

ECOLOGICAL FACTORS IN THE RISE OF CIVILIZATION¹

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Introduction

Ernest Haeckel introduced the term "ecology" for the study of "the relationships of animals with both the inorganic and the organic environments . . . in a word, all of the intricate interrelations that Darwin referred to as the conditions of the struggle for existence." Following this definition, "human ecology," could be considered a subdivision which is concerned with the relationships of human populations with the environment. However there has been little agreement about more specific applications of the term, and at present it is attached to diverse studies in several disciplines. As a result there are very different conceptions of the precise interests and objects of study. In medicine, human ecology is often thought of as the study of the interrelationship of man and epidemic disease; in geography, man and climate; in sociology, man and urban life; and in anthropology, man and mode of subsistence (Bates 1953:701-702).

But in spite of what appear to be wide differences of emphasis, the viewpoints mentioned are all basically concerned with certain aspects, broad or narrow, of the complex action and reaction of human beings with the environment and with each other. If this observation is correct, there is present an underlying unity of a very general sort consonant with the broadest definition of the term "human ecology." A possible conclusion, suggested by Bates, is that human ecology may best be considered simply as a point of view which orients research in diverse areas rather than as a distinct social or biological science as the suffix "ology" would imply. From this standpoint its acceptance as a unifying concept, applicable to problems in separate academic disciplines, depends on its heuristic utility. The criterion, then, of whether or not a particular piece of research is from the point of view, or in the tradition of, human ecology would be the degree of exploitation of the implications and possibilities suggested by its general definition.

Within sociology, according to Hawley, the ecological approach focuses on the form and development of the community, defined as "the structure of relationships through which a localized population provides its daily requirements" (1950:180). Although not all students would wish to limit its scope to the localized community, it is generally agreed that human ecology, from the point of view of the sociologist, is concerned with the description and explanation of the macro-phenomena of human social organization, structure, or morphology. Steward suggests a similar objective for what he calls "cultural ecology" (1955b:36-37). Although he considers it problematic whether an ecological approach can establish general principles applicable to any cultural-environmental situation, he believes that this approach serves to explain the origin of the particular cultural features--social, political, and religious--most closely related to subsistence activities which characterize different areas.

Durkheim attempted a similar sort of analysis in the Division of Labour. He wished to explain the development of advanced societies which are distinguished by complex structure from more simple societies in which social unity is based on similarity of the constituent units. Much of the current sociological work in human ecology is an extension and elaboration of the kind of analysis Durkheim used to explain the development of extreme differentiation within advanced societies.

It had long been noted that "competition" occurs in both human and animal populations whenever the number of individuals with similar demands exceeds the supply of means to satisfy the demands. Although not the first to do so, Malthus had concluded that if this competition was for the means of subsistence, it would be resolved by an increase in the death rate or a decrease in the birth rate or both. These fluctuations in vital rates would bring the number of individuals with similar demands in line with the available supply. Durkheim recognized that at least in human populations, differentiation in the form of increased division of labor could lessen the extent of demand for certain things by establishing demand for new alternatives or substitutes. He also noted, however, that differentiation is not a necessary result of increase in population size; differentiation occurs only with a concomitant increase in social interaction. Thus Durkheim's explanation involves the assumption of the presence of factors, primarily technological, facilitating increased social interaction or "social density" in addition to the factor of absolute increase in population size.

Human ecologists have come to realize that there are in fact a number of possible resolutions of the competition arising from an increase in demand. Some of the most obvious means are: demographic changes as Malthus noted (increase in the death rate, decrease in the birth rate, or migration); technological changes (utilization of previously unused resources, improved transportation and communication resulting in utilization of resources from a wider area, improved utilization of energy sources); or organizational changes (redistribution of "wealth," general lowering of living standard, or finally, occupational and territorial differentiation as Durkheim suggested).

It is evident that several of these mechanisms which tend to resolve competition may be operating simultaneously in a given situation and thus, in practice, must be considered to be closely interrelated. As a result social ecologists have tended, either implicitly or explicitly, to isolate, as a first approximation in descriptive studies, the broad category, organization, as a dependent variable and the equally broad categories, population, technology, and environment, as independent variables (Schnore 1958:627-632). Now the processes subsumed under these broad categories are considered at least in part to explain rather than simply describe variations in competition. Moreover, the ubiquitous nature of such processes immediately suggests the possibility that they are of value in the analysis and explanation of other features of the man-environment relationship. But in this wider context it is not known to what extent and at what level of abstraction, the categories per se might be considered as more than simply descriptive. The present state of development of ecological studies does not permit any definite conclusions on this point. For the present, then, only their presumed "systematic utility" in describing the "ecological complex" can be emphasized.

Many scholars in various disciplines before and since Durkheim have been interested in the differences between complex and simple societies, and have attempted both analytic and historical explanations of these differences. Currently, much effort is being directed, on the basis of the archaeological data available from Mesopotamia, Egypt, India, China, Mesoamerica, and Peru, toward a detailed examination of the sequence of development from simple isolated farming communities to complex urban centers of civilization in these areas (Childe, 1950, 1952, 1954a; Steward 1955a, 1955b; Braidwood, 1952; Braidwood and Reed, 1957). Many of the processes mentioned above have been noted, but as yet no attempt has been made to organize them explicitly and systematically under the broad headings of the "ecological complex," organization, population, technology, and environment. The balance of this paper will be oriented in that direction.

However, the discussion will primarily focus on a single aspect of the development from simple to complex societies--increasing differentiation, the characteristic which Durkheim sought to explain. Four very general activities--warfare, irrigation, religion, and trade--which can be readily inferred from the archaeological remains of early civilizations, and which are generally thought to have direct bearing on the extent of differentiation, will be examined in this connection. First, differences between simple agricultural communities and the earliest urban societies which are of interest to the ecologist will be outlined briefly. Secondly, the archaeological evidence from Mesopotamia which documents the transition of simple rural society to urban specialization will be summarized. Finally, an effort will be made to examine critically some of the existing explanations of this transition to determine their implications for a general ecological approach to the problem of social differentiation. In this evaluation data from some of the other areas of early urban development mentioned above will be used in order to assess the generality of these explanations.

At this point the question might arise as to the relevance of this kind of analysis for the sort of work that sociologists do in connection with modern urban phenomena under the name "human ecology." The reply is that it is simply an attempt to extend the scope of general concepts developed primarily in investigations of modern society to the beginnings of civilizations; if these concepts are found to have wider utility than formerly thought, their generality is extended and their validity enhanced.

In what follows, for descriptive simplicity and clarity, Childe's terminology is followed. The term "savagery" will be applied to communities subsisting by hunting, gathering, and fishing; "barbarism" will be applied to simple independent agricultural communities; and "civilization" will be used to refer to communities which have developed a distinctive level of population concentration and differentiation. Obviously this threefold division is an oversimplification of actually existing differences. However, the archaeological and ethnological evidence presently available for finer distinctions is incomplete and often non-existent (Braidwood and Reed 1957:23). Furthermore, the present level of accomplishment in studies of this area of social development would seem to indicate that a preliminary gross typology is still adequate for most purposes.

