (6792 ± 114 B.C. and 7527 ± 134 B.C.), which contains obsidian. (See discussion on chronology, below, p. 85.) But obsidian was found in small quantities in earlier units: A 168, A 158, A 152, A 142, A 128 and A 119.

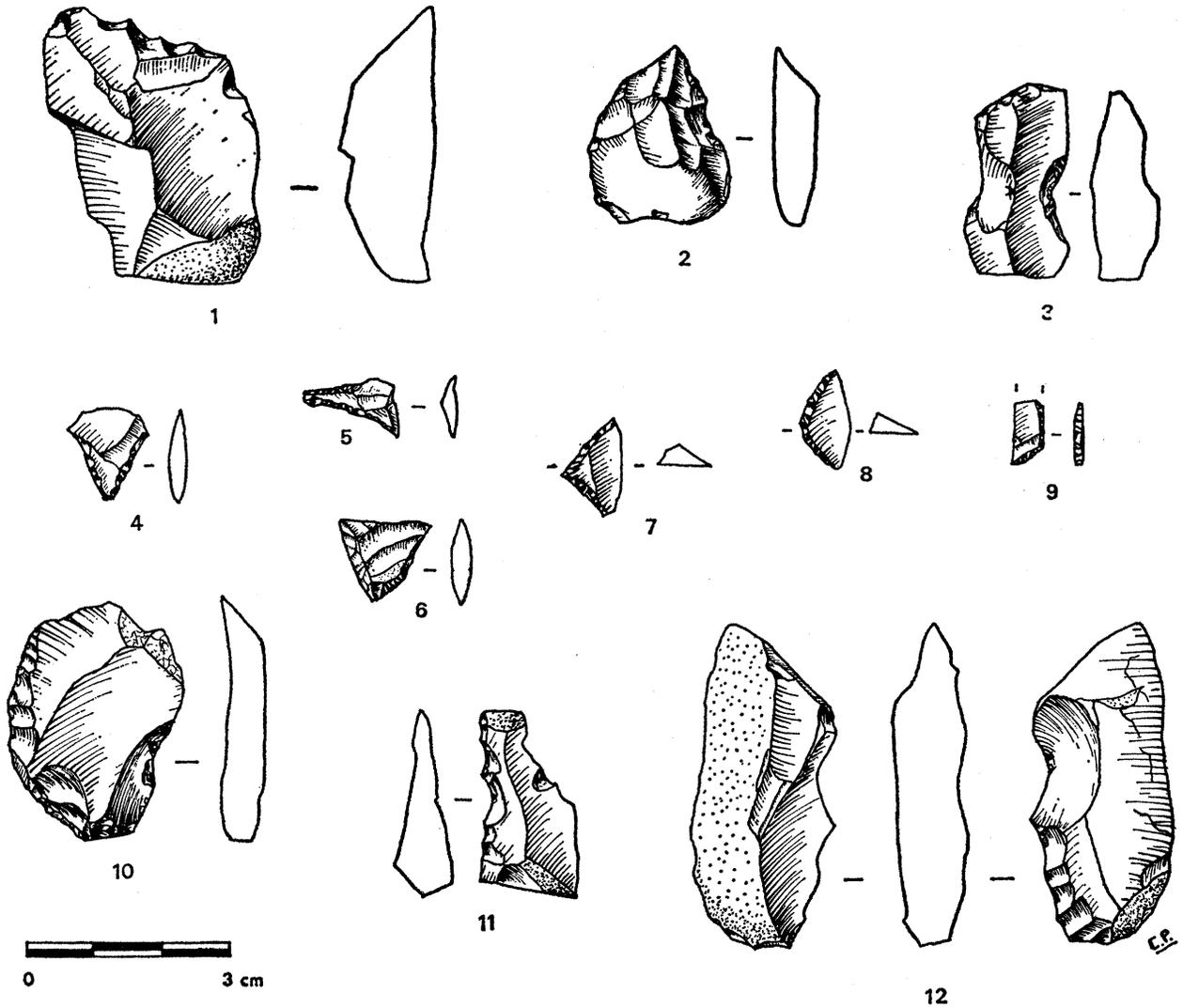


FIG. 9. Lower Mesolithic tools (1-3) and upper Mesolithic tools (4-12). 1, 11, 12, denticulates; 2, unifacial mousteroid point; 3, notch, 4, 6, transverse arrowheads; 5, irregular trapeze; 7, triangle; 8, lunate; 9, fragment of elongated scalene triangle; 10, convex side-scraper. All of flint or chert.

no influence on the techniques reflected by the lithic assemblage. A great change had occurred before, during the Palaeolithic itself, but the microlithic Upper Palaeolithic did not evolve directly into a microlithic Mesolithic.

(2) Units A 121 to A 99: an upper Mesolithic, with appearance or reappearance of different types, the most important of which being microliths. But, unlike Pit G-1, these microliths occur at the end of the sequence and do not disappear again.⁵⁶ This could mean that the H-1 sequence presents a brief interruption at the end of the Mesolithic, before the Neolithic. Radiocarbon dates would not contradict this hypothesis, since the lowest Mesolithic date in H-1 is 6792 ± 114 B.C. (Unit A 117), while it is 6239 ± 78 in G-1 (Unit 22). When compared, the Mesolithic of Sidari in Corfu⁵⁷ and Franchthi's industry show certain points in common, e.g. the scarcity of blades and bladelets and the presence of geometrically shaped microliths with snapped edges. But the two industries differ notably on other technical points, such as the absence at Sidari of punch percussion or steep retouch.

NEOLITHIC

Two new parallel sequences have been studied, from F/A North Balk (137N to 59N) and F/A South Balk (126S to 59S). Following the ceramic evidence, both are mainly Middle Neolithic and Late Neolithic. But the transition between Early and Middle Neolithic (E.N./M.N.) could be observed at the base of the excavated area by the end of the 1971 season.

