Investigating the Origins of Mesopotamian Civilization

An ecological approach suggests interrelated factors that may have triggered the emergence of civilization.

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In southwest Asia, between 8000 and 3000 B.C., human society developed from self-sufficient bands of nomadic hunters to economically and politically integrated city dwellers who specialized in a variety of occupations. A central archeological problem is to try to discover the factors that triggered these fundamental changes in man's way of life. For want of evidence and for want of a satisfactory model of the conditions existing during the period in question, searching for origins and attempting to discover the course of events that led to civilization is difficult. Prehistorians deal with nameless cultures, trusting to reconstructions from physical remains for their picture of life in ancient times. They must work directly with geographic, technological, and demographic factors and only indirectly infer ideologies and philosophical concepts. Archeologists are thus limited in what they can hope to learn by the nature of their data and the tools they have for interpreting them. Within these limits, however, it is possible to construct some plausible theories about the origins of civilization and to test them through controlled programs of excavation and analysis. In this article I define the problem under consideration in ecological terms, review the current evidence, and suggest topics for further study.

Mesopotamian (Sumerian) civilization began a few centuries before 3000 B.C. and was characterized by temples, urban centers, writing, trade, militarism, craft specialization, markets, and art. Inferred characteristics are a class-stratified society and well-defined mechanisms for regulation of production and distribution of resources. To be sure, Sumerian civilization must have had many other important but intangible characteristics, but most of these cannot be inferred from archeological data (*1*).

The early Mesopotamian civilizations were restricted to southern Mesopotamia, the alluvial plain that stretches south from Baghdad to the Persian Gulf. Remains of immediately antecedent cultures have been excavated in the same area, and still older cultures have been excavated in the surrounding Zagros mountain valleys of Iraq and Iran and on the steppes at the verge of plain and mountain in Khuzistan, southwest Iran (*2*) (see Fig. 1).

Intensive agriculture is a precondition for civilization. The Sumerian societies for which we have some historical records were sustained by cultivation of irrigated barley and wheat, supplemented by crops of dates, and the production of sheep, goats, cattle, pigs, and fish. In 8000 B.C. people were just beginning to plant cereals, raise animals, and live in permanent villages; their societies were small, self-sufficient, egalitarian groups with little differentiation of occupation or status. These people had fewer of the artifacts and qualities of civilization than the Sumerian city dwellers had 5000 years later. In this article I use 8000 B.C. as a convenient base line and attempt to assess some 5000 years of culture history (see Table 1).

Theories of Development

Recognizing the obvious changes in society that occurred during the 5000 years, archeologists and others have proposed causal factors such as characteristics of geography to account for them. The most detailed examination of the relationship between geographic features and social forms has been made by Huntington (*3*), but other scholars working with data from Southwest Asia have had more influence on archeologists. For example, in attempting to explain the origins of agriculture, Childe proposed climatic change, specifically desiccation, as the initiating event and set off a chain of thought that is still favored by some authors (*4*). Childe argued that "incipient desiccation . . . would provide a stimulus towards the adoption of a food-producing economy. . . ." Animals and men would gather in oases that were becoming isolated in the midst of deserts. Such circumstances might promote the sort of symbiosis between man and beast implied in the word *domestication*. Although Childe's theory is attractive, there is no conclusive evidence that the climate in Southwest Asia changed enough during the period in question to have affected the beginnings of agriculture and animal husbandry (*5*).

It was once fashionable to think of culture as inevitably rising or progressing, and this trend was thought to be analogous to biological evolution. Except in a most general way, however, modern prehistorians do not think of universal stages of cultural development (*6*). Rather than focusing on evolutionary stages, many scholars have examined the role of particular social and economic activities in triggering the emergence of complex forms of society. For instance, Marxists have explained the form of society (government, broadly speaking) on the basis of modes of production. Marxist evolutionists even today explain the development of social classes and political states in similar terms. They argue that, as people gained control over the production of food, the concept of private property crept in, and later the mass of people were exploited by the propertied few. "The creation of a state was necessary simply to prevent society from dissolving into anarchy due to the antagonisms that had arisen" (*7*). Information on the emergence of Sumerian civilization that might support this idea, however, is lacking.

Another attempt to correlate technological systems and social advances was made by Karl Wittfogel in *Orien-*

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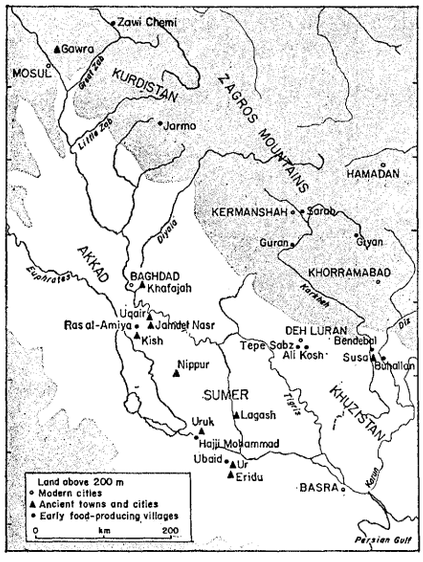

Fig. 1. Archeological sites in the alluvial basin of southern Mesopotamia and in the valleys of the Zagros mountains.

tal Despotism. He contended that, where people had to depend on irrigation, they inevitably led themselves into an escalating dependence on an organizational hierarchy which coordinated and directed the irrigation activities. "The effective management of these works involves an organizational web which covers either the whole, or at least the dynamic core, of the country's population. In consequence, those who control this network are uniquely prepared to wield supreme political power" (*8*). Although Wittfogel's analysis seems valid in many instances, archeological investigation in both Mesopotamia and the Western Hemisphere leads to the conclusion that there was no large-scale irrigation at the time of the emergence of the first urban civilization (*9*).