Savagery, Barbarism, and Civilization

Savagery

After the appearance of modern forms of Homo sapiens in the Upper Pleistocene, most ecological niches suitable for hominid exploitation were open to this omnivorous animal possessing such unusual habits as the use of fire and the manufacture of stone tools. With the earliest human populations the tendency to outstrip the food resources of a given area could probably be resolved to a large extent by migration into empty regions. There is evidence that most regions at all suitable for a savage level of subsistence were rapidly occupied (Birdsell, 1957). Except for the islands of the Pacific and perhaps several relatively inaccessible regions of the New World, the major regions of the world were most likely populated up to their capacity to support a savage level of technology shortly after the last retreat of Pleistocene glaciers. From that time until the development of plant and animal domestication, competition for the means of subsistence would be regulated primarily by fluctuations in vital rates. Except in very favorable environments such as California or British Columbia, the density of population which can be supported on this level of subsistence is very low. Based on ethnological data which are often conflicting, aboriginal density seems to have varied from as low as one person per hundred square miles to three persons per square mile in the Andaman Islands (Braidwood and Reed, 1957:21-23; Steward, 1955b:149, table 2). At this subsistence level social differentiation is almost non-existent except for minimal division of labor by age and sex. Artists and shamans are only part-time specialists; the rigors of the food quest require that all should participate. Again from ethnological evidence, the social unit is usually limited to a roving patrilineal or bilateral band averaging about 50 persons which wanders over a well delineated territory (Steward, 1955:tables 1 and 2).

Barbarism

What Childe has called the "neolithic revolution" brought about drastic changes in the adaptation of human groups to the environment. Present archaeological evidence indicates that plant and animal domestication first appeared around 6-7000 B.C. in the Near East, probably in the grassy hill country which arches over classic Mesopotamia (Braidwood, 1952:10, fig. 4). It is, in effect, a technological change facilitating both a more intensive utilization of existing resources and a utilization of new resources. With agriculture and animal breeding, population units become sedentary or semi-sedentary, and increase, with respect to land occupied, both intensively and extensively. The observed ability of human populations to double in size every generation, given adequate means of subsistence, led, under these new technological conditions, to an absolute increase in size of communities and the migration of colonizing segments of established communities into new lands at the expense of the previous savage occupants. Except in very favored areas such as some islands of the Pacific, density rises to a maximum of about 25 to 30 persons per square mile (Braidwood and Reed, 1957:22; Childe, 1950:4). However, unless crops are watered by a form of irrigation in which soil is replenished by a deposition of silt, primitive agricultural techniques are inefficient in the sense that a large proportion of arable land must lie fallow at any given time. With the slash-and-burn method, widely distributed throughout the world today in tropical

regions, and more widely distributed in the past, a field which is cleared will be productive for one, two or at most three years; it subsequently must lie fallow about seven to twenty years depending on soil and other local conditions (Palerm, 1955). Therefore a permanent settlement of a given size must have a great deal more land than is under cultivation at any one time. Of course, the fallowing period in a semi-arid region with little soil leaching such as northern Iraq in the past would be much shorter than in a region with heavy rainfall such as parts of Mesoamerica or Southeast Asia, and thus the amount of land required by a village of given size varies to some extent under different environmental conditions. If transportation facilities are rudimentary, population increases are limited, in a given community, by the extent of land surrounding it that can be conveniently cultivated. This technological factor places a limit on the size of the local aggregate and minimizes the possibility of inter-community division of labor as well. According to Childe, Neolithic communities generally contained from 200 to 400 people (1950:6).

On the basis of both ethnological and archaeological evidence, the material technological equipment is very little advanced in many barbarian societies over that of a savage economy. Tools used in agriculture, for instance, are often quite rudimentary, consisting of a simple digging stick for planting. There is, however, a great advance in sedentary communities in the ability to store food. Cereal crops have a long storage life, and pottery containers in which to keep them begin to supplement basketry containers in many groups. Shelter increases in size and permanence and weaving from domestic plant and animal fibers becomes widespread. On the basis of evidence from present barbarian groups, social organization in general remains based on kinship ties (mechanical solidarity in Durkheim's terminology). Greater occupational specialization occurs to some extent, but as Childe observes, specialists are usually forced to travel from one small community to another, because the demand for their skills and goods is not sufficient in one group to support them full-time (ibid.:7).

In short, primitive agricultural communities generally have attained a level of technology (shifting agriculture) which permits intensive use of environmental resources that were not available to a savage economy, and these resources in turn permit extensive population growth. Certain technological limitations prevent indefinite population growth within the community unit, the village, and internal differentiation remains slight. Other technological limitations, especially in transportation, prevent extensive territorial differentiation and thus the primitive agricultural community remains an independent and isolated unit.

Civilization

What Childe has called the "urban revolution" brought about remarkable changes in hitherto existing patterns of social organization. But certain methodological and terminological difficulties arise in an attempt to describe these changes. To begin with, unlike the types of communities described above, there are no communities existing today that more than remotely resemble those that appeared in the valleys of the Tigris-Euphrates, the Indus, or the Nile around 3000 B.C., or those that appeared independently, several thousand years

later in Peru and Mesoamerica. Consequently, descriptions of social organization must be laboriously reconstructed, largely from archaeological evidence. This presents certain unique problems when it is remembered that unlike studies performed on current communities, archaeological excavation, in effect, destroys the evidence as it collects it. The "cities" of this period, in terms of population size, would probably no more than compare favorably with contemporary provincial urban communities of about 10,000 to 20,000 people. When differentiation and specialization are mentioned in connection with these early communities as distinctive and well-developed, it is not so much in terms of a comparison with differentiation and specialization in present urbanized regions but rather with that which prevailed in previous savage and barbaric communities. Furthermore, it is difficult to apply to these early societies the criteria as to what constitutes an urban community, which are applicable to present population concentrations. Even with available statistical data there is difficulty in reaching agreement on what is to be considered a city in contemporary worldwide urban studies. In the case of archaeological sites, the problems are multiplied since population statistics must be derived by very indirect means. Thus agreement on which mounds of rubble are likely to have been centers of large dense population and which are only the remains of "towns" is not readily attainable. Finally, some confusion has arisen with respect to the terms "civilization" and "urban." Some writers, Childe included, seem to consider them as practically synonymous; others, Braidwood for example, think that civilization does not necessarily imply urbanization. Still others have held the reverse. At this point the disagreement will be simply recognized as a disagreement, and the following will be a description of the more salient features of "early civilization."