The samples are far smaller than in the Palaeolithic or Mesolithic, and we had thus to group units in order to give percentages on the raw material or the debitage. Not all units in both trenches have been water-sieved and sorted, but since the industry is of rather large dimensions, the comparison between water-sieved and dry-sieved units is easier than for the Mesolithic.

Raw Material. F/A sequences show the same characteristics as F/F-1 and G-1 (dominance of obsidian in all units, as well as the use of local and imported flint). The obsidian appears to be generally of the best quality that can be found in Melos. As was already noted, the proportion of obsidian as raw material tends to increase from earlier to later Neolithic, but this increase is not regular and differs from one excavated area to the other.⁵⁸ As for local flint or chert, it is noteworthy that in contrast to the practice of previous periods, only the best local material was picked up for flaking. Burnt pieces are almost completely absent from the samples.

⁵⁶ *Franchthi*, I, p. 356.

⁵⁷ A. Sordinas, *Stone Implements from Northwestern Corfu, Greece*, Memphis State University Anthropological Research Center, Occasional Papers, No. 4, 1970, pp. 8-15.

⁵⁸ In F/A North, the variation is as follows:

Middle Neolithic (137N to 123N): 72.15% of obsidian; transitional Middle Neolithic to Late Neolithic (122N to 110N): 61.53% of obsidian; beginning of Late Neolithic (109N to 98N): 75.82% of obsidian; Late Neolithic (97N to 59N): 96.01% of obsidian.

Debitage. Even in the Neolithic thedebitage remains mostly a flakedebitage, but the percentage of blades and bladelets is far higher than it was before. This percentage varies according to the phases of the Neolithic. On the whole, it is higher in Middle Neolithic and at the end of Late Neolithic than at the beginning of Late Neolithic.⁵⁹ There is a correlation between the higher percentage of blades and bladelets and the higher percentage of obsidian, which the flaking qualities of this raw material easily explain.

Various flaking techniques can be observed, such as soft hammer and punch percussion. But true pressure flaking exists also for obsidian bladelets. This technique is found in the Middle Neolithic and then tends to disappear until the very end of the Neolithic. The number of cores and core rebutes is very low, showing an intensive use of the material. Yet a few good and regular conical cores have been recovered, and at least some of the numerous splintered blades must be considered as worn-out cores.

Retouched Pieces. The proportion of retouched pieces is generally very high (between 10% and 30%), the tools being well made with occasional long pressure retouch. An interesting feature of the tools prepared from imported "honey-flint" is that most of them show a clear difference between the unretouched and the retouched parts; the unretouched surfaces are brilliant (on the ventral as well as the dorsal faces), while the retouched parts are dull. The limits of this luster correspond exactly to those of the retouch, which shows that it has been removed by the retouching of the piece. This brilliance cannot be compared with silica- or use-gloss, since it has quite a different aspect and position on the piece. A possible explanation of this would be a pre-treatment of the flint by slow heating, as already shown in some cases to make pressure retouching easier. It does not seem indeed to be the result of any natural weathering of the blanks before the retouching, but this hypothesis demands experiments to be confirmed.

On the whole, the typology of the F/A industry does not differ basically from those studied previously, and we will just add a few observations.

Arrowheads are fairly common and varied (Pl. 17, b); they are of transverse, shouldered, tanged, and barbed and tanged types. Although transverse arrowheads are found both in Neolithic and Mesolithic, they differ in fact entirely in the technique of fabrication and shape. Mesolithic arrowheads are true microliths (i.e. blade or bladelet sections with double truncation) while Neolithic arrowheads are prepared on a whole flake and shaped by bilateral and bifacial long, semi-abrupt or flat retouch (Fig. 9, Nos. 4 and 6; Fig. 10, No. 5; Pl. 17, b, upper left).

⁵⁹ The percentages of blades and bladelets in F/A North are as follows:

Middle Neolithic, 39.62%; transitional Middle Neolithic to Late Neolithic, 16.50%; beginning of Late Neolithic, 16.51%; Late Neolithic, 57.96%.

