12 AGRICULTURAL ORIGINS IN THE NEAR EAST AS A GEOGRAPHICAL PROBLEM

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INTRODUCTION

THE PREVIOUS CHAPTERS attempted to appraise man-land relationships during the slow process of cultural innovation characterizing the Paleolithic and "Mesolithic." These hunter-gatherer populations had all been very sparsely settled and technologically simple, with a limited or even negligible impact on the natural environment. However, the same transition of Pleistocene and Holocene that left Europe at the cultural level of advanced food-collecting, witnessed the dramatic beginnings of agriculture in the Near East.

The culture groups of the Near Eastern late Pleistocene were specialized hunter-gatherers (Hole, Flannery 1967; Flannery 1965). But, at least as far as their tool inventory is concerned, these Upper Paleolithic people were comparatively uninteresting and not remarkably progressive or specialized. Then about 11,000 years ago two cultures appear in the Levant and northeastern Iraq: the Natufian and Karim Shahirian. Both assemblages were characterized by so-called agricultural implements such as sickle-blades, grinding stones, and polished stone axes known as celts and presumed to have been used as hoes in many cases. None of these tools as such necessarily indicate agricultural activity, but the combination suggests partial subsistence on either wild grains or cultivated cereals. And at Zawi Chemi Shanidar, one site of the Karim Shahirian assemblage, there is fairly good proof of the presence of domesticated this part of the model. First, the intensity of land utilization is

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sheep (Perkins 1964), *ca.* 8900 B.C.[1] By 7000 B.C. subsistence-farming had become a common economic trait in parts of the Near East.

A focus of agricultural origins in this particular area and at this particular time is of environmental and geographical interest. Firstly, localization of early domestication is to some extent circumscribed by environmental factors. Suitable biological resources must be present if local domestication is to be possible. A second problem concerns possible environmental influences on the cultural processes implied by agricultural origins. And thirdly, the invention of agriculture is of great physical import, marking a drastic change in man-land relationships. The following chapter attempts to outline some of these environmental problems in relation to the hearth of domestication in the Near East. Beyond doubt the environmental problems related to first domestication in other culture areas, for example in the New World, are quite distinct. But their consideration lies beyond the scope of a selective survey of man-land relationships at different cultural and technological levels.

THE NEAR EAST AS A HEARTH OF DOMESTICATION

There have been several hearth areas in which domestication of specific associations of plants and animals was apparently first carried out. Basically such areas are habitats with a number of wild plants and animals suitable for domestication, and presumably where such species could first be domesticated in the habitat of their wild ancestors (Braidwood 1958). There were at least two independent hearths of domestication (in the Old and New World) and probably three, specifically (*a*) Mesoamerica and the Andean Highlands, (*b*) the Near East, particularly the hill country of southwestern Asia, and (*c*) southeastern Asia, probably along the margins of the Bay of Bengal and in Burma (Sauer 1952; Gorman 1969). At least the first two hearths had no obvious cultural intercommunications; in the case of areas (b) and (c), one in a subhumid winter rainfall belt, the other in the humid tropics, techniques and cultural backgrounds are so different that any *initial* contact would be rather difficult to establish. Lastly there *may* be minor hearths of domestication in which single species were first domesticated

1 C^{14} dates 8910±300 B.C. and 8640±300 B.C., W-681, W-667 (Solecki and Rubin, 1958).

before an agricultural economy had been introduced from without. North China (Watson 1969), Ethiopia, and West Africa (Alexander, Coursey 1969) provide possibilities of this kind.

The Near Eastern hearth region provided the biological materials, intellectual achievements, and cultural associations that underlie the civilizations of western Asia, northern Africa, and Europe. The basic biological inventory includes seed plants (cereals) and herd (as opposed to household) animals. More specifically, the food-producing cultures of these areas have from the very beginning depended primarily on the cultivation of wheat and barley for subsistence (Helbaek 1959).

THE NATURAL HABITAT OF THE CEREALS

According to Helbaek (1959) the locus of domestication of a wild plant would presumably be within its area of original distribution in the wild state. Consequently, a prehistoric group dependent upon wild wheat as its main food should have developed its subsistence pattern within the original area of natural distribution of that species. The same should apply to a culture primarily dependent upon barley.

The wild ancestor of domesticated barley (*Hordeum spontaneum*) is now distributed across the Near East and in several parts of southern Europe and northern Africa.[2] On the other hand the two wild wheats, from which all domestic wheats have been derived directly or by complex hybridization, are more restricted in range. The large-grained *Triticum dicoccoides*, direct ancestor of emmer wheat (*T. dicoccum*), has its natural distribution in the Zagros Mountains of Iraq and Iran, the Taurus of southeastern Turkey, and much of the Levant. The wild small-grained *T. aegilopoides*, straight-line ancestor of einkorn (*T. monococcum*), occurs through much of Turkey and the Zagros (Harlan, Zohary 1966). If one can assume that the distribution of wild wheat and barley was 12,000 years ago as it is today,[3] it would seem that the cradle

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[2] Harlan and Zohary (1966) feel that the wild barley of northern Iran and Afghanistan on the one hand and of Cyrenaica and the Aegean area on the other have spread as a result of the disturbances of agricultural settlement.

[3] Different climatic conditions during the terminal Würm may have modified the natural distribution, while man may since have eradicated the wild species in some areas. Barley, in particular, is cold-sensitive (Harlan, Zohary 1966).

of the "western" plant husbandry cultures lies in the winter rainfall zone of the Near East (Helbaek 1959).

Helbaek (1959) considers that cereal domestication proceeded in several stages. The first essential change from reaping of wild cereals to planting may have included concentration of the desired plant by sowing, improvement of growth by tilling, exclusion or removal of unwanted plants from the tilled plot, and protection of the crop against animals and birds.

Another major step was to select particular types of grain and thus begin the process of selection, specialization, and ultimately adaptation to peculiar environments outside of the limited natural range of distribution. In the case of wheat it meant moving down the domesticant to (a) the plains or, later on, into the artificial ecology of the irrigated flood plains, and (b) into more northerly zones or higher altitudes (Helbaek 1960b; Flannery 1965).

The last major step was the hybridization of the wheats into more advanced, specialized types such as club wheat, bread wheat, spelt, and naked wheat and the apparent evolution of barley into another, six-rowed type (Helbaek 1966a).

Besides conscious "primary" domestication, Helbaek distinguishes a "secondary" domestication, namely the segregation, for intentional cultivation, of a weed growing in cultivated soil which already unintentionally was subjected to selection through being reaped along with the intended crop. Either wheat or barley was probably so introduced, and rye and oats are typical examples. Both of the latter were introduced as weeds in wheat fields, rye from west-central Asia and oats from the Near East or eastern Europe. Both "appear" very late in the archeological record and were probably never primarily planted anywhere but in cooler latitudes where they proved to be particularly hardy plants. They play no role whatever in the Near East.