An exhaustive definition of the results of the changes which took place in the areas mentioned above is difficult to find. However, a comparison of Braidwood's outline (1952:2) with that of Childe (1950:9-16) is suggestive. According to Childe, "ten rather abstract criteria, all deducible from archaeological data, serve to distinguish even the earliest cities from any older or contemporary village." Braidwood says we are dealing with a civilization if we find a culture which has most of the characteristics listed below. The table summarizes the criteria of the urban revolution outlined by Childe and compares them with Braidwood's criteria of civilization. (Table 1, page 7.)

In general the lists of characteristics are quite similar. It is interesting to note that Childe does not give the existence of a formal political state as a defining feature. His discussion implicitly acknowledges the likelihood of well-defined political organization arising eventually. But his emphasis on the administrative and integrating potentialities of religious institutions seems to indicate that he considers the political unit, as such, a secondary development in the urban revolution. The changes in the variables of the ecological complex that must have occurred can be inferred readily from at least some of the items on this list.

Technological changes such as the introduction of irrigation agriculture and the use of the plow result in increased food production. Palerm states that in present-day Mexico irrigated land produces over twice the crop that fallowed land produces; the difference in this case may be unusually large, but if the total amount of land necessary for continued yields, including that

lying fallow, is considered, the superiority of irrigation is even more evident (Palerm 1955). In fact, the basic techniques of irrigation agriculture have been little improved upon since, and still support a large proportion of the world's population.

TABLE 1
CRITERIA OF THE URBAN REVOLUTION

Childe	Braidwood
Community size 7 - 20,000	Cities, urbanization
Craft specialization	
Concentration of surplus food production	Fully efficient food production
Monumental buildings	Formal projects and works
Social stratification	Classes and hierarchies
Writing	Writing
Arithmetic, geometry, astronomy, calendar	
Naturalism in art	Monumentality in art
Widespread external trade	
Group membership based on residence rather than kinship	Formal laws, a new sense of moral order
	Formal political state

Increased food supply in turn permits population increase, and further technological developments in transportation facilitate the concentration of increasing numbers in a relatively small area, in that the produce of distant fields can be transported to the growing towns by sailing boat or by wheeled vehicle, both of which were present in the Near East by 3000 B.C. (Childe 1954b:716; Bowen 1960:117). Thus, some of the conditions limiting individual community size at the level of barbarism had been overcome.

Transportation improvements also permit increased volume of trade between distant points and encourage the development of regional specialization. Moreover, greater division of labor is possible within the community since the production of the community's food supply no longer requires the labor of all the adult population.

The end products from which archaeology infers these changes are in themselves impressive. The physical plan of the community becomes much more orderly. Streets and squares are often carefully laid out, and public buildings, especially temples, reach relatively large dimensions. Such products as

pottery and often metal show indications of relative "mass production" in centralized work shops. With these developments rationalized methods of accounting occur and in many cases lead to the appearance of writing. Thus, with technological and demographic changes go organizational changes, notably the emergence of craft specialization, full-time priests, political officials, merchants, and soldiers. Gradually increasing social stratification appears in connection with these changes and the society comes to be dominated by religious and military hierarchies.

In what follows, the specific character of this development in Mesopotamia will be described in an effort to pin down the ecological variable "environment" which has been neglected so far in this discussion.

The Archaeological Sequence in Mesopotamia

The modern state of Iraq, which includes the ancient region of Mesopotamia, consists primarily of a low plain extending north and west of the Persian Gulf. It is bounded on the east and north by the hilly flanks of the high Iranian and Turkish plateaus, on the south-west by the low Arabian desert plateau, and on the west by the hilly regions of Jordan and Syria. The plain of Iraq is cut from north-west to south-east by the Tigris and Euphrates rivers which rise in the hill regions of Syria and Turkey and drain into the Persian Gulf. Closely following this crescent of hills which roughly bounds Iraq and the easterly regions of Syria and Jordan, are the 8"-16", 16"-24", 24"-40" isohyets (or rain lines). Thus the central region of Iraq, the alluvial plains of the Tigris-Euphrates, has in general an annual rainfall of less than 8". As a result present-day agriculture without irrigation is only practical in the crescent of hills which bound the plain on three sides. Braidwood suggests that the rainfall isohyets in the Near East have not changed their pattern to any significant extent since the close of the Pleistocene (1952:13). The areas suitable for agriculture without irrigation in the past would roughly coincide with those of today. However, the hilly region might have been slightly more favorable in former times in that probably tree cover was much more extensive, and erosion was not as widespread. As a result, the water table was probably higher and the soil retained more moisture.

Temperature fluctuations in the alluvial valley of Iraq are extreme, varying between 30°F in winter and 120°F in summer. The flood periods of the Tigris and Euphrates are not exactly predictable; they rise without warning and on variable dates. In addition, the rivers carry a large amount of sediment and a considerable amount of salt in solution. Consequently irrigation agriculture in the valley, at any period, would demand the use of a certain amount of skill in preventing excess flooding, keeping ditches open, and insuring sufficient drainage of the land.

Thus generally, two sorts of environmental variables may be distinguished; first, phenomena which fluctuate in seasonal or yearly cycles; and second, phenomena which vary gradually over extremely long periods of time. These may be called "short-run" and "long-run" variations respectively. It has often been argued that once a human population has become settled in a region in which long-run environmental changes are negligible, and has adapted its activities to the short-run variables, then the environment need no longer be

considered. This point of view fails to consider that human populations often change in response to other ecological variables, and thus their life requirements in a particular environment change over time. This, in effect, suggests that human populations often constantly re-adapt to a given environment. In southern Mesopotamia the life requirements of the first migrants to the area must have been quite different in many ways from those of the subsequent city dwellers.

The archaeological sequence in Iraq begins about 100,000 years ago with paleolithic hunting and gathering cave-sites in the northern Kurdish hills.² The latest "cave-stage" materials dated about 9000 B.C. come from a cave site called Palegawra. The animals hunted by the group at this site were wild but of modern type--sheep, goat, pig, gazelle, deer. The next available material comes from Karim Shahr in the same Kurdish hill region. This site is significant in that it represents: the first indication of open encampments in the area; the development of the pecking and grinding technique in the manufacture of stone artifacts--mortars and milling stones, beads, pendants, and bracelets; and the heavy reliance, as a source of food, on animals that were later domesticated. The proportion of bones of potentially domesticable animals was well over 50 percent. This and similar sites in the region are thought to have been occupied between 9000 and 7000 B.C.

The Jarmo site in the hill region east of the Tigris, marks a distinct change in the subsistence pattern of the region. It is a mound about three acres in area with twelve distinguishable levels of building renovation and change. The settlement is made up of permanent houses with mud walls and stone foundations. Portable pottery appears only in the upper levels, but baked in place floor basins which were probably used as storage containers occur throughout the sequence. Flint blades and microliths are present including sickle blades recognized by the characteristic sheen imparted by cutting vegetable material. Implements of obsidian indicate external trade since the closest source of obsidian is in Turkey to the northwest. There is a wide variety of ground stone ornaments and implements, and unbaked clay figurines are also present. There is evidence, from seed impressions, of the cultivation of barley, wheat and peas, and 95 percent of the bones found are those of sheep, goat, pig, and ox. Jarmo represents settled village life in the hill region where rainfall is sufficient for dry cultivation; it has been dated by the C14 method at approximately 6700 B.C., and is one of the earliest known agricultural sites. As yet no sites have been found in Iraq which can be called transitional from terminal hunting and gathering to settled agriculture.