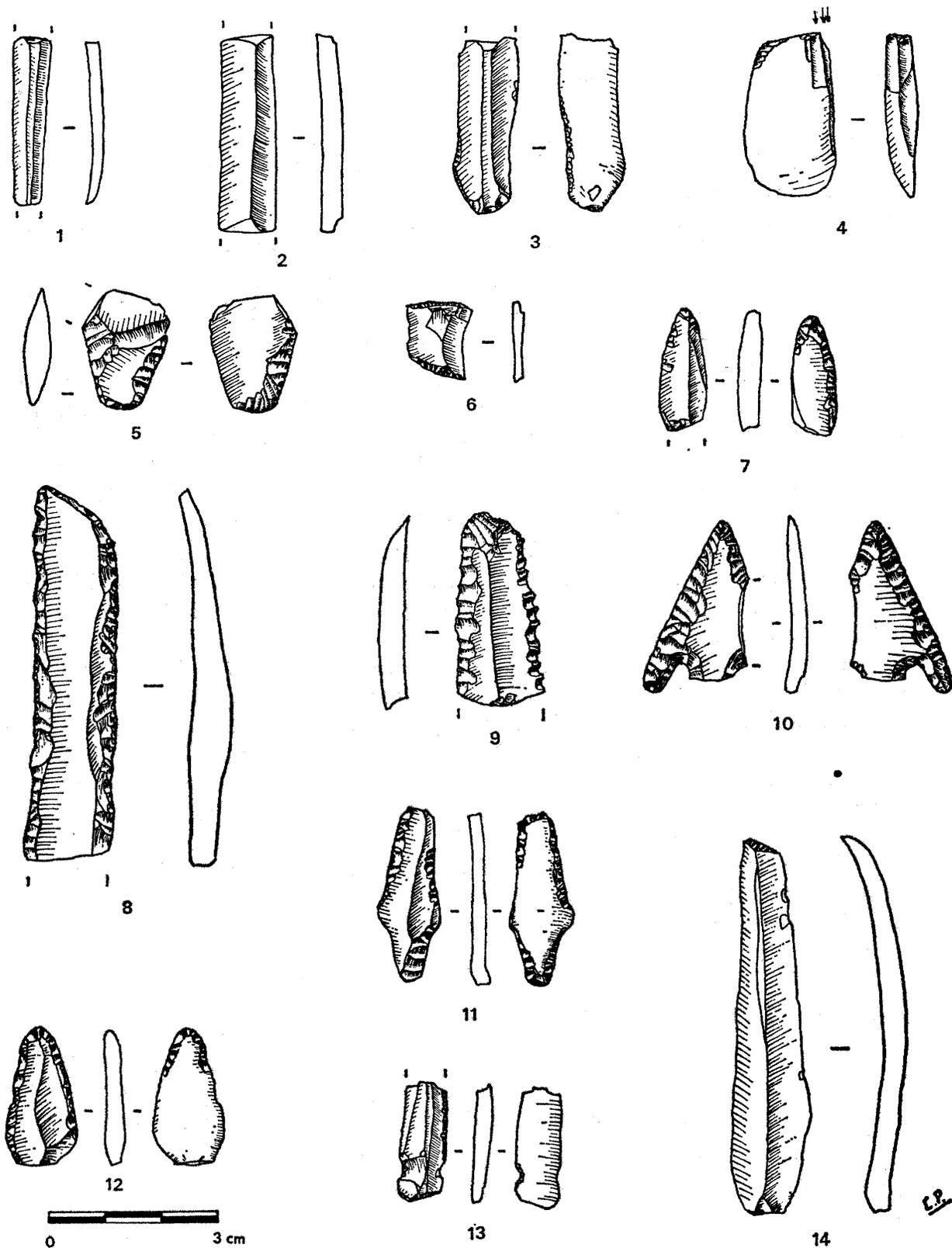


FIG. 10. Middle Neolithic (1-4, 6, 7), transitional Middle to Late Neolithic (5) and Late Neolithic tools (8-14). 1, 2, bladelets; 3, marginally retouched bladelet; 4, burin; 5, transverse arrowhead; 6, trapeze; 7, 12, retouched bladelet and flake with heavy blunting of the distal end; 8, blade with two backed edges and heavy blunting on both; 9, denticulated blade (*scie à encoches*); 10, fragment of tanged and barbed arrowhead; 11, arrowhead-shaped piece with inverse truncation of the distal end; 13, fragment of retouched bladelet with proximal truncation and opposite notches; 14, truncated blade. All except No. 5 of obsidian.

Marginally retouched blades, end-scrapers, notched pieces and awls are fairly common; burins, backed blades, slugs and sickles appear to be rarer. Among the retouched blades and bladelets is an interesting group which cannot be put into any category from a strictly typological point of view, although their function is quite clear. It consists of small blades or bladelets with direct marginal retouch and inverse retouch of the distal end. This end presents a very heavy blunting of the edges and facets, which are smooth and flattened but not polished (Fig. 10, Nos. 7 and 12). These pieces may well have been used as awls.

Stratigraphic Distribution. The F/A sequence supports the stratigraphic distribution of the different types of arrowheads in the Neolithic. Transverse arrowheads appear in transitional Early to Middle Neolithic and mostly in Middle Neolithic; they are sometimes found in transitional Middle to Late Neolithic but never later. Tanged or barbed and tanged arrowheads occur in Late Neolithic and only in this period. The shouldered points could be transitional between transverse and tanged arrowheads, but this demands confirmation. At the very end of Late Neolithic, it seems that the tanged arrowheads disappear, to be replaced by large triangular bifacial points (e.g. Pl. 17, b, right). Each type of projectile point would then be a good indicator of each Neolithic phase.

Apart from arrowheads, the Middle and Late Neolithic industries do not show many differences. Yet there is another point that distinguishes between these two phases, and that is the presence of two obsidian trapezes, one in the transitional Early to Middle Neolithic, the other in the Middle Neolithic (Fig. 10, No. 6). Neolithic trapezes did not occur previously in Franchthi, but their presence in Aceramic Neolithic has been observed at Sesklo and Argissa, as well as in Early Neolithic at Nea Nikomedeia and Knossos.⁶⁰

The two trapezes found in Franchthi would appear to be just slightly more recent than those from other sites in Greece, but they attest to the presence of this type of tool near the beginning of the Neolithic in the Peloponnese as well.

C. P.

THE SOURCE OF THE FRANCHTHI OBSIDIANS

The obsidian from the pre-Neolithic levels at the Franchthi Cave is of particular interest, being the earliest from any well-dated context in the Aegean. The Aceramic levels at Knossos (radiocarbon date 6100 B.C.: BM 124) and the Early Neolithic

⁶⁰ Sesklo: D. R. Theochares, "Compte Rendu des fouilles de Sesklo," *B.C.H.*, LXXXVIII, 1964, p. 781; Argissa: V. Milošević, J. Boessneck and M. Hopf, *Die deutschen Ausgrabungen auf der Argissa-Magula in Thessalien*, I, Bonn, 1962, p. 25; Nea Nikomedeia: R. Rodden, "Excavations at the Early Neolithic Site at Nea Nikomedeia, Greek Macedonia (1961 season)," *Proceedings of the Prehistoric Society*, XXVIII, 1962, p. 276; Knossos: J. D. Evans, "Excavations in the Neolithic Settlement of Knossos, 1957-1960. Part I," *B.S.A.*, LIX, 1964, p. 150.

levels at Nea Nikomedeia (radiocarbon dates between 6200 B.C. and 5300 B.C.) have yielded obsidian which proved on analysis to be of Melian origin,⁶¹ and obsidian occurs in early levels in Thessaly. No earlier contexts than these are known in the Aegean.

