jat, O. N. Rudčenko, *Dokl. Akad. Nauk. SSSR* **155**, 937 (1964); R. Beukers, *Photochem. Photobiol.* **4**, 935 (1965); R. B. Setlow and W. L. Carrier, unpublished experiments suggested by R. Beukers.
17. R. B. Setlow and W. L. Carrier, *J. Mol. Biol.*, in press.
18. R. H. Haynes, in *Physical Processes in Radiation Biology*, L. Augenstein, R. Mason, B. Rosenberg, Eds. (Academic Press, New York, 1964), p. 51.
19. W. Sauerbier, *Virology* **15**, 465 (1961).
20. A. Wacker, H. Dellweg, D. Weinblum, *J. Mol. Biol.* **3**, 787 (1961); K. C. Smith, *Photochem. Photobiol.* **3**, 1 (1964).
21. R. Beukers, J. Ijlstra, W. Berends, *Rec. Trav. Chim.* **78**, 883 (1959).
22. A. Wacker, D. Weinblum, L. Träger, Z. H. Moustafa, *J. Mol. Biol.* **3**, 790 (1961); K. C. Smith, *Photochem. Photobiol.* **2**, 503 (1963).
23. D. L. Wulff, *Biophys. J.* **3**, 355 (1963).
24. H. E. Johns, M. L. Pearson, J. C. LeBlanc, C. W. Helleiner, *J. Mol. Biol.* **9**, 503 (1964); K. B. Freeman, P. V. Hariharan, H. E. Johns, *ibid.* **13**, 833 (1965).
25. S. Y. Wang, *Nature* **190**, 690 (1961).
26. W. Füchtbauer and P. Mazur, *Photochem. Photobiol.* **5**, 323 (1966).
27. R. B. Setlow, *Biochim. Biophys. Acta* **49**, 237 (1961).
28. This conclusion does not hold for dimers of orotic acid. They are formed by irradiation in solution. E. Sztumpf and D. Shugar, *Photochem. Photobiol.* **4**, 719 (1965).
29. H. E. Johns, S. A. Rapaport, M. Delbrück, *J. Mol. Biol.* **4**, 104 (1962); R. A. Deering and R. B. Setlow, *Biochim. Biophys. Acta* **68**, 526 (1963).
30. E. Sztumpf and D. Shugar, *ibid.* **61**, 555 (1962).
31. M. J. Ashwood-Smith, B. A. Bridges, R. J. Munson, *Science* **149**, 1103 (1965); K. C. Smith, personal communication; R. O. Rahn, Abstract, Biophysical Society, 1966, p. 83.
32. P. A. Swenson and R. B. Setlow, *Photochem. Photobiol.* **2**, 419 (1963).
33. R. B. Setlow and J. K. Setlow, *ibid.* **4**, 939 (1965).
34. J. K. Setlow and R. B. Setlow, Abstract, Biophysical Society, 1966, p. 72.
35. D. L. Wulff and C. S. Rupert, *Biochem. Biophys. Res. Commun.* **7**, 237 (1962); J. K. Setlow, *Photochem. Photobiol.* **3**, 405 (1964).
36. J. Jagger and R. S. Stafford, *Biophys. J.* **5**, 75 (1965); Abstract, Pacific Slope Biochemical Conference, Los Angeles, Sept. 1965.
37. Two of the photoproducts of TpT are interconvertible but are not monomerized by irradiation (*24*).
38. Research sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation.

Research in the Prehistory of Central Western Iran

Recent preliminary excavations promise to document 40,000 years of prehistory in the Zagros Mountains.

T. Cuyler Young, Jr., and Philip E. L. Smith

A noticeable recent trend in Near Eastern archeology is toward the study of a particular problem, such as the development of village farming communities or of urbanism, across a number of local time boundaries, accompanied by research in depth in a given geographical region. The activities of Braidwood in Iraq and adjoining countries, Perrot in Israel, Solecki in the Shanidar Valley of Iraq, and Mellaart in southwestern Anatolia, to mention only the best-known instances, have placed in proper perspective the development of culture and cultures across long spans of the food-gathering and food-producing eras in this vital area of the Old World, and amply demonstrate the advantages inherent in interdisciplinary field research (*1–3*). Dyson, working in the Solduz region of northwestern Iran, has demonstrated that this approach can be applied profitably in time ranges as late as the 1st millennium B.C. (*4*).

This article is a preliminary notice of further research of this type recently carried out (1965) in western Iran. One of us (Smith) is a prehistorian concerned mainly with the cultures of the Stone Ages (Paleolithic to Neolithic), while the other is principally interested in the Neolithic to Iron Age Near East. By combining our interests and methods of research in a program of field work over a number of digging seasons we hope to develop, in a relatively restricted region, a nearly continuous archeological sequence from at least Middle Paleolithic to Iron Age times. Studies of the natural setting of this sequence should enable us then to present the human history and the fluctuating Quaternary ecology of the area over an unusually long period of time.