An Ecological Approach

Single factors such as technology are unquestionably important, but they can be understood only within the cultural, social, and geographic context. A more comprehensive view that takes into account the interrelation of many factors is called human ecology. In a consideration of cultural development, the relevant concept in human ecology is adaptation, hence the approach is to try to discover how particular factors influence the overall adaptation of a society. By means of the general approach, human ecology attempts to understand what happened in the histories of particular cultures. It does not address itself to making general statements about cultural progress or evolution.

In an ecological approach, a human society is treated as one element in a complex system of geography, climate, and living organisms peculiar to an area. To ensure survival, various aspects of a human society must be complementary and the society itself must be successfully integrated with the remainder of the cultural and physical ecosystem of which it is a part (*10*). From the ecological view, such factors as technology, religion, or climate cannot be considered apart from the total system. Nevertheless, some parts of the system may be considered more fundamental in the sense that they strongly influence the form of the other parts (*11*). Anthropologists, through their study of modern societies, and archeologists, through inference, find that such factors as geographical features, the distribution of natural resources, climate, the kinds of crops and animals raised, and the relations with neighboring peoples strongly influence the forms that a society may take. These factors comprise the major elements of the ecosystem, and societies must adapt themselves to them.

Archeological Evidence

For the period 8000 to 3000 B.C., archeological data are scattered and skimpy. This naturally limits the generality of any interpretations that can be made and restricts the degree to which we can test various theories. Ideally we would wish to work with hundreds of instances representing the range of environmental and cultural variation; instead, for the whole of Southwest Asia we can count fewer than 100 excavated and reported sites for the entire range of time with which we are dealing. Of course the number of unexcavated or unreported sites about which we know something is far greater, but we cannot but be aware of how little we know and how much there is to find out.

In all of Southwest Asia only about 15 villages that date to 8000 B.C. have been excavated, and only two of these, Zawi Chemi and the Bus Mordeh levels at Ali Kosh, give good evidence of the use of domesticated plants or animals (*12*). In short, data for the

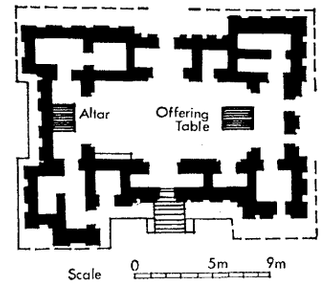

Fig. 2. Floor plan of temple VII in Eridu, about 3500 B.C. This basic plan was used in later temples such as the ones in Khafajah and Ur (see *31*).

time of our base line are woefully inadequate. We have much fuller information about the villages of 5000 B.C., but, unfortunately, for periods subsequent to 5000 B.C. the *kind* of data we have changes drastically. Thus, although there is historical continuity in the series of known sites, there is discontinuity in some of the data themselves because few archeologists have worked sites spanning the whole period from 8000 to 3000 B.C. Most of the sites dating to about 3000 B.C. were excavated by "historic" archeologists who struck levels that old only incidentally as they plumbed the depths of the cities they were digging. These scholars depended far less on artifacts than on history for their interpretations. The earliest sites were dug by prehistorians who based their inferences on results generated by an array of scientific experts. In order to understand the origins of civilizations, we thus need to bridge two quite different "archeological cultures." Archeologists and their various colleagues working in the early villages painstakingly teased out grains of charred seeds, measured metapodials and teeth of early races of sheep or cattle, and analyzed the chemical and mineral constituents of obsidian and copper; their counterparts working in the historic sites busied themselves with the floor plans of temples, the funerary pottery in the graves, the esthetics of an art style, and the translation of cuneiform impressions in clay (*13*).

Bearing in mind the reservations I have already expressed, we can begin to try to pick a coherent path through 5000 years of history. In dealing with Mesopotamia, it is usual to regard the presence of towns, temples, and cities as indicative of civilization. If we do so, we can divide our history into two parts, beginning with small food-pro-

ducing villages and following with more complex societies that include towns and cities. In the ensuing discussion I assess the available evidence and, for both forms of community, outline the characteristics and indicate how the community developed.

Table 1. Generalized chart showing the chronology of phases and sites mentioned in the text (*39*).

