18 January 1963, Volume 139, Number 3551 SCIENCE

Prehistory in Shanidar Valley, Northern Iraq

Fresh insights into Near Eastern prehistory from the Middle Paleolithic to the Proto-Neolithic are obtained.

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The archeological investigations of two sites in Shanidar Valley, northern Iraq (Figs. 1 and 2), have been made more significant through the use of interdisciplinary studies. The combined information provides concrete data regarding man and his environment in this region from the Middle Paleolithic age (perhaps 100,000 years ago) to the present.

The significance of the Shanidar Valley investigations is that here, in this one locality, there is an almost continuous sequence of human history dating from the time of the Neanderthals. The information derived from these investigations contributes to biological, paleontological, climatological, and geological studies, as well as archeological and anthropological ones—the major concerns of the project. The Shanidar data do much to elucidate man's history in a most interesting period of his existence—the time of the Neanderthals and the replacement of this long-dominant people by *Homo sapiens*.

The project is of further special interest because Shanidar lies within the area where domesticated plants and animals—the basis for the great Neolithic economic, social, and cultural revolution—appear to have been first developed. The Shanidar excavations provide data reflecting the effect on the people in this remote valley of the introduction of the new mode of living, which was dependent on the products of the fields and on tamed animals rather than exclusively on the hunt. The great alternations of climate and temperature which mark the Pleistocene, a recent geological period of the ice ages dating back more than a million years, are reflected in the cultural history.

The sites, Shanidar cave and the nearby village site of Zawi Chemi Shanidar, have given us a long preface to Mesopotamian history. Thus far, the cultural sequence for Shanidar Valley is outlined on a relatively firm basis by carbon-14 dates from about 50,000 years ago, and by "guess dates" for periods before that. Paleoclimatological inferences have been made on the basis of pollen remains and of trace elements in soil studies. Osteological materials from seven Neanderthals and 28 representatives of post-Pleistocene *Homo sapiens* have been found. There is also a wealth of faunal data. The presence of domesticated animals in Shanidar Valley at the relatively early date of 8900 B.C seems likely (*1*).

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The Sites

Shanidar cave (Fig. 3) is situated at longitude 44°13′E, latitude 36°50′N, about 400 kilometers due north of Baghdad, within the outer folds of the Zagros Mountains. The cave, of limestone-solution origin, is about 2.5 kilometers from the Greater Zab River, a major tributary of the Tigris River. The precipitous mountains there reach an elevation greater than 1900 meters. The region is relatively well wooded. There is still some wild game to be seen in the area.

The cave lies at a measured elevation of 765 meters, facing south. The mouth is about 25 meters wide and 8 meters high, and the cave extends about 40 meters to the rear, with a maximum width of about 53 meters. Its earthen floor is about 1200 square meters in area. The cave is inhabited by several families of Kurdish shepherds during the winter months.

During the four seasons of excavation (*2*), a series of cultural deposits nearly 14 meters deep were explored down to bedrock. The deposits consist of an easily dug loamy soil and material indicative of at least five major rockfalls. These rockfalls were very effective man-traps—apparently they caused the death of most of the Neanderthals so far found in the cave. From top to bottom the occupation sequence includes four major layers, arbitrarily labeled layers A, B, C, and D (Fig. 4). Layer B was divided subsequently into two parts, B1 and B2. There are cultural, stratigraphical, and chronological breaks between each of these layers, so far as can now be determined.

Layer A consists of extensive, multicolored, dry and dusty ash beds, hearths, and black organic-stained soil. It includes remains of modern, historic, and Neolithic age. As deduced from observations of contemporary Kurdish-herdsmen occupation at Shanidar cave and neighboring caves, much of the heavy organic staining must be due to the droppings of livestock herded in the interior of the cave.

Fig. 1. Selected archeological sites in northern Africa, the Near East, and the Middle East: Haua Fteah (Libya); Mount Carmel and Kebara (Israel), Ksâr 'Akil and Ras el-Kelb (Lebanon); Yabrud and Jerf Ajla (Syria); Shanidar Cave, Zawi Chemi Shanidar, Bab-

khal, Zarzi, Hazar Merd, and Karim Shahir (Iraq); Belt Cave, Hotu Cave, Bisitun, and Warwasi (Iran); Kara Kamar (Afghanistan); and Teshik-Tash (Uzbekistan).

Layer B is somewhat thinner and markedly less heavily stained with organic matter than layer A. The two divisions of this layer, B1 and B2, are distinguishable from each other by soil coloration, artifact content, and carbon-14 dates. The upper part, B1, is Proto-Neolithic (*3*) and is dated at about 8650 B.C. (*4*). The lower part, B2, is Mesolithic (or very late Upper Paleolithic) and is dated at about 10,000 B.C. (*5*).

Shanidar B1 is contemporary with the basal layer of the Zawi Chemi Shanidar village site, which has a carbon-14 date of about 8900 B.C. (*6*). The artifact contents of cave and village layers are quite similar. In addition to bone artifacts and chipped stone implements, larger tools of ground stone, such as querns, mortars, and hand rubbers, were found. These indicate that some sort of vegetal foods, possibly acorns or even cereal grains, were prepared as part of the diet. The find, in the cave, of fragments of matting or basketry, the oldest yet known, suggests that collecting baskets may have been used. Twenty-eight skeletons were associated with the B1 layer in Shanidar cave; of these, 26 were found in a cemetery group. Associated with the cemetery were platforms of stones (*7*) and an arc-like alignment of flat stones (Fig. 5).

There is evidence that the Proto-Neolithic people ranged far for manufacturing materials. Obsidian was brought in from the north, probably from the Lake Van region. A material which looks very much like bitumen was used as an adhesive (*8*); bitumen is found more than 100 miles to the south.

Several pieces of evidence suggest that the B1 peoples had a more assured food supply than their predeces-

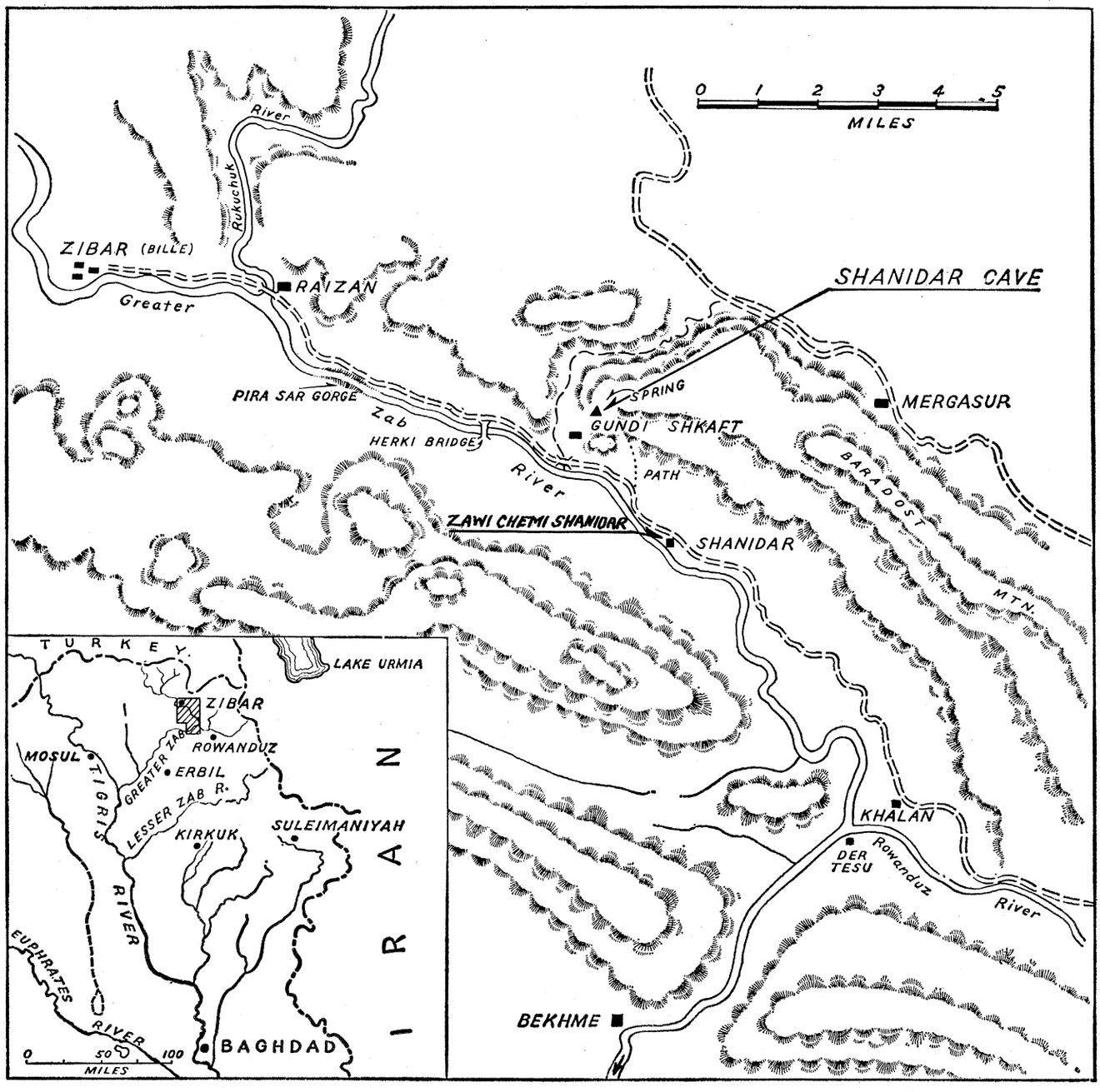

Fig. 2. Map showing the location of Shanidar Valley in northern Iraq.