Following Jarmo, two phases, Hassuna and Halaf (5700-5000 B.C.) are distinguished in northern Iraq on the basis of differences in pottery designs and techniques. The number of sites of both traditions indicate increasing spread of barbarian communities throughout the Near East. Pottery becomes very well finished although still made without the use of the wheel, flint tools diminish gradually in importance, and ground stone implements and ornaments increase both in number and variety. External trade increases; copper beads (probably of native copper) and shells from the Persian Gulf appear. There is also some evidence of intercommunal specialization; one excavated Halafian village, near Lake Van, was evidently primarily engaged in quarrying obsidian (Childe 1952:112). Significantly, no hint of fortifications have been found in this period (Adams 1955:9).

Ubaid, the next distinctive phase in the archaeological record, is widely distributed and marks the earliest known settlement of the flood plains of southern Mesopotamia (Sumer). The early settlers must have been faced with the formidable task of draining the swamps which likely extended for great distances from the main river channels.

With irrigated fields a more diversified diet was possible; vegetable and date cultivation which require more moisture, could supplement the traditional cereal crops; and fish from the rivers and canals also probably became an important food source. However, the alluvial plain is deficient in many other resources that were coming to be essential. Flint, obsidian, and copper do not occur in the region; consequently fired clay sickles and axes were often substituted for their stone and metal prototypes. The date palm is the only tree that flourishes in the area, and its wood and the ubiquitous marsh reeds replaced building materials that had been used in the northern area; thus reed huts became the prevalent dwelling unit. The phase is marked by the appearance of towns of some size and buildings made of moulded mud bricks which can only be temples. The time is around 4100 B.C.

By the end of the following two archaeological phases, Warka and the Protoliterate (Uruk and Jemdet Nasr, in the older terminology), community life in southern Mesopotamia displays a majority of the features of civilization. Technological developments abound; sailing boats, wheeled carts, plows, pottery wheels, cast copper implements, the use of writing, all appear at this time. Monumental temple architecture grew to impressive proportions. The latest temple of the previous Ubaid period, at Eridu, had been built on a raised platform and was approximately 75 by 40 feet; during the Protoliterate period the temple at Jemdet Nasr reached 300 by 150 feet on a platform or ziggurat 900 by 600 feet (Childe 1952:119, 134). Facing of temples with white limestone became common and must have resulted in most impressive buildings. The founding of totally new "urban" communities at this time and the expansion of formerly small communities indicates increasing population (Childe 1952; Adams 1955:11). Braidwood estimates that there were probably no more than twenty population centers occupied at any one time in Sumer during this period and they averaged around 17,000 inhabitants each (1957:29). Total population is thought not to have exceeded between 350,000 and 500,000. This is not an impressive number by modern standards, and most likely, the "urban" population included many of the farmers who tilled the surrounding fields which provided the community's food. There is even evidence that some fields remained within the town itself. However, the quantity and quality of craft products suggest that full time specialization had developed in many crafts. Practically all archaeological and written evidence seems to show that the temples and their officials occupied a dominant position in the direction of the affairs of the community; they owned large tracts of land under cultivation, hired bands of artisans, and probably directly controlled most foreign trade. Although there are artistic representations of battles, warrior-kings did not appear until the following dynastic period. According to Jacobsen, aside from loose "democratic" coalitions in times of crises, political control apparently fell to temple officials by default (cited by Adams 1955:12).

The following dynastic period began about 3200 B.C., and represents an intensification and elaboration of the developments of the previous periods.

No striking technological advances occur except the casting of bronze. The size of urban communities probably reached 30,000, but Adams states that the abandonment of some centers in this period probably indicates that population size did not absolutely increase to any extent (*ibid.*:13-14). He also remarks that since the whole era was marked by evidence of warfare, population had probably expanded to the limits the land that could be put under irrigation would support and what followed was a precarious balance between population and food resources. During the Dynastic period the palaces of warrior-kings rival the temples in size and magnificence, and fortifications become prominent features of the cities. The existence of large private houses along main thoroughfares, with the smaller residences crowded into back alleys, implies increasing social stratification at this time. There is also other evidence that private capital in trading and manufacturing began to compete with the still economically important temples.

Some Explanations of the Rise of Civilization

In summary, the argument thus far has been that the earliest populations of Homo sapiens were hunters and gatherers; it is probable that pressure of such a population on resources was, in the earliest periods, regulated primarily by migration into previously empty ecological niches, and only later, when most suitable regions were filled, by fluctuations in vital rates. The adoption of plant and animal domestication facilitated, first a more intensive utilization of resources within a given area by increased populations, and second colonization of increasingly wider regions at the expense of the previous hunting and gathering occupants. The subsequent appearance of civilization implies new organizational patterns. This in turn suggests the possibility that occupational and territorial differentiation increased in importance as a resolution of population pressure.

As mentioned previously, the aspect of chief concern here in the development of civilization is the marked increase of differentiation. At least three sorts can be distinguished: territorial differentiation between communities in goods produced; occupational differentiation within communities; and hierarchical differentiation within or between communities with respect to authority, power and prestige. These divisions are not mutually exclusive in actual situations, but for purposes of analysis will be treated separately as far as possible.

Most students of the rise of civilization begin by observing that extensive occupational differentiation involves the support of artisans, traders, and other specialists not directly engaged in food production, by the quantity of food over and above what is consumed by those directly engaged in its production. It has been inferred from this by some that, before differentiation developed to any extent in a society, each individual food producer could and did produce approximately the same amount as did each individual food producer in the period after extensive differentiation had appeared. From this sort of assumption it is possible to conceive the prior existence of large food surpluses, per se, as the primary explanatory factor in the appearance of differentiation. But that such a state of affairs ever existed can not be demonstrated readily from ethnological or archaeological evidence. The "surplus" explanation adopts a very over-simplified view of the interrelationship between population, technology and organization.

This is not meant to deny the possibility that in many societies individuals or groups, whatever the units of production and consumption may be, have a fairly wide choice in the disposition of what is produced. Income can be directly consumed or part of it invested as technological capital, human capital (more children), supernatural capital (control by magic) and so on. The point to be stressed is that the range of possible choice in this disposition varies widely from society to society. In broad terms a distinction can be made between societies on this basis; first, those in which the given combination of factors of environment, technology, population, and organization result in extremely narrow choices in kind and amount of investment in productive activities with a consequent long-term stable equilibrium at a low level of development; secondly, those societies in which the combination of ecological factors permits wider investment possibilities and as a result growth and development are established. It is the latter type of society which is of interest here and the first problem to be investigated is the conditions which permit the concentration of capital resources, to begin with, primarily in the form of food, in amounts which would be effective in instituting new activities. From this, it should then be possible to suggest how differentiation is elaborated.