Date (B.C.)	Settlement subsistence type	Cultural phase	Ethnic group
2500		Early Dynastic III	Sumerians
		Early Dynastic II	Sumerians
		Early Dynastic I	Sumerians
2900	Walled cities	Jamdet Nasr	Sumerians
3500	Cities	Uruk	?
4000	Towns	Ubaid	?
5300	Temples	Eridu	?
5500	Irrigation	Sabz	
5800		Mohammad Jaffar	
6500	Food production	Ali Kosh	
8000	Food production aid small, settled villages	Bus Mordeh	
Pre-8000	Nomadic hunters	Zarzian	

Food-Producing Villages

Small food-producing villages have had a long history, but here we are chiefly interested in those that existed between 8000 and 5000 B.C. None of these communities is known thoroughly, and the following descriptions are based on data from several excavated sites and from surface surveys. The fullest data come from the phases represented in Ali Kosh and Tepe Sabz, in southwest Iran, and from Jarmo, Sarab, and Guran in the Zagros mountains. Additional data derive from extensive surveys in Khuzistan and the valleys of the Zagros (*14, 15*).

During this period villages are small and scattered, typically less than 1 hectare in size and housing perhaps 100 to 300 people. They are situated on the best agricultural land in regions where farming is possible without irrigation. From a handful of sites known to be about 10,000 years old, the number of settlements had increased by 5000 B.C., when many villages were within sight of one another and almost every village was within an easy day's walk of the next. There is no evidence of great migrations or any serious pressure of population during this time. By 4000 B.C. some villages occupy areas as large as 2 hectares (*14, 16*).

The increase in population appears to have been a direct consequence of improved agricultural techniques. In 8000 B.C., only primitive, low-yield races of emmer wheat and two-row barley were grown; sheep and goats were both in the early stages of domestication. By 5000 B.C. a modern complex of hybrid cereals and domesticated sheep, goats, cattle, and pigs were being exploited, and irrigation was practiced in marginal agricultural areas such as Deh Luran (*17*). The effects of developed agriculture are soon apparent, for, by 4000 B.C., settlement of new areas by prehistoric pioneers can be shown clearly in such places as the Diyala region to the east of Baghdad (*18, 19*). The age of the earliest settlements in southern Mesopotamia proper is unknown, but it would be surprising if groups of hunters and fishers had not lived along the rivers or swamps prior to the introduction of agriculture. The oldest settlement, Eridu, has been dated to about 5300 B.C., but there are no contemporary sites. In fact, there are few villages known in southern Mesopotamia that antedate 4000 B.C.

Towns and Cities

The millennium between 4000 and 3000 B.C. saw the rapid growth of towns and cities. Villages were also abundant, but some evidence suggests that they were less numerous than in earlier periods. "In part at least, the newly emerging pattern must have consisted of the drawing together of the population into larger, more defensible political units" (*14*). The trends I describe here pertain almost exclusively to southern Mesopotamia; in the north and in the valleys of the Zagros, the pattern remained one of small villages and—emerging later than their counterparts in the south—townships (*20*).

From southern Mesopotamia, archeological data for the period before 3000 B.C. are skimpy. Deep soundings at the bases of such sites as Eridu, Ur, Uqair, Tello, Uruk, and Susa and test excavations at Ubaid, Ras al-Amiya, and Hajji Mohammad are about all we have (*2*). Only at Ras al-Amiya is there direct evidence of agriculture, although at Eridu a layer of fish bones on the altar of temple VII suggests the importance of the sea and of fishing (Fig. 2). Archeological evidence from several of the remaining sites consists either of temple architecture or pottery, the latter serving more to indicate the age of a site than the social or cultural patterns of its inhabitants. Some temple plans are known, but published data on domestic architecture are few, and the sizes of the communities can be inferred only roughly.

There are extensive enough excavations at sites like Uruk, Khafajah, Kish, Ur, and Nippur to indicate the scale of urbanism and many of its more spectacular architectural and artistic features for the period after 3000 B.C. The largest Early Dynastic site was evidently Uruk, where 445 hectares are enclosed by the city wall; contemporary Khafajah and Ur comprise 40 and 60 hectares, respectively. By contrast, the Ubaid portion of Uqair had about 7 hectares (*2*).

Historical Reconstructions

Pictographic writing began by about 3400 B.C., but it is difficult to interpret, and in any case early writing tells little about society; it is confined to bookkeeping (*21*). Nevertheless, by depending on myths, epics, and tales written some 1000 years later, scholars have attempted historical reconstructions of the emerging urban societies (*22–24*).

The oldest texts that characterize the Sumerian community are no earlier than 2500 B.C. and were written at a time when the "Temple-city" had already become the characteristic feature of the Mesopotamian landscape (*25*). In the view of many authors (*26*), the city was an estate belonging to gods of nature and maintained on their behalf by completely dependent and relatively impotent mortals. Controversy centers around the degree

to which the temple controlled the economy. The extreme view is that it controlled everything while the more popular moderate view is that it controlled only part of the economy. In the Early Dynastic period, it seems clear, some, if not all, people were responsible to a temple which in turn directed most of the production and redistribution of goods and services. For practical purposes there was no distinction between the economic and the religious roles of the temples, but their administrators may not have had much political influence. Some temples listed large staffs of attendants, craftsmen, laborers, and food producers, but the precise relationship of these people to the temple is by no means clear. Moreover, such staffs would have been associated with the largest temples and not with the host of lesser temples and shrines that seem to have been present in the larger cities. Political control was vested variously in the *en* (lord), *lugal* (great man, or king), or *ensi* (governor-priest), depending on the historical period, the city referred to, and the translator of the text. In early times religious and secular titles seem not to have been held by the same person. Jacobsen describes, for pre-Early Dynastic times, a "primitive democracy" with the leader appointed by and responsible to an assembly of citizens (*27*). The arguments about the nature of Sumerian cities are summarized by Gadd (*28*): "The issues barely stated here have been discussed with much elaboration and ingenuity, but only a notable increase of contemporary evidence could raise the conclusions to a possibility of much affecting our conception of Sumerian government."