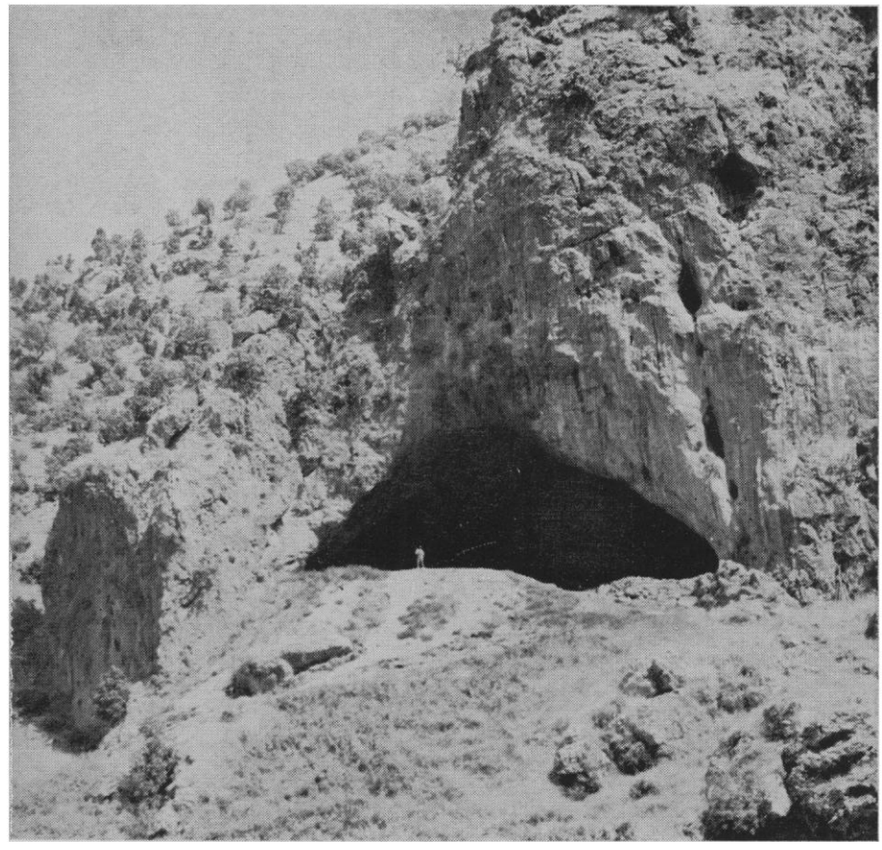

Fig. 3. The limestone cave of Shanidar, seen from the south. The swallow holes at the right enter into the cave. The long grass slope in front receives nourishment from the spilled human occupational debris.

sors in the valley. First, a number of pits, which may have been food storage pits, were found intruding into the B2 layer (Fig. 6). Second, a number of "luxury" items, such as beads, pendants, and inscribed slates, are found for the first time in the cave in layer B1—items not strictly related to the onerous and time-consuming business of securing a living (Fig. 7).

The B2 layer, in contrast to the overlying B1 layer, contained no grinding stones. Several pits which were noted in this layer could have served as storage pits for food that was not stone-ground (of course, perishable material such as wood could have been used for preparing food). The artifact assemblage is different from that found in layer B1. It includes a large number of microliths of the "geometric" type, carefully made and reflecting an expert and sophisticated flint-chipping industry (Fig. 8). It is inferred from the technological and cultural level of these people that they were more oriented to the hunt than their followers a thousand years later. We may also assume that they had a more complex technology and economy than their predecessors at Shanidar.

Layer C is easily distinguishable from layer B on the basis of stratigraphy and artifact remains (Fig. 9). The top part of this layer has been dated by the radiocarbon method at about 26,700 B.C. (*9*); the bottom part, at about 33,100 B.C. (*10*). Thus far in the excavations we have been unable to find remains linking layers B and C. There is an abrupt change of industries, from a blade-tool type reminiscent of the Upper Paleolithic "Aurignacian" (here called "Baradostian") (*11*) in layer C to the more highly evolved microlithic industry of basal layer B. The stone equipment of layer C indicates a high degree of skill in the woodworking crafts (only a few worked bones were found). Especially numerous are the burins, which are characterized by several types of working-bits. No human skeletal remains have been found in

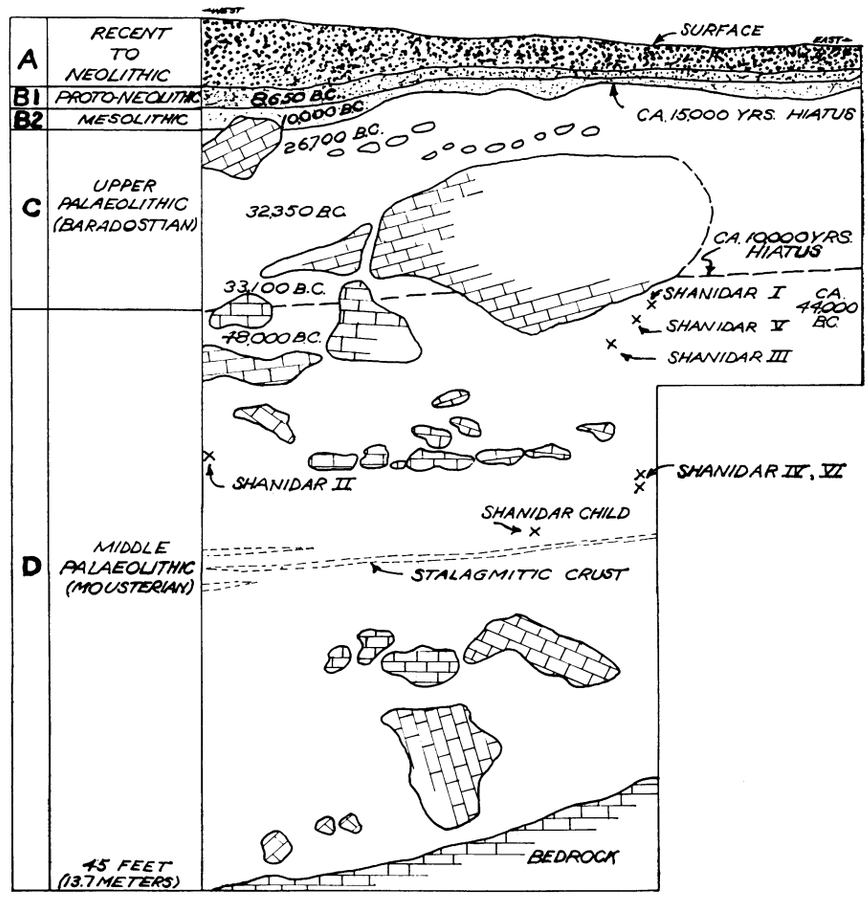

Fig. 4. Schematic cross section of the Shanidar cave excavation, showing the major cultural layers, the pertinent radiocarbon dates, and the relative positions of the Shanidar Neanderthals.