Regarding other plants, the various millets have an obscure history (Von Wissmann 1957). These are summer rainfall plants, so it is unlikely that they were first cultivated in the Near East with its Mediterranean-type climate. Of further note is the wild flax plant, *Linum bienne,* used for fiber and oil, which has the same habitat and cultural context as wheat and barley. Together with starchy vegetables of Near Eastern origin, the wine grape, olive, date, fig, apple, pear, cherry, etc., also seem to originate somewhere in the Near East. In overview, winter-rainfall *cereal cultiva-*

tion, orchard husbandry, and viticulture are characteristic of early plant domestication in the Near Eastern hearth (Helbaek 1959, 1960a).

THE NATURAL HABITAT OF THE HERD ANIMALS OF THE NEAR EAST

Present knowledge on the locus of first domestication of the herd animals is far less satisfactory than that of the "western" cereals. The former range of the wild ancestors is usually extensive; the wild progenitor(s) is frequently a matter of strong controversy, often due to rather muddled taxonomic situations; and the archeologic-osteologic material is far less complete. The most up-to-date surveys of the problem have been made by Zeuner (1963), Reed (1960; 1969), and Higgs and Jarman (1969).

The dog (*Canis familiaris*) is generally considered to be descended from the wolf, although later interbreeding with jackals may have taken place in the semiarid subtropics. The natural habitat of the wolf includes the greater part of the forest zone of Eurasia and North America. As the domestication of the dog took place rather early among European Mesolithic groups during the Pre-boreal or Boreal, the dog has no necessary association with agriculturists. There is, however, evidence of domesticated dogs in the Near East by 7000 B.C. (Reed 1969).

The goat (*Capra hircus*) is most generally thought to be descended from the bezoar goat (*C. aegagrus*), ranging from Palestine to the Caucasus, from Greece to the Indus. Fossil bezoar goats are also known from the late Pleistocene of the Levant. The actual habitat of the wild goat is somewhat more limited as a result of the ecological niche to which the goat is adapted, i.e., rough ground with rocky slopes which enable this agile climber to escape possible predators.

The sheep (*O. aries*) is probably mainly descended from the urial (*O. orientalis*), although other species of wild sheep may have contributed to certain breeds of domesticated sheep. The urial occurs in northern Iran, Afghanistan, northwestern India, and adjacent parts of Central Asia. Another possible wild ancestor, the eastern mouflon (*O. musimon* ssp.) inhabited Anatolia, Caucasia, and western Iran. Yet another, the argali (*O. ammon*), is found in Central Asia. Sheep are adapted to open, rolling country, avoiding open plains or dense forest.

Cattle (*Bos taurus*) are in all probability descended from the large, long-horned, wild *B. primigenius,* or aurochs, once distributed throughout the forested regions of Europe, southwestern Asia, and northern Africa. A short-horned species called *B. longifrons* or *B. brachyceros* has been postulated, but these animals were probably females of *B. primigenius.* Wild cattle favored woodland or forest as a habitat.

Originally there were several subspecies of wild pig (*Sus scrofa*) native to the woodlands of Eurasia and North Africa. The European domesticated pigs are essentially descendants of the wild boar (*S. scrofa scrofa*), and the Chinese ones of the banded pig (*S. vittatus*) native to southeastern Asia.

Domestication of horse, reindeer, and camel came relatively late and played no role in the original transition to food production, so that these genera are of peripheral interest in this discussion.

The natural habitats of the western Asiatic herd animals in a broad way overlap with the native distribution of the wild wheats and barley in the Near Eastern highlands. The range of the wild ancestors of the herd animals is very much greater than that of the wild wheats and barley however. Although the boar, aurochs, and possibly also barley were native to the alluvial flood plains of Mesopotamia and Egypt, sheep, goat, and wild wheats were absent. The Syrian, Iranian, and Central Asian deserts fall outside of this natural habitat zone.

THE NATURAL HABITAT ZONE

If there was sound reason to believe that cereal domestication preceded animal domestication, the Near Eastern hearth of agricultural origins could be more or less localized into a zone of preference —the Near Eastern highlands, and possibly a more peripheral zone, the alluvial flood plains of the Nile and Tigris-Euphrates. So far archeological evidence of animal domestication predates the earliest proven domesticated grains by as much as two millennia. It is only as a matter of convenience that the zone of overlap of the wild cereals and wild herd animals is emphasized here, even though the available archeological evidence suggests that the evidence may not be fortuitous.

A brief examination of the physical geography of the modern natural habitat of the wild wheats can be rather informative. The areas involved are characterized by irregular and diversified terrain and a minimum annual precipitation of 300–500 mm., and they coincide with the subtropical Mediterranean-type woodlands of the Fertile Crescent and the temperate forests of Anatolia (Fig. 1). Significant is the exclusion of this particular habitat from the steppe or semi-desert areas. Equally interesting is the location of known agricultural communities predating *ca.* 5000 B.C. These were all found within or at the peripheries of the woodland belt.

The alluvial valleys enjoy somewhat different environmental conditions. Apart from the peculiar terrain features of flood plains, neither the lower Nile Valley nor the Tigris-Euphrates lowlands have sufficient rainfall for non-irrigated agriculture. But crops could be planted as the annual floods receded (October in Egypt, June in Mesopotamia), and the moisture retained in the soil would normally be sufficient to bring one crop to maturity. The ecologic patterns of these alluvial flood plains were generally quite distinct from those of the highlands, even though a winter growing season would be common both to Egypt and the wooded hill country.

The geographical traits and subsistence economy of the earliest known Near Eastern farming communities speak for agricultural origins in the winter rainfall belt. This region corresponds closely to that ideal physical environment envisaged for first agriculture by C. O. Sauer (1952). From a different premise, Sauer argued that agriculture began in wooded lands rather than in grasslands with deep and continuous sod. This argument is based on the difficulty of cultivating heavy sod with primeval agricultural tools. Rather, a varied, open woodland could be more easily cleared by deadening the trees, so providing open spaces with looser topsoil for easy sowing. Dense forests were also inimical to primitive hoe agriculture. Sauer (1952:5–6) emphasizes that diversity of terrain is optimal in providing numerous ecologic niches—"a land of hills and valleys, of streams and springs, with alluvial reaches and rock shelters in cliffs." For it is here that the greatest diversity of plants and animals and suitable genetic reservoirs are to be found.