Four factors have been considered important in the prehistoric concentration of social capital; broadly speaking, they are: trade, religion, warfare, and irrigation. Following the intentions stated earlier each of these factors will be analyzed in terms of what has been called here the "ecological complex." It should be pointed out that analyses of this kind must begin at some rather arbitrary point. Thus it is assumed here that in the initial phases of the developmental sequence to civilization, at least some rudimentary differentiation was present. In short, no attempt will be made to explain the first appearance of priests, warriors, traders, and so on. Only their increasing importance in the community is considered.

1. Trade clearly existed to some extent among the communities practicing dry cultivation in northern Mesopotamia. After the movement to southern Mesopotamia, trade with regions outside this new environment became essential since raw materials such as flint, timber and copper are non-existent in the alluvial plain. Increasing population, which resulted from the relative efficiency of agriculture in the new environment, would of course increase the demand for goods not found in river valleys. Finally technological improvements in transportation would permit trade to be carried on in increasingly wider areas, and other improvements in handling and storage of goods would permit a wider range in the articles of trade.

The direct and obvious organizational results of these conditions are increased accumulation of wealth (profits) in the hands of traders and probably an increase in the number engaged in trade. Several possible consequences of this situation are of interest. First, perhaps most directly, such increases in trade would tend to encourage and increase territorial differentiation. Second, increased wealth of traders would tend to increase hierarchical stratification within the community. Finally, increased inter-community communication which is a direct result of trading activity would enable merchants to recognize new opportunities. Since they had probably also accumulated the means to initiate appropriate new enterprises in addition to expanding traditional ones, a necessary condition for division of labor within a community was present.

2. Religion, according to present evidence, has always been an important factor in human activity. In an arid region where agriculture is completely dependent upon irrigation, knowledge of fluctuations in the annual cycle of water supply is extremely important. Religious officials, as well as attempting to insure an adequate quantity of water by various means, supernatural and otherwise, could be expected to provide supernatural and natural predictions concerning the phases of the annual cycle. With increases in population the total amount contributed to the support of religious organizations for these and other services would increase and thus their wealth and number would almost certainly grow. In addition to an established widespread control of certain necessary supernatural and natural techniques connected with agriculture, it is likely that religious specialists would be favored with leisure to investigate and experiment with new techniques in many fields. Their position as technological innovators would serve to increase their wealth in two ways. They or their gods could be paid directly for their services, especially to agricultural production, as has been mentioned. Second, the religious organization itself may also have been an economic unit in the community in the sense that a certain proportion of the fields were cultivated for the deity under the direct supervision of his officials. In this second case the economic activities of the religious organization would benefit directly from the application of advanced techniques and knowledge and since its economic activities in general would be more functionally specific than the activities of other economic units of primary agricultural production, such as the extended or nuclear family, its wealth would grow as a result of this differential efficiency. In addition, the religious organization might be expected to have a greater stability through time than other food producing units at this period.

The direct organizational results that could be expected under these ecological conditions are similar to those suggested for trade activities; increased accumulation of wealth and perhaps to some extent an increase in the number of religious institutions. The concentration of wealth by religious bodies likely would result in greater stratification within the community and possibly a tendency to centralization of deities and their priests in one community. The demands of the gods can be virtually inexhaustible. The knowledge obtained by relationships with wider areas (through trade for instance) opens up demand for exotic building materials, precious stones and shells, and so on. Increases in wealth are essential to the realization of these demands, and provide again a necessary condition for division of labor within the community.

3. Warfare, raids and other sorts of organized aggression are widespread throughout history and prehistory. In a flat arid region which depends on river irrigation, conflicts between communities over water rights are inevitable. The terrain tends to encourage, in offensive maneuvers, the rapid movement of large armies, and defensively, the construction of elaborate fortifications around concentrated settlements. Population increases tend to result in conflicts over land, and at the same time make possible larger armies for both offense and defense. These large populations, if concentrated in towns, would require increasingly elaborate defensive measures against external invasion. Technological innovations such as weapons of metal made aggression against more backward groups potentially profitable and new methods of transportation increased the area in which such aggression was possible. At the same time, innovations in building materials, the use of bricks and quarried stone, would increase the efficiency of defensive measures.

The direct organizational results of successful aggression under such circumstances probably would be the concentration of the spoils of war in the hands of military leaders and the possible establishment, perhaps only temporarily, of an area-wide hierarchy of communities. The necessity of increasingly elaborate defensive organization would again require concentration of resources under the control of some sort of military oligarchy, and lead to some extent to stratification within the community. War, defensive or offensive, requires soldiers; however, it is difficult to estimate the size and duration of operations in which full-time soldiers would be advantageous or necessary. Organized armies also require the products of metalsmiths, masons, armorers, carpenters, and so on. Here again unless they can be obtained by force some concentration of capital is requisite to the attainment of an adequate supply of these necessities.

4. Irrigation is the basis of intensive food production in arid areas. In areas such as Mesopotamia where sizable rivers flow through arid regions, large tracts can be cultivated. But the construction of dykes, irrigation canals and ditches, the removal of accumulated silt, and the allotment of water within the system requires much effort and careful planning and coordination. With small farming communities spread out thinly along the banks of the main water source the effort to plan, build and maintain the system could be readily provided on the basis of informal cooperation. Over time, as population increased, communities not only grew in size but multiplied in number and larger canals became necessary to direct water to new village sites farther removed from the main channels. As the irrigation system in a given region became more elaborate, the coordination of building and maintenance activities would become more elaborate. Central administration would become essential for further growth. Technological aspects of an irrigation system could probably be most efficiently applied by a centralized authority. More efficient distribution of canals, improvements in construction of dykes, techniques to combat silting of canals and salting of the soil, better water storage basins, all may be considered advantages that could be widely and rapidly adopted in an irrigation system with such coordination.

Centralized coordination of a system is likely to require enforceable decisions as to water allocation in times of shortage. If other features of the system of community organization make such decisions possible when required, there is reason to believe that there will be increasing control of the land itself and disposition of the harvest by the central authority. Thus as in the other factors there would be a tendency towards increased concentration of food resources in the hands of a few, again directly resulting in a trend toward social stratification on the basis of wealth. This concentration of wealth in turn can be considered as a prerequisite for the acquisition of goods and services of an increasingly specialized nature which come to be essential to the operation of the irrigation system.