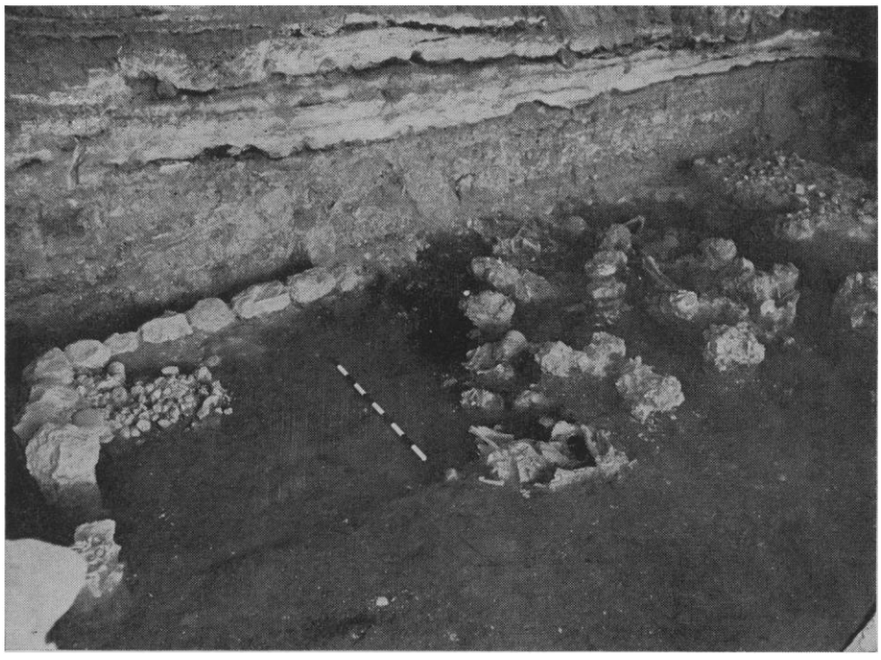

Fig. 5. Looking northeast over the cemetery and associated features in the Proto-Neolithic layer of Shanidar cave. The stone wall and the rough pavements of stones may be part of a mortuary custom of this age. The light, broad horizontal streaks in the upper part of the section are ash lenses in layer A, the Recent-to-Neolithic layer.

Fig. 6. A stone-filled pit with four associated boulder querns and quern fragments in the Proto-Neolithic layer of Shanidar cave. These indicate food grinding and probably food storage.

this layer, but it is assumed that these people were a variety of true *Homo sapiens*.

Layer D (Fig. 10) is the thickest layer in the cave (about 8.5 m). There is evidence of heavy occupational concentration toward the middle of the layer. The Mousterian artifacts include rather typical points, scrapers, and knives made on unifacial flakes (Fig. 11). Seven Neanderthal skeletons [six adults (numbered from I to VI) and one child (unnumbered)] were found in the upper third of the layer (*12*). Since only about one-tenth of the cave has been excavated thus far, more human remains are likely to be found in future seasons. Shanidar Neanderthals I and V were found near the top of layer D, in the level dated approximately 44,000 B.C. (*13*). T. Dale Stewart, of the U.S. National Museum, is studying the adult skeletons (*14, 15*). The late Muzaffer Senyürek, of the University of Ankara, studied the skeleton of the Shanidar child (*16*).

Investigation

Several approaches are currently being studied for investigating the Shanidar materials, and each of these opens new phases of research. Three broad avenues of investigation are discussed here. The first is the establishment of a chronological framework to serve as support for the study (Fig. 12). Comparative studies of the Shanidar sites and of other sites of the same age in the same broad geographical zone also are made. The second approach is the study of populations that lived in the Valley, from perhaps 100,000 years ago, to find what can be learned of them and their movements from their ancient leavings. The third is investigation to find where the Shanidar Valley fits in the great food-production revolution that supposedly took place in southwestern Asia.

Chronological Framework

Archeology without the backdrop of a time scale has little meaning. The cultural-temporal positioning of the occupations on the basis of the artifact typology was accomplished first. The chronology was fixed by 16 carbon-14 dates from all four layers at Shanidar cave and by one from Zawi Chemi Shanidar. The samples were dated by four different laboratories in studies of which several were duplicate checks (*17*). The dates range from about A.D. 1750 for layer A to about 48,000 B.C. for layer D. Several obsidian samples from layers B and C were also dated (*18*).

On the framework of this chronological scale, the climatological data obtained from studies of noncultural materials in the deposits were arranged. We enlisted the aid of a palynologist, Arlette Leroi-Gourhan of Paris, whose findings (nine samples) were independently corroborated, with one exception, by trace-element analyses of the soils (five samples), made by Bruno E. Sabels of the University of Nevada (*19*). These analyses indicated marked fluctuations

of climate in the late Pleistocene (Fig. 13), bearing out the geological observations made elsewhere in Kurdistan by Herbert E. Wright, Jr., of the University of Minnesota (*20, 21*).

Data for the 8.6-meter level (the lowest for which there is information), well into the Mousterian layer, indicate a climate much warmer than that in the area today and growth of the date palms (*Phoenix dactylifera*) not far away (*22*). Data for the 7.5-meter level show a reversal to an exceedingly cool climate and growth of fir trees (*Abies*) in the area. Pollens near the top of layer D, at depths of 4.25 and 4.35 meters, suggest a return to warm climate about 44,000 B.C. Findings for layer C suggest a change from a dry, steppe environment near the start of the Upper Paleolithic Baradostian occupation, at about 34,000 B.C., to a wet and cold climate near its end, at about 25,000 B.C. Data are lacking for the next 15,000 years, to the base of layer B. However, findings for the two parts (B1, B2) of layer B indicate a relatively cool climate changing to a warmer one similar to the present climate. A culture horizon comparable to B1 at Zawi Chemi Shanidar was also evidence of warmer conditions.

We are painfully aware that the minimum four conditions postulated by Edward S. Deevey, Jr. (*23*), as requisite for the application of pollen analysis to the problems of prehistory are only half satisfied at Shanidar. Lacking are a "standard pollen sequence" and a "knowledge of the regional plant ecology." But a start has been made toward a climatological sequence for Shanidar Valley.

The question at this point in the studies is this: If the suggestions of climate changes are correct, where do the alternations at Shanidar fit into the Pleistocene climate sequence? The dated part of the cave chronology, to about 48,000 B.C., can be checked against generalized curves. Beyond that, there is some doubt. An attempt to date the Shanidar cave deposits below the oldest carbon-14 determinations can be made by rough extrapolation on the basis of guessing the rate of accumulation of cultural deposit in feet per 1000 years (*24–27*). Assuming a constant rate of cultural deposition of about 1.25 feet per 1000 years, we guess that the Shanidar cave deposits began accumulating close to 100,000 years ago. The chronological fit of the projected curve with Flint and Brandtner's interpretations of climate change since the Last Interglacial (*28*) is better than the fit with Zeuner's or Emiliani's interpretations (*29*) (Fig. 13). The deepest pollen sample (8.6 m) and the corresponding trace-element sample (8.3 m) which reflect a very warm climate could correspond with Flint and Brandtner's "Eem," or Last Interglacial. The next Shanidar curve position could be interpreted as corresponding with their Early Würm stadial. The much disputed Göttweig Interstadial (*29*) in their analysis corresponds with the climatological evidence from the lower part of layer C and the upper part of layer D: a colder climate about 20,000 years ago is indicated at Shanidar. The gap between layers B and C falls in what is called the Würm Maximum (etc.), in the European Alpine sequence. The Zagros Mountain glaciers advanced down the slopes during this interval, causing in all probability a lowering of