POSSIBLE ENVIRONMENTAL CHANGES IN THE NEAR EASTERN AREA AT THE CLOSE OF THE PLEISTOCENE

Climatic conditions in western Asia during the late Pleistocene have been discussed by Butzer (1970). Any specific changes that

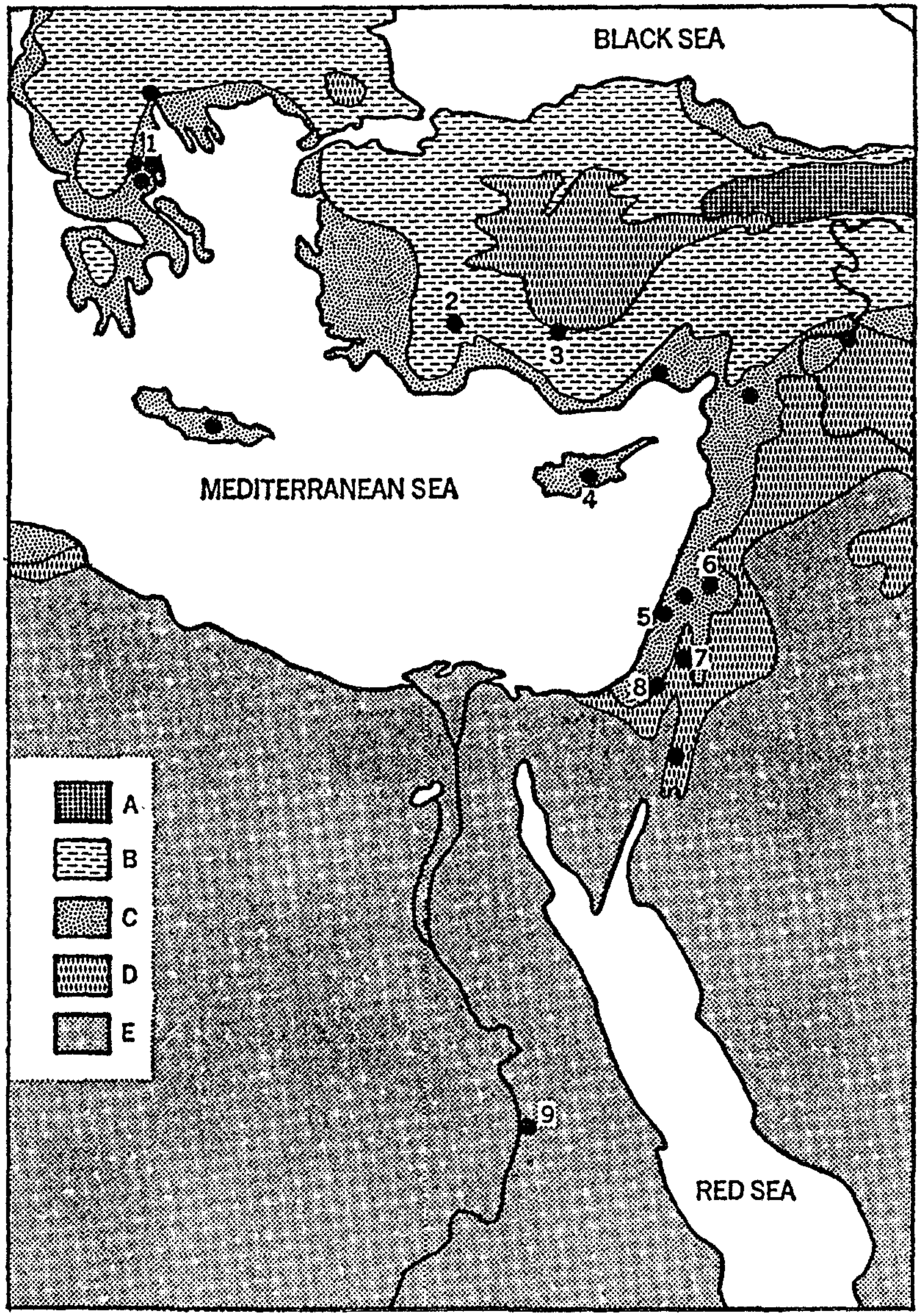
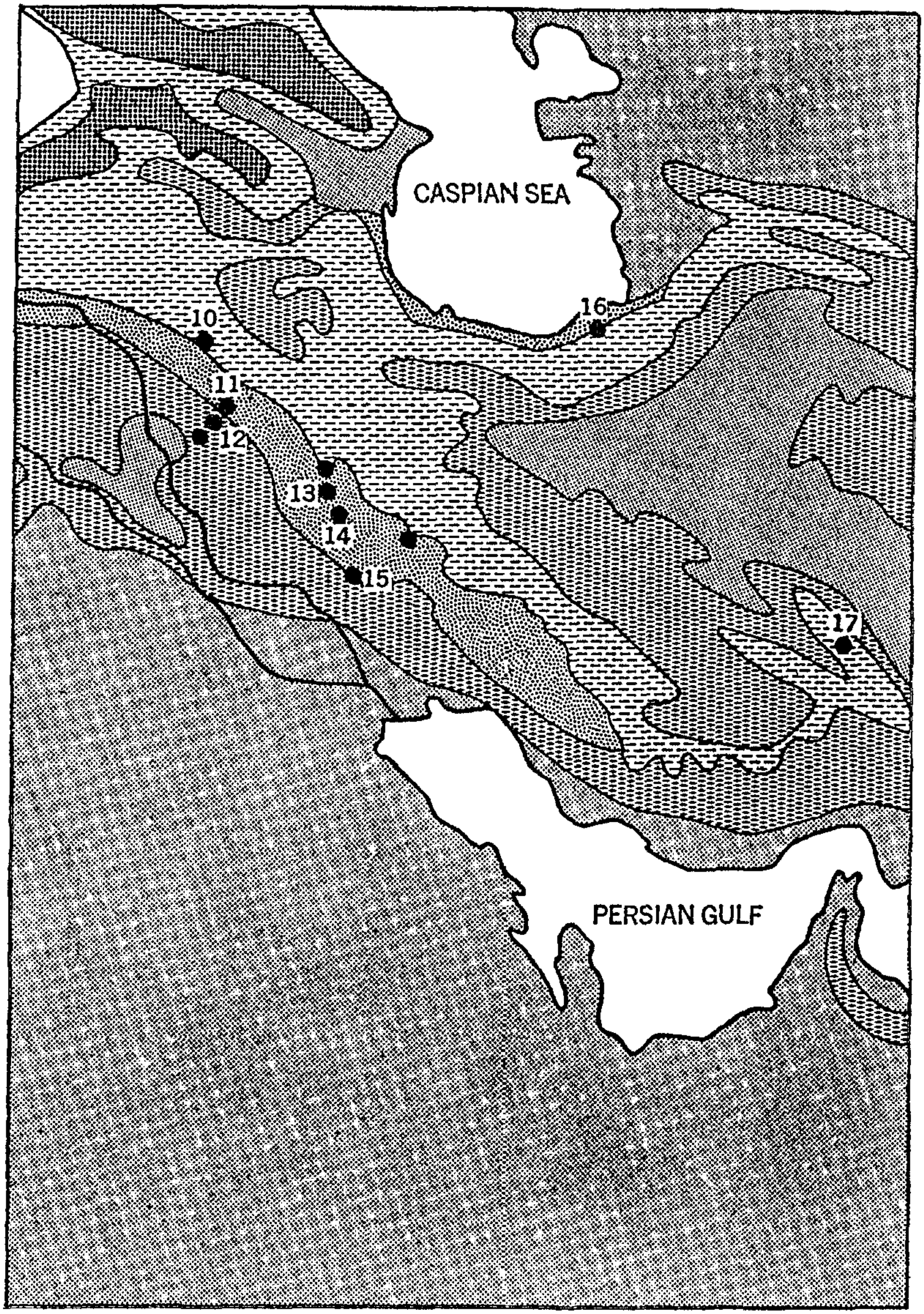