After a broad survey of central western Iran during 1964–65, from northern Luristan to Azerbaijan, we have selected the upper reaches of the Gamas Ab River basin, in the core of the Zagros mountain chain of southern Kurdistan, for long-range study. Here a valley system about 60 kilometers long and 15 kilometers wide, stretching from just east of the town of Kangovar to the villages of Bisitun and Harsin, defines the modern ethnic border between Kurdistan and Luristan and straddles the ancient high road into Iran—the principal route linking the alluvial plains of Mesopotamia with the high Iranian plateau (Fig. 1).

Central western Iran is by no means virgin territory archeologically. A considerable amount of work has been done in areas adjacent to the Kangovar-Bisitun Valley. In 1931–33 G. Conteneau and R. Ghirshman excavated a series of Bronze and Iron Age tombs at Tepe Giyan, near modern Nehavand, in the valley immediately south of Kangovar; and in 1933 Ghirshman sounded Tepe Bad Hora, a Bronze Age site, in the Assadabad Valley just to the northeast of Kangovar (*5*). Within the area of our concern C. S. Coon, in 1949, excavated a Paleolithic rock shelter at Bisitun (*6*). In 1959–60 Braidwood and his associates examined a series of sites ranging from Middle Paleolithic to Uruk times in the Kermanshah Valley to the west (*7*). Recently, a Danish expedition under the general direction of J. Meldgaard has excavated the site of Tepe Guran in the Hulailan Valley to the southwest (*8*). Finally a study of the historical remains of Bisitun is in progress under H. Luschey and the German Archeological Institute of Tehran (*9*).

To date we have examined some 84 mounds and 10 caves and rock shelters

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in the Kangovar-Bisitun area. Of the sites where preliminary soundings have been made, three are of unusual value: the Paleolithic cave site of Ghar-i Khar, the small aceramic Neolithic mound of Ganj-i Dareh Tepe (both in the Bisitun area), and the large site of Godin Tepe (in the Kangovar area) with a sequence from Neolithic with pottery to the Iron Age.