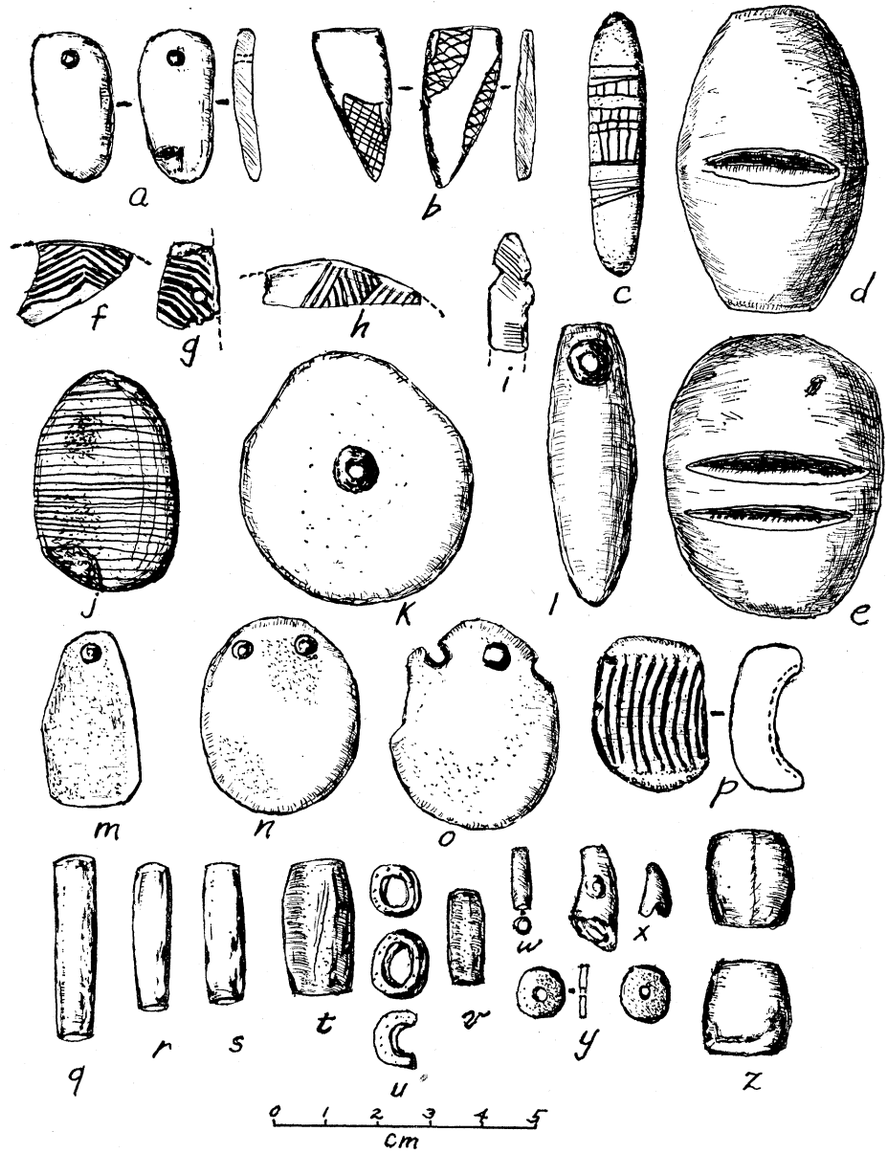

Fig. 7. Pendants, beads, and other objects from the Proto-Neolithic layer at Shanidar cave (*a–d*) and Zawi Chemi Shanidar village (*e–z*). *a*, Shell pendant; *b*, incised slate tablet; *c*, incised slate pebble; *d*, single-grooved plano-convex steatite stone object; *e*, double-grooved steatite stone object; *f–h*, incised fragments of bone tools; *i*, carved fragment of bone tool; *j*, flat pebble bearing parallel incised scratches; *k*, flat single perforated pebble pendant; *l*, elongate single perforated pebble pendant; *m*, flat single perforated green stone pendant; *n*, *o*, double perforated limestone (marble?) pendants; *p*, small steatite object with single U-shaped groove in which there are nine deeply incised cuts; *q–s*, cut tubular bone beads; *t*, barrel-shaped steatite stone bead; *u*, three squat steatite stone beads; *v*, tubular limestone (marble?) bead; *w*, small tubular cut bone bead; *x*, perforated animal teeth (probably *Cervus elaphus*); *y*, two flat disk beads of indeterminate material; *z*, two broad bone beads.

temperatures and a retreat of the flora and fauna (*21*). Man could not tolerate such an icebox very long (the glaciers came down to elevations of about 1500 m), and he sensibly left for the Florida of his time. According to the inferred Shanidar climatological data, the climate had improved greatly (from man's standpoint) by 10,000 B.C., and by about 8000 B.C. had changed to a warmer, postglacial climate very much like that of today (*21, 30*).

Unfortunately, no other pollen or trace-element climatological studies have been made for this range of prehistorical time in the Near East, and thus there are no data with which the Shanidar data can be compared (*31*). Changes in climate have been established on faunal evidence; such evidence, however, even in natural (non-cultural) contexts is recognized as being of secondary reliability (*29*).

One of the best-known examples of climate sequence based on faunal evidence from a Near Eastern archeological site is at Mt. Carmel (*32*). Primarily involved are two fauna, a cool-wet-loving deer and a warm-dry-loving gazelle. Zeuner (*33*) adapted the Mt. Carmel faunal-frequency chart in his correlation with the European late Pleistocene sequence. This touched off a debate which is still alive as fresh data are gathered (*20, 34–36*). Especially illuminating are Hooijer's (*37*) investigations of the deer and gazelle frequencies from Ksâr 'Akil, in the Lebanon. These throw some doubt on the climate interpretations from the Mt. Carmel sequence.

Another late Pleistocene climate sequence, based on faunal evidence, primarily the large bovines, has been offered for the North African and Mediterranean area (*38, 39*).

Concerning faunal curves, Hooijer's admonition (*34*) is pertinent: "What the vertebrate palaeontologist does rather more than anything else when studying the 'fauna' of an occupation site is sampling the history of the menu of the local population of prehistoric man." Today, you cannot find a Kurd at Shanidar who will eat snails or the flesh of boars, even though both abound. These are restatements of the observation that the fauna of an area, as identified in archeological contexts, is passed through the filter of human occupation. Cultural selection of fauna in a particular region, however, is obviously dependent upon the existing

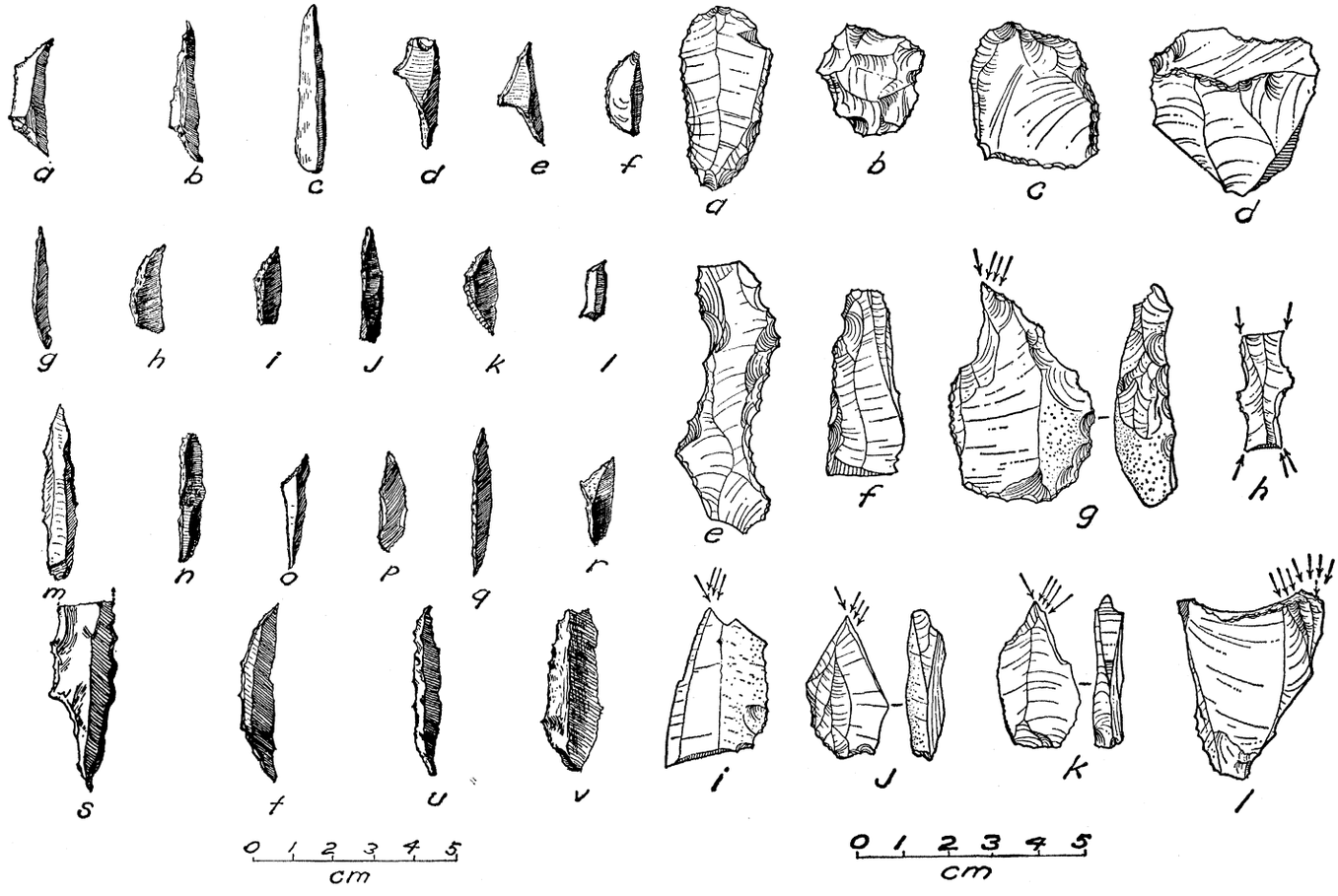

Fig. 8 (left, *a–r*). Various forms of finely executed points and side blades of flint from the upper and lower subdivisions of Layer B (Proto-Neolithic and Mesolithic horizons) at Shanidar cave. They are pressure retouched. With the exception of *m*, a "Gravettian" type point, and *s*, a single-shoulder based point, all the specimens shown are blunted-back retouched on one side. Some of them were probably side blades for composite implements. From the points, at least, it is inferred that the bow and arrow were known—a great technological advance. Fig. 9 (right, *a–l*). Flint artifacts from layer C (Upper Paleolithic, Baradostian horizon) at Shanidar cave. They were made by percussion striking and pressure retouching, principally on blades. These artifacts indicate a heavy preoccupation with wood-working (very few bone implements were found). A fireside activity requiring special talents is clearly shown by the diversification of the tool kit, indicating gouging, incising, cutting, shaving, and scraping arts, specialized forms being found within each group. *a*, End scraper; *b*, "circular" scraper; *c*, side and end scraper combination; *d*, "nosed" steep scraper on a blade core; *e*, notched or "strangled" blade; *f*, chisel-ended implement; *g*, combination nosed burin (or graver) and end scraper; *h*, multiple-ended burin; *i*, angle-struck burin; *j*, stepped-bit *"bec de flute"* type burin; *k*, nosed-bit *"bec de flute"* type burin; *l*, heavy bitted burin with polyhedric facets.

faunal inventory, which must have first passed through the screen of natural environment.