FIGURE 1 Natural postglacial vegetation of the Near East and location of early agricultural and proto-agricultural sites (*ca.* 9000–5750 B.C.). A, coniferous forests; B, deciduous and mixed forests; C, subtropical woodlands; D, grassland, E, desert-grassland, semidesert and desert. The galeria woodlands of the major rivers are not shown. Sites: 1, Sesklo; 2, Haçilar; 3, Çatal Hüyük; 4, Khirokitia; 5, Mount Carmel



caves; 6, Ain Mallaha; 7, Jericho; 8 Judean Desert Caves; 9, Gebel Silsila and Sebil; 10, Shanidar and Zawi Chemi; 11, Karim Shahir; 12, Jarmo; 13, Asiab; 14, Sarab; 15, Ali Kosh; 16, Hotu Cave; 17, Kerman. Only sites mentioned in text are labelled. (Note: new sites have been added to map at points indicated by unnumbered circles. Original map taken from 1964 edition.)

may have occurred at the close of the Pleistocene appear to have been confined to the highlands, with little evidence for ecologically significant change in the more mesic low country.

The fauna of the Mesolithic-type Zarzian culture of Iraq, dated 12,400±400 B.P. (W-179), is not considered indicative of a different climate than today's according to Braidwood, Howe *et al.* (1960:167–70). The fauna at Palegawra (965 m. elevation) includes gazelle, wild goat and sheep, wild cattle, red and roe deer, boar, onager (?), red fox, wolf, lynx (?) and a hedgehog (Braidwood, Howe *et al.* 1960:58–59), while the fauna of the corresponding Shanidar level B-2 (730 m. elevation) is dominated by wild goat (60 per cent) and red deer (20 per cent), together with bear, wild sheep, and boar (Perkins 1964). Pollen studies from Lake Zeribar, near Marivan (1300 m.) in the Zagros, indicate a change from almost 100 per cent NAP to about 15 per cent oak *ca.* 10,000 B.C. Oak then increases in an irregular fashion, while Chenopodiaceae decrease from 70 to 50 per cent, with Artemisia fluctuating around 10 per cent (Zeist 1967). An open, oak parkland is postulated (Wright *et al.* 1967). Northern microfaunal elements are gradually replaced by southern ones, documenting a rise in temperatures (Megard 1967). The late Upper Paleolithic fauna of Ksar Akil, Lebanon (Hooijer 1961), is equally indicative of more or less contemporary conditions. From this, one must conclude that local ecological conditions during the late Würm were similar to those of the present.

However, the cold relapse of the Younger Dryas possibly did not pass quite unnoticed in this part of the world. *Éboulis secs* horizons are found in contemporary horizons of Ksar Akil, Lebanon (Ewing 1951) and the Haua Fteah cave, Cyrenaica (McBurney 1967), offer possible suggestions but no proof for a cooler and moister climate at the close of the Pleistocene. Similarly there is evidence for recessional stages of the Würm glaciers of the Caucasus, eastern Anatolia, and northwestern Iran, some of which have been compared with the final Würm oscillations of the Alpine glaciers (see references and discussion in Butzer 1970). It is quite probable, although beyond the possibility of accurate dating at the moment, that a small glacial readvance occurred in the highlands at this time. Seen in this perspective it would, therefore, be unjustified to say that ecologic conditions were truly "modern" prior to *ca.* 8000 B.C.

Although the rather modest temperature changes suggested for the Younger Dryas cannot have been significant for human habitation, a possible depression of 1° to 3° C. would have had an effect on the distribution of the wild cereals. Wild wheats are now found to over 2000 m. in southeastern Turkey and Iran, while wild barley is rarely found above 1500 m. (Harlan, Zohary 1966; Helbaek 1959). Colder late glacial climates may therefore have excluded these species from parts of the Near Eastern highlands during the late Würm.

Locally, in Palestine and the Sinai, conditions may have been somewhat moister during a part or all of the Natufian period (*ca.* 9000–7000 B.C.). The gazelle, a characteristic open-country biotype, is comparatively infrequent at this level in the Mt. Carmel caves of Palestine, and a half dozen species of this genus disappeared at the time (Bate 1940). Complementing the faunal record is archeological evidence of fishing in the dry wadis of the arid south Judean highlands. This suggests permanent pools of water available throughout the year. The presence of hunting populations in the Negeb and Sinai deserts, as indicated by plentiful distribution of Natufian flints, also seems relevant. Corroboration is provided by contemporary spring deposits and alluvia in the Jordan Valley (Picard 1963; Vita-Finzi 1969; Nir, Ben-Arieh 1965). And in Egypt there is good evidence of local wadi alluviation during the terminal late Pleistocene (Butzer, Hansen 1968). These seem to be the available indications of greater moisture during the last millennium or so of the Pleistocene. The evidence appears to be limited to the lowland areas peripheral to the subtropical deserts. Such a "moist spell" probably did not have ecological significance in the mesic woodlands or cool high country.

ARCHEOLOGICAL EVIDENCE OF EARLY AGRICULTURE AND LIVESTOCK RAISING

In reviewing the archeological record it is often difficult to determine whether a particular community practiced food production or whether agriculture and livestock herding were entirely unknown. Smolla (1960) has devoted considerable attention to this problem of archeological evidence for early agriculture and animal domestication.

The stone artifacts commonly associated with agricultural operations are not unequivocal.

Sickle blades, consisting of rectangular flint blades, were designed to be mounted into a wooden or bone haft. Such bone hafts have been found on numerous occasions. However the sickles need not have been used to reap cereal crops, but may just as well have been employed on certain wild grasses or on reeds used for matting and hut construction. The sheen or luster frequently developed on such blades may be a silicon deposit derived from straw or grasses (Smolla 1960:109 ff., with references). Since wild cereals "shatter" upon touch, it is questionable whether sickle reaping would be possible at all. In fact the ethnological record shows that the simplest primitive reaping of wild cereals is performed by plucking the ears or by beating the plants and catching the grain or seeds in a basket (Smolla 1960:110). Sickle harvesting in the unripe state would not produce sickle sheen, while the seeds may not be reproductive.

Mortars, consisting of hollowed stone vessels, and querns or pestles used as handstones, are pre-eminently effective as grinding stones for grain or seed crushing to make flour. However *some* Natufian mortars were used to grind pigment (Garrod 1958), while mortars and pestles are sometimes used for meat grinding today (L. Binford, R. J. Braidwood, personal communication), and could also be employed for grinding acorns, wild grains, or bone grease.

Stone celts, resembling polished axes or hoes, may have been used as axes or hoes. There are, however, no good ethnological parallels for stone hoes (Smolla 1960:53).

All in all, the so-called agricultural tools are difficult to interpret, although when found in association and in large numbers they strongly suggest the intensive use and preparation of vegetable foods and probably of domesticated crops. Unfortunately there is no archeological record of more meaningful items such as digging sticks.