Careful visual inspection in 1969 of all the pieces excavated to that time suggested the initial hypothesis that all the material originated from the two natural sources on the Cycladic island of Melos. Most specimens fall within the visual range of the two Melian varieties (in terms solely of appearance): opaque with a milky or pearly luster in reflected light, or partially translucent with alternating transparent and opaque bands or striations in transmitted light.

TABLE 6. LIST OF FRANCHTHI OBSIDIANS SELECTED FOR ANALYSIS BY OPTICAL SPECTROGRAPHY.

SAMPLE NO.	OBJECT	PHASE	LEVEL	CAT. No.	TRANS- LUCENCY/ TRANSPARENCY		REMARKS
					COLOR (TRANS.)	TRANS- PARENCY	
439	Blade	Mesol.	H-1: A 128	—	G	2	PX
440	Lump	Mesol.	H-1: A 112	6478	G	4	—
441	Lump	Mesol. ?	H-1: A 99	7066	G	2	P
442	Flake	L.N.	F/A 59N	5291	G	2	P
443	Blade	L.N.	A 29	2993	G	6	S
444	Fragment	L.N.	F/A 66N	5349	G	2	—
445	Fragment	L.N.	F/A 66N	5347	G	2	S
446	Blade	L.N.	A 25	2960	G	4	S

Abbreviations. Color in transmitted light: G indicates gray.

In the Translucency/Transparency column, the scale signifies:

0: not transparent/opaque; 1: not transparent/almost opaque; 2: not transparent/fairly translucent; 3: fairly transparent/almost opaque; 4: fairly transparent/fairly translucent; 5: fairly transparent/translucent; 6: transparent/translucent.

In the Remarks column, P signifies pearly luster; S: striations in transmitted light; X: presence of some cortex.

In view of the well-known difficulty of ascribing a source to obsidian on the basis of appearance alone, further tests were needed. A selection of pieces was made, including a number of samples from the earlier levels and several pieces whose appearance did not at first sight seem to fit the usual Melian range. The contexts of these pieces, and their appearance, are set out in Table 6. Table 7 presents the results of a trace-element analysis carried out by J. E. D. using the Hilger-Littrow E 478 spectrograph of the Department of Mineralogy and Petrology of the University of Cambridge.⁶²

⁶¹ C. Renfrew, J. R. Cann and J. E. Dixon, "Obsidian in the Aegean," *B.S.A.*, LX, 1965, pp. 225-247.

⁶² We are very grateful to Professor T. W. Jacobsen for making the samples available to us, with the cooperation of the Greek Archaeological Service, and to Mr. R. Allen of the Department of Mineralogy and Petrology, University of Cambridge, for running the samples.

The results at once indicated that No. 440, of unusual appearance, was of anomalous composition. Further examination showed it to be of flint, although superficially similar in appearance to obsidian. We have no opinion as to its origin, although it may well be local. All the other pieces examined fall in Group 1c of the existing classification of Mediterranean obsidians,⁶³ and this supports the Melian origin of

TABLE 7. TRACE-ELEMENT COMPOSITION OF OBSIDIANS ANALYZED.

Analyses in parts per million (p. p. m.) are given for 15 elements for each of the specimens analyzed.

Sample No.	p.p.m.													x 10 ⁻²		
	Ba	Sr	Zr	Y	Nb	La	Rb	Li	Mo	Ga	V	Pb	Ca	Fe	Mg	
439	1100	180	45	18	16	100	80	27	<3	11	<3	10	64	56	450	
440	6	<10	<8	<5	16	70	<28	<13	<3	<2	<3	<5	18	<20	250	
441	880	180	30	13	16	70	80	27	<3	7	<3	10	72	47	800	
442	880	180	30	13	<10	100	63	22	<3	7	16	5	72	70	540	
443	880	230	30	13	16	100	47	27	<3	11	10	36	83	70	800	
444	1100	180	85	13	16	130	125	22	<3	7	<3	22	64	56	450	
445	880	180	62	13	<10	130	100	22	<3	7	10	22	64	70	670	
446	1100	230	85	10	16	130	80	27	<3	7	6	10	72	70	800	

the material. It should be stressed that no obsidian from the sources at Giali or Antiparos was detected, although care was taken to include in the selection analyzed several specimens which on the grounds of appearance might have come from these sources. It was therefore concluded that, unless there be some as yet unlocated source in southern Greece yielding obsidian closely similar to that of Melos, both in appearance and composition, the obsidian from Franchthi originated in Melos.

There is as yet no indication of any obsidian source in mainland Greece, and all other reported sources in the Aegean (beyond Melos, Antiparos and Giali) have proved to be illusory.⁶⁴

This result is of real significance, documenting not only the earliest known use of obsidian in the Aegean, before the inception there of farming life, but also, by implication, the development of seafaring. The characterization study in fact gives the earliest clear documentation of seafaring in the world. For it implies that boats from the mainland of Greece were already crossing to Melos before 7000 B.C.

In view of the importance of the results, two further analytical techniques have been used to confirm the Melian origin of the Franchthi obsidian. The first, Fission Track Analysis, conducted by S. A. Durrani, H. A. Khan and M. Taj of the Depart-

⁶³ J. R. Cann and C. Renfrew, "The Characterisation of Obsidian and its Application to the Mediterranean Region," *Proceedings of the Prehistoric Society*, XXX, 1964, pp. 111-133.