Environment and Subsistence

By combining the geographic, economic, and historical data, we can construct some plausible theories about the course of development and the situations that triggered it (*29*). The remarkable thing, from an ecological view, is the change in relations between men and products, and then between men and their fellows during the 5000 years. If we return for a moment to the pre-agricultural ways of life, we find small bands of hunters exploiting the seasonally available resources of a large territory by wandering from one place to another. Each community was self-sufficient, and each man had approximately the same access to the resources as his fellows. The earliest villagers seem to have maintained this pattern, although, as agriculture and stock breeding became more developed and important economically, the villagers tended more and more to stay put. People settled down where they could raise large amounts of grain, store it for the future, and exchange it for products they did not produce. In return for dependability of food supply, people gave up some of their dietary variety and most of their mobility. From a pattern of exploiting a broad spectrum of the environment, there developed a pattern of exploiting a relatively narrow spectrum (*30*).

As long as people stayed where they could find sufficiently varied resources through hunting and gathering, they could be self-sufficient. When people settled in villages away from the mountains, out of the zone of rainfall agriculture, they were no longer independent in the sense that they personally had access to the varied resources they desired or needed. Psychologically and sociologically this marked a turning point in man's relations with his environment and his fellows. Southern Mesopotamia is a land with few resources, yet in many ways this was an advantage for the development of society. In a land without timber, stone, or metals, trade was necessary, but the role of trade in the emergence of civilization should not be overemphasized. Date palms and bundles of reeds served adequately instead of timber for most construction, and baked clay tools took the place of their stone or metal counterparts in other areas. On the other hand, travel by boat is ancient, and extensive land and sea trade is attested in early documents. It was easy to move goods in Mesopotamia (*31*).

In order to live as well as the farmers in Deh Luran did, the Sumerians had to cooperate through trade, barter, or other means with their fellow settlers. We should remember that the barren vista of modern Mesopotamia on a dusty day does not reveal the full range of geographic variation or agricultural potential of the area. Swamps and rivers provided fish and fowl and, together with canals, water for irrigation and navigation. With sufficient water, dates and other fruits and vegetables could be grown. The unequal distribution of subsistence resources encouraged the beginnings of occupational specialization among the various kinds of food producers, and this trend was further emphasized after craftsmen started to follow their trades on a full-time basis (*32*).

Economics and Management

Because of the geographic distribution of resources and the sedentary and occupationally specialized population, a social organization that could control production and redistribution was needed. Clearly, any reconstruction of the mechanics of redistribution in emerging Mesopotamian civilization is subject to the severe limitations of the evidence. If we recognize this, however, we may then seek in contemporary societies analogs that may help us imagine appropriate redistributional structures. In modern economies, money markets act as the agency of redistribution, but in virtually all "primitive" societies where surpluses or tradeable goods are produced, a center of redistribution of another kind grows. The "center" can be a person (for example, the chief); an institution, like a temple and the religious context it symbolizes; or a place, like a city with some form of free markets (*33*). Jacobsen suggests that in Sumeria temples served as warehouses, where food was stored until times of famine.

Sahlins's (*34*) studies in modern Polynesia are also relevent to this point. He found that there is a close relation between surplus production and the degree of social stratification in Polynesia—that in a redistributional economy, the greater the surplus is, the greater is the degree of stratification. Of course we can only speculate about Mesopotamia, but, granting this and following Sahlins's findings, we may say that the chief of the Mesopotamian town would have acted as the center of redistribution. In Mesopotamia, most of the surplus labor or food went directly or indirectly into building and maintaining temples. One would also have expected the chief to use a good bit of the surplus to support himself and his family, to pay the wages of craftsmen, and to buy the raw materials that were turned into artifacts, such as jewelry and clothing, that served to distinguish his rank. Others in the lord's biological

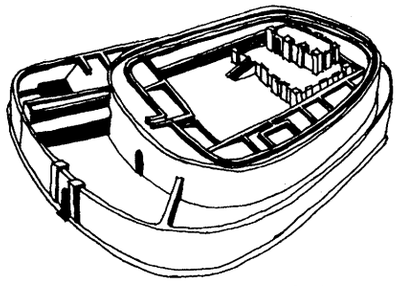

Fig. 3. A reconstruction of the temple oval in Khafajah, about 2700 B.C. The oval wall enclosed a number of structures which may have been used as storerooms, workshops, and quarters for temple officials. The temple itself is located on a platform at the rear of the enclosure. [After P. Delougaz, *The Temple Oval at Khafajah* (Univ. of Chicago, Oriental Institute, Chicago, 1940)]

or official family would also have profited from his control of the resources and ultimately have become recognized as a social class entitled to special prerogatives. This social stratification would have been associated with a similarly burgeoning system of occupational differentiation.