Botanical evidence of plant domestication can be recognized, but many of the morphological changes resulting from domestication take place very slowly. Theoretically, a single mutation will produce a "non-shattering" grain, so that selection of "non-shattering" mutants could rapidly produce a new domesticated stock with new morphological characteristics (J. D. Sauer, personal communication).

Osteological evidence for earliest domestication would be difficult or impossible to demonstrate by bone anatomy alone. An interesting example of circumventing this problem has been made by Perkins (1964) at Zawi Chemi Shanidar, the site of the earliest evidence of animal domestication to date. Here the faunal compositions of the Middle and Upper Paleolithic strata were quite uniform with wild goat outnumbering wild sheep by 3 to 1, and constituting about 60 per cent of the fauna. About 25 per cent of the animals were juveniles under a year of age. Suddenly, in the Zawi Chemi horizon, sheep bones jumped to 75 per cent, of which 60 per cent were immature. Goat dropped down to 10 per cent, still with 25 per cent juveniles. It is concluded that the sheep must have been domesticated at this stage, and that the larger part of each year's young was killed for food and skins before the end of the year. The hunting of wild goats had consequently become relatively unimportant.

As a result of these difficulties in accurate assessment of the archeological record, the absence of evidently domesticated cereals or animals from many sites need not prove that agriculture was unknown. Equally so, the presence of so-called agricultural implements does not necessarily prove knowledge of crop planting.

THE NEAR EASTERN ARCHEOLOGICAL RECORD PERTAINING TO EARLY AGRICULTURE

The Near Eastern tool inventory of various Upper Paleolithic cultures, culminating with the Kebaran assemblage in Palestine, the Nebekian in Syria, and the Zarzian in northeastern Iraq (Howell 1959; Hole, Flannery 1967), is broadly comparable with the European counterparts, although showing early microlithic traits. Settlement was largely concentrated in caves, although some Zarzian open-air sites have been tentatively identified (Braidwood, Howe *et al.* 1960:155–57). The only contemporary cultural group that falls out of this framework is the Sebilian complex of the Egyptian Nile Valley. The Sebilian groups are of particular interest since they were semisedentary, occupying campsites on the banks of the Nile, where they intensively used the aquatic and riverine food resources of their localized environment (Butzer, Hansen 1968:Chapter 4). Modest kitchen middens on the Kom Ombo area of Upper Egypt testify to considerable use of fresh-water molluscs, fish, and, more rarely, turtle and crocodile; in addition, a wide range of woodland and steppe mammals was hunted. Grinding stones are already present, often in great numbers. Geologically, the Sebilian and other contemporary industries in the Kom Ombo area have been dated *ca.* 15,000–10,500 B.C. (Butzer, Hansen 1968), i.e., no later in time than the Kebaran or Zarzian.[4]

Rather abruptly, archeological indications of agriculture appear in the Levant and Iraq *ca.* 9000 B.C., suggesting a very early diffusion of agriculture in the Near Eastern highlands. Sickle blades and pounding and milling stones appear more or less simultaneously in both the Natufian assemblage of Palestine, Lebanon, and Syria (Garrod 1958) and the Karim Shahirian of Iraqi Kurdistan (Braidwood, Howe *et al.* 1960). The contemporary Asiab assemblage of northwestern Iran (Braidwood, Howe, Reed 1961) does not yet appear to have sickles, grinding stones, or celts. An analogous culture with microliths, sickle blades, and grinding stones has also been discovered at Kerman, in southeastern Iran (Hückriede 1962). No evidence of cereals is available yet from either the Natufian or Karim Shahirian, but it is very probable that plant domestication was at least well under way. Domesticated sheep are present in the Karim Shahirian. These two cultures, which possibly extend through most of the ninth and eighth millennia precede a bona fide agricultural economy, certainly established in parts of western Asia by 7000 B.C. Both assemblages are essentially found within the natural habitats of wild wheat, barley, sheep, and goat. This may be the elusive stage of "incipient agriculture and animal domestication"—which Braidwood (1960a) describes as experimental manipulation of potential domesticates within a dominant food-collecting economy, at first still within the ecological niche to which the wild ancestor of the domesticate was adapted. However, successful adaptation to the lowland steppes began very early, as is shown by the Bus Mordeh assemblage of Ali Kosh in the Khuzistan foothills (Hole, Flannery 1967). Emmer and barley were cultivated and both goats and sheep were kept.

By 7000 B.C. agriculture had become the primary subsistence of village farmers found in the Levant, the Zagros area, and southwestern Anatolia. These people grew einkorn, emmer, and barley,

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[4] A full ecological interpretation of the Sebilian complex will contribute to understanding agricultural origins in the Near East. However, this will only be possible after detailed publication of the archeological results by P. E. L. Smith and M. A. Baumhoff.

and kept domesticated goats and sheep. The domesticated pig also appears in the archeological context somewhere in the seventh millennium in the pottery levels of Jarmo, northeastern Iraq. For the sixth millennium village-farming communities are varied in Thessaly (Renfrew 1969), Crete (Higgs, Jarman 1969), Cyprus (Dikaios 1953), Anatolia (Mellaart 1965; Renfrew 1969; Reed 1969), a good range of sites in the Levant, northern Iraq, and adjacent parts of Iran as well as in the Belt Cave on the Caspian shores of Iran (Ralph 1955).

The regional appearance of the various achievements of cultural innovation and evolution in the Near East is summarized in Table 1. The major expansion of food-producing populations of the Neolithic level into the cooler environments of temperate Europe and into the different environment of the Tigris-Euphrates and Nile flood plains appears to postdate 5000 B.C.

THE ECOLOGY OF THE NATUFIAN IN PALESTINE

Remains of the Natufian cultural assemblage, dating from approximately 9500–7000 B.C., are widely distributed in the southern Levant.[5]

One of the best published and culturally important sites of the Natufian is found in the Mugharet el-Wad cave of Mt. Carmel, at base of the cave is 12.5 m. above the wadi floor, and extends for some 85 m. with an average height of 10 m. The Natufian strata underlie 0.3–1.2 m. of a consolidated brown earth and limestone rubble with early Bronze Age and later remains. About 0.2–3.0 m. thick, these beds consist of unconsolidated, stony red earth with an elevation of 45 m. on the southern face of a small wadi.[6] The

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[5] Sites have been found in the Jabrud cave of Syria (Rust 1950), at Beirut, in three caves of the Mt. Carmel area of Palestine (Garrod, Bate 1937; Garrod 1958), at the base of Jericho (Kenyon 1959a), at Ain Mallaha near Lake Huleh (Perrot 1957, 1962, 1966), as well as in a number of caves in the wadis of the Judean hills, both northwest and southeast of Jerusalem (Neuville 1951). Surface finds have been made east of the Jordan River, in the Negeb and Sinai deserts, and at el-Omari and Helwan, near Cairo.