Of import to the Shanidar study is a comment by Charles A. Reed of Yale University, who has studied Shanidar faunal data from three excavation seasons. He says that the remarkable thing about the fauna of Shanidar cave is that outwardly all of the bones look to be of the same age and of recent date, having the appearance of a "single-age, post-Pleistocene fauna" (*40*). The bones or faunal evidence, therefore, suggest that the climate at Shanidar did not change a great deal from Middle Paleolithic times on. Yet the primary climatological data, the available pollens, show otherwise. At present there is no ready explanation of this contradiction. Broadly speaking, animals are less sensitive to climate change than plants. Furthermore, some animals, such as sheep, are less sensitive to change than others (*39, 41*). Could this be the root of the problem at Shanidar? Or is it that here, as in the Mediterranean area (*34, 37*), the hunters had access to a large region with a very wide range of environmental conditions from which to draw their game animals?

We must wait until a regional sequence of pollen data has been obtained from the Shanidar area before we can say that the climate-change yardstick can be applied in the Near East with precision. Nevertheless, in the two faunal curves and the admittedly incomplete pollen curve of Shanidar (Fig. 13), some broad correspondence can be seen, with one notable exception. The plot for Tabūn B in the Mt. Carmel diagram, indicating a wet and cold climate, is not in accord with the other curves. It occurs at about the time the Mousterian cultures in this part of the Near East were dwindling.

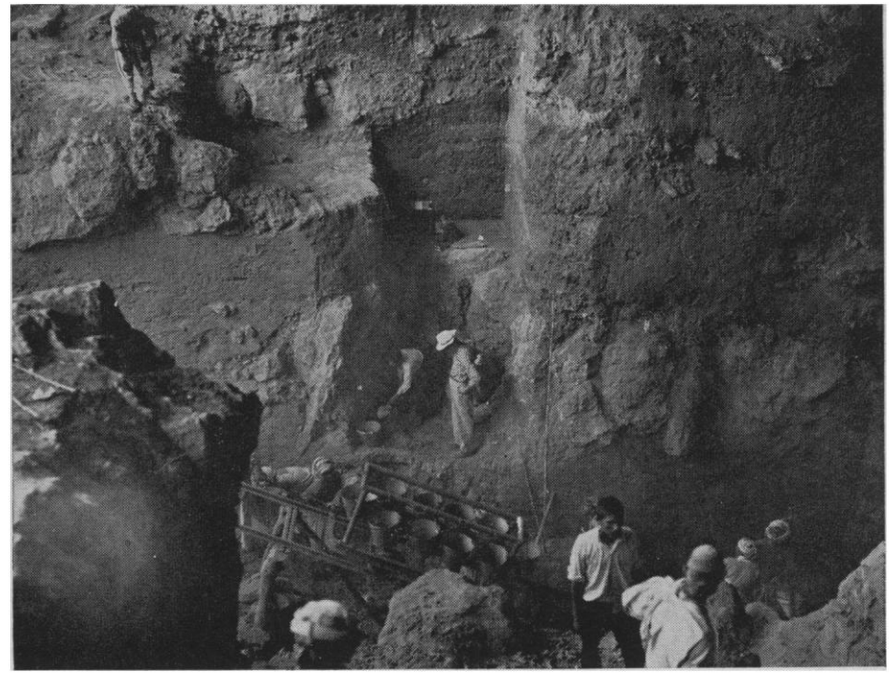

Fig. 10. The Shanidar cave excavation, looking west toward the "find" spot of Shanidar II in the keyway pit. The deepest part of the excavation is at right.

Human Populations of Shanidar Valley

Study of human populations of the Shanidar Valley is a complex process, its complexity compounded by incompleteness of the Shanidar, or related investigations and by a lack of data. However, some general observations can be made on the basis of the available Shanidar data.

The Mousterian layer seems to have been built up by a series of Neanderthals who were relatively stagnant culturally; there were 2000 generations of them in the perhaps 60,000 years of its accumulation. Preliminary analysis of the tool types, from bottom to top, indicates that, except for the brief vogue of what looks like the "Emiran" type point (*42*), there were no changes in the deposit. These basally inverse retouched points were found in the middle of a heavy occupational zone at a depth of about 8.5 meters—a zone which, as noted earlier, is probably evidence of a climate warmer than that of today. Neither fauna nor culture seem to have been much affected by the change to a very cool climate that is indicated by remains at a depth of about 7.5 meters. About this time (about 60,000 years ago), three of the six adult Neanderthals (Nos. II, IV, and VI) whose skeletons have been recovered were killed, all crushed by rocks (Fig. 14). Shanidar III, found at a depth of 5.4 meters, lived in a warmer climate perhaps 50,000 years ago. Shanidar I (Figs. 15 and 16) and Shanidar V were found at a depth of about 4.3 meters in a horizon dated about 44,000 B.C., also in a warm environment. Physical violence, compassion for the living (*43*), and a certain regard for the dead are reflected in the skeletal finds. Stewart (*14, 44*) has shown that the Shanidar Neanderthals have morphological features similar to the Tabūn skeletons of Mt. Carmel, which postdate the Shanidar Neanderthals by at least 5000 years. Stewart has also shown, on the basis of his studies of the skulls of Shanidar I and II, that an almost classic Neanderthal skull form was retained over a period of at least 15,000 years. The form was seemingly unaffected by the climatic changes inferred here. The carbon-14 dates recently obtained for Tabūn B (about 39,500 years ago) and Tabūn C (about 41,000 years ago) (*45, 46*) suggest that the Mt. Carmel sequence falls almost entirely within the Last Glaciation (Würm in the Alpine sequence).

There are certain differences in tool types between the Mousterian cultures of Mt. Carmel and Shanidar—for example, the absence of the Levallois core technique at Shanidar (*47*) and evidence of the technique at Mt. Carmel. This undoubtedly must have some basis in the difference in environment. The recently obtained dates for Mt. Carmel point up the difficulties in making cultural correlations on the basis of industry typologies (*48*) and negate my conclusions from typological comparison of the Mt. Carmel and the Shanidar Mousterian (*47*). If the Mt. Carmel dates were some 6000 years older, they would make the cultural sequences, at least, match better with those of other sites in the Near East.

Viewed broadly, the Shanidar Mousterian is a reasonably good example of the Mousterian culture horizon which ranged from Western Europe and North Africa to Uzbekistan (*49,*