⁶⁴ Renfrew, Cann and Dixon, *op. cit.* Investigations on Methana by members of the Franchthi excavation team likewise failed to reveal any sources of obsidian.

ment of Physics, University of Birmingham,⁶⁵ supported the conclusions obtained by optical spectrography. The second, Neutron Activation Analysis, conducted by A. Aspinall and S. W. Feather of the School of Applied Physics, University of Bradford, gave further corroboration,⁶⁶ and achieved a separation between the two Melian sources of Adhamas and Dhemenegaki. The analyzed pre-Neolithic specimens from Franchthi derived from Adhamas. (It is planned that further details of these results will be given in the final report of the Franchthi excavations.) We conclude, without hesitation, that the obsidian from Franchthi is of Melian origin.

J. D. and C. R.

ABSOLUTE CHRONOLOGY

The results of nine samples submitted for analysis by the radiocarbon method were published in our first preliminary report.⁶⁷ Since that time an additional 25 dates have become available, largely through the efforts of the Radiocarbon Laboratory at the University of Pennsylvania.⁶⁸ Therefore we now have a total of 34 dates from the site, all but three of which (the two post-Neolithic samples, P-1658 and P-1663, and the earliest Palaeolithic sample, I-6140) are represented in conjunction with their provisional archaeological phases in Table 8. Eight samples, published here for the first time, are also listed individually below. Four of the latter were too small to be processed in Philadelphia and therefore were analyzed by Teledyne Isotopes Laboratories of Westwood, New Jersey.

Although two samples from the 1971 season still remain to be processed as this is being written, the total presently available represents the largest number of dates from any one site in the Aegean Basin. Nevertheless the chronology of certain phases in this long sequence is still only imperfectly known. One such phase is the Middle Neolithic, where the existing dates reflect certain anomalies. Perhaps the most troublesome of these is P-1824 (4718 ± 74 B.C.), which seems to be 200-300 years too low. This discrepancy may be at least partially explained by the fact that the sample was too small to be pretreated for the removal of possible humic acid con-

⁶⁵ A. Durrani, H. A. Khan, M. Taj and C. Renfrew, "Obsidian Source Identification by Fission Track Analysis," *Nature*, CCXXXIII, 1971, pp. 242-245.

⁶⁶ A. Aspinall, S. W. Feather and C. Renfrew, "Neutron Activation Analysis of Aegean Obsidians," *Nature*, CCXXXVII, 1972, pp. 333-334.

⁶⁷ *Franchthi*, I, pp. 374-375.

⁶⁸ We should again like to thank Dr. Elizabeth K. Ralph and her staff for their continued cooperation in processing our samples.

It should be noted that 26 of the dates now available were published in 1971: Barbara Lawn, "University of Pennsylvania Radiocarbon Dates XIV," *Radiocarbon*, XIII (No. 2), 1971, pp. 364-367.

<i>Lab. No.</i> ⁶⁹	<i>Franchthi Context</i>	5568 <i>Half-life</i>
I-6128*	F/A Balk, 120N Transitional LN/MN	4905 ± 190 B.C.
P-1922 ⁷⁰	F/A Balk, 129N Middle Neolithic	4835 ± 87 B.C.
P-1824	F/A Balk, 137N Transitional MN/EN	4718 ± 74 B.C.
I-6139*	H-1: A173 Mesolithic	8510 ± 210 B.C.
I-6129*	H-1: A175 Upper Palaeolithic	8930 ± 160 B.C.
P-1923 ⁷⁰	H-1: A181 Upper Palaeolithic	9287 ± 140 B.C.
P-1827	H-1: A199 Upper Palaeolithic	10,593 ± 176 B.C.
I-6140	H-1: A219 Upper Palaeolithic	20,380 ± 1270 B.C.

tamination.⁷¹ That NaOH pretreatment does make a difference in the results is strongly suggested by our samples P-1518 and P-1518-A from the same Mesolithic unit (G-1: 46). About 200 (radiocarbon) years separated the results of these samples, the lower of the two (P-1518-A) being that which was *not* pretreated with NaOH. A somewhat different problem is to be found in another pair of dates from our Mesolithic levels, P-1665 and P-1666 from H-1: A117. The disparity here seems to be due to the fact that one sample (that with the lower result, P-1666) was collected by flotation from dry-sieved residue, while the other (P-1665) was collected by normal procedures in the trench. Although care was taken to avoid contamination, the results suggest that radiocarbon dates from samples collected by flotation are less reliable than those collected (and immediately isolated) during the course of excavation.⁷²