In an emerging system where both technology and governmental forms are relatively simple but susceptible of improvement, there is a maximum opportunity for feedback. That is, if a certain level of production will support a certain degree of social stratification, efficient management by the social elite may result in more productivity (*34*, p. 110). It is interesting to speculate on how much the construction of enormous irrigation systems during later Mesopotamian history may have depended on the rising aspirations of the ruling elite.

Although the need for management of production might in itself have been sufficient cause for a developing social stratification, other factors were probably contributory. Turning now to law and politics, I should point out that, with the establishment of irrigation and the concentration of population in urban centers, man's basic attitudes toward the land must have changed. The construction of irrigation systems, even if primitive, makes the land more valuable to the builders, and this, if it did nothing else, would lead to some notions of property rights and inheritance that had not been necessary when abundant land was available for the taking. An irrigation system also implies that some men may have more direct control over the supply of water than others. This could have led to an increase in the power of individuals who controlled the supply of water, and it certainly must have led to disputes over the allocation of water. It seems inevitable that a working system of adjudicating claims over land would then have been necessary, and the task may have fallen to the chiefs (lords) (*35*).

The presence of "neighbors" also has ecological implications; it is worth recalling that property invites thievery. Adams argues that the "growth of the Mesopotamian city was closely related to the rising tempo of warfare," and Service points out that the integration of societies under war leaders is common, and clearly an adaptation to social-environmental conditions. Several Early Dynastic II cities had defensive walls, attesting to conflict between cities and perhaps between settled farmers and nomadic herders, but the historical evidence for warfare begins only about 2500 B.C. (*36*).

If we consider both the agricultural system and the wealth, we see conditions that enhanced opportunities for leadership and, ultimately, for direction and control. With these situations, the emerging systems of rank and status are understandable without our resorting to notions of "genius," "challenge and response," or immigration by more advanced peoples.

Religion

The role of religion in integrating emerging Mesopotamian society is frequently mentioned. By 3000 B.C. texts and temples themselves attest to the central place of religion in Sumerian life; theoretically, at least, cities were simply estates of the gods, worked on their behalf by mortals (*26*). How closely theory corresponds to fact is a question that cannot be answered. Although we cannot date their beginnings precisely, we know that temple centers were well established by 5000 B.C., and that towns and temples frequently go together. Whether towns developed where people congregated because of religious activities or whether temples grew in the market centers where the people were cannot be decided without more data. Both interpretations may be correct. Historic evidence suggests that economic activities were controlled by

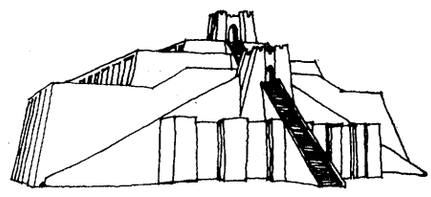

Fig. 4. A reconstruction of the ziggurat of the moon-god Nanna in Ur, dated variously between 2100 and 2250 B.C. Excavation under the ziggurat would probably reveal smaller, older temples like the ones at Eridu. [After C. L. Woolley, *Ur Excavations V* (Oxford Univ. Press, Oxford, 1939)].

the temples, but this evidence says nothing about the original relationships between the two. Furthermore, the interpretation of the historical documents is open to question. As Gadd (*28*, p. 39) points out, the picture of Sumerian economy that the various authors use is based on the "detailed records of one temple (Lagash) over a rather short period."

In regard to this limited view of the role of religion, it is well to recall that major settlements had several temples. At Khafajah, for example, perhaps as early as 4000 B.C. there were three temples, and a fourth was added later. Our image of the Sumerian temple is nevertheless likely to be that of the large temple oval at Khafajah or Ubaid rather than that of the smaller temples that were contemporary and perhaps just as characteristic (Fig. 3). The temple oval appears to have housed a society within a city, but many temples had no auxiliary buildings. More impressive even than the temple ovals were the great ziggurats erected on artificial mounds—at Uruk 13 meters high and visible for many kilometers (Fig. 4). Again this was only one of several temples at the same site. In Ubaid, Eridu, and Uqair, for example, where temples were originally associated with residential settlements, the towns were later abandoned and only the temples with cemeteries were maintained (*37*).

Summary

It seems unlikely that Mesopotamian society took a single path as it approached the rigidly organized, hierarchal civilization of Early Dynastic times. Rather, we imagine that there was considerable experimentation and variety in the organization of society

as people adapted to their physical environment and to the presence of other expanding communities.

Some towns and cities probably arose as the demographic solution to the problem of procuring and distributing resources. It would have made sense to have central "clearing houses." Similarly, it would have made sense to have the craftsmen who turned the raw materials into finished products live close to their supply (probably the temple stores). Temple centers are natural focal points of settlements. Cities and towns, however, are not the only demographic solutions to the problem of farming and maintaining irrigation canals. Both of these tasks could have been carried out by people living in more dispersed settlements. City life in Mesopotamia probably also presented other benefits. For example, as warfare came to be a recurrent threat, the psychological and physical security of a city must have been a comfort for many. Finally, to judge from some historical evidence, Mesopotamian cities were places of diversity and opportunity, no doubt desiderata for many people as long as they could also gain a suitable livelihood (*38*).