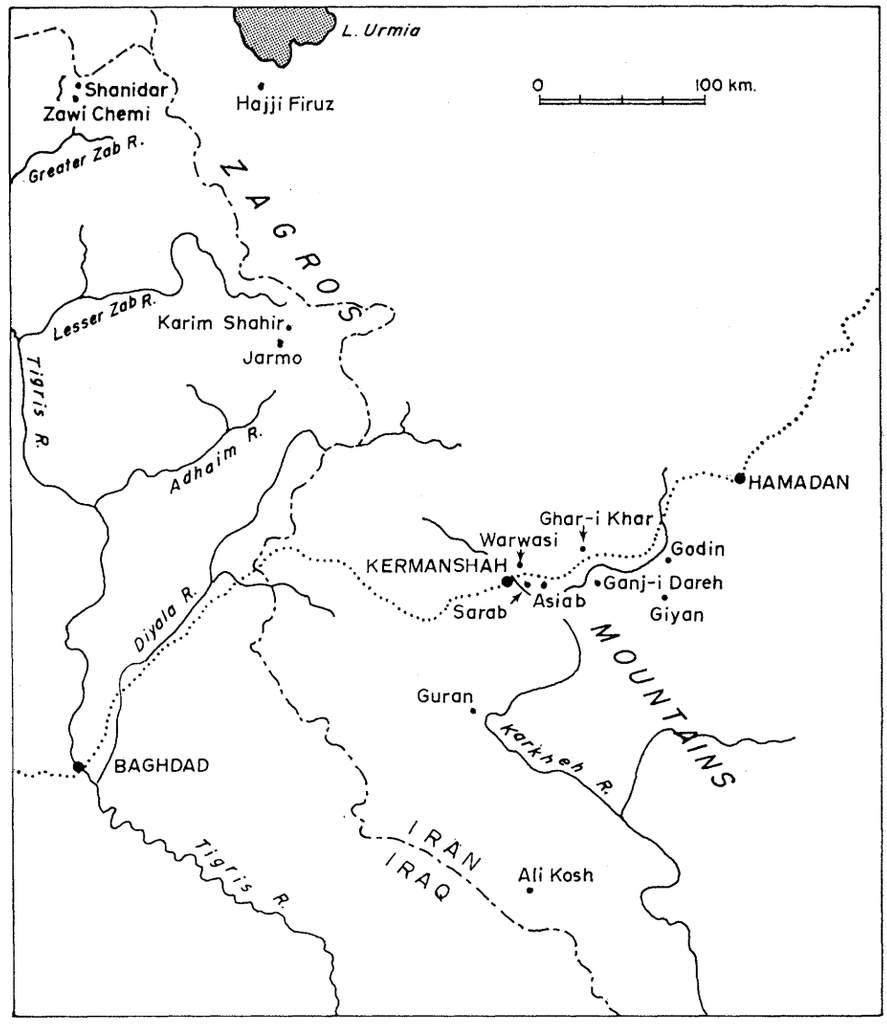

Fig. 1. Central western Iran, with the principal prehistoric sites. The dotted line represents the traditional route, now a modern highway, across the Zagros from Mesopotamia to the Iranian plateau.

Ghar-i Khar

Ghar-i Khar ("Donkey Cave") is a long, narrow solution cave situated in the limestone cliff face of Bisitun Mountain. Its inconspicuous entrance faces south toward the broad valley of the Gamas Ab River. The length of the cave is about 27 meters, but its depth is unknown; our 1965 sounding, which extended slightly more than 5 meters below the present floor, did not reach bedrock. The soil in the deposits is typically dark brown or reddish brown cave earth, interspersed with large blocks and small fragments of limestone fallen from the roof and walls. In our preliminary sounding it was difficult to establish clear lines of demarcation between the various cultural zones and occupation surfaces, but it is clear that the cave has been occupied at intervals from at least the Middle Paleolithic (which probably ended about 35,000 B.C.) until recent times. Stone artifacts and faunal remains were plentiful, and hearth areas could be distinguished throughout the sequence of occupations.

At the base of the sounding a Middle Paleolithic level was reached which yielded typical Mousterian artifacts such as asymmetrical side-scrapers and thick retouched blades. The raw materials used (reddish chert and jasper) and the typology of the artifacts indicate a close relationship with the Mousterian levels at the small cave excavated by Coon in the nearby village of Bisitun (*6*).

The artifacts in the zones extending approximately 1 meter above the Mousterian are somewhat difficult to diagnose on the basis of our limited sampling, but in all likelihood they represent occupations by Advanced (or Upper) Paleolithic groups who produced blade-tools analogous to certain artifacts of the Baradostian industry as defined at Shanidar Cave in northern Iraq (*2*). This is suggested by the relative frequency of burins, including those with multiple blow facets, by the types of end-scrapers, round scrapers, backed blades and occasional backed bladelets, and notched and strangulated blades, and by the infrequency of worked bone tools. However, the relationship between the time spans covered by these occupations and by those at Shanidar Cave is not yet known.

No stratigraphic break was discernible between these occupation zones and those in the next highest meter of deposits. There is also no clear indication of cultural discontinuity. Some elements persist, such as backed bladelets and blades, retouched blades, and certain scraper types. However, there are now present new elements, such as microburins, triangles, truncated backed bladelets, Gravette-like points, curved backed bladelets, chipped stone implements (axes?), grinding stones, and worked bone awls. These permit a tentative cultural and temporal correlation with some phase or phases of the Zarzian industry of terminal Pleistocene or early Holocene age in the Zagros region (*2*). A somewhat similar assortment of tools is present in the "Seal Mesolithic" of Belt and Hotu Caves on the Caspian foreshore of northern Iran (*6*, *10*).

The next 1.5 meters cannot be diagnosed with precision until more extensive excavations are carried out. In spite of the presence of occasional small sherds of pottery, there is a good possibility that an aceramic assemblage is represented and that the sherds are intrusive from higher levels where there are traces of an early straw-tempered pottery. Whether the artifacts that are present, which include backed blades and some geometrically shaped flints, represent a continuation of the microlithic Zarzian-like occupations, or

an occupation by aceramic food-producing groups, is difficult to say at present.

Above this are nearly 2 meters of deposits which for the most part seem considerably later. By now the main locus of activity in the Bisitun-Kangovar Valley had probably shifted to open sites on the valley floor. Although there are traces of what may be an early Neolithic straw-tempered "software" pottery, the cave was not intensively occupied hereafter. However, the presence, near the surface, of an early historic baked brick, some Islamic pottery, and a silver coin of the 15th century A.D. indicates sporadic frequentations of this isolated site, which have continued up to the present day, when shepherds and goatherds occasionally use it to shelter their animals.