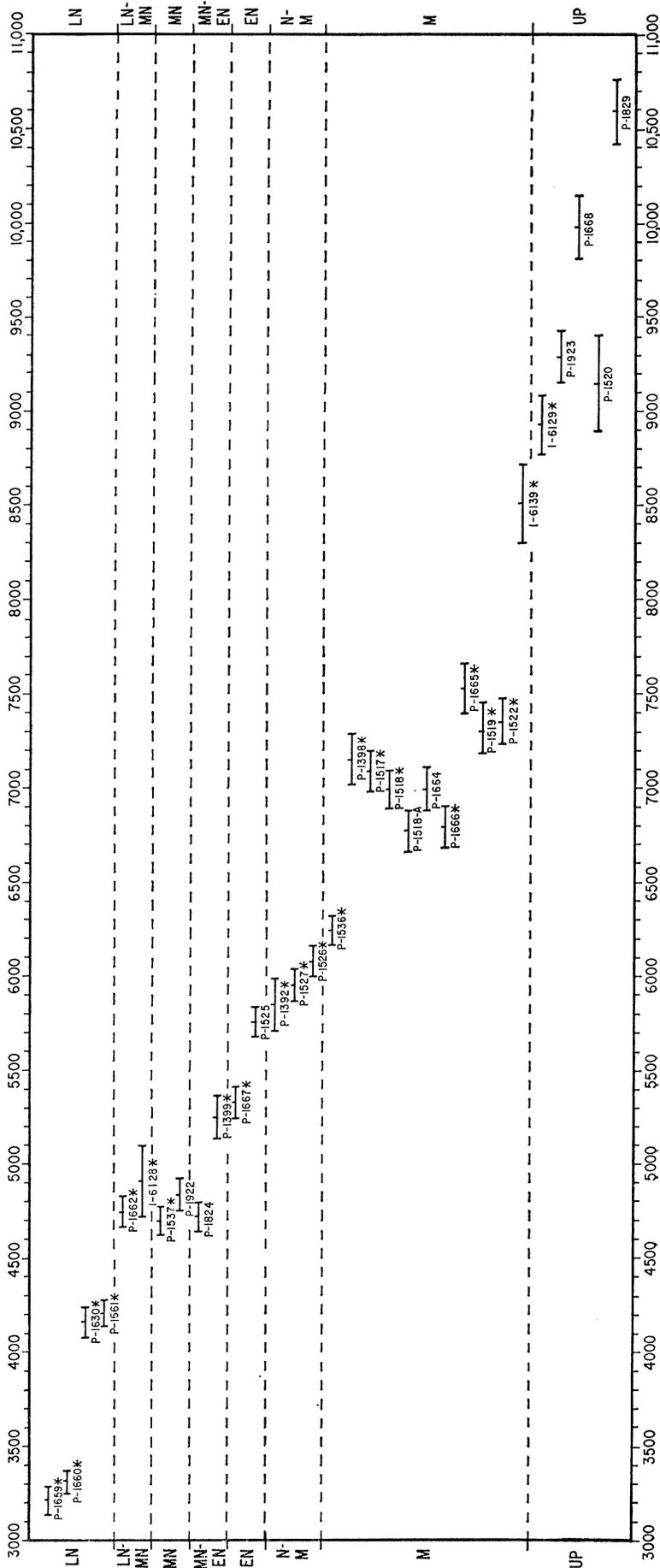
⁶⁹ The sample numbers with asterisks have been treated for humic acid contamination.

⁷⁰ The results, P-1922 and P-1923, were received only a few days before this report went to press. The Radiocarbon Laboratory at the University of Pennsylvania has requested that they be regarded as preliminary determinations.

⁷¹ The preliminary date, P-1922 (4835 ± 87 B.C.), is perhaps slightly less troublesome, but it too has not received NaOH pretreatment. Yet the sample from this unit (F/A Balk, 129N) was divided into two parts, and half of it (P-1922-A) will receive such treatment. The results of P-1922-A were not available at this writing.

⁷² We have not as yet attempted to compare the results of samples collected in the trenches with those collected from our new water-sieving device. Yet it seems logical to assume the possibility of greater risk of contamination among those collected in the water-sieve. This is rather a pity since the latter greatly facilitates the collection of larger samples of charcoal.

TABLE 8. RADIOCARBON DATES FROM FRANCHTHI CAVE, EXCLUDING P-1658, P-1663 and I-6140. ASTERISKS ADDED TO SAMPLES PRETREATED FOR POSSIBLE HUMIC CONTAMINANTS.



In spite of the above (and one or two other problematical results), this rather large series of dates is striking in terms of its overall internal consistency. Indeed one might regard it as strong support—if support is needed—for the basic validity of the radiocarbon method.

One final note is in order as regards the absolute chronology of this sequence. In 1969, Dr. Martin Aitken of the Research Laboratory for Archaeology at Oxford visited our site and collected a group of nine Late Neolithic potsherds from F/A Balk (Units 94N-95N). These samples were later subjected to analysis by Thermoluminescence (sample OxTL 122a), and the result (4030 ± 320 B.C.) has since been kindly provided by Dr. Aitken. (In a personal letter dated 14 August 1972, Dr. Aitken requested that it be emphasized that this is a provisional date, adding “it is possible that the application of revised techniques to this material would yield a date up to 600 years less recent.”) The TL date is of particular interest because it is flanked in our sequence by two C-14 dates, P-1630 (4160 ± 86 B.C.) from Unit 89N and P-1661 (4206 ± 70 B.C.) from Unit 120N. Although a certain discrepancy is apparent, this combination is important because it represents a beginning (at least in Aegean archaeology) towards the correlation of these two valuable dating techniques.

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a. Bay of Koilada from Southeast (from Mt. Profitis Ilias)



b. Bay of Koilada from South. Franchthi Headland in Middle Ground.



c. Mouth of Franchthi Cave from Northwest. Note Breakdown from Brow in Foreground.



d. F/A Balk ("South") at End of 1969 Season. Pit F/F-1 at Right.



a. F/A Balk at End of 1971 Season. Exposed "West" Scarp at Left.



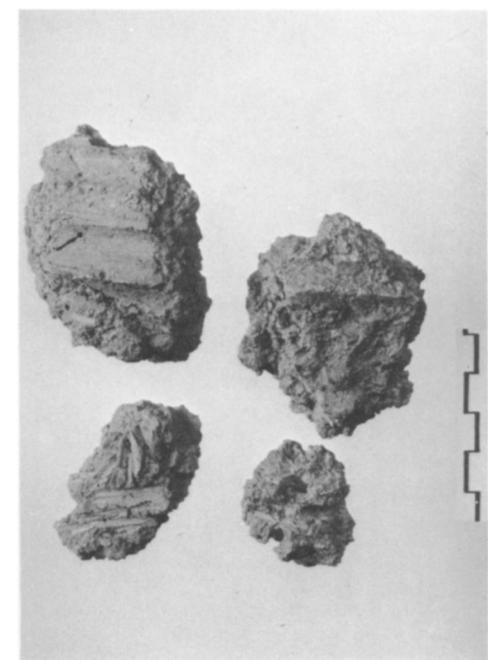
b. Pit H-2. Wall from "East."



c. Pit H/H-1 from "South" during 1971 Season. Workman Standing in H-2.



d. Pit H-2. Looking to "North." Wall in Foreground, Rockfall from Brow in Background.