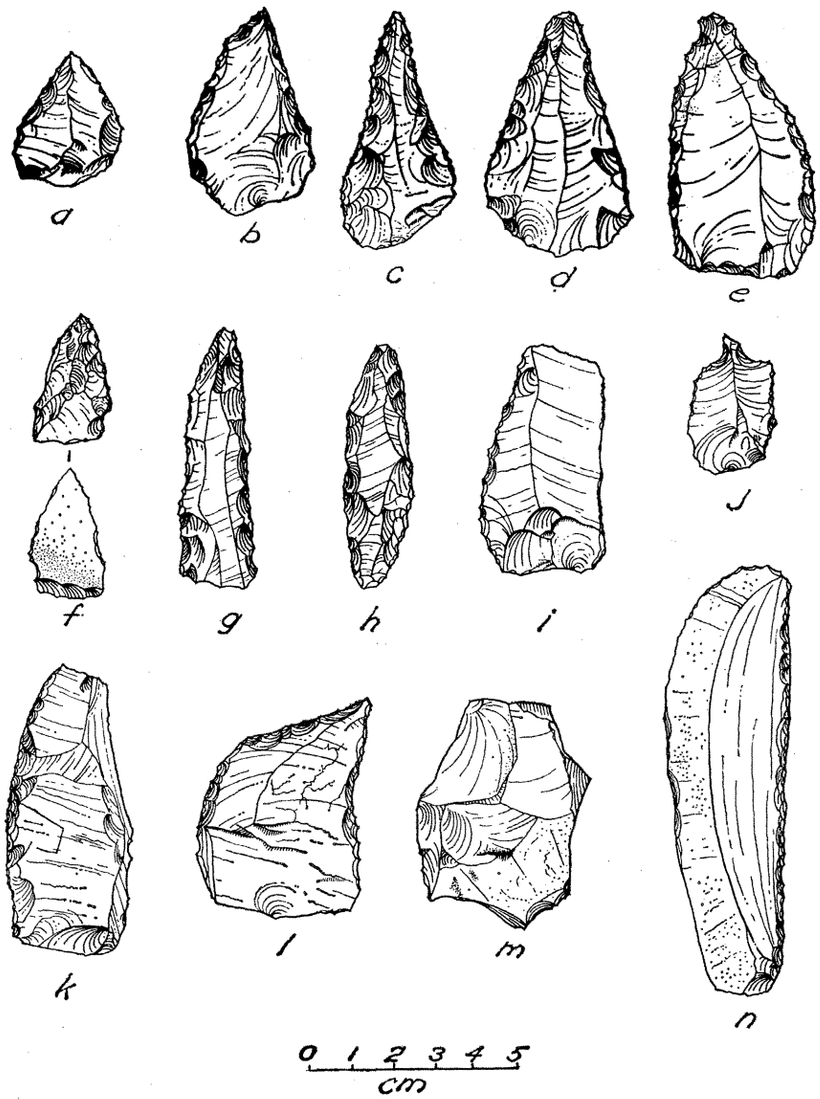

Fig. 11. Examples of artifacts from layer D (Middle Paleolithic Mousterian horizon) at Shanidar cave. They are percussion struck, and made on unifacial flakes of flint. These represent the simplest implements at Shanidar cave, presumably used for tipping spears, as skinning knives, and as simple wood-working tools. No Levallois prepared cores were found, although many of the artifacts exhibit "facetted butt" preparation on their basal ends. *a–e*, Typical Mousterian points; *f*, "Emireh"-type point with basal inverse retouch; *g*, elongated Mousterian point; *h*, double-ended point; *i*, convex-edged side scraper; *j*, borer; *k*, convex-edged sidescraper on a thick flake; *l*, assymetrically shaped point or *"déjeté"* type sidescraper; *m*, flake core; *n*, unusually long sidescraper and knife combination.

50) and Central Asia (*51*) in a rough ellipse around the Mediterranean, Black, Caspian, and Aral seas (*52*). An interesting parallel can be drawn between the Shanidar and the Teshik-Tash Mousterian (*49, 50*), where, in similar mountainous environments, the principal animals hunted were goats. In the Iraq-Iran area, an occupation closely related to the Shanidar Mousterian occurred at the shelter-cave sites of Hazar Merd, Babkhal, Spilik, Bisitun, and Warwasi, and occupations less closely connected, at the open sites of Tarjil, Serandur, and Telegraph Pole 26/22 (*53, 54*). Hazar Merd and Bisitun, at least, appear to be statistically related to Shanidar (*55*).

The Mousterian lingered on longer at Mt. Carmel than it did in the Zagros Mountains, a finding that upset former chronological estimates for Mt. Carmel (*56*). The terminal date for the Mousterian has been set at about 35,000 to 40,000 years ago in the Levant (*45*); this is about the same as the date established for the beginning of the Upper Paleolithic III Baradostian of Shanidar. The date for the end of the Mousterian in Libya has been set at about 35,000 to 40,000 B.C. (*57*). The Mousterian came to Haua Fteah and to Shanidar at about the same time, but for some reason it seems to have been late in appearing at Ksâr 'Akil and Mt. Carmel. One must conclude that the Acheulian industries lingered on until quite late at Mt. Carmel, if the inferred chronology is true (Fig. 13). The Mousterian was part of an abrupt introduction, possibly stemming from Africa (*58*). But neither the spread nor the final extinction of this culture was uniformly smooth. The carbon-14 dates hint that the final Mousterian cultures occurred at the same time as initial Upper Paleolithic occupations in the Near East.

What happened eventually to the last Shanidar Neanderthals is not known. It is hardly likely that unfavorable climate was a contributing cause of their departure. The possibility that they were eliminated by a prehistoric catastrophe cannot be ruled out. There is no evidence, but perhaps the Upper Paleolithic true *Homo sapiens* contributed to this extinction at Shanidar. However, if the Neanderthals had been bested in combat (and this surely would have been an unequal fight), it might be expected that the newcomers would have taken over their homes (*59*). There seems to be evidence of cultural intermixture of the Upper Paleolithic and the Mousterian Middle Paleolithic in a transitional industry (the Emiran) in the Levant (*60*), and similarly, passage of the Mousterian culture into the Upper Paleolithic Perigordian I in France (*61*). But such was not the case at Shanidar. After, at most, a lapse of 10,000 years, the new occupants of Shanidar cave, the Baradostian people, took over a wilderness restocked with game, with no one to dispute their hunting territory claims.

On the basis of their tool inventory, it appears that these Upper Paleolithic peoples were most closely related to the Southwest Asian and European blade- and burin-using populations (*11, 62, 63*). The Baradostian industry is unique in Iraq, although it has been reported from Warwasi cave in western Iran (*64*). Nothing is known of cave or "home" art. It looks as though the Baradostian people had adapted their hunting methods to local conditions and pursued the same game animals (mainly goats) as their Neanderthal predecessors in Shanidar Valley. Probably they drove these gregarious herbivores over cliffs or trapped them in blind canyons nearby.

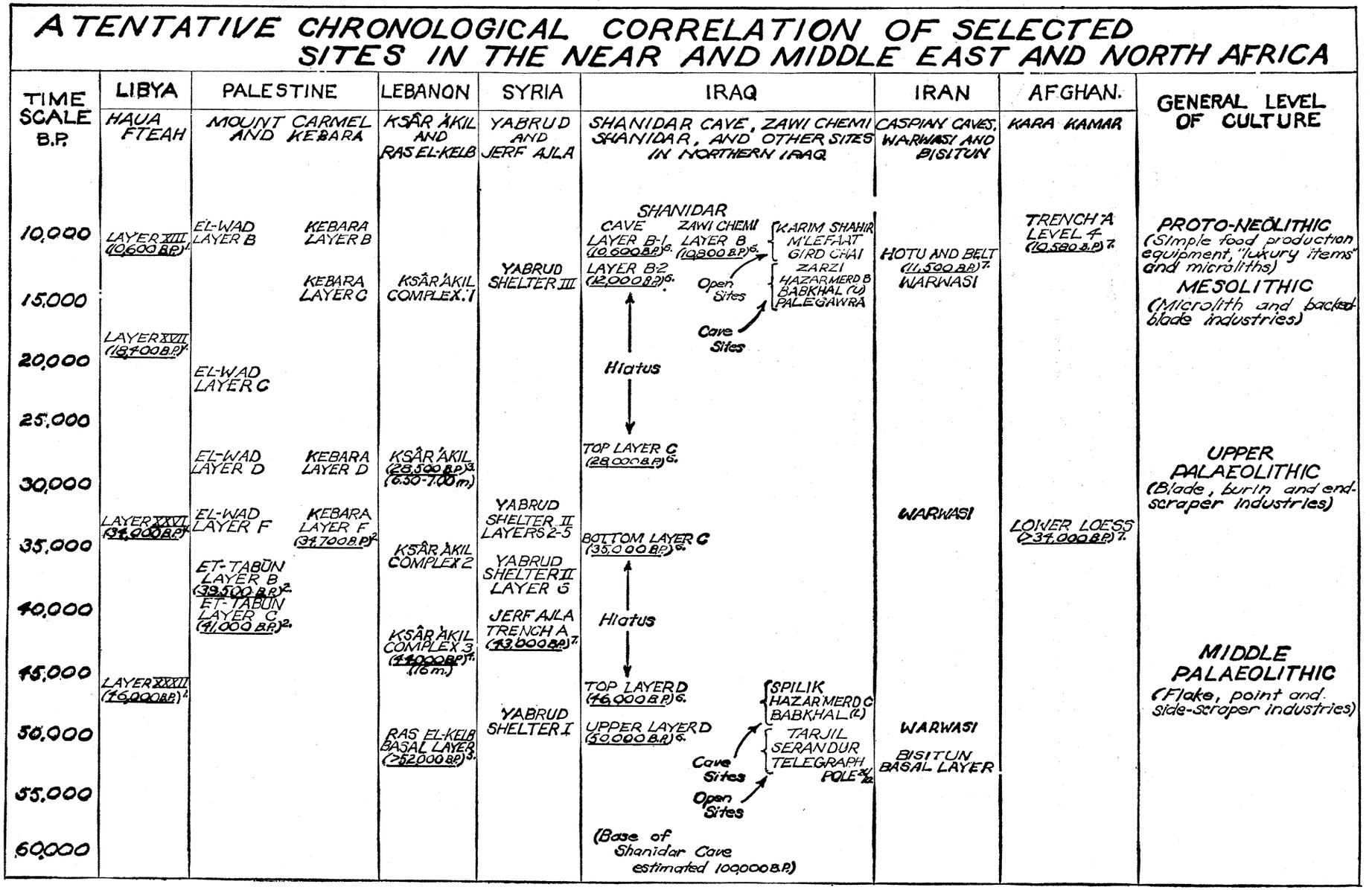

Fig. 12. A tentative chronological correlation. The dates given for the various sites are round numbers based on carbon-14 determinations reported as follows: 1) C. B. M. McBurney, *Advan. Sci.* **18**, 496 (1962); 2) K. P. Oakley, *ibid.* **18**, 415 (1962); 3) J. Perrot, in R. J. Braidwood and G. R. Willey, "Courses Toward Urban Life," *Viking Fund Publ. No. 32* (962), p. 150; 4) J. Franklin and S. J. Ewing, personal communication (Sept. 1962); 5) D. A. E. Garrod and G. Henri-Martin, *Bull. Musée de Beyrouth* **16**, 4 (1961); 6) R. S. Solecki (see text); 7) C. S. Coon, *The Seven Caves* (Knopf, New York, 1957), pp. 210, 252, 253, 315. Layers without carbon-14 dates are given relative positions in their respective sequences.