Ghar-i Khar is the third site in the Zagros region of Iraq and Iran now known to contain an archeological sequence extending from the Middle Paleolithic to final Pleistocene and later times. The other two are Shanidar Cave in northern Iraq and Warwasi shelter near Kermanshah, both known only from preliminary reports (*2, 7*). Although the Mousterian in the Near East beyond the Mediterranean zone is reasonably well known in broad outline, we are nowhere near being able to distinguish temporal, spatial, or possible functional variants of the industries. In particular, the cultural interface between the Mousterian and the Advanced Paleolithic is poorly known, and although it is doubtful that the latter developed from the former in this region, the nature of the changeover is not understood. Ghar-i Khar may provide some assistance in this respect. The investigation of the Advanced Paleolithic here and its relationship to the Baradostian should shed further light on this transition, particularly if it helps to fill in the hiatus of perhaps 15,000 years which exists at Shanidar between the Baradostian and the Zarzian (*2*). Whether the Zarzian itself has stages older than the end of the Pleistocene is still unknown and can be resolved only by further excavations. Excavations in the microlithic assemblages near the close of Pleistocene times should also yield new evidence on the situation immediately preceding the earliest recognizable stage of food production, for it is likely that, in this region, at least, the incipient or manipulative stage of domestication of plants or animals or both had its roots in late Pleistocene conditions. Finally, the indications that an early Neolithic culture that produced pottery may be represented at Ghar-i Khar suggest further details on a cave-occupying facies of the food-producing stage. The abundance of well-preserved faunal remains and charcoal at all levels in the cave and the possible presence of pollen spores promise that a rather full chronological and environmental sequence may be established here to supplement the scanty data from the few other sites with long occupations so far investigated in this part of the Near East.

Ganj-i Dareh Tepe

The site of Ganj-i Dareh Tepe ("Mound of the Treasure Valley") is located in the Bisitun valley system about 14 kilometers south of Bisitun village, at an altitude of between 1300 and 1400 meters. At the present time the mound is broadly conical in profile and irregularly oval in ground plan. The maximum depth of its deposits is about 7 meters, extending to virgin soil about 1 meter below the modern ground surface. Its present maximum width is about 40 meters, but ploughing has probably removed part of the original site. The mound is primarily the result of a number of levels of mud-walled houses (*11*) whose superstructures have partially or wholly collapsed. We did not extend our sounding trench of August 1965 far enough to reveal a house plan and can say little about the architectural aspects. Several strata of collapsed mud walling could be distinguished from top to bottom, with a number of zones of occupational debris and ashy deposits. At the top are the remains of a collapsed wall of rough red brick whose relationship with the underlying yellow and gray strata is still uncertain. We might expect in the interior of the mound a cluster of mud-walled houses which had been rebuilt at least several times. The size of these successive villages and the number of houses present cannot even be estimated until more of the site is excavated, but obviously the villages reflect a succession of small groups of people whose interests were so closely identified with the immediate locality that they remained there for a considerable period. The length of occupation of the site is not known, although a rough guess might be a few centuries; there are no erosion surfaces between strata to indicate long abandonments of the site. A radiocarbon analysis of charcoal from the lowest ashy zone gives a date of 8450 ± 150 B.C. (*12*). Further radiocarbon assays on charcoal from the higher strata may provide a partial answer to the question of the time span covered by the occupation of the site.

On the basis of our relatively small sampling of artifacts from each stratum we can at present detect no significant changes through time. For the moment, the artifact assemblages will be considered as broadly homogeneous. No traces of an occupation level containing pottery could be distinguished in our sounding trench, and the handful of sherds collected from the surface of the mound and its periphery were obviously very recent or modern. Animal bones and horn cores were abundant and well preserved. Flint seems to have been the principal lithic material, and flint artifacts were present in large quantities. No obsidian was found. The flint nuclei are often very finely worked, usually cylindrical or pyramidal in form and prismatically flaked in order to remove long, regular, parallel-sided blades and bladelets. Among the finished chipped stone implements are backed bladelets (sometimes truncated by retouch), side scrapers, end-scrapers, denticulated pieces, and nibbled blades. There were also some core-choppers, a chipped axe or pick, and some fragments of what may be worked stone dishes or querns. We recovered no geometric flints, burins, polished stone tools, or identifiable reaping-knife elements. However, a number of worked bone implements (awls, perforators, and sawn pieces) were found.

The typology of the artifacts and the absence of pottery suggest that the site of Ganj-i Dareh belongs completely to what is usually called the pre-pottery or aceramic phase of the Neolithic. Furthermore, and with all due caution in dealing with a single radiocarbon dating, a date in the 9th millennium B.C. for the beginning of settlement seems indicated. This would place it near the start of the postulated "era of incipient cultivation" (*1*, p. 182) which is estimated to have begun in this part of the Near East between approximately 10,000 and 8,000 B.C. This initial phase of food production in the Near East is notoriously poorly known, although most authorities believe that food production originated here. Unfortunately there are still very few well-preserved sites capable of being dated

which document the processes of this crucial and interesting phase of cultural development. The principal excavated sites which seem to represent this phase are Zawi Chemi and the adjoining Shanidar Cave in northern Iraq (*2*), Karim Shahir and M'lefaat in northeastern Iraq (*1*, pp. 50, 52), and, possibly, the basal and pre-pottery levels of Jericho in Jordan and Eynan in Israel (*13*). However, in the Iraq-Iran area only Zawi Chemi and Shanidar Cave have yielded radiocarbon dates (8920 ± 300 B.C. and 8650 ± 300 B.C., respectively) for this "era of incipent cultivation," which Solecki calls the Proto-Neolithic (*1, 14*).