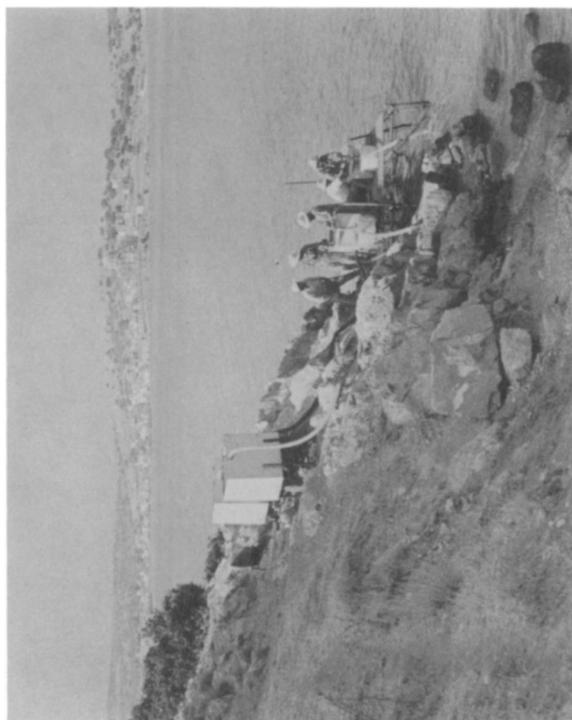
a. Lumps of Clay Daub with Reed Impressions from Pit H-2.



c. B/E Balk from North. Strings Indicate Original Dimensions of Excavated Area.

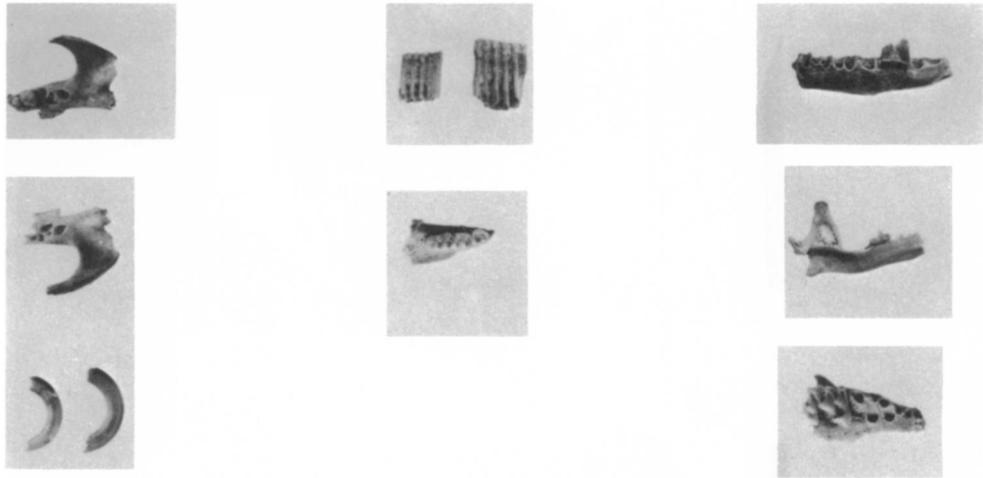


b. Pit H-2. Partial Human Skeleton Next to Wall.

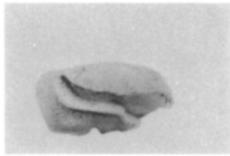


d. Water-Sieve in Operation, 1971.

PLATE 16



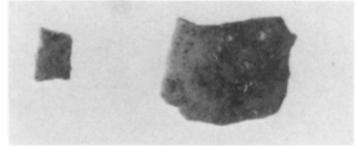
Small Mammals



Otolith



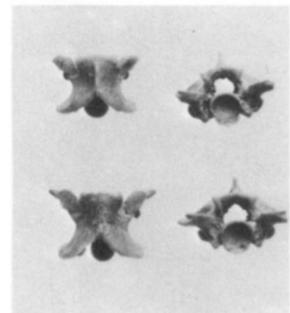
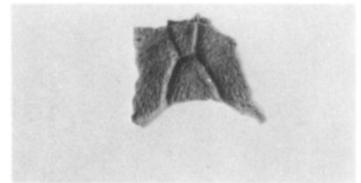
Amphibian