From what has been said about these four factors it might appear that each one stands alone as a single sufficient condition for the concentration of food and other resources as developmental capital. But it is not evident that any one of them can be established as such a condition in empirical investigation of an archaeological nature. In any excavation, evidence of the simultaneous presence of several of these factors appears. This difficulty

can be overcome in part by assuming, to begin with, that none of these factors or any similar one, is by itself a sufficient explanation of the accumulation of resources for expansion. Therefore they must be considered to be inter-related at any given time. If this is the case, then all that can be said is that very few attempts have been made to analyze the interrelationship of the factors, and until this is done any hypothesis as to their individual importance can not be tested adequately. In fact it would probably be a life's work to formulate the problem in a manageable way. However, in the meantime the possibilities suggested here must be used as they stand with no further apologies.

In the above exposition the influence of population, environmental, and technological conditions on these four activities has been emphasized. Obviously, in turn, the effects of trade, warfare, religion, and irrigation on the ecological variables also could be outlined. But at this point the wide variety of possible effects should be apparent and only one will be briefly noted in addition to the consequences for organization mentioned above. That is the tendency that all four of these factors must have had to increase concentration or density of settlement pattern. The reasons for increasing density are fairly obvious. External trade usually involves transshipment points at strategic locations and population would tend to cluster around these centers. Again, the establishment of permanent markets, in internal trade, would encourage increased permanent settlement around them. Religious organizations, if successful in the fulfillment of claims of control of the outcome of events, could influence the settlement of increasing numbers within their jurisdiction. The advantages of concentrated settlement for defense are clear; the smaller the area in which the total population is distributed, the smaller and more manageable the ramparts. Finally, the efficient distribution of water in an irrigation system (shorter canals, less water loss, less maintenance, and so on) also encourages dense settlement of land.

So far, possible explanations of the concentration of resources have been presented. An effort has been made to show that a pre-existing authority possessing ultimate sanctions which forcibly wrests from each individual food producer a portion of his production is not the only sort of organization which may make concentration possible. The factors which might have influenced the growth of territorial differentiation and hierarchical stratification within the community have been mentioned very briefly. The central problem remains; the growth of division of labor within the community.

Durkheim conceived of the division of labor as an alternative resolution of the competition for resources in human populations. If this is accepted as a legitimate explanation of the rise of occupational differentiation, the question of major importance then becomes: how did this sort of differentiation in part replace fluctuations in vital rates as a resolution of competition in human populations?

First, Durkheim's analysis must be examined further. Differentiation, he claimed, occurs only when there is an increase in social interaction as well as an increase in population size. It is not difficult to grasp the importance of population size in the division of labor. The most basic competition in human populations, as in other animal populations, is for food.

Differentiation within a community of a given size can not decrease directly the demands for food; on the other hand, it can only serve to increase the supply of food if the productive unit is of such a population size that specialization within production activities will in fact be more efficient than non-specialization in terms of food output. However Durkheim criticized the view of Spencer that differentiation was simply a necessary consequence of absolute increase in population size alone. China and Russia, he pointed out, have very large populations but differentiation remains slight as compared to countries of western Europe. What then is the importance of social interaction in the division of labor? It is only in a context of growing social interaction that individuals become increasingly aware of alternative occupational opportunities and act upon this knowledge. If the factors of population size and social interaction are combined, it becomes clear that the variable which is of primary importance in a comparative analysis is the size of the population unit which interacts in the allocation of resources. In actual situations the size of the unit will most likely vary to some extent depending on the particular resource or set of resources in question.

It is now possible to apply this analysis to the major problem of concern here. Four general categories of activities which could lead to the concentration of resources have been discussed. There is evidence of a growing demand for goods and services of full-time specialists. A remaining aspect of the problem, then, involves investigation of how the growing demand could be satisfied. To begin with, two hypothetical types of community will be analyzed in terms of population size and social interaction.

Type 1. In this situation population is dispersed, interaction is at a minimum, and land is limited.

Case A. If each producer resembles all others and there develops acute competition for food resources with increases in population and no improvement in technology, competition will be resolved by fluctuations in vital rates.

Case B. If in this same sort of hypothetical situation, it is postulated that production technology improves for all producers in approximately direct proportion to the rate of population growth, there will be no increase in competition for food and the community in theory will expand indefinitely.

Case C. If in this community it is supposed that technology is again fixed, but there is a differential in productivity between units, competition for resources will still be resolved by fluctuations in vital rates, for since there is little interaction there will be no recognition by members of less productive units of alternative opportunities in or in relation to the more productive units.

Type 2. In this situation population is concentrated, social interaction is at a high level, and land is limited.

Case A. If each producer resembles all others, and the level of technology is fixed, there will develop acute competition for food resources with increased population and it will be resolved by fluctuations in vital rates.

Case B. If it is postulated as in Case 1B that technology improves directly with increase in population, then the same results will occur as in 1B.

Case C. Finally, if technology is fixed and other conditions are the same as in Case 1C, competition for resources could be resolved at least in part by movement of people from the less productive units and the establishment of new social and economic relationships with the more productive units, because with increased interaction there is recognition of alternative opportunities for gaining a living.

These simple models have been outlined in an attempt to reconstruct in the most general sense conditions which would make it possible for certain agricultural workers to seek alternative occupations in the growing towns in these early civilizations. Most simply stated the explanation is this: Certain factors probably resulted in differential accumulation of food resources within these early communities. At the same time population pressure increased competition for food among some segments of the community. This competition in turn would be interpreted by those involved as primarily status or occupational competition. Other factors, in part technological developments, resulted in increased social interaction. As a result of this increased interaction some members of those segments of the society in which competition was high, would become aware of alternative occupational opportunities in connection with the satisfaction of the new demands which were arising with the accumulation and concentration of resources.

Of course conditions in real situations do not remain conveniently constant. Technology did improve and land under cultivation did expand. However there is sound evidence that population also expanded and the question, which incidentally can not be answered directly by archaeological investigation, is whether or not most everyone was well fed during most of these developments. If in spite of expanding populations there was, from the beginning periods of the development of civilization, "surplus food" produced by all those engaged in agriculture (in this instance virtually everyone since differentiation had not yet developed to any extent) then competition for the means of subsistence would be non-existent and some other explanation of the factors determining differentiation would have to be found.

The Archaeological Evidence

It is perhaps suggestive and worthwhile to review the appearance of these factors connected with differentiation in other regions besides Mesopotamia. In order even to approach any sort of verification of the significance of these factors we must first have relatively complete and detailed evidence of the sequence from barbarism to civilization. The sequence in Mesopotamia is the most complete in this respect. What of the other regions of early civilization?

In China the present evidence is so incomplete that this case will not be considered. In the Indus Valley present archaeological evidence shows no transition to civilization from barbarian communities (Piggott 1950:139-140). In Egypt, peculiarities of archaeological goals have resulted almost exclusively in the excavation of burials. Actually, the emphasis on burials from

areas that were actually outlying regions in dynastic times is also conditioned by the fact that the alluvial valley of the Nile is today 20 feet higher than it was then, and as a result, the main settlements on the Nile cannot even be located accurately. Thus, here too the sequence is not as adequate as in Mesopotamia. As for the New World, in Peru, only the sequence of the northern coastal plain is reasonably complete. In Mesoamerica only the beginnings have been made on the organization of the data on the sequence to civilization. Lack of data from China and lack of adequate organization of the features of interest here in Mesoamerica will regrettably result in their omission from this brief comparative approach.