Part of the significance of Ganj-i Dareh lies in the fact that it is one of the few early aceramic Neolithic sites in the region with solid architecture. At Zawi Chemi there were stone rings and ovals which may have been the foundations of houses, but no traces of the walls could be distinguished (*15*). Karim Shahir was apparently a temporary or seasonal encampment with no very solid structures (*1*). Jarmo, which did have mud-walled houses, seems to have been settled considerably later, probably in the 7th millennium B.C., as was Ali Kosh in Khuzistan (*1, 16*). At Tepe Guran in the Hulailan Valley of Luristan only traces of wooden huts could be found in the aceramic Neolithic levels, and mud-walled houses did not begin until the ceramic phases were well established (*17*). Ganj-i Dareh offers the double advantage of not being covered by irrelevant later deposits and of being of moderate size so that, if necessary, the entire site can be exposed level by level. This would reveal, for the first time in the region, a detailed picture of the ground plan of such an early settlement, the degree of elaboration of the architectural features, the artifact contexts, and the changes, if any, which were introduced during the period of occupation.

There is as yet no direct evidence of food production at Ganj-i Dareh, but it is improbable that such a stable settlement in this geographical area was dependent solely on hunting and collecting. Sheep domestication seems to have already been under way at Zawi Chemi in Iraq by this time (*18*), the earliest known instance of any animal domestication. The study of the abundant faunal remains at Ganj-i Dareh should shed light on the status of the other actual or potential domesticates (goats, cattle, pigs) as well. Equally significant is the possibility of recovering evidence relating to plant domestication, especially wheat and barley; no such evidence has been preserved at Zawi Chemi or Karim Shahir, unfortunately, and the earliest instances so far known come from Ali Kosh in Iranian Khuzistan and from Jarmo, apparently some time shortly after 7000 B.C. (*16*). But domestication must have begun earlier, and if cereal grains are preserved in the ashy zones of Ganj-i Dareh they should help solve the problem of whether the two forms of domestication developed independently, or whether, as some zoologists believe, animal domestication could begin only after plant cultivation was already under way.

Godin Tepe

Godin Tepe is located in the southeastern corner of the Kangovar Valley, at an altitude of about 1400 meters. Strategically situated, it controls a gap between two hill spurs through which the east branch of the Gamas Ab River passes into the Kangovar Valley. The mound is roughly oval, with its principal axis running east and west, and covers approximately 10 hectares. A high central citadel mound, itself about 5 hectares in area, rises to a height of 26 meters above a sprawling outer town flat which has an average height of 4 meters above virgin soil. The entire north side of both the citadel and the outer town has been cut away by the Gamas Ab at flood stage, until at present this side of the mound forms an almost vertical face. Altogether perhaps a quarter of the site is missing.

In the 1965 excavations, lasting from mid-September to early November, we dug two trenches on the vertical north face which together sampled the entire stratigraphic sequence on this side of the site. Trench A was 5 meters wide, averaged 5 to 6 meters in length, and was carried from the high point on the citadel mound to a depth of 14 meters. Trench B, located a little distance to the east of Trench A, was 4 meters wide and 3 to 4 meters long. Its upper strata considerably overlapped the lowest strata cleared in Trench A, and its lowest stratum rested on virgin soil at a total depth from the citadel summit of 29.3 meters. Tentatively, the sequence recovered can be divided into seven cultural phases (numbered from the top down). Further excavation will certainly lead to refinements in both cultural divisions and terminology.

Period VII. The earliest cultural phase at Godin is thus far represented by some 3 meters of trash strata mixed with debris from the collapse of at least two construction levels uncovered by a very limited cut (1 by 4 meters) at the bottom of Trench B. Walls were of *chineh* (*11*). The pottery was uniform throughout the deposit: straw-tempered, rather poorly fired, soft, fairly porous, with an uneven fracture. The core color is usually gray. Surface color ranges from buff-pink to orange-red. Burnishing is fairly common. Vessels were handmade, both thick- and thin-walled, and occur in a simple range of shapes: for example, deep open bowls or pots with straight, simple, pinched rims. We found very few artifacts other than pottery. A number of long, regular, parallel-sided blades with extensive retouch were found, all in flint. No implements of obsidian, ground stone, or bone were recovered from the limited area opened.