[6] The present-day climate has a January mean temperature of 13° C., a July mean of 27° C., and an annual precipitation of 625 mm. falling almost exclusively during the three winter months. The natural vegetation of the area is Mediterranean woodland.

TABLE 1 Archeological Evidence of Early Cereal Cultivation and Animal Herding in the Near East
(Based on Hole, Flannery, 1967; Mellaart, 1965; Reed, 1959, 1961, 1969; Renfrew, 1969; and others)

SITES AND STRATIGRAPHY	APPROXIMATE DATES B.C.	BARLEY	EINKORN	EMMER	BREAD WHEAT	SHEEP	GOAT	CATTLE	PIG	DOG
Aegean Area										
Argissa (Thessaly), Aceramic	6500	x	x	x		x	x	x	x	?
Nea Nikomedeia (Macedonia)	6200	x		x		x	x	x	x	?
Knossos (Crete), stratum X	6100	x		x	x					
Khirokitia (Cyprus), Aceramic	6000					x	x			
Sesklo (Thessaly), Aceramic	6000–5000	x		x						
Ghediki (Thessaly), Aceramic	6000–5000	x	x	x						
Anatolia										
Haçilar, Aceramic	7000			x						?
Haçilar, Ceramic	5800–5000	x	x	x	x					?
Çayönü	7000					x			x	x
Çatal Hüyük, VI–II	7000		x	x	x	x		?		
Levant										
Tell Ramad (Syria)	7000	x	x	x	x					
Jericho, Prepottery Neol. A.	7000–6500	x		x						
Jericho, Prepottery Neol. B.	6500–5500	x	x	x						
Beidha (Jordan), Prepottery	5850–5600			x			x			

Amouq (Antioch), A.	5750	x		x			x			
Mesopotamia-Khuzistan										
Ali Kosh, Bus Mòrdeh	7500–6750		x	x		x	x			
Ali Kosh, Ali Kosh	6750–6000	x		x		x	x			
Ali Kosh, M. Jaffar	6000–5600	x		x		x	x			
Tepe Sabz, Sabz	5500–5000	x			x	x	x	x		x
Tell es-Sawwan (Samàrra)	5800–5600	x	x	x	x					
Hassuna	5800	x		x			x			
Kurdistan-Luristan										
Zawi Chemi, Karim Shahir	8900					x				
Jarmo	6750–6500		x	x		x	x		x	x
Tepe Sarab	? 6500					x	x			
Tepe Guran	6200–5500	x								
Matarrah	5800	x		x					x	

limestone talus in the sections located in front of the cave entrance. The underlying deposits of the interior cave contain Upper and Middle Paleolithic industries. Interpretive geomorphological work has not yet been carried out, so that the implications of the beds are obscure.

In the further absence of known botanical remains, the rich faunal collection of the Mugharet el-Wad is ecologically important. It includes rodents and insectivores with two species of hedgehog, mole rat (*Spalax*), a vole, squirrel, hare, the gerbil, and hyrax (*Procavia*). Spotted hyena, red fox, wolf (not dog, Clutton-Brock 1963), badger, marten, musteline, the Syrian bear (?), wildcat, and leopard number among the carnivores, while the bulk of the animals represented is composed of various ungulates: fallow deer (*Dama mesopotamica*), gazelle, wild goat, wild cattle, onager, and boar. Ecologically these species are partly woodland, partly open country, and partly even desert or cliff forms (the gerbil and hyrax). They corroborate the local situation of wooded upland to the northeast and perennial streams or ponds with fringing forests and widespread open country on the Pleistocene dunes of the coastal plain to the south. They also show that diversified hunting played an important role in the Natufian economy.

The cave floor included a mass of flint implements, waste materials, broken and occasionally charred animal bones, burials, and some crude stonework, possibly associated with the interments. Although architecture is lacking at this site, house foundations have been uncovered at Ain Mallaha (Perrot 1966). Some thirty-nine burials have been found, the dentition of which shows excessive wear and a very high frequency of abscesses of the premolars. Dahlberg (1960 and personal communication) believes this indicates a gritty diet, probably with a dominance of cereals or other coarse vegetable foods.

The technological inventory contains, in part, a number of implements common to the Upper Paleolithic: backed blades, burins, massive scrapers, rough picks, together with naturalistic carving in bone and stone. Great numbers of microliths, and at certain other sites also bone spear points, harpoons, fishhooks, pins, needles, and awls recall certain Mesolithic innovations. Novel for the Natufian in general, however, are lustrous sickle blades (saw-toothed varieties appearing in the Upper Natufian), some blades with bone hafts, as well as celts, mortars, and pestles. Flint arrowheads figure among the few innovations of the Upper Natufian. However the total assemblage shows a distinct shift of relative proportions between a dominance of Paleolithic artifacts in the Lower, of more characteristically Neolithic artifacts in the Upper, Natufian.

The Natufian culture represents one of the most interesting transitional assemblages of the Near East. Partly dated at 8840 B.C. (GL-70, Zeuner 1963:31; see also Mellaart 1965; Kenyon 1959a) from the Middle Natufian underlying Jericho, the populations in question were at least semisedentary judging by cave occupancy or house habitation in the open. Intensive exploitation of the different ecologic niches of the natural environment is a well-established characteristic, recalling both the earlier, Middle Sebilian, and the later European Mesolithic. Simultaneously, cereal agriculture was very probably known, judging by the abundant presence of all so-called agricultural implements and the dietary value of gritty foods as suggested by the dentition. Unfortunately no plant foods have been found so far, and the suggested domestication of pig, goat, and cattle at one of the Judean cave sites is unverified (Reed 1959). But the beginnings of plant and animal domestication must be conceived of at a stage and in a setting such as that of the Natufian or the broadly contemporary Karim Shahirian of Iraq.

ECOLOGY OF A VILLAGE-FARMING COMMUNITY: JARMO, NORTHEASTERN IRAQ

The townsite of prehistoric Jarmo is located on a bluff at some 770 m. above sea level in the rolling hill country of the Kurdish foothills of northeastern Iraq.[7] The village appears to have been occupied more or less continuously for about a quarter of a millennium shortly after 7000 B.C., judging by a wide scatter of radiocarbon dates (Braidwood, Howe *et al.* 1960; see also the ecological synthesis of Braidwood, Reed 1957).

The irregular terrain is a consequence of dissection of late Pleistocene silts by steep-sided stream valleys and gullies. An intermittent stream, probably perennial before the destruction of the natural vegetation, has partially destroyed the western end of the site by

[7] By extrapolation from other climatic stations in the area the January mean temperature is about 6.5° C., the July mean 29° C., the annual precipitation about 630 mm., falling predominantly in winter. The natural vegetation is that of a Mediterranean woodland.

undercutting. During the period of settlement (Wright 1952), the site was located at about 36 m. above this stream bed, which probably formed the major water supply of the village.

Botanical remains at Jarmo include both domesticated and wild emmer and einkorn wheat, domesticated two-row barley as well as acorns, pistachio nuts, lentils, the field pea, and blue vetchling.