In considering the development of civilization, an ecological approach forces us to consider multiple factors. Seeking isolated causes among the many factors possibly involved ignores the central concept of adaptation, with its ramifications of interaction and feedback. Still, we are a long way from fully understanding the emergence of Mesopotamian civilization. In particular, we need a great deal more archeological data that relate to the 2000 years preceding 3000 B.C. in southern Mesopotamia. Specifically, there are three projects which ought to have high priority in the planning of future archeological work in this area. First, we need thorough surveys in order to determine the early history of settlement in Mesopotamia. By means of these surveys in and around the early cities, we would try to determine the duration of occupation, and the variety and location of additional sites. Second, we need extensive excavation of selected smaller sites and portions of larger ones in order to determine the characteristics of different settlements. We would like to know in what way the cities, towns, temple centers, and villages were integrated to form a socioeconomic network. A third question, which gets at the crux of the matter, is, What structural form did the emerging Sumerian society take? Answers to this question must depend in large part on the results of future surveys and excavations of the kind suggested above. Then, selective excavations focusing on successive periods should yield data on the relative roles of economic and religious activities and on social differentiation and stratification. These data, after they are eventually pieced together, will comprise the story of the emergence of the world's first civilization.

References and Notes

1. Archeological criteria: V. G. Childe, *Town Planning Rev.* **21**, 3 (1950). Sociocultural criteria: R. M. Adams, in *City Invincible*, C. H. Kraeling and R. M. Adams, Eds. (Univ. of Chicago Press, Chicago, 1960), pp. 30–31; E. R. Wolf, *Peasants* (Prentice-Hall, Englewood Cliffs, N.J., 1966) ["It is the crystallization of executive power which serves to distinguish the primitive from the civilized . . . when the cultivator becomes subject to the demands and sanctions of power-holders outside his social stratum" (p. 11)]. The "form" of civilization: H. Frankfort, *The Birth of Civilization in the Near East* (Doubleday, Garden City, N.Y., 1956), chap. 2.
2. Relevant sites are Ubaid, Eridu, Ras al-Amiya, Ali Kosh, Guran, Sarab, and Jarmo. For a bibliography of publications on Mesopotamia and Iran, see articles by E. Porada and R. H. Dyson in *Chronologies in Old World Archaeology*, R. W. Erich, Ed. (Univ. of Chicago Press, Chicago, 1965), pp. 133–200, 215–256.
3. E. Huntington, *Mainsprings of Civilization* (Wiley, New York, 1945).
4. V. G. Childe, *New Light on the Most Ancient East* (Praeger, New York, 1952), p. 25; J. Mellaart, *Earliest Civilizations of the Near East* (Thames and Hudson, London, 1965), pp. 19–20.
5. Studies based on archeology, paleontology, geography, palynology, and geology fail to disclose post-Pleistocene climatic changes that would have been of major cultural significance. See R. J. Braidwood and C. A. Reed, *Cold Spring Harbor Symp. Quant. Biol.* **22**, 19 (1957); K. W. Butzer, in *Cambridge Ancient History* (Cambridge Univ. Press, Cambridge, 1965), vol. 1, chap. 2; K. V. Flannery, *Science* **147**, 1247 (1965); H. E. Wright, Jr., *Eiszeitalter Gegenwart* **12**, 160 (1960); W. van Zeist and H. E. Wright, Jr., *Science* **140**, 65 (1963). Moreover, as I discuss more fully later, the development of urban civilizations doubtless depended more on sociocultural factors such as trade, surplus production, and economic interdependence than on geography *per se* [see R. M. Adams, in *City Invincible*, C. H. Kraeling and R. M. Adams, Eds. (Univ. of Chicago Press, Chicago, 1960), p. 291].
6. For a general discussion of these ideas, see R. J. Braidwood in *Evolution and Anthropology: a Centennial Appraisal* (Anthropological Society of Washington, Washington, D.C., 1959), pp. 76–89; S. Piggott, in *Evolution After Darwin*, S. Tax, Ed. (Univ. of Chicago Press, Chicago, 1960), vol. 2, pp. 85–97.
7. M. W. Thompson, *Antiquity* **39**, 108 (1965).
8. K. A. Wittfogel, *Oriental Despotism* (Yale Univ. Press, New Haven, Conn., 1957), p. 27.
9. R. M. Adams, in *City Invincible*, C. H. Kraeling and R. M. Adams, Eds. (Univ. of Chicago Press, Chicago, 1960).