The closest parallels to the pottery of Godin VII are found in the plain buff wares of Sarab, Ali Kosh, Guran, and Hajji Firuz (*7, 8, 19, 20*), all sites in the pottery-Neolithic horizon in western Iran. At these sites the plain buff ware occurs along with various kinds of painted, red-slipped, and red burnished wares; and no two sites in the horizon have exactly parallel ceramic assemblages. Since the sites in this time range are spread out over a large area one must certainly make allowance for a considerable amount of regional variation within a single horizon. On the other hand, the evidence from Guran suggests that variations in pottery from site to site may reflect differences through time (*21*, fig. 7). In any case, the absence of painted, red-slipped, or red-burnished pottery in Godin VII could be only the result of our small sampling of the available material. The evidence in hand points to a date for Godin VII fairly late in the pottery-Neolithic horizon, about 5500 to 5000 B.C.

Period VI. This cultural phase will certainly be subject to important subdivision as more evidence accumulates from excavation. It is represented by some 4.2 meters of mixed trash and construction strata in Trench B only. Walls were of both *chineh* and sun-dried mud brick. Three principal types of pottery characterize the period. In all strata a straw-tempered painted buff ware roughly comparable to the paint-

ed pottery of Couche V at Tepe Giyan was found (*5*). In the lowest levels of the period this painted ware was accompanied by the plain straw-tempered buff ware characteristic of Period VII. Gradually this plain ware was replaced in the sequence by a better-made, less porous, finer plain straw-tempered ware in a quite different range of colors and shapes. There is, therefore, no sharp cultural or chronological break at Godin between Periods VII and VI (*22*). Other finds included a fair number of the long flint blades characteristic of Period VII, and two copper pins. Both these latter finds came from fairly deep in the deposit (*23*). Tentatively, on the basis of parallels with Giyan V, we date the period to about 5000 to 3500 B.C.

Period V. The deposit datable to this period covers some 2.7 meters and includes at least two construction levels in both Trenches A and B. A thin pebble stratum representing at least a local erosion surface separated the lowest stratum of Period V from the upper Period VI deposit in both trenches. Walls were of both *chineh* and mud brick, and one was set on a rather substantial stone foundation. The pottery of the period is in almost all respects a pure Uruk assemblage, but shows certain deviations from the Mesopotamian pattern for the Uruk period (for example, there is no Uruk Grey Ware). Interest in the Uruk period, of course, centers around such questions as the origin of the Sumerians, the development of cities, and the beginning of writing in Mesopotamia. Among major unsolved issues is the origin of the Uruk culture, which in many ways represents a break in the developmental sequence for southern Mesopotamia. Heretofore, this culture has been known in western Iran only from surface collections. The relationship between the Iranian Uruk and the Uruk of Mesopotamia is by no means clear. Further excavation at Godin and the collection of a good series of radiocarbon dates should tell us much. Probably the period dates from between 3500 and 3000 B.C.

Period IV. This period is represented in Trench A by 1.2 meters of deposit and a single construction level, and in Trench B by 4.6 meters of deposit and at least three construction levels. A marked erosion surface separated strata of Periods IV and V in Trench A only. Walls were predominantly of mud brick. The pottery of the period is a distinctive gray incised ware in almost all respects similar to the Early Bronze Age pottery found at Yanik Tepe in eastern Azerbaijan (*24*). Nonpottery finds include clay and stone loom weights, a small copper/bronze chisel, a few flint blades of Period VII type, and clay and shell beads. Pottery similar to that of Period IV at Godin has been found on the surfaces of several sites in central western Iran but has heretofore not been excavated south of Yanik Tepe, near modern Tabriz. Suggested dates for the period are about 2700 to 2000 B.C.

Period III. This period was recovered in Trench A only, in a deposit of some 7.2 meters which contained several construction levels. Early in the period walls were of mud brick and *chineh* without stone foundations, whereas in the upper levels mud brick on heavy stone foundations was the rule. The ceramic assemblage consists of mixed plain and painted wares, the painted ware being roughly comparable to that of Couche III at Tepe Giyan (*5*, pp. 70-72). Non-pottery finds include stone loom weights, clay spindle whorls, stone weights for digging-sticks (?) and a small copper/bronze pin. A bracelet of frit, stone, paste, and shell beads was found in a burial from the cemetery area dating to this period (in the outer town flat to the south, where some four burials in all were uncovered). On the basis of similarities between its pottery and that of Giyan III the period may be dated to between 2000 and 1600 B.C.