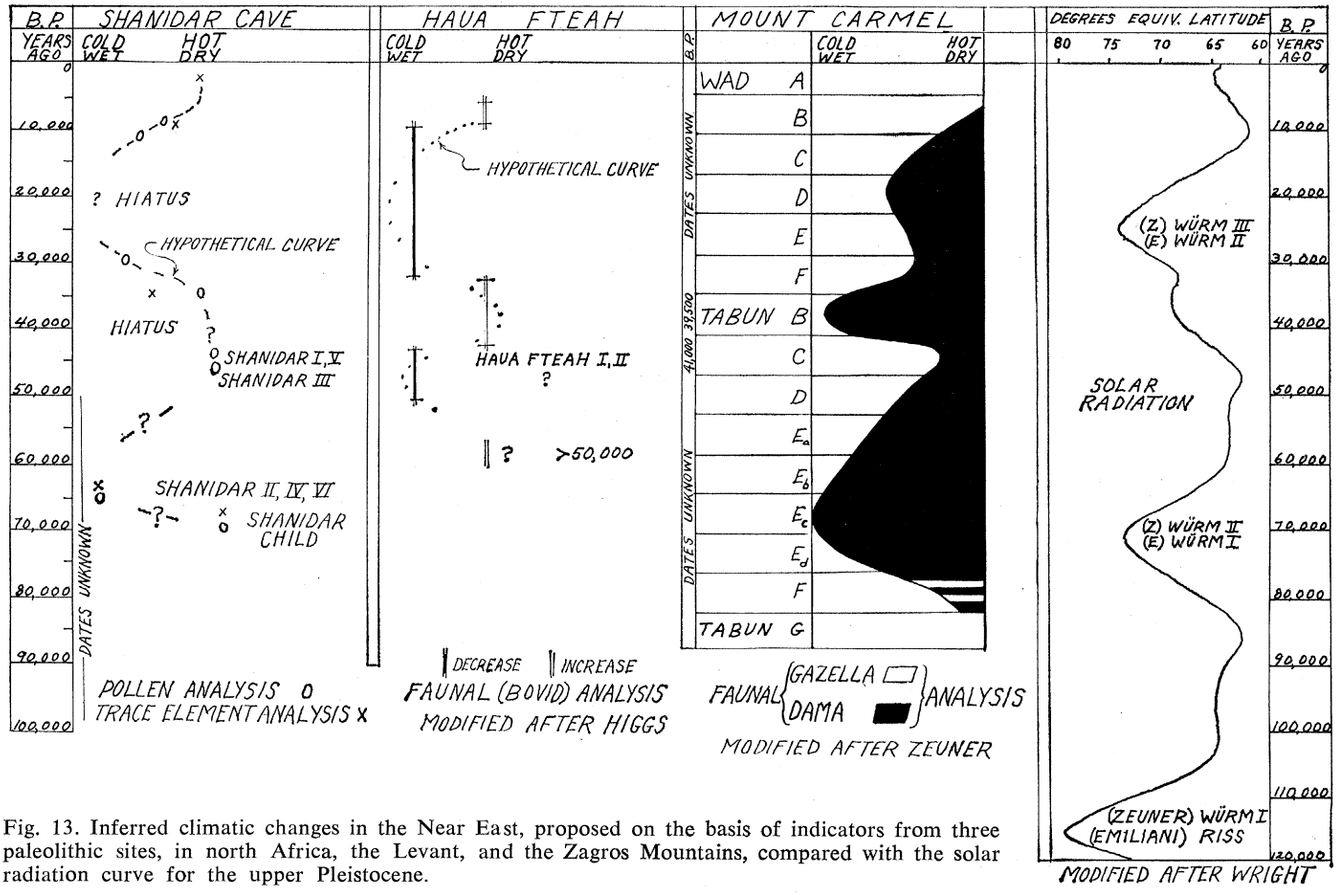

Fig. 13. Inferred climatic changes in the Near East, proposed on the basis of indicators from three paleolithic sites, in north Africa, the Levant, and the Zagros Mountains, compared with the solar radiation curve for the upper Pleistocene.

In the four known caves in the Zagros area which contain a Mousterian occupation overlaid by a Mesolithic one, only Shanidar and Warwasi caves have an intervening Upper Paleolithic occupation. There are more numerous, related occupations to the west in the Levant. There the closest parallels to the Baradostian are at Yabrud (shelter II, layers 4 and 5) in Syria, at Abu Halka (layer IVc) in Lebanon, and at Mt. Carmel Wad E in Palestine—or what R. Neuville (*65*) calls Upper Palaeolithic III (*11*). The Upper Paleolithic had a longer and more complete cultural history in the Levant than in the mountain hinterland of the Zagros area. While it is evident that the Baradostian did not have the time spread of the Mousterian, a more likely explanation of the sparseness of distribution for the Zagros area is a lack of population. It is possible that this interior mountain environment necessitated a special economic adjustment.

About 26,000 B.C., it is surmised, the climate became too cold for man at Shanidar and he left. The next occupation was not until about 15,000 years later. No barren soil layer was noted between layers B and C with which this hiatus can be correlated. This apparent desertion of Shanidar in the later Upper Paleolithic is paralleled at other dated and undated sites in the Near East, from Kara Kamar (*66*) in Afghanistan to southern Turkey (*67*). There may well have been a low population density during the peak of the Last Glaciation, between about 13,000 and 23,000 years ago (*68*). This is borne out by the dwindling number of sites even in the historically rich area of the Levant, where the Upper Palaeolithic stage V of Neuville (*35, 65*) is clearly defined in only two sites, both in Palestine (Mt. Carmel Wad C "Atlitian," and el Khiam E). The hiatuses occur between the period of blade and burin industries of the Upper Paleolithic and the Mesolithic of the very late Pleistocene. In neighboring Soviet Asia we find a similar situation, with even longer hiatuses between the Mousterian and the Mesolithic (*50, 69*). After the close of the Last Glaciation, about 9000 to 10,000 B.C., there was a rash of Mesolithic settlements. As in the Near East, they blossomed over what is now Soviet Asia like desert flowers after a rain, taking advantage of an apparent cultural vacuum, meeting with little or no resistance. Surely something new must have been added to the economy, or new techniques and innovations must have broadened the economic base, contributing to this evident population spurt (*70*).

The date of this movement, at least in this part of the Near East, was about 10,000 B.C., and the movement probably lasted not more than one and a half millennia. There are ten known sites of this relatively brief culture horizon [generally belonging to the "Zarzian" (*71*)] in the Iraq-Iran Zagros Mountain area in contrast to the lone pair of known Baradostian sites, spanning a period about five times as long. The Mesolithic layer B2 of Shanidar cave is one of these culturally related "Zarzian" sites; the others are components in the cave sites of Zarzi, Hazar Merd, Babkhal, Palegawra, Hajiyah, Barak, and Warwasi and in the open sites of Turkaka and Kowrikhan (*53, 54, 64, 72*). Outside the Zagros Mountain area, on the Caspian Sea in Iran, are the Belt and Hotu caves (*35, 42, 73*), which have occupations of comparable date and culture.

The origins of this Mesolithic culture are not definitely known. Certainly it did not stem from the Baradostian at Shanidar. It could have come from the Levant, but related cultures to the

north beyond the Caucasus area may have been just as compelling (*62*). This people marked the end of the true hunters and gatherers, analogous to the Azilians and Tardenoisians in Europe prior to the Neolithic cultures. The sudden abundance of snail shells, the marked discoloration of the soil (from vegetal stuffs?), and the suggested presence of pits and basins in the Mesolithic layer of Shanidar cave suggest that these people were successfully launched on the road of experimentation with nontraditional food.