10. It is misleading to think that at any moment all parts of a system are necessarily functioning harmoniously, let alone perfectly. One finds situations that can only be understood as a result of historical accident. For example, immigrants may carry with them customs and practices that are inappropriate to new circumstances.
11. For examples of the effect of environmental conditions on socio-political integration, see J. H. Steward, *Bull. Bur. Amer. Ethnol.* **120**, (192→ M. D. Coe, *Comp. Studies Soc. Hist.* **4**, 65 (1961).
12. R. L. Solecki, *Intern. Congr. Quaternary, 6th* (1964), vol. 4, pp. 405–412; F. Hole, K. V. Flannery, J. A. Neely, *Current Anthropol.* **6**, 105 (1965). Since this article is restricted to Mesopotamia, I have ignored such spectacular and large early sites as Catal Hüyük in Anatolia and Jericho in Jordan. These developments were essentially independent of Mesopotamia and must be explained in their own contexts.
13. Kramer expressed the view of many Sumerologists when he spoke of "Mesopotamian archeology in all its aspects: architecture, art, history, religion, and epigraphy" [S. N. Kramer, *The Sumerians* (Univ. of Chicago Press, Chicago, 1964), p. 28]. Historical archeologists often base their interpretations of culture on less tangible factors than those discussed in this article—on catastrophe, invasion and destruction, migration, religious inspiration, inventive genius, moral decadence, and the like.
14. R. M. Adams, *Science* **136**, 109 (1962).
15. R. J. Braidwood, *Illustrated London News* **237**, 695 (1960); F. Hole, *Science* **137**, 524 (1962).
16. For an example of the spacing of settlements and their relation to subsistence patterns, see F. Barth, "The land use pattern of migratory tribes of South Persia," *Norsk Geograf. Tidsskr.* **17** (1959).
17. K. V. Flannery, *Science* **147**, 1247 (1965).
18. R. M. Adams, *Land Behind Baghdad* (Univ. of Chicago Press, Chicago, 1965).
19. As agricultural techniques improved and the social organization for exploiting them developed, the population increased and settlement expanded slowly into the less favorable areas, a process that continues even today with the introduction of moldboard plows, tractors, and motor-driven water pumps.
20. A. J. Jawad, *The Advent of the Era of Townships in Northern Mesopotamia* (Brill, Leiden, 1965).
21. A. Falkenstein, *Archaische Texte aus Uruk* (Harrassowitz, Berlin, 1936).
22. A. Deimel, *Sumerische Templewirtschaft zur Zeit Urukaginas und seiner Vorgänger* (Päpstlisches Bibelinstitut, Rome, 1931).
23. A. Falkenstein, *Cahiers Hist. Mondiale* **1**, 784 (1954).
24. H. Frankfort, *The Birth of Civilization in the Near East* (Doubleday, Garden City, N.Y., 1956), chap. 3; S. N. Kramer, *The Sumerians* (Univ. of Chicago Press, Chicago, 1964); T. Jacobsen, *Z. Assyriol.* **52**, 91 (1957). For a criticism of the Templewirtschaft, see N. M. Diakonoff, *Sumer: Society and State in Ancient Mesopotamia* (Academy of Sciences, Moscow, 1959) (in Russian, with English summary). A summary of the views of Russian scholars is given in F. I. Andersen, *Abr-Nahrain* **1**, 56 (1959–60).
25. For a general review of Sumerian history, see C. J. Gadd, in *Cambridge Ancient History* (Cambridge Univ. Press, Cambridge, 1962), vol. 1, chap. 13. General accounts of Sumerian life are given in S. N. Kramer, *The Sumerians* (Univ. of Chicago Press, Chicago, 1964) and ———, *History Begins at Sumer* (Thames and Hudson, London, rev. ed., 1961). The cuneiform texts take Sumerian history back to the ruler Mesilim, about 2500 B.C. A summary of the kind of texts available is given in T. Jacobsen, *Z. Assyriol.* **52**, 91 (1957).
26. See especially A. Deimel (*22*) and A. Falkenstein (*23*).
→ T. Jacobsen, *J. Near Eastern Studies* **2**, 159 (1943); *Z. Assyriol.* **52**, 91 (1957).
28. C. J. Gadd, in *Cambridge Ancient History* (Cambridge Univ. Press, Cambridge, 1962).
29. Many of the ideas in this section are derived from the work of R. M. Adams; see *9, 14, 18.*
30. For an analogous situation, see M. D. Coe and K. V. Flannery, *Science* **143**, 650 (1964).
31. The desirability of trade is an effective stimulus to demographic consolidation and political integration; s→ M. D. Coe, *Comp. Studies Soc. Hist.* **4**, 65 (1961). A clay model at Eridu gives the earliest evidence for boats; see S. Lloyd, *Illustrated London News* **213**, 303 (1948). For a summary of early trade, see C. J. Gadd (*28*, p. 41).
32. R. M. Adams (*9*, p. 276) discusses the Su-

merian subsistence base. Sumerian texts make poignant reference to famine and the insecurity of life in Mesopotamia [see T. Jacobsen, *Proc. Amer. Phil. Soc.* **107**, 476 (1963)].