The upper construction level of Period III was probably destroyed in a violent earthquake, after which the site was abandoned for perhaps 700 or 800 years. (The area is well known today to be structurally unstable.) During this hiatus in occupation the north side of the mound had its most severe period of erosion by the Gamas Ab River.

Period II. Only a thin stratum of loose wash, the origins of which were one or more construction levels, remains from this period. The pottery recovered dates to between the 8th and 4th centuries B.C. and can be closely compared with pottery from Hasanlu III, Ziweyeh, and Pasargade (*25*). At the end of the 4th century the mound was again abandoned, this time for over 2000 years.

Period I. This period is represented by a single occupation of recent date: an Islamic fortification, perhaps no more than a strong guard tower, and probably no older than the 18th century A.D.

Conclusions

The archeological sequence in the Bisitun and Kangovar valleys promises to fill a number of gaps in the prehistory of this part of southwestern Asia. Ghar-i Khar should yield data concerning the degree of cultural continuity or discontinuity in the Upper Pleistocene and early Holocene ranges of prehistory. This cave site should also be helpful in gaining further insight into the climatic conditions during these times, and in particular on the prevalent fauna and flora (and the human use of them) at the close of the Pleistocene, when some groups may already have been leading ways of life foreshadowing the Neolithic. Ganj-i Dareh offers the opportunity of examining in detail what seems to be an early farming community at or very near the beginning of an important shift in methods of subsistence. The geographical position of this latter site may also be of unusual significance in studying the spread of the Neolithic; located as it is near the traditional route across the Zagros Mountains into Iraq, this site, as well as others in the region, may have played an important role in the diffusion of the new elements and methods to other parts of the mountainous zone. That is, within the broad "natural habitat zone" it may be useful to distinguish optimum areas of development and diffusion during the early phases of the Neolithic. Comparison with small sites like Tepe Asiab in the Kermanshah Valley (considered to have been a temporary encampment of clam collectors) (*7*) may place such sites in their proper perspective as seasonally occupied satellites of more permanent villages such as Ganj-i Dareh; the same possibility is open for the later ceramic Neolithic phase now that the oldest level of Godin Tepe shows a community to which nearby sites on this time horizon can probably be related. However, it will require an intimate study of the two valleys as microenvironments, and comparison of them with each other and with the Kermanshah and Hulailan valleys, in order to reach a fuller understanding of the interrelationships of the various aceramic and ceramic Neolithic sites from the 9th to the 6th millennium. Again, only further exploration in the region will reveal whether the absence of recognizable farming-community sites in the Zagros region during the 8th millennium reflects a genuine hiatus or simply insufficient investigation (*21*).

A broader clearance of Period VII at Godin Tepe itself will enable us better to define the period during which material from Period VII is found stratigraphically associated with later material. Through the horizontal clearance of one of the six small sites in the Kangovar-Bisitun area where similar materials in the pottery Neolithic period are found on or near the surface, by sounding perhaps one other such site, and by plotting all the sites in the region that date to this period, we should be able to reconstruct a reasonably complete picture of this valley at the time of Godin VII. One of these small sites in the neighborhood may yet yield evidence on the relationship between the aceramic and pottery phases of the Neolithic. Godin, of course, provides us an excellent opportunity to examine the relationship between the pottery of the Neolithic and subsequent cultural periods in western Iran, since there appears to be no major break in the developmental sequence between Godin VII and VI.

For the periods after the pottery Neolithic in western Iran we have had only the more or less stratified sequence of tombs excavated at Tepe Giyan on which to base our understanding of the developmental sequence from the 6th to the 1st millennium B.C. Even the evidence from our preliminary testing of Godin Tepe indicates how sketchy that understanding has been, since previously we had only suspected the presence of the Uruk culture in the area and had no evidence at all that the culture defined at Yanik Tepe near Tabriz, which has strong links with eastern Anatolia and the Caucasus, ever spread as far south as the central Zagros. Continued research at Godin will shed light on these new problems as well as on many of the long-standing issues that have puzzled archeologists concerned with the Bronze and Iron ages in western Iran.