Faunal materials include the remains of domesticated goat and pig (the latter in the upper strata of the site only, Reed 1961), as well as a fair number of wild animals representing the hunting booty of the community. Species listed are red fox, wolf, gazelle, wild cattle, red and roe deer, wild sheep, boar, and onager (?).[8] Great masses of terrestrial snails (*Helix salomonica*) are present together with some fresh-water crabs and fish. The faunal selection suggests a woodland environment with some areas of open plain or rough country.

The village covered a total area of about 12,500 sq. m., and the cultural materials attain about 7 m. in depth. A good third of this area was never occupied by houses, and a total of 25 houses is estimated as the maximum size of Jarmo. This includes a guess on how much of the site has been destroyed by gullying. Each house presumably represented a family unit. Assuming a family-household size of 5 to 7 people, 25 houses would indicate a population of 125 to 175 people. The lower figure is probably closer to the truth. This is, incidentally, the average size of villages in the area today.

The architecture itself, although well-defined, was not pretentious. Sun-dried mud was employed, being laid in successive 10 to 15 cm. tiers often set on foundations of unmortared stone. The resulting mud-walled house had several rectangular rooms and was not unlike the local houses of today. The village had no regular plan, and consisted of simple houses, animal shelters, and storage buildings, without evidence of community buildings or social structure.

The technological inventory of Jarmo contains various flint implements, among which great quantities of sickle blades and microliths made of a glassy volcanic rock, obsidian, are of most interest. The obsidian was quarried some 500 km. to the north in the Lake Van area, indicating commercial contacts. Together with the celts are various grinding stones and bowls. Pottery only appears in the upper third of the settlement strata. Other items include bone needles,

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[8] Statistical analyses were apparently not carried out.

awls and the like, as well as evidence of reed matting. The technology is then a complex of domestic, of hunting, and of agricultural equipment. The dentitions of seven skeletons show signs of only moderate wear (Dahlberg 1960), implying a less coarse diet than was common for the Natufian population. This probably points toward better preparation of vegetable foods, and possibly also to a fair proportion of meat in the dietary economy.

All in all, the farmers of the village of Jarmo appear to have established a well-balanced economy which, even at the stage of primitive subsistence agriculture, insured adequate local food resources for permanent habitation over two centuries. The absence of the plow, or for that matter plow animals, means that some form of hoe agriculture was practiced. Although cereals dominated in the sown fields, a number of vegetable crops may also have been grown. Domesticated animals, apparently present in good numbers after the local introduction of the pig, supplied a dependable and possibly appreciable meat fraction to the diet. Hunting was still an important economic trait, while gathering of wild plant and animal foods is substantiated by finds of acorns, pistachio nuts, and snails. Jarmo is indeed the prototype of agricultural villages which already dotted the moister hill country of the Near East by the close of the seventh millennium. The origins of the cultural landscape and the expression of man-land relationships at the food-producing level will be considered in the subsequent chapters.

THE DESICCATION THEORY OF AGRICULTURAL ORIGINS

Although the cultural and intellectual processes basic to the economic transition from food-collecting to food-producing are of no direct concern to the natural scientist, the abundant environmentalist theories on that topic certainly are. These theories are based on the belief that late glacial or early Holocene desiccation affected wide areas of the subtropics that had enjoyed pluvial conditions earlier during the Pleistocene. As a result, the former hunting populations of the deserts of northern Africa, Arabia, Iran, India, and Central Asia were allegedly expelled or forced to concentrate along sources of permanent water at springs or along permanent streams.

The oldest of these hypotheses can be associated with R. Pumpelly (1908:65–66), who excavated at the Neolithic site of Anau, southern Turkmenistan:

> With the gradual shrinking in dimensions of habitable areas and the disappearance of herds of wild animals, man, concentrating on the oases and forced to conquer new means of support, began to utilize the native plants; and from among these he learned to use seeds of different grasses growing on the dry land and in marshes at the mouths of larger streams on the desert. With the increase of population and its necessities, he learned to plant the seeds, thus making, by conscious or unconscious selection, the first step in the evolution of the whole series of cereals.

In the same sense Peake and Fleure (1927:14) write:

> . . . men naturally turned their attention back to the old habit of collecting food as their hunting became less successful. In certain regions however, men were led towards a new idea; it occurred to them to produce food by the cultivation of edible plants.

Or as Childe (1929:42) describes the same process in more detail:

> Enforced concentration in oases or by the banks of ever more precarious springs and streams would require an intensified search for means of nourishment. Animals and man would be herded together round pools and wadis that were growing increasingly isolated by desert tracts and such enforced juxtaposition might almost of itself promote that sort of symbiosis between man and beast signified in the word domestication.

For Childe, the resulting "emancipation from dependence on the whims of the environment" (1929:46) was *the* impetus for the economic revolution ("Neolithic revolution") heralded by the invention of food-production. Toynbee (1935:Vol. I, pp. 304–5) adopted the same economic revolution and the same impetus as the "physical challenge" at the root of ancient Egyptian and Mesopotamian civilization, as well as for the origin of nomadic pastoralism (Toynbee 1935:Vol. III, pp. 10–12). Similar ideas persist in more recent revisions of both Childe and Toynbee.

There is no doubt today that the simple patterns envisaged by the theories of Pumpelly, Peake and Fleure, Childe, and Toynbee are archeologically not tenable, since the food-producing revolution does not seem to have taken place in the deserts. In the hill country of western Asia, where the decisive steps of local agricultural invention were probably undertaken, the desiccation theory loses all meaning. These are well-watered regions where pluvial-interpluvial oscillations would not seriously reduce wild game resources. The native vegetation of the Near Eastern highlands is a subtropical or warm-temperate woodland under modern climatic conditions.

Streams from the higher country provide abundant, perennial waters or at least did so before the catastrophic impact of deforestation and soil erosion in historical times. Even if rainfall changes had occurred, they would only have carried limited ecological implications in an area of varied topography and with numerous local ecological niches. Instead, temperature changes may have had greater importance, particularly, in late glacial times when the cold highlands once more became habitable. Such changes would therefore have enlarged the area of suitable lands at about the time of agricultural origins.

In conclusion, the previous review of paleoclimatic information does not suggest any incisive changes in the late glacial and early Holocene record of western Asia, and the climatic changes that did take place certainly did not follow a simple pattern of progressive desiccation. It seems unlikely that the cultural innovation of the Near Eastern hearth of domestication was associated with any dramatic ecological changes at the close of the Pleistocene. Instead, a bountiful natural environment with a fortuitous assembly of suitable domesticates presumably favored the geographic location of the Near Eastern hearth.

POSTSCRIPT 1969

It is becoming apparent that the concept of a Near Eastern "nuclear area" requires modification. During the late 1940's and early 1950's, the literature dealing with agricultural origins in the Old World was highly speculative. Little factual material was available and wide-ranging hypotheses were formulated on the basis of limited evidence. Today, some fifteen years later, the wealth of available archeological and biological data favors a more empirical approach. There is no lack of speculative writing, but serious attempts to interpret the evidence have become unduly restricted. New finds are often categorized within the increasingly rigid framework of a single "nuclear area" and a single cultural-ecological association. In fact, some workers have adopted a new form of environmentalism that obscures the fact that the origin of agriculture is, in the first place, a cultural phenomenon.