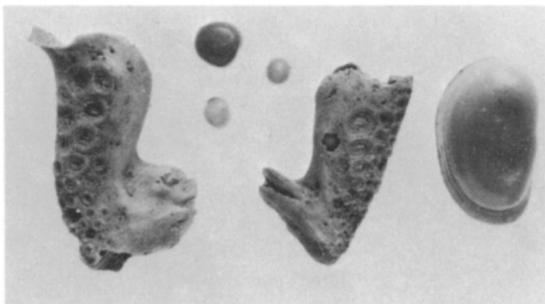
Bird: Eggshell



Vertebrae



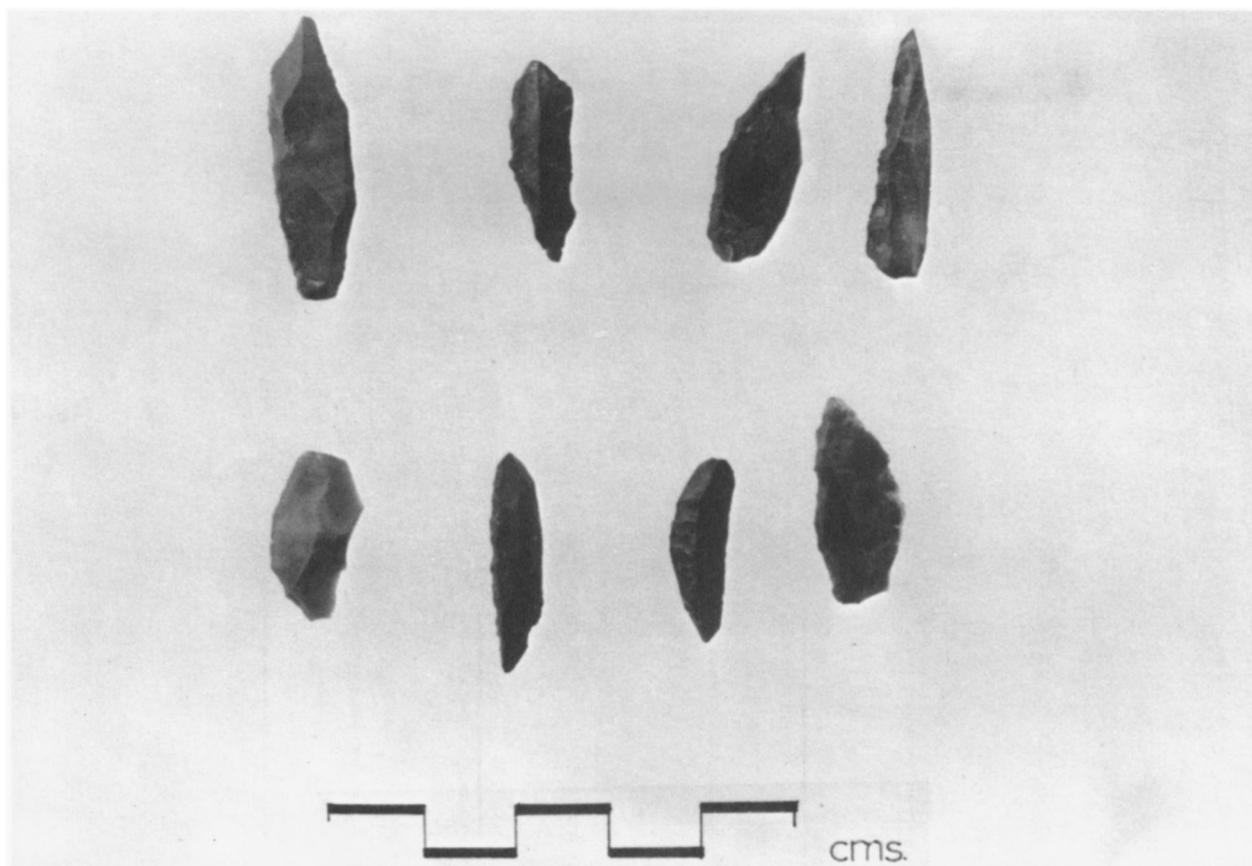
Reptiles



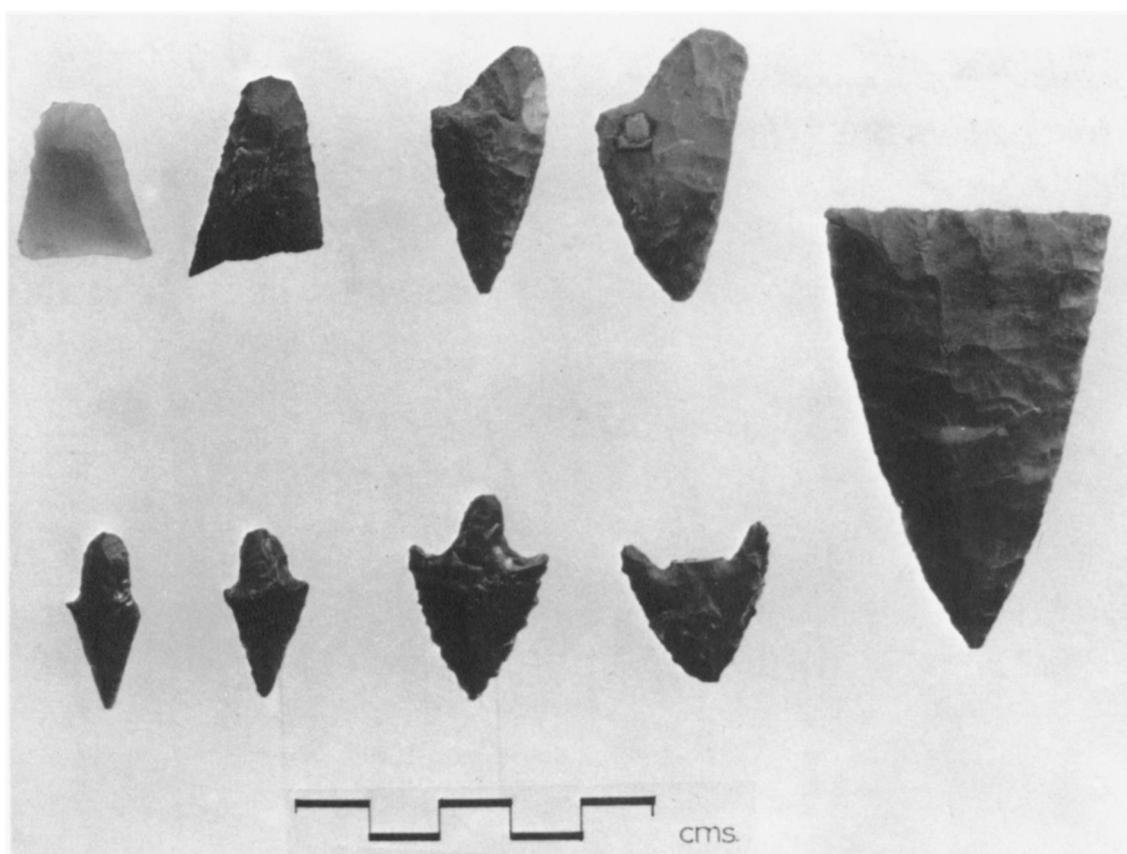
Jaws and Teeth

Fish

Sample of Smaller Bones Recovered by Water-Sieving (ca. 1:1).



a. Upper Palaeolithic Backed Bladelets, H-1: A 198-200.



b. Neolithic Projectile Points.