References and Notes

1. R. J. Braidwood and B. Howe, *Prehistoric Investigations in Iraqi Kurdistan* (Studies in Ancient Oriental Civilization No. 31, Oriental Institute, Chicago, 1960).
2. R. S. Solecki, *Science* **139**, 179 (1963).
3. J. Mellaart, *Anatolian Stud.* **13**, 43 (1963).
4. R. H. Dyson, Jr., *Science* **135**, 637 (1962).
5. G. Conteneau and R. Ghirshman, *Fouilles du Tépé-Giyan* (Geuthner, Paris, 1935).
6. C. S. Coon, *Cave Explorations in Iran, 1949* (University Museum, Philadelphia, 1951).
7. R. J. Braidwood, B. Howe, C. A. Reed, *Science* **133**, 2008 (1961).
8. J. Meldgaard, P. Mortensen, H. Thrane, *Acta Archaeol.* **34**, 97 (1963).
9. H. Luschey, *Anjoman-i Fathang-i Iran-i Bastan* **2**, 19 (1965).
10. L. B. Dupree, *Proc. Am. Phil. Soc.* **96**, 250 (1952).
11. *Chineh* in Persian, *tauf* in Arabic: horizontally extended multiple layers of sun-dried mud, a common construction technique in the modern Near East.
12. 10,400 ± 150 B.P. (GaK-807), determined by Prof. Kunihiko Kigoshi, Radiocarbon Laboratory, Gakushuin University, Tokyo. This is based on the Libby half-life of 5570 years; the age should be increased to about 8700 B.C. if the more precise half-life of 5730 years is used.
13. J. Perrot, in *Courses toward Urban Life*, R. J. Braidwood and G. R. Willey, Eds. (Viking Fund Publications in Anthropology, No. 32, New York, 1962), p. 147.
14. The use of such terms as "era of incipient cultivation" and "Proto-Neolithic" points up problems in defining the term "Neolithic." At the present time, the only general agreement on this term is that food production should remain the *sine qua non* of the definition, but that features such as pottery, polished stone, and size and type of settlement and architecture are not, by themselves, good criteria for defining a Neolithic phase of development. This problem, brought into focus by the results of excavations at Jericho (Jordan) and Eynan (Israel), has been illustrated most recently by the discoveries of M. van Loon at Tell Mureybat in Syria, where it has been suggested that a large community of hunters and collectors lived in a village with solid architecture for approximately a thousand years [*Sci. Am.* **214**, No. 5, 53–54 (1966)]. We use the term "Neolithic" here as shorthand for small food-producing groups (agricultural or pastoral) in which metallurgy is absent or unimportant, while realizing that this definition also leaves much to be desired. We assume that, given its geographical location, further investigations will demonstrate that Ganj-i Dareh meets these requirements.
15. R. L. Solecki, in *Rep. Intern. Congr. Quaternary, 6th, Warsaw 1961* (Lodz, 1964), vol. 4, p. 405.
16. F. Hole, K. Flannery, J. Neely, *Current Anthropol.* **6**, 105 (1965).
17. J. Meldgaard, P. Mortensen, H. Thrane, *Acta Archaeol.* **34**, 110 (1963).
18. D. Perkins, *Science* **144**, 1565 (1964).
19. F. Hole and K. Flannery, *Iranica Antiqua* **2**, 97 (1962).
20. T. C. Young, Jr., *Illustrated London News* **241**, 707 (1962).
21. P. Mortensen, *Sumer* **20**, fig. 7 (1964).
22. Compare the stratigraphic situation at Dalma Tepe, where plain Neolithic ware also underlies later painted wares (*20*).
23. Trench B, strata 17 and 22. Both pins appear to be cast and are, therefore, early examples of their type.
24. C. Burney, *Iraq* **23**(2), 138 (1961); *ibid.* **24**(2), 134 (1962).
25. Iron Age III and Achaemenid sites. See R. H. Dyson, Jr., *Near Eastern Stud.* **34**, 193 (1965); T. C. Young, Jr., *Iran* **3**, 53 (1965).

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NEWS AND COMMENT

Oceanography: PSAC Panel Calls for Setting Up New Agency

Unlike the space program, which is effectively in the hands of NASA and the Defense Department, the government's vast and growing oceanography program has evolved as an orchestrated anarchy of some 20 agencies that, for one reason or another, are concerned with the oceans. Their meeting ground is the Interagency Committee on Oceanography, an Executive Office body charged with planning and coordinating the overall program, which now costs $310 million a year—a 12-fold increase in less than a decade.

This blend of diversity and centralization is displeasing to Congress, which likes to know where to get information and whom to blame or influence when it comes to the conduct of federal programs. But within the Executive branch, the balkanized structure of oceanography has regularly been defended in terms of the substantive characteristics of the subject itself. Spokesmen for the Executive branch have argued that oceanography is a label for an agglomeration of variously motivated and diverse activities, ranging from the national security interests of the U.S. Navy, which supports two-thirds of the entire national program, to the State Department's $500,000-a-year contribution to eight international fisheries commissions. The fragmentation of authority, the spokesmen contend, simply reflects the fact that each participating agency has its own reasons for working in the ocean. Congress has generally accepted this reasoning and has never put much support behind proposals to consolidate oceanographic activities under one administrative authority. But, still interested in a more precisely defined authority, it passed a bill in 1962 directing the Office of Science and Technology to establish a position of Assistant Director for Oceanography. Since presidents don't like Congress