The occurrence of trade, warfare, elaborate religious organization, and irrigation will be compared then, only in the Indus Valley, Egypt, Mesopotamia and Peru.

The Mesopotamian sequence has been outlined in some detail, but to recapitulate briefly, there is little trade in the Ubaid period, and temples are small and the existence of warfare has not been established. In the Warka and Protoliterate phases, trade expands rapidly, temples become large and the first signs of warfare appear. In the Dynastic period, trade becomes extensive, temples grow to relatively large proportions and warfare becomes endemic to Mesopotamia. In order to make a tabular comparison, the phases Ubaid; Warka-Protoliterate; and Dynastic will be considered as development stages and assigned the letters A, B and C respectively. The developmental stages in the other regions are then arranged to coincide roughly with the Mesopotamian pattern. A qualitative estimate of the presence and extent of the conditions or factors can then be plotted. It must be remembered that the tables only roughly equate corresponding developmental phases in the various areas and are not meant to indicate absolute dates for the beginnings of the sequences nor the temporal duration of any single period.

From these tables, in spite of the obvious gaps in knowledge, it is perhaps reasonable to observe that during phase A the presence of the conditions is variable; in phase B the conditions are more consistently present, and in phase C all are present. From this sort of evidence it would be quite arbitrary to conclude of course what phenomena are to be considered as causes and what phenomena are to be considered as effects. Finally another problem is apparent. In connection with this table it must be remembered that such terms as "extensive," "prevalent," "expanding," and so on, are almost completely impressionistic. This, of course, is not to say that they are therefore invalid, but they do not in this form contribute very much to an attempt to ascertain how much trade, what kind of warfare, or which religious beliefs and rituals are necessary for the accumulation of capital goods.

Trade (Fig. 1)

The table presented here primarily indicates extent of external trade. Evidence of this kind of trade is relatively easy to secure in a given site and often the area from which the raw materials or trade goods came can be determined accurately. In all the sequences listed, trade increases substantially in each succeeding phase. The growth trend in this activity is one of the most consistent features of each sequence. The general tendency toward

centralized control of external trade especially by religious officials suggests how closely the factors described in these tables are interrelated.

Figure 1
Presence of Trade in Four Areas of Early Civilization

Period	Mesopotamia	Indus	Egypt	Peru
C	extensive trade	extensive trade	extensive trade	extensive trade
B	expanding trade	No sites known for this period	trade present	expanding trade
A	limited trade	Baluchistan limited trade	trade present	limited trade

Trade in Mesopotamia has been discussed previously. It is only necessary to mention here that external trade was probably carried on almost exclusively by the agents of the temple up to the end of phase B (Warka-Protoliterate). During phase C, where decipherable records are available, private merchants appear although temple trade was still prevalent.

The material listed for the Indus civilization does not represent a completely indigenous sequence in the valley of the Indus. However, trade in copper and lithic materials was present in what Piggott calls the Bronze Age peasant communities of Baluchistan (listed in the tables as phase A in the Indus sequence). There is evidence that trade was centrally controlled in phase C in the cities of the Indus valley itself, and trade outposts were established at that time in the peasant communities of Baluchistan. Environmental, population, and technological conditions here are quite similar to those in Mesopotamia.

Again in Egypt the ecological conditions are quite similar to those in Mesopotamia. Evidence of trade appears in the earliest sites of the Egyptian sequence. Constant growth of trade throughout the developmental sequence presented in the tables is well documented (Childe 1952:43, 65, 89). In the later periods all external trade of any importance was apparently directly controlled by representatives of the Pharaoh, the god-king.

For Peru, the development represented is that of the northern coastal plain. Here civilization appears along the river valleys which cut across the desert plain from the Andes to the Pacific. These valleys are small when compared with those of the Old World, but environmental conditions are similar within the valleys to the conditions in the valleys of the Indus, Nile and Tigris-Euphrates. Here too external trade seems to have gradually become a monopoly of the central authority. It is significant that wheeled vehicles were never developed in Peru. However, an extensive system of roads was developed (Willey 1953:361-371) and balsa rafts were used in intercoastal trade.

Religion (Fig. 2)

The universal index of extent of religious influence used in archaeological investigations is the size and elaboration of religious structures--pyramids, temples, and the like. The chart indicates that monumental religious structures are not common to all the sequences in phase A. By phase C religious architecture reaches massive proportions in all the areas except Peru, where religious monuments had declined from their maximum size in the preceding period. The environmental features of the various regions reviewed here make wide contacts with regions outside the river valleys essential in order to obtain the exotic materials which come to be thought essential for the adornment of these edifices. The extent of theocratic rule seems to vary from one period to another within a sequence and from one sequence to another. In Mesopotamia, the power of the temples was greatest in phase B and declined thereafter, giving way to the power of a secular king. In Egypt the Pharaoh was both king and god but did not become firmly established over all of Egypt until Dynastic times. Before the unification of the Upper and Lower Kingdoms local priest kings were probably the dominant political as well as religious figures. In Peru priest-kings appear in what is here called phase B as rulers of valley-states. This form of control remained dominant until the time of the conquest when one priest-king controlled the whole Peruvian Empire. The exact nature of religious influence is not known in Indus civilization. There are no large religious structures known from what is called here phase A, and the function of the larger public buildings in phase C is not certain.

Figure 2

Presence of Religious Structures in Four Areas of Early Civilization

Period	Mesopotamia	Indus	Egypt	Peru
C	large temples ziggurats	citadels thought to have religious functions	temples large pyramids	small pyramids
B	temples ziggurats	No sites known for this period	large tombs	large pyramids
A	small temples platforms	Baluchistan no religious structures known	no religious structures known	temples

Warfare (Fig. 3)

Generally, extent of fortifications and quantity of weapons are used as indicators of warfare. Although the table suggests that warfare was present in the early stages of three sequences, it is difficult to draw definite

conclusions as to its extent and importance. Since many of the tools of the hunt are also used as tools of war, without independent evidence in the form of fortifications, conclusions must remain tenuous. There are illustrations of combat in some of the early materials from Egypt. In the Indus and Peruvian sequences, fortifications appear in phase A, but there is very little known about the general prevalence of these structures. Evidence of warfare is completely absent from the earliest phase in southern Mesopotamia.

The trend in warfare is at least superficially similar in all the areas and will not be examined in any detail. Warfare in these regions usually first appears as localized conflicts between individual population centers. Gradually as certain groups become successful in these ventures, conquest states arose. The subsequent history of these states is marked by recurring periods of military ascendancy and decline.

Figure 3
Presence of Warfare in Four Areas of Early Civilization

Period	Mesopotamia	Indus	Egypt	Peru
C	warfare prevalent	warfare prevalent	warfare prevalent	warfare prevalent
B	warfare present	No sites known for this period	warfare present	warfare present
A	No evidence of warfare	Baluchistan warfare present (based on a few fortified sites)	warfare present (based on illustrations of combat)	warfare present (late sites of this period are fortified)

Irrigation (Fig. 4)

Three fairly distinct stages can be distinguished in the development of an irrigation system in an alluvial plain such as that of the Tigris-Euphrates. In the first stage, "local" irrigation, water is supplied directly from the river to the fields of one community only. This phase involves no need of solidarity and cooperation beyond the local community. The engineering skills needed do not require specialists. An "intermediate" irrigation system links the fields of a number of local communities in a given area. It arises out of local irrigation in an area of flat land and large water supply. At this stage irrigation skill must be more highly developed. Finally, in a "regional" irrigation system a river valley of great size and low slope is encompassed. This stage arises out of the consolidation of a number of intermediate systems. Major canals and numerous subsidiary canals are needed. Specialized engineering techniques are demanded in this sort of system, for silting and drainage become a major problem and thus centralized control is necessary.

Figure 4

Presence of Irrigation in Four Areas of Early Civilization

Period	Mesopotamia	Indus	Egypt	Peru
C	intermediate (possibly regional)	no evidence of irrigation	basin irrigation	regional
B	intermediate	No sites known for this period	no evidence available	regional
A	local? (no direct evidence)	Material used in other tables based on sites outside the Indus valley	no evidence available	intermediate (late) local?

If a river valley is to be utilized to its full potential an organization of the third type is required. If, however, centralized control is not required until this third stage then water control is not a condition for civilization in Mesopotamia. The extent of irrigation systems in southern Mesopotamia, where the first sites representative of civilization appear, is not known, but in northern Mesopotamia where urban sites appear slightly later, irrigation was not established until 500 to 300 B.C. (Jacobsen and Adams 1958: 1256).

The prodigious quantities of fired bricks in the sites from the Indus suggest an extensive tree cover of the area at the time and in turn probably indicates a climate in which elaborate irrigation was not necessary. Careful archaeological search has failed to uncover any evidence of canals.

Basin irrigation in Egypt is of interest in this respect. The peak of the Nile flood is in September after the heat of the summer. A crop can be planted in the mud after the water has subsided and in the cool late fall growing season no further irrigation is needed. Flood waters rise gradually over an extended period, July to mid-September, and cover the valley from desert edge to desert edge (Drower 1954:535-539). A simple checkerboard system of dykes serves to regulate the gradual rise of water with great precision and from current practice of the system in Upper Egypt, it would seem that although some planning and cooperation is required in the building of dykes, no centralized control is necessary. The first evidence for dykes comes from the Protodynastic period about 3000 B.C. Archaeological indications of earlier dykes would be difficult to obtain because the plain of the Nile has been built up some 20 feet since that time.

The archaeological sequence from the Viru valley of the northern coastal area of Peru demonstrates inter and intra valley irrigation systems, but it must be remembered that the valleys in this region are small in comparison with those in the Old World centers. In prehistoric times it is estimated

that irrigated land was double that of today (Willey 1953:361-371). However, it is difficult to determine precisely the size of irrigation systems in the early periods and little information is available on such problems as regularity of water supply, gradients, volume of water, extent of salting and silting, and so forth.

Conclusion

This paper has attempted to investigate some of the ecological conditions in the growth of differentiation in the regions in which civilized society first appeared. In fact only one aspect of differentiation, division of labor, has been treated in any detail. In summary the argument has been that patterns of activity, present in types of community organization which preceded the appearance of civilization, increased in intensity and magnitude under certain ecological conditions. The result, it is postulated, was a tendency toward concentration of wealth in one or a few segments of the community. Further, some of the same conditions which encouraged this concentration of wealth also led to increasing concentration of people in densely populated towns or "cities." In this situation, differentiation with respect to division of labor was made possible because increased social interaction permitted recognition of alternative occupational opportunities by those members of the community among whom competition for food was keen and who had traditionally depended on agricultural pursuits for subsistence.

It should be noted in this connection that although differentiation is held to reduce competition, other aspects of the ecological complex may tend to produce just the opposite effect. Thus once established the phenomenon of differential accumulation of wealth within a community would not only tend to encourage further differentiation but also tend to positively increase the differences in distribution of goods. In effect, this might be called a situation of positive feedback: accumulation of wealth in some segments of society → increased competition in other segments → increased differentiation → a resulting increased efficiency in those segments making use of the advantages of differentiation → further accumulation of wealth in the originally favored segments of society. In simple terms, the rich get richer and the poor get poorer. This sort of result also serves to account in part for increasing social stratification. In such early communities in which energy is almost exclusively obtained from organic sources, plants and animals, wealth in foodstuffs is literally "power."

The charts presented in this paper have been used in an attempt to give a brief summary of the occurrence of some of the factors which are generally conceded to encourage accumulation of wealth. In spite of great gaps in knowledge, it is reasonably clear that these factors become intimately linked with one another in the social matrix of the society as it expands and develops.

However, present archaeological evidence is of little help in determining whether or not the concept of competition is not only a useful working postulate (at present, one among several alternatives) but also directly applicable to a state of affairs which actually exists or formerly existed. It seems reasonable, then, to conclude with some suggestions for further research on this question.

The primary need is for careful comparative study of contemporary communities which practice irrigation agriculture on a scale similar to that thought to have been used at different periods in the early civilizations. Special emphasis would have to be placed on matters of fluctuation in water supply, amount of maintenance necessary, and man-to-land ratio. Demographic and production figures would permit some comparison with estimates of population for the centers of civilization at various periods. Such data would also permit correlations of organizational features with per capita output of the agricultural systems involved. From these comparative ethnological studies it would be possible, perhaps, to estimate the level of subsistence maintained by such communities and the possibilities present in them for internal growth and development. In short, analysis of the factors which inhibit or encourage expansion in current simple, relatively independent, communities based on irrigation agriculture would be expected to throw some additional light on events in the past that led to civilization.

With respect to archaeological investigations, one of the primary gaps apparent in existing knowledge is the lack of anything but very impressionistic estimates of the magnitude of most of the phenomena discussed in this paper. In the case of warfare this could probably never be changed. In the case of such activities as irrigation and trade, as mentioned above, more use could be made of the same phenomena in existing societies. A similar recommendation could be made with respect to studies of population and settlement patterns but in these areas many excellent beginnings have been made on specific regions but very few works of general synthesis of such materials are available.

ENDNOTES

1. Grateful acknowledgment is made to Leo Schnore who first stimulated my interests in human ecology and to René Millon. Both gave me valuable suggestions and criticisms in the preparation of the present version of this paper.
2. This outline is based primarily on Adams (1955), Braidwood (1952, 1957) and Childe (1951, 1952, 1954a). The dates for the early part of the sequence follow Braidwood and Howe (1960:155-162).

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