The cultural analog to the qualified "Zarzian" horizon in the Levant is the "Kebaran" of the Upper Paleolithic VI stage (*62, 63*). In North Africa, the analog to this culture horizon is the Oranian, which appears to date from later than 15,000 to 12,000 B.C. in the Maghreb (*27, 36*). Is it possible that Oranian-related cultures swung eastward along the Mediterranean and inland through the Zagros arc and on eastward? It is too soon to say, but we are on the threshold of knowing. If this were true, then the movement of the later Proto-Neolithic horizon would be an interesting phenomenon to trace. The matter of the relationship of "Zarzian" to the open-air sites of the Ukraine, a thousand miles away, is still not clear (*62*).

The next culture horizon in Shanidar Valley is known from the Proto-Neolithic occupation at the cave (layer B1) and at the open site of Zawi Chemi Shanidar (*74*). These sites were probably seasonally occupied. Related components are found at such sites as Karim Shahir, M'lefaat, and possibly Asiab (*53, 54, 64, 72, 75*). The evidence from Zawi Chemi Shanidar shows that this culture, especially, was well on its way toward full food production; the domesticated sheep was already known—an innovation probably brought in from some other area (*1*). In the Levant the analogous Proto-Neolithic culture seems to have been the Natufian of Palestine (*76*). A more distant analog is the Capsian culture in North Africa (Maghreb), emergent there sometime after 9000 B.C. (*36*). The interrelationships among these widely dispersed cultures, like those for the previous Mesolithic horizon, are not yet positively shown, but the thread of cultural similarities cannot be dismissed (*77*).

Fig. 14. The skull of Shanidar II, as it appeared when discovered, crushed under a rockfall. The skull is lying on its right side, face to the front. The stone to the left was found directly over the left temple. This individual lived in a cool climate.

The contrast between the Mesolithic and the Proto-Neolithic cultures at Shanidar is very marked. The compelling problem is that of determining the origin of the Shanidar B1–Zawi Chemi Shanidar culture horizon (Proto-Neolithic), with its focus on economic change. It may be that the preceding Shanidar B2 type culture and its Mesolithic equivalents elsewhere were for some reason, possibly ecological, already heavily predisposed toward experimental food collection and preparation of such edibles as acorns, nuts, and wild grass seeds. Social changes must have accompanied the new mode of life, but inferences about this are somewhat more difficult to make. At any rate, it is an inescapable fact that a

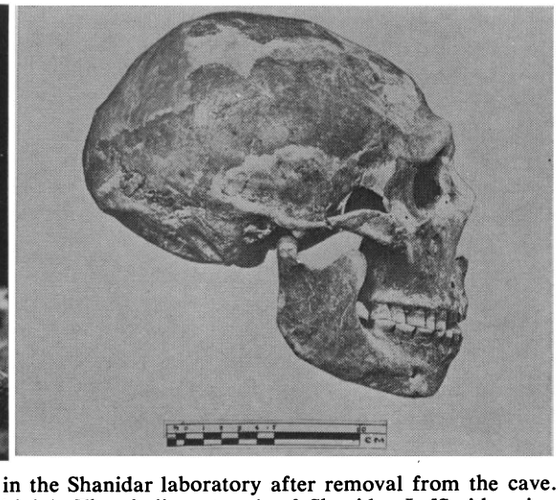

Fig. 15 (left). The skull of Shanidar I, dated about 44,000 B.C., as it looked in the Shanidar laboratory after removal from the cave. The vertebrae are in place. This individual lived in a warm climate. Fig. 16 (right). The skull, restored, of Shanidar I. [Smithsonian Institution]

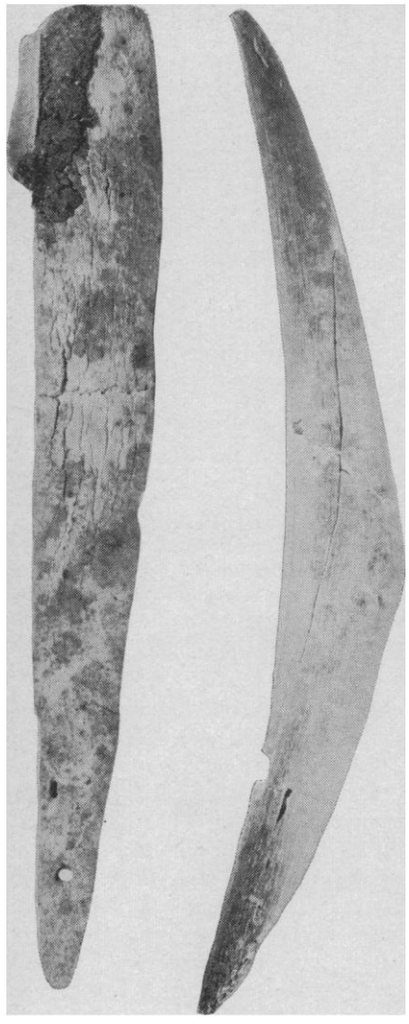

Fig. 17. (Left) A knife, 20.9 centimeters long, made of a flint blade held with a tarry substance in a bone handle, found in the Proto-Neolithic cemetery at Shanidar cave. (Right) A laterally grooved bone handle, 21.7 centimeters long, which presumably held flint blades, from the Proto-Neolithic layer at the Zawi Chemi Shanidar village site. This was probably a sickle for cutting grasses.

food-production revolution of a sort is evidenced at Shanidar cave layer B1 and at Zawi Chemi Shanidar. It did not evolve directly out of Shanidar B2, but the change probably took place not very far away.

This great revolution seems to have occurred at just about the time of an abrupt world-wide rise in temperature (*78*). Undoubtedly the same sort of climatic change had occurred before in man's history, but without a similar aftermath, so far as we know. Presumably, man did not have the right combination of mental, technological, and social attributes earlier in his development to search out and utilize radically new ways of getting a living, or else he was not in an area where the proper combination of ecological factors obtained. But given these, a kind of trigger was needed to make him depart from being a perpetual "lotus-eater," forever dependent upon hunting and gathering for his existence. In the area under discussion, the rise in temperature could have served as just such an indirect stimulus. The same sort of shock stimulus and subsequent concatenation of events was felt in the American Southwest at about the same time (about 8000 B.C.) (*79, 80*), where, paralleling developments in the Near East, there were shifts to an economic base more dependent upon food gathering, especially the gathering of vegetal foods, than on hunting. The hallmark of the so-called American Desert Culture was the flat milling stone, or quern, and the gathering basket (*80*). At Shanidar and related sites we find evidence of the introduction of querns and hand milling stones [also, at Shanidar cave, baskets (?), and at Zawi Chemi Shanidar, possibly some kind of reaper (Fig. 17) (*8*)], indicating vegetal foods. The wild goat, known since the first occupation at Shanidar cave, was now of minor importance as compared to the sheep, which was found domesticated in Shanidar Valley. The stage was set for a "mixed-farming" economy.

As for the Desert Culture of the American Southwest, it seems that food production did not take hold there as it did in the Near East. Lacking was the combination of potentially domesticable animals and wild cereal prototypes, which in the Near East were the touchstone to civilization (*81*).

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The Imitation of Man by Machine

The view that machines will think as man does reveals misunderstanding of the nature of human thought.

Ulric Neisser

Popular opinion about "artificial intelligence" has passed through two phases. A generation ago, very few people believed that any machine could ever think as a man does. Now, however, it is widely held that this goal will be reached quite soon, perhaps in our lifetimes. It is my thesis that the second of these attitudes is nearly as unsophisticated as the first. Yesterday's skepticism was based on ignorance of the capacities of machines; today's confidence reflects a misunderstanding of the nature of thought.

There is no longer any doubt that computing machines can be programmed to behave in impressively intelligent ways. Marill (*1*) does not exaggerate in saying, "At present, we have, or are currently developing, machines that prove theorems, play games with sufficient skill to beat their inventors, recognize spoken words, translate text from one language to another, speak, read, write music, and learn to improve their own performance when given training." Nevertheless, I will argue that the procedures which bring about these results differ substantially from the processes which underlie the same (or other) activities in human beings. The grounds for this assertion are quite different from the "classical" reasons for skepticism about thinking machines, but the latter should be considered first. This amounts to reviewing the similarities between men and computers before stressing the differences.

First of all, it was formerly maintained that the actions of a mechanism would never be purposive or self-directed, whereas human behavior can be understood only in terms of goals and motives. Two counterexamples will be enough to show that this argument has become untenable. In the realm of action, it is difficult not to be impressed with the "homing" missile, which pursues its target tenaciously through every evasive action until it achieves its de-

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