33. K. Polanyi, in *Trade and Market in the Early Empires*, K. Polanyi, C. M. Arensberg, H. W. Pearson, Eds. (Free Press, Glencoe, Ill., 1957), pp. 250–256; for a discussion of chiefdoms, see E. R. Service, *Primitive Social Organization* (Random House, New York, 1962), pp. 144–152. The practical consequence of redistribtuion in the Mesopotamian case was the development of a tributory peasant society as a distinct social stratum [see E. R. Wolf, *Peasants* (Prentice-Hall, Englewood Cliffs, N.J., 1966), pp. 10–11; T. Jacobsen, *Proc. Amer. Phil. Soc.* **107**, 476 (1963)].
34. M. D. Sahlins, *Social Stratification in Polynesia* (Univ. of Washington Press, Seattle, 1958).
35. On the role of lords, see C. J. Gadd (*28*, p. 13); T. Jacobsen, *Z. Assyriol.* **52**, 91 (1957). On the development of political authority, see R. M. Adams (*9*, p. 278); K. A. Wittfogel (*8*); M. Fried, in *Culture in History*, S. Diamond, Ed. (Columbia Univ. Press, New York, 1960), pp. 713–731.
36. Part of Jacobsen's reconstruction of kingship emerging from a base of primitive democracy is based on the need for a rapidly mobilized defense and the holding of power by war leaders; see T. Jacobsen, *Z. Assyriol.* **52**, 91 (1957); R. M. Adams, *Sci. Amer.* **203**, 153 (1960); E. R. Service, *Primitive Social Organization* (Random House, New York, 1962), p. 114.
37. Abandonment of any city with irrigated fields would be unlikely unless the water failed or the fields became too salty for use. Both of these circumstances have been important in Mesopotamia since settlement began, and we may not be able to infer much about the role of religion in society from the lack of settlements around temples that were probably maintained for a time out of a sense of tradition by people living elsewhere.
38. S. N. Kramer, *The Sumerians* (Univ. of Chicago Press, Chicago, 1964), p. 89.
39. Table 1 is based in part on E. Porada, in *Chronologies in Old World Archaeology*, R. W. Erich, Ed. (Univ. of Chicago Press, Chicago, 1965). Since there is archeological continuity from Eridu times into the Sumerian period, there is probably biological continuity in the population, too. Strictly speaking, however, *Sumerian* is a term that refers to the language and not to the people.
40. The research in Iran was supported by NSF grants GS-67 and 724 and by the University of Chicago and Rice University. The Archeological Service, Musée Bastan, Tehran, granted permission to excavate and provided assistance in the field. I thank Edward Norbeck and Barbara Stark for advice in preparing the manuscript and Steve Wood for the drawings.

NEWS AND COMMENT

National Research Policy: Ambuscade for the "Establishment"

In the course of a series of hearings in recent weeks, Senator Fred R. Harris (D–Okla.) has emerged as a new and potent factor in the affairs of science and government, roaring forth as a champion of the country's science-poor regions and itching for combat with the so-called "scientific establishment." "I'm interested in shaking folks up," said the Senator in an interview, and that is precisely what he did last week when he snapped at the mild-mannered Donald F. Hornig, science adviser to the White House: "quit talking down to members of Congress." A moment before, he had accused Hornig and NSF Director Leland J. Haworth of being "a little bit patronizing and condescending" in defending the distribution of federal research and defense funds. The Senator, who is chairman of the Government Operations Committee's subcommittee on research, was venturing into what, over the past few years, has become rather well-plowed territory—the administration of federal research programs. But in effect, if not by design, Harris has brought something new to congressional interest in science, and that is a keen scent for the fundamentals of power and conflict inside the tangled complex of science, education, and regional economics and politics.

The ability to discern who is mad at whom and to orchestrate discontent is one of the most essential traits of the politician who would go far. And, on the basis of Harris' inquiry into federal science programs, it appears that he has the ability in ample quantity. In any case, at age 36, with a Phi Beta Kappa key from the University of Oklahoma and top place in his law class at the university, he has logged a great deal of political mileage, having served for 8 years in the Oklahoma State Senate, before winning a special election 2 years ago to serve out the unexpired term of the late Senator Robert S. Kerr. Added to which, it might be noted, Harris faces a reelection campaign this year in a state that stands 37th in the national rankings of federal R&D receipts and 40th in R&D funds per capita.

Representative Henry Reuss (D–Wis.) chairman of Harris' counterpart subcommittee in the House, has emerged as the Don Quixote of congressional science affairs; and Representative Emilio Q. Daddario (D–Conn.), chairman of the House Science and Astronautics committee's subcommittee on Science, research, and development, has chosen the stance of statesman, seeking a balance between his own independence and harmony with the National Academy of Sciences and other venerable institutions of science. Harris, on the other hand, has detected that the political tides of science are shifting, that the long-enduring influence of Cambridge is on the wane, and that the long-slumbering have-nots have evolved from a mass into an interest. And Harris, accordingly, is abiding by one of the first laws of politics, which is: associate yourself with the inevitable. As far as the scientific and academic communities are concerned, this association may well have far-reaching effects for them and Harris. For the issues involved can only become more important and more contested, and Harris has early staked out a claim to filling an unoccupied role in the U.S. Senate, namely, that of "Mr. Science." Though low in seniority, Harris stands high in the regard of the Senate elders—as evidenced by his early arrival at a subcommittee chairmanship. And, though it can be argued as to just where the Senate "club" begins and ends, it is generally agreed that Harris is on the verge of admission.

Harris' main problem may lie in Government Operations being a "watchdog" committee which handles neither regular authorization legislation nor appropriations. On the other hand, however, forceful members of the committee in the past have demonstrated that Government Operations can be a powerful instrument for focusing congressional attention and for imposing change on the Executive.

The young Senator's latest foray into the affairs of science and government arrived at the stage of formal proceedings on 18 July, when in the Hiltonesque splendor of the New Senate Office Building, he called 14 in-