The archeological record remains very incomplete, despite the increasing number of excellent sites that span a long range of time, and appear to reflect on different stages in the development of food-producing economies. Anatolia has already brought many surprises, and wider exploration is bound to reveal further evidence that the warm-temperate environments of modern Turkey were far from being a cultural hinterland of the Taurus-Zagros area. The amazing Neolithic sites of Macedonia and Thessaly now show that southeastern Europe was one of the core areas of early agriculture, and studies further afield in Iran and Transcaucasia are bound to extend the concept of a "nuclear area."

Patterns of sedentary or semisedentary settlement—believed by some to be vital for the earliest agricultural innovations—were common in late Pleistocene and early post-Pleistocene times. They must already be inferred for some Acheulian populations, and both the open-air and cave sites of Upper Paleolithic groups in the tundra-steppes of Europe frequently indicate seasonal if not semipermanent occupation of suitable localities. A similar record of semisedentary settlement is suggested for the Sebilians and other groups that were settled along the Nile River as early as 15,000 B.C. Long-term residence at one or several closely adjacent sites may reflect availability and reliability of food sources more clearly than technology. Such prerequisites were present at many times and at many places during the course of the Pleistocene; they were not unique to the Near Eastern "nuclear area" at the close of the Pleistocene.

Given suitable food resources, intensified food collecting provided the basis for large settlements of considerable permanence. Recent excavations have adequately demonstrated this proposition for the Tehuacán Valley in south-central Mexico and for the Tennessee and Wabash valleys in the central United States. At Tehuacán, intensified food collecting permitted a significant increase of population over several millennia, at a time when cultigens provided less than 10 per cent of the food intake. In the case of the eastern woodlands of North America, efficient exploitation of riverine environments permitted large and stable villages for some 3000 years prior to the local adoption of agriculture. The Sebilians and other folk of Egypt and Nubia are another case to point, with some large cemeteries speaking for populations of at least moderate size. Here intensive utilization of a river-oasis remained practical or preferable for ten millennia, until agriculture first penetrated the Nile Valley—presumably with fresh populations—at a surprisingly late date. Much more recently, certain Indian populations of California and the Pacific Northwest provide examples of the same process.

These examples should serve to remind that farming and livestock raising were not the only means of supporting relatively large populations in suitable meso-environments. Situations of this kind were the exception rather than the rule, but they are almost certainly relevant to agricultural origins and diffusions.

The first steps to agriculture marked no sharp break in subsistence patterns or population level among semisedentary groups with an intensive food-collecting economy. When agricultural traits spread and were adapted by preference or necessity, there probably were few discontinuities between the subsistence forms of adjacent agricultural and non-agricultural populations. The strong distinction made between farmers and hunters today reflects western cultural attitudes that have intensified over millennia, reinforced by an increasing technological gap. Initially, however, the convergence of unlike economies would not have been considerable within any one meso-environment. On the other hand, regional specializations must have been conspicuous. Each environment provided an individual set of potential resources that were managed and exploited distinctively, before the introduction of agriculture as well as after. Consequently, the early stages of agricultural innovation must have been marked by strong regional contrasts, reflecting both different resources and traditions. Barring violent conquest or displacement, traditional methods, attitudes, and preferences may have persisted over centuries or millennia, long after the introduction of agricultural traits.

Viewed within this perspective, wheat-and-barley farming can reflect but a part of the spectrum of advanced subsistence patterns in the Near Eastern area before 5000 B.C. One set of questions that can be raised concerns the variable role played by one or more domesticated animals in different areas. Were there food collectors who herded animals? Were there herders who cultivated some grains during part of the year? Did or did not herding precede farming initially—at the very beginning, or locally—in certain areas? Did herding and farming originally have different roots among regionally specialized food collectors or did they spring from a single, regional tradition? Did herding and farming traits diffuse at similar or different rates? In their entirety or selectively? Another group of questions could be formulated about the relative role of legumes and certain other vegetables. Such plants were cultivated in Mexico for almost 3000 years before the first domestication of maize, and grains may also have been preceded by other cultigens such as peas and lentils in the Near East. Our cultural bias has favored an overemphasis of grain farming in the current Near Eastern literature, possibly obscuring the significance of other domesticates.

In retrospect, it appears that archeological research must be directed at a wider range of problems. Present understanding of the "terminal food-collecting stage" in North America shows how much more we need to know about the intensive food-collecting economies of a broader area in northern Africa, southeastern Europe, and western Asia. We have learned little new about the "stage of incipient agriculture" in the Near East during the past decade, despite ongoing excavations. Perhaps there has been too much attention to house structures, burials, and the identification of habitation residues—with only rudimentary analysis of total archeological associations. Only conscious effort will serve to demonstrate dietary and subsistence patterns, and allow inferences on different regional traditions. On presently available evidence, the nuclear area of the Near East must be extended into southeastern Europe, to account for evidence there of advanced, domesticated cattle a millennium earlier than anywhere in western Asia. Future excavations will probably reveal that the "nuclear area" included parts of Transcaucasia and Iran, beyond the Zagros ranges to Turkmenistan.

The basic environmental requisites for the complex of agricultural traditions of the Near Eastern hearth area are fairly simple: a winter growing season with sufficient moisture for dry farming. This submediterranean environment now extends through Anatolia into the Aegean world and certain uplands of the central and western Mediterranean Basin. The essential restricting factor would seem to have been the availability of suitable domesticates. In the case of potential herd animals, the situation is still rather fluid, with few limitations. In fact, it now seems probable that cattle were first domesticated in the Aegean area and possibly also in some part of Africa; the progenitors of sheep and goats remain a puzzle, and the last word has not yet been said on the locus of domestication of the first farmyard pigs. If, indeed, wheat was the original cultigen in the Near East, the locus of first domestication was more restricted. But the abundance of wild wheats in natural habitats may be exaggerated, for wild wheats now thrive in deforested areas made available by human interference in historical times. In undisturbed woodlands wild wheat would hardly be so abundant as to permit a subsistence based primarily on the harvesting of such primitive stands.

In concluding, we make a plea for the primary relevance of cultural traditions in agricultural origins. The Near Eastern-Aegean "nuclear area" must have contributed a number of local subsistence patterns that were ultimately adapted and fused to a hybrid, food-producing economy with exchange and competition between neighboring groups. Just as the subtropical forests of Transcaucasia may have provided orchard trees and the temperate woodlands of Macedonia the domesticated cow, other meso-environments may have contributed not only to the array of cultigens but to other facets such as manipulation, preparation, patterns of complementary cultivation, and, above all, dietary preferences. Hopefully, renewed archeological search will extend beyond the established village farmers to those groups of more diversified food collectors who made the first steps to agriculture possible in the Near East, and who each put their stamp upon the subsistence economy that subsequently diffused through mid-latitude Eurasia.