Archaeology and ecology

Bruce Trigger

Historical survey

Prehistoric archaeology began to develop in the first half of the last century with the realization that a coherent study of the past could be based on archaeological data alone. Since that time, archaeologists have engaged in a continuing search for theories and techniques that will permit them to wrest as complete an understanding of human behaviour as possible from their data. Yet, in spite of these ambitions, archaeologists habitually have been apologetic about the nature of their data, which, they have generally agreed, are more limited in scope and more difficult to interpret than are those used by historians and ethnologists. It is not surprising that much of the theorizing in archaeology has been concerned with stratagems which, it was hoped, would maximise the output of archaeological data and permit archaeology to compete on a more equal footing with the other social sciences. These stratagems sometimes have led archaeology astray and to some extent continue to do so.

The earliest of these stratagems reflects the important role played by the concept of *unilineal evolution* in the last century. At that time, it was widely maintained that all societies evolved in a fixed sequence; the only variable and apparently unpredictable feature being the rate of development, which differed among cultures. Less advanced societies that survived to the present were viewed as examples of stages which the more advanced societies had outgrown. All present-day cultures were arranged in a single continuum from simplest to most complex, and this continuum was assumed to represent all but possibly the very primitive stages through which the most advanced cultures had developed. The strictly archaeological aspect of interpreting archaeological data was thus limited to determining the level of sociocultural development particular artefact assemblages had reached; the rest was no more than an exercise in applied ethnography (Clark 1957: 170–2; Daniel 1968a; 1968b: 57–63).

With declining interest in unilineal evolution, the concept of cultural *diffusion* quickly gained in importance. Although the early diffusionists frequently were rigorous in their methodology and paid much more attention to the formal properties of artefacts than their predecessors had done, they were no more interested in studying artefacts as parts of a cultural system than the latter had been. Instead, they concentrated on tracing the origin and spread of specific types of artefacts (Montelius 1899; Childe 1925). Yet long before matters were carried to an untenable extreme in the hyperdiffusionary theorizings of ethnologists such as G. Elliot Smith and W. J. Perry, most archaeologists were at

least vaguely aware that the concept had limited explanatory potential. Above all, it was realized that in order to be able to explain why diffusion had occurred, the archaeologist needed to understand the nature of the recipient culture (Trigger 1968: 528–9). Attempts to acquire such knowledge led British archaeologists to develop two approaches, both of which were concerned with adaptive features of individual cultures and therefore were, at least implicitly, ecological. This encouraged the development of a functional and systemic view of culture in place of the early diffusionist 'bits-and-pieces' interpretation.

The first and more rudimentary approach was a geographical one, which became popular in Britain through the cartographic work of O.G.S. Crawford (1921) and H. L. Fleure's and W. E. Whitehouse's (1916) studies of prehistoric distributions of population in Wales. While often criticized for being overly deterministic, Cyril Fox's work (1923, 1932) established beyond doubt the value of a geographical approach to prehistory.

The second, and more important, result of a growing interest in adaptation was the development of what Grahame Clark (1953) has called the 'economic approach' to the study of prehistory. This approach led to a complete restructuring of the goals and general orientation of British archaeology and has provided the foundations for modern archaeological interpretation. While concepts borrowed from ecology played an important role in the development of this approach, their main effect was to increase the interest of archaeologists in the empirical study and comparison of individual archaeological cultures. The result was the formulation of an implicitly functional approach to the study of prehistoric cultures, within which interest was to remain largely focused on the economic sector. Site reports such as Star Carr (Clark 1954) and synthetic studies such as *Prehistoric Europe: the Economic Basis* (Clark 1952) illustrate the success of this approach.

Growing interest in adaptation encouraged archaeologists to collect data that permitted a far more detailed reconstruction and interpretation of the economic basis of individual prehistoric cultures than had been attempted hitherto. From the 1920s on, increasing attention was paid to plant and animal remains in archaeological sites with a view to reconstructing patterns of subsistence. Artefacts took on new significance as elements within systems of production and distribution. Archaeologists had to forge closer links with palaeoecology and to develop, or adopt, an imposing array of techniques for eliciting new information from their data (Biek 1963; Brothwell and Higgs 1963; Cornwall 1958; Dimbleby 1967; Hodges 1964; Rosenfeld 1965; Semenov 1964). More specialized techniques for recovering data also had to be developed and this encouraged even greater attention to detail in excavation of sites.

As a result of these developments, archaeologists gained confidence in their ability to use archaeological data to reconstruct and interpret the economic patterns of individual prehistoric cultures. On the other hand, they grew generally less optimistic about how much could be inferred about the social, intellectual and spiritual life of prehistoric cultures (Childe 1951: 55). Christopher Hawkes (1954: 161–2) was expressing a widely-held view when he argued that the techniques which produce artefacts were easy to infer to, subsistence-economics fairly easy, social/political institutions considerably harder and religious institutions and spiritual life the hardest inferences of all.

Nevertheless, a theoretical justification for this approach was evolved, which served to minimize the significance of the seeming weakness of archaeological data for reconstructing social customs and beliefs. It was argued that economic institutions played a

leading role in any culture and determined, at least in a general way, the social structure and value systems that were associated with it. The materialist view that was implicit in this corresponded in a general way with much of the thinking of the time and, in particular, with Marxist theory, which Childe (1936; 1942; 1946) proclaimed was the basis of several of his own highly influential interpretations of archaeological data. Progress had been made, however, in two directions. First, instead of the whole culture being treated in this way, only its non-economic aspects were. Secondly, archaeologists generally regarded reconstructions of this sort as being far more tentative and speculative than their predecessors had done. On the whole, the idea was rejected that broad general theories could be used to predict in detail the nature of specific cultures.

The American systemic approach

It was to be expected that as the interpretation of prehistoric economic patterns grew increasingly routine, enterprising archaeologists would seek to devise methods to study the apparently less tractable aspects of prehistoric cultures. It is perhaps no accident that the first explicit demand to move in this direction was made in the United States, where archaeological methods lagged behind those in Britain and where the close academic ties that had bound archaeology and ethnology together during the period when unilineal evolutionary theory was in the ascendant had never been dissolved. A concern to justify and strengthen this association appears to account, at least in part, for the unprecedented outpouring of programmatic statements there during the past decade (Binford and Binford 1968; Chang 1967; 1968; Deetz 1967; Willey and Phillips 1958).

The initial step in this direction was the publication of Walter W. Taylor's (1948) *A Study of Archeology*. This book was a much-deserved reaction against the prolonged survival in American archaeology of an interest in identifying culture units, working out local chronologies and tracing external cultural connections, much in the spirit of the early diffusionists. Taylor attacked the neglect of non-material aspects of culture and the failure of archaeologists to consider artefacts in a functional context. Yet, instead of advocating that Americans adopt the British approach, Taylor argued that they should view their artefacts as products of total cultural systems and attempt to reconstruct these systems, at least in general outline. The functionalism that Taylor was advocating, differed from that of the British by being much more explicit and seeking to embrace as much of culture as possible. Taylor was attempting, in effect, to introduce into archaeology a view of culture broadly similar to that which Malinowski had advocated for studying contemporary peoples.

Taylor argued that archaeologists should strive to create conditions in which archaeological and ethnographic information could be used for the same purpose; to generalize about the nature and working of culture. The very different nature of the two kinds of data was not seen as an obstacle to archaeology and ethnology sharing common goals and constituting homologous branches of a single discipline. Taylor's point of view was adopted by Willey and Phillips (1958), who paraphrased Maitland's famous dictum with the statement that 'American archaeology is anthropology or it is nothing' (p. 2). Later, L. R. Binford (1962) challenged the assumption that most of the information to be derived from archaeological data concerns technological and economic matters. He

argued that artefacts must be viewed as products of total cultural systems, which, in turn, are made up of functionally interrelated subsystems. Especially when viewed in its archaeological context, every artefact may provide information, not only about the economy, but also about the social structure, aesthetic concepts and religious beliefs of its makers (and/or users). Binford suggested that the unequal amount of information that archaeological data shed on various aspects of culture may result not so much from the nature of the data, as from the failure of archaeologists to develop adequate interpretational skills. This is perhaps a somewhat polemical position, but is undeniably an antidote against naïve complacency!

On a programmatic level, Taylor's approach has had far-reaching impact. There is widespread agreement that artefacts must be studied as products, and therefore as reflections, of cultural systems. There is also growing interest in developing techniques to elicit new kinds of information from archaeological data; particularly concerning social (and to a lesser degree political) structures. Much more attention is now being paid to the micro-distribution of artefacts within individual sites in the hope that these distributions will shed light on the social behaviour of the people who made or used these artefacts (Hill 1966; 1968; Longacre 1968). Related to this is an increasing concern with settlement patterns, which are viewed as the fossilized stage on which social action has taken place (Chang 1958; 1962; 1968; Trigger 1965: 2). Multivariant analysis of stylistic variation, along lines pioneered by James Deetz (1965), has helped to shed valuable light on prehistoric residence patterns, although archaeologists have tended to draw unwarranted inferences about other features of social organization from such data (Aberle 1968). Archaeologists have also been making forays into the ethnographic literature to search out detailed correlations between aspects of material and non-material culture that can be used to interpret archaeological data (Chang 1958; 1962; Cook and Heizer 1968). Many of these studies require manipulating vast quantities of data and have been practicable only with the assistance of computers.

In spite of early attempts to view burials as fossilized rituals (Fox 1959; Sears 1961), there have been few, if any, comparable advances in the study of belief systems or aesthetics, although inconclusive efforts have been made to discover regularities between art styles and certain aspects of social organization (Fischer 1961). The most successful studies remain those which are text-aided or grounded in the direct historic approach. In several highly successful attempts to deal with more general problems of interpreting art and burial customs, Peter J. Ucko (1968; 1969; Ucko and Rosenfeld 1967) has reaffirmed that the best use that can be made of ethnographic analogy in these areas is to broaden the archaeologist's awareness of unsuspected alternatives in the possible significance of his data. Yet, even if recent efforts to interpret the non-economic aspects of prehistoric cultures have had their greatest success in dealing with socio-political organization, they nevertheless mark the beginning of an attempt to extend the empirical reconstruction and explanation of prehistoric culture into new areas and to upgrade field methods to provide new kinds of data.

These practical developments have helped to stimulate interest in a thorough reappraisal of the theory and assumptions of prehistoric archaeology. The ultimate purpose of these discussions is to define the future aims of prehistoric archaeology and to establish an effective relationship between this discipline and the other social sciences. In the

course of these discussions, almost every concept that has ever been considered by archaeologists has come under scrutiny (Bayard 1969; Binford 1962; 1965; 1967; and Binford 1968; Chang 1967; 1968; Clarke 1968; Deetz 1965; Trigger 1968). Some of these concepts have been made more explicit, but in many cases clarification has resulted in hitherto unforeseen points of disagreement being recognized. It is indicative of the continuing importance of the British economic approach that much of the debate about cultural theory (as distinguished from general methodology) concerns problems that can be grouped under the general heading of ecology. Here two opposing views can be distinguished: one tending towards a narrower and more deterministic conceptualization of ecology than has prevailed among archaeologists hitherto; the other towards a broader and more empirical approach. Many individual positions fall somewhere between these two extremes and therefore a discussion of these tendencies as ideal types may do injustice to the subtlety of certain positions. Nevertheless, I believe that such a discussion is justified in terms of the light it sheds on the general issues that are involved. It will also demonstrate the extent to which current controversies are embedded in the past history of archaeological theory.

Deterministic ecology

Deterministic ecology has been influenced heavily by the cultural materialist approach in American anthropology, the growth of which is closely linked to that of cultural ecology and neo-evolutionary theory generally (Harris 1968). Yet, in spite of its largely American origins, the deterministic approach in archaeology is based on many of the key concepts of the British economic approach. Total cultures are studied as adaptive systems, as Grahame Clark advocated they should be. Both approaches share a materialist bias, but in place of the tentatively expressed British assumption that loosely-defined economic institutions play a leading role in the development of other features of culture, deterministic archaeologists have tended to adopt Leslie White's (1949) more rigorous premise that total cultures are the product of their technology interacting with the natural environment. In a recent study, for example, we are informed that 'the settlement pattern . . . is an essential corollary of subsistence' and that 'Variations between cultures are responses to differing adaptive requirements of specific environments; accordingly, varying ecological potentialities are linked to different exploitative economies and the latter, in turn, to differing integrative requirements met by differing forms of social structure' (Streuver, 1968a: 134–5; 133); in another study, on the advice of David Aberle, Streuver (1968b: 311) has expressed a more open approach to ecology.

While White (1945: 346) has warned that his general theories cannot be used as a basis for making inferences about the specific features of individual cultures, not all archaeologists have chosen to take this admonition seriously. They assume that if White's deterministic hypotheses are correct, any archaeologist who is able to reconstruct the technology and environment for an individual prehistoric culture should be able to predict what the rest of this culture, or at least its key features, was like (Meggers 1960). Shortcomings in such reconstructions are considered as the result of inadequacies in general anthropological theory, not in archaeological data or the archaeologist's ability to interpret these data. Archaeological studies which concentrate on subsistence patterns

and assign to them a leading role in the evolution of other aspects of culture have considerable support for the investigation of both simple (Streuver 1968b) and complex (Sanders 1968; Sanders and Price 1968) societies.

The materialist approach and the idea that culture can be reconstructed by broad analogy provide much scope for the application of neo-evolutionary theory in archaeology. Evolutionary theory in anthropology has always been preoccupied with problems of cultural typology and has operated on the assumption that the degree of variation in the total morphological pattern of individual cultures is strictly limited (Rouse 1964). Moreover, the search for causal relations has been conceived of as an effort to explain the similarities, rather than the 'unique, exotic and non-recurrent particulars' (Steward 1955: 209), observed in these patterns. At present, this is equally true of the unilineal evolutionism of Leslie White (1959) or V. Gordon Childe (1942, 1951) or the multilineal evolution of Julian Steward (1955), even though the latter attempts to account for patterns of variation resulting from adaptations to a variety of different kinds of environments. The cultural theory that underlies both approaches is, in fact, very similar (Sahlins and Service 1960). Cultures are viewed as made up of 'core' features, which are basic to their general structure, and other features which are not. The core features are mainly technological and social structural and are posited to develop in response to the adaptive needs of a culture. They occur, therefore, in a limited number of total patterns, which represent responses to specific classes of environments by peoples at various levels of technological development. Thus, by determining which total cultural pattern corresponds most closely to his data, the archaeologist is assumed to acquire knowledge of the key features of his culture. In this manner, cultural evolution becomes a 'practical research tool' for archaeologists (Meggers 1960).

It is ironic that just as new techniques are being devised to elicit independent information about social structure from archaeological data, arguments should be advanced that resemble so closely those advocated by earlier schools of archaeological interpretation to justify not basing their interpretations on a detailed exegesis of such data. Technology and environment have replaced index fossils and the economy as a datum line, but the faith remains that cultural patterns are limited enough in variety that the major outlines of any culture can be inferred from knowledge of only one part of it.

Another important feature that the deterministic approach has in common with neo-evolutionary theory is its anti-diffusionist bias. An interest in diffusion is interpreted as being antithetical, or irrelevant, to the study of cultures as adaptive systems. It is argued that diffusion occurs less frequently than uncritical archaeologists have claimed and that it is usually trivial in its consequences, at least as far as adaptation is concerned. It is also maintained that if conditions are right for a trait to be adopted in a recipient culture, a homologous trait, or one that has similar socio-economic significance, would ultimately evolve even if that culture were to remain totally isolated (Binford 1963; Sanders and Price 1968: 58–73; Renfrew 1969). Such a position is the mirror-image of the early diffusionists' lack of concern with the manner in which traits became integrated into recipient cultures.

On the whole, the deterministic approach tends to be more narrowly focused and more dogmatic than its economic predecessor. None of its major concepts is new and, taken individually, each of them has been criticized in various ways. The deterministic

approach has been unduly protected by the theoretical prestige which has accrued to it through its close ties with cultural materialism and neo-evolution. Yet, to point out the shortcomings of the deterministic approach does not necessarily imply a totally, or even partially, negative evaluation of these more general hypotheses. What the archaeologist must be concerned with is the degree to which these concepts are of practical value for interpreting his data.

In this respect, it must be observed that cultural materialism and its allied approaches, whatever their ultimate value, are, as yet, neither sufficiently sophisticated nor comprehensive to be able to explain the cultural variability noted in the ethnographic record, even if interest is confined to 'core' items. Most ecological explanations of ethnographic data are *ad hoc*, in the sense that they adduce plausible reasons to account for what is observed, but are unable to demonstrate that, given the same set of conditions, alternative solutions would be either impossible or highly unlikely. Widely differing explanations are offered concerning how particular features of culture are adaptive, and anthropologists are far from agreed that all behaviour can best be interpreted in this manner (Harris 1966).

Because of the complexity of cultural phenomena and the inadequacy of our present understanding of culture process, all deterministic, and indeed all functional, approaches remain essentially non-predictive, except at very general or mundane levels. An analogy with the biological sciences is perhaps instructive. Although the understanding of biological processes far exceeds that of socio-cultural ones, the biologist is unable to predict the specific changes that any particular species will undergo through time. This is largely because he is unable to control, to a sufficiently accurate degree, for a large number of external variables, including geological, climatic and solar conditions, as well as for the other plants and animals that are part of the eco-system. Thus, the complexity of the parameters that must be controlled for, even more so than the problems of understanding process, rules out the possibility of detailed and far-reaching predictions, either forwards or backwards in time. The current inability of social scientists to control for the even greater number of variables that affect cultural processes rules out the possibility of cultural theory being used by archaeologists as an 'effective research tool' for reconstructing individual prehistoric cultures (Trigger 1970: 33–5).

A sharp distinction must be drawn between the manner in which non-archaeological evolutionists seek to reconstruct the past using only their understanding of cultural theory and of present conditions and the archaeologist's efforts to understand the past as it is reflected in the archaeological record. The scenarios of cultural evolution that non-archaeological anthropologists have produced to date are largely descriptive generalizations, often highly impressionistic ones, rather than adequate explanations of the processes that have shaped the evolution of culture. For the archaeologist, the latter must be synonymous with the actual record of human development as revealed by culture historical research. The general schemes of cultural evolutionists can neither aid the archaeologist to interpret individual prehistoric cultures, nor, being themselves the product of cultural theory, can they contribute information that will permit archaeologists to understand cultural processes better.

There is a tendency, as Paul Tolstoy (1969: 558) has pointed out, for determinists to consider worthy of attention only those traits with which their theories appear equipped

to deal. These studies are generally restricted to dealing with structural features that are cross-culturally recurrent; the implication being that fundamental causal relationships (that is, those which concern adaptation to the environment) can be discovered only through the examination of such features. Although no criteria have ever been established that can discriminate objectively between the core and non-core characteristics of a culture, it is generally agreed that the former are those which play an active role in adapting the culture to its environment. Other features, such as art styles or symbols of rank, are treated as 'outward symbols', functionally related to the core, but of only peripheral structural significance. While concentration upon structural features can be extremely useful, as I have argued at length elsewhere (1968: 533–7), at best it offers a partial view of culture which must be complemented by an examination of less obviously recurrent or adaptive features. Archaeologists must never lose sight of one of anthropology's basic assumptions: that culture as a whole (and not merely those aspects which are causally related with the environment) is orderly. They must strive therefore to explain the total range of variation in their data and not be content merely to deal with gross structural similarities.

Another major shortcoming of deterministic ecology is its tendency to study individual cultures as closed systems; a procedure reminiscent of the organic fallacy in social anthropology. This bias is clearly related to the desire to study environmentally adaptive features of culture, but when applied dogmatically it is unrealistic for understanding both structure and process. Few cultures, if any, have existed in total isolation from all others. Many have been in such close contact with their neighbours that they lack the clear-cut boundaries which anthropologists find so convenient (Trigger 1967: 151). Networks of social, political and economic relations tend to proliferate across cultural boundaries and link cultural systems together. Viewed in structural terms, the impact that different cultures have had upon one another is far from insignificant. No one would deny, for example, that the spread of industrial technology, and of an associated international economic system, has had an enormous impact outside the area of western Europe where the Industrial Revolution was initiated. Because of variations in local culture, as well as in natural resources and the circumstances under which industrial technology was introduced, the impact of this technology has been different in each of these areas, and from what it was originally in western Europe. Some determinists postulate that eventually all industrial societies will tend to evolve a very similar set of social, economic and political institutions which are ideally suited to an industrial technology, much as Childe (1951) postulated that divergence followed by convergence is the normal process in the evolution of societies from one level of technological adaptation to another. Yet to dismiss the experience of the Third World as being of little evolutionary interest, as White's unilineal approach would lead us to do, is clearly inadequate both from an historical and a processual point of view. While it is legitimate, and highly desirable, to study the history of particular peoples in terms of the continuing evolution of their social systems, this does not provide a theoretical justification for ignoring either diffusion or the impact that interacting societies have had upon one another's socio-political institutions. Cultures clearly must be treated as important components in each other's environment.

Finally, we must reject the last-ditch defence that a deterministic ecological approach is

better suited to the interpretation of simple societies than it is to more complex ones. Such an argument is based on the assumption that structurally primitive societies are more directly dependent on their environment and, therefore, strictly limited in terms of the adaptive responses that are open to them. Such an argument is based on an unduly simplistic view of simple societies (Lee and DeVore 1968) and is reinforced by the relatively small amount of archaeological data that is available concerning any single primitive culture. Complex societies, such as those of ancient Egypt or of the Maya, simply leave behind too wide a range of archaeological evidence not to give rise to doubts about such formulations. This has helped to expose overenthusiastic attempts to distort such societies and fit them into unsuitable preconceived patterns. There is neither archaeological nor ethnological evidence to support the assumption that primitive cultures are necessarily any more lacking in adaptive variation than are complex ones.

Deterministic ecology thus appears to combine many of the weaknesses of the older evolutionary and economic approaches and fails to take advantage of recent significant advances in the interpretation of archaeological data. Its attempt to reconstruct prehistoric cultures on the basis of an assumedly limited variation in total morphological pattern seems to be theoretically unjustified and unproductive of new insights such as are derived from attempts to explain in detail the archaeological evidence for particular cultures.

Open-system ecology

What I have called open-system ecology consists of a body of assumptions shared by various archaeologists who nevertheless have never thought of themselves as members of a particular school of archaeological interpretation. Because of this, there is less programmatic literature associated with this approach than there is with deterministic ecology, although the number of substantive studies is probably greater. Most of the assumptions of the open-system approach are in accord with recent developments in cultural ecology generally and they reflect growing confidence among archaeologists in their capacity to interpret basic data. For these reasons, the open-system approach appears to be a more progressive, and ultimately a more productive, development than deterministic ecology.

The open-system approach is based on the assumption that cultural ecology is concerned with the total manner in which human groups adapt to and transform their environments. Cultures are conceived of as being at least partially open systems, some of whose institutions may be tied in with those of other cultures. Because of this, simplistic efforts to treat cultures as self-contained units may impede the interpretation of archaeological data. Cultural systems are seen as having to adapt to a total environment made up both of natural elements and of other cultures.

Open-system ecology assumes that there is a considerable degree of individual variation among both ethnological and archaeological cultures. While cultural phenomena are assumed to be orderly and hence subject to scientific enquiry, the open-system approach insists that any explanation of culture must prove its worth by being able to cope with patterns of variation observed in real cultures, rather than with the variations

hypothesized to exist among a limited number of ideal types, such as the neo-evolutionists postulate. Order must be sought, not in neat cultural typologies, but rather through understanding those processes by which cultural similarities and differences are generated. Only in this manner can sufficient allowances be made for the wide variety of contingent factors that influence the development of any one culture. The open-system approach also argues that, because of the complexity of these external factors and the archaeologist's inability to control for them adequately, it is not possible to reconstruct the whole of a cultural system from knowledge of only part of it. Instead, it insists that every facet of a prehistoric culture that can be reconstructed must be done so through the interpretation of data relevant to that part. For the same reason, it is doubted that the core features of any one culture can be distinguished on an *a priori* basis from non-economic, non-adaptive features.

Open-system ecology remains interested in subsistence patterns and economics, but assumes that developments affecting any one aspect of culture can ultimately produce further adjustments throughout the system and affect the system's relationship with its natural environment. Hence, open-system archaeologists are equally interested in studying trade, communications, political organization, warfare, population movements, religious ideas, disease patterns and other features of, or influenced by, culture, as far as this can be done from the archaeological record, in order to construct as complete a picture as possible of factors which influence the adaptation of a society to its total environment, both natural and cultural (Trigger n.d.). Moreover, while interest remains high in studying whole cultures, there is also a growing interest in examining in detail the functional relationship between restricted segments of prehistoric cultures, such as irrigation systems and political organization. Such studies are important from an ecological point of view because they contribute to the better understanding of the adaptive features of a culture.

The open-system approach has been one of several factors promoting a growing interest in the study of archaeological settlement patterns (Trigger 1965; 1968). It is assumed that the quantity, type and distribution of the material remains of human activities (including settlements, houses, fields and artefacts) constitute reliable evidence concerning the manner in which former inhabitants adjusted to their environment and that all of the factors that influenced this adjustment are reflected, either directly or indirectly, in the settlement pattern. Attempts to explain settlement patterns therefore should result in a more comprehensive understanding of this adaptation than a study that concentrates on subsistence patterns or the economy and which tries to explain the settlement patterns only, at best, in terms of these factors (Streuver 1968a: 134–5). It is recognized, of course, that a settlement pattern is the product of a variety of factors, some of which reinforce certain trends, others of which are opposed to one another. The pattern therefore is often a compromise among a number of conflicting tendencies. A simple example is the contradiction in some agricultural societies between the desire for dispersed homesteads in order to be near fields and for nucleated settlements for protection against enemies. It is not always possible to untangle the forces that have been at work, given the sort of archaeological data that are normally available. It is suggested, however, that the attempt to explain an archaeological settlement pattern constitutes a dynamic approach to the study of the cultural ecology of prehistoric societies.

The first substantial effort to study settlement patterns in this manner was Gordon Willey's report on the Viru Valley in Peru (1953). In this study, Willey treated settlement patterns as a reflection of 'the natural environment, the level of technology on which the builders operated, and various institutions of social interaction and control which the culture maintained' (p. 1). He demonstrated that not only the development of subsistence patterns, but also political and economic competition between valleys and changes in the relationship between the sacred and secular areas of cultures had played important roles in shaping the development of settlement patterns in the Viru Valley. Moreover, the development of subsistence patterns only became intelligible once these other factors had been taken sufficiently into account.

In *Land Behind Baghdad*, R. M. Adams (1965) carried the approach further by using archaeological and historical evidence to demonstrate that political and economic factors had played a more important role than had technological ones in shaping the development of irrigation systems in a part of Iraq over a 6,000-year period. Similarly, studies of Nubian culture history have shown that the size and distribution of population in this region, from at least 3000 B.C. to the present, have been determined not only by subsistence patterns but also by trade, warfare, political organization, religious beliefs and disease patterns and especially by Nubia's relationships with Egypt and the Sudan (Trigger 1965; n.d.). The vast array of factors that has been shown to influence settlement patterns in these regions, clearly demonstrates the theoretical limitations of deterministic ecology. Moreover, in none of these studies is it claimed that the full range of factors has been deduced or their relationship to one another completely worked out. In each study at least some of the factors are known from historical rather than archaeological data.

Within an open ecological framework, studies of subsistence patterns take on new significance. Michael D. Coe (1969) has pointed out that hitherto most theorizing about ancient ecosystems has been limited to the 'supposed permissive or limiting effects of major biomes, such as desert, steppe or tropical forest' upon cultural development. He cites, as examples of such theories, Wittfogel's (1957) thesis that despotic states arise to provide the controls needed to administer large-scale irrigation systems or Meggers' (1954) related theory that tropical forest environments preclude the independent rise of complex societies and eventually destroy such of them as are introduced from outside. Coe and Flannery (1964) argue that such general theories do not take account of the variations within major biomes and for this reason frequently are not in accord with the facts. This is essentially the same kind of objection that has already been levelled in this paper against the neo-evolutionist approach to the study of culture. In their work on lowland Mesoamerica, Coe and Flannery suggest that the explanation of cultural development requires a detailed knowledge of the micro-environments to which individual people actually adapt. It is through an understanding of such micro-environments and of the kinds of adjustments that the members of any one culture have made to those available to them that a picture of subsistence patterns and of their carrying capacity may be built up. More recently, in a discussion of his work on Oaxaca, Flannery (1968) has pointed out that some groups do not adapt to micro-environments as much as to a small number of plants and animals that may cross-cut several such environments. He has suggested that cybernetic-type models may help to provide useful explanations of stability and change in such adaptations (for a discussion of this suggestion see Doran

1970). Coe (1969) has followed the recent lead of geographers and economists in arguing that agricultural systems must not be viewed as independent variables in the study of culture but rather as parts of a much broader cultural system and therefore as responsive to changes initiated in various other parts of the system. He stresses that social, cultural, ceremonial and religious factors may influence subsistence patterns, particularly in so far as they effect changes in population. He also stresses the potential value of analytic concepts borrowed from geography, such as central-place theory, nearest neighbour analysis and von Thunen's 'isolated state' theory for the analysis of archaeological data and the generation of new explanatory models. The tendency to view population, not as an automatic response to food production, but rather as related to the total cultural pattern and hence influenced by many different kinds of factors is clearly an integral part of the open-system approach. Such ideas serve to tie some of the most recent thinking in archaeology in with modern ecology in general.

Conclusions

Archaeologists must learn to live with the realization that their desire to study whole cultural systems cannot be realized. This, however, is not meant to be an unconstructive comment. On the contrary, the real weakness of much modern archaeology can be attributed to the tendency of many archaeologists to treat their discipline as being merely the 'past tense of ethnology' or a kind of 'palaeoanthropology', rather than defining its goals in terms of the potentialities of its data. Archaeologists must learn to ask the kinds of questions with which their data are equipped to deal (Clarke 1968: 12–24).

The relationship between archaeology and ecology is bound to be affected by such questions. As long as ecology was conceived of in a deterministic fashion, it appeared to be an approach totally adapted to take advantage of the strong points of archaeological data and to circumvent their weak points. Now, however, it is apparent that because archaeology is unable to reconstruct whole cultural systems, an ecological approach can at best be partially applied and that the lessons drawn from it will tend to be limited to the relationships between certain adaptive features of culture. From a theoretical point of view, the main contributions that prehistoric archaeology is likely to make in the near future will concern the manner in which specific economic, social and demographic variables interact with one another in specified environmental settings over long periods of time. Subject to these limitations, prehistoric archaeology has a unique contribution to make to an understanding of the manner in which culture evolved down to the beginnings of recorded history.

Author's note:
This paper, which is an abbreviated version of one prepared for the 1969–70 McGill Faculty Seminar on Human Ecology, is the third part of a trilogy dealing with current controversies in archaeological theory. The first paper (Trigger 1968) dealt with concepts of culture and society; the second (Trigger 1970) with the nomothetic and ideographic goals of the discipline. The present paper is concerned with aspects of processual concepts such as cultural evolution,

diffusion and adaptation. Each of these papers approaches current debates from an historical perspective.

24.vi.1970

Department of Anthropology,
McGill University

References

Aberle, D. F. 1968. Comments by David F. Aberle, S. R. Binford and L. R. Binford. In *New Perspectives in Archaeology*, eds. S. R. and L. R. Binford: 353–59. Chicago.

Adams, R. M. 1965. *Land Behind Baghdad.* Chicago.

Bayard, D. T. 1969. Science, theory and reality in the 'New Archaeology'. *American Antiquity.* 34:376–84.

Biek, L., 1963. *Archaeology and the Microscope.* London.

Binford, L. R. 1962. Archaeology as anthropology. *American Antiquity.* 28:217–25.

Binford, L. R. 1963. 'Red Ochre' caches from the Michigan area: a possible case of cultural drift. *Southwestern Journal of Anthropology.* 19:89–108.

Binford, L. R. 1965. Archaeological systematics and the study of cultural processes. *American Antiquity.* 31:203–10.

Binford, L. R. 1967. Smudge pits and hide smoking: the use of analogy in archaeological reasoning. *American Antiquity.* 32:1–12.

Binford, L. R. and Binford S. R. (eds). 1968. *New Perspectives in Archaeology.* Chicago.

Brothwell, D. R. and Higgs, E. S. (eds). 1963. *Science in Archaeology.* London.

Chang, K. C. 1958. Study of the Neolithic social grouping. *American Anthropologist.* 60:298–334.

Chang, K. C. 1962. A typology of settlement and community patterns in some circumpolar societies. *Arctic Anthropology.* 1:28–41.

Chang, K. C. 1967. *Rethinking Archaeology.* New York.

Chang, K. C. (ed). 1968. *Settlement Archaeology.* Palo Alto, California.

Childe, V. G. 1925. *The Dawn of European Civilization.* London.

Childe, V. G. 1936. *Man Makes Himself.* London.

Childe, V. G. 1942. *What Happened in History.* Harmondsworth.

Childe, V. G. 1946. *Scotland Before the Scots.* London.

Childe, V. G. 1951. *Social Evolution.* New York.

Clark, J. G. D. 1952. *Prehistoric Europe: The Economic Basis.* London.

Clark, J. G. D. 1953. *The Economic Approach to Prehistory.* Albert Reckitt Archaeological Lecture, British Academy.

Clark, J. G. D. 1954. *Excavations at Star Carr.* Cambridge.

Clark, J. G. D. 1957. *Archaeology and Society* (3rd ed.). London.

Clarke, D. L. 1968. *Analytical Archaeology*. London.

Coe, M. D. 1969. Photogrammetry and the ecology of the Olmec civilization. (Paper read at Working Conference on Aerial Photography and Anthropology, Cambridge, Mass., 10–12 May.)

Coe, M. D. and Flannery, K. V. 1964. Microenvironments and Mesoamerican prehistory. *Science*. 143:650–4.

Cook, S. F. and Heizer, R. F. 1968. Relationships among houses, settlement areas, and population in aboriginal California. In *Settlement Archaeology*, ed. K. C. Chang. 79–116. Palo Alto, California.

Cornwall, I. W. 1958. *Soils for the Archaeologist*. London.

Crawford, O. G. S. 1921. *Man and his Past*. Oxford.

Daniel, G. E. 1968a. *The First Civilizations*. London.

Daniel, G. E. 1968b. One hundred years of Old World prehistory. In *One Hundred Years of Anthropology*, ed. J. O. Brew. 57–93. Cambridge, Mass.

Deetz, J. 1965. *The Dynamics of Stylistic Change in Arikara Ceramics*. Urbana, Illinois.

Deetz, J. 1967. *Invitation to Archaeology*. New York.

Dimbleby, G. W. 1967. *Plants and Archaeology*. London.

Doran, J. 1970. Systems theory, computer simulations and archaeology. *World Archaeology*. 1:289–98.

Fischer, J. L. 1961. Art styles as cultural cognitive maps. *American Anthropologist*. 63:79–93.

Flannery, K. V. 1968. Archaeological systems theory and early Mesoamerica. In *Anthropological Archaeology in the Americas*, ed. B. J. Meggers. 67–88. Washington.

Fleure, H. J. and Whitehouse, W. E. 1916. The early distribution and valley-ward movement of population in south Britain. *Archaeologia Cambrensis*. 16:101–40.

Fox, C. 1923. *The Archaeology of the Cambridge Region*. Cambridge.

Fox, C. 1932. *The Personality of Britain*. Cardiff.

Fox, C. 1959. *Life and Death in the Bronze Age*. London.

Harris, M. 1966. The cultural ecology of India's sacred cattle. *Current Anthropology*. 7:51–66.

Harris, M. 1968. *The Rise of Anthropological Theory*. New York.

Hawkes, C. F. C. 1954. Archaeological theory and method: some suggestions from the Old World. *American Anthropologist*. 56:155–68.

Hill, J. N. 1966. A prehistoric community in eastern Arizona. *Southwestern Journal of Anthropology*. 22:9–30.

Hill, J. N. 1968. Broken K Pueblo: Patterns of form and function. In *New Perspectives in Archaeology*, eds. S. R. and L. R. Binford. 103–42. Chicago.

Hodges, H. W. M. 1964. *Artifacts: an introduction to early materials and technology*. London.

Lee, R. B. and DeVore, I. (eds). 1968. *Man the Hunter*. Chicago.

Longacre, W. A. 1968. Some aspects of prehistoric society in east-central Arizona. In *New Perspectives in Archaeology*, eds. S. R. and L. R. Binford. 89–102. Chicago.

Meggers, B. J. 1954. Environmental limitation on the development of culture. *American Anthropologist*. 56:801–24

Meggers, B. J. 1960. The law of cultural evolution as a practical research tool. In *Essays in the Science of Culture*, eds. G. E. Dole and R. L. Carneiro. 302–16. New York.

Montelius, O. 1899. *Der Orient und Europa*. Stockholm.

Renfrew, A. C. 1969. Trade and culture process in European prehistory. *Current Anthropology*. 10:131–69.

Rosenfeld, A. 1965. *The Inorganic Raw Materials of Antiquity*. London.

Rouse, I. 1964. Archaeological approaches to cultural evolution. In *Explorations in Cultural Anthropology*, ed. W. H. Goodenough. 455–68. New York.

Sanders, W. T. 1968. Hydraulic agriculture: economic symbiosis and the evolution of states in central Mexico. In *Anthropological Archaeology in the Americas*, ed. B. J. Meggers. 88–108. Washington.

Sanders, W. T. and Price, B. J. 1968. *Mesoamerica: the evolution of a civilization*. New York.

Sears, W. H. 1961. The study of social and religious systems in North American archaeology. *Current Anthropology*. 2:223–46.

Sahlins, M. D. and Service, E. R. 1960. *Evolution and Culture*. Ann Arbor.

Semenov, S. A. 1964. *Prehistoric Technology*. London.

Steward, J. H. 1955. *Theory of Culture Change*. Urbana, Illinois.

Streuver, S. 1968a. Problems, methods and organization: a disparity in the growth of archaeology. In *Anthropological Archaeology in the Americas*. ed. B. J. Meggers. 131–51. Washington.

Streuver, S. 1968b. Woodland subsistence-settlement systems in the lower Illinois valley. In *New Perspectives in Archaeology*, eds. S. R. and L. R. Binford. 285–312. Chicago.

Taylor, W. W. 1948. *A Study of Archeology*. Menasha, Wisconsin.

Tolstoy, P. 1969. Review of W. T. Sanders and B. J. Price: Mesoamerica. *American Anthropologist*. 71:554–8.

Trigger, B. G. 1965. *History and Settlement in Lower Nubia*. New Haven, Connecticut.

Trigger, B. G. 1967. Settlement archaeology – its goals and promise. *American Antiquity*. 32:149–60.

Trigger, B. G. 1968. Major concepts of archaeology in historical perspective. *Man*. 3:527–41.

Trigger, B. G. 1970. Aims in prehistoric archaeology. *Antiquity*. 44:26–37.

Trigger, B. G. n.d. The cultural ecology of Christian Nubia. In *Nubische Kunst in Christlicher Zeit*, ed. E. Dinkler, (forthcoming).

Ucko, P. J. 1968. *Anthropomorphic Figurines of Predynastic Egypt and Neolithic Crete*. London.

Ucko, P. J. 1969. Ethnography and archaeological interpretation of funerary remains. *World Archaeology*. 1:262–80.

Ucko, P. J. and Rosenfeld, A. 1967. *Palaeolithic Cave Art*. London.

White, L. A. 1945. Diffusion vs. Evolution: an anti-evolutionist fallacy. *American Anthropologist*. 47:339–56.

White, L. A. 1949. *The Science of Culture*. New York.

White, L. A. 1959. *The Evolution of Culture*. New York.

Wittfogel, K. A. 1957. *Oriental Despotism*. New Haven, Connecticut.

Willey, G. R. 1953. *Prehistoric Settlement Patterns in the Viru Valley, Peru*. Washington.

Willey, G. R. and Phillips, P. 1959. *Method and Theory in American Archaeology*. Chicago.

Abstract

Trigger, B. G.

Archaeology and Ecology

This paper traces the development of an ecological approach in prehistoric archaeology, relating it to other major theoretical developments. A distinction is drawn between a deterministic and an open-system approach to ecology in current archaeology. The merits of these two approaches are evaluated and an attempt is made to forecast the implications that the open-system approach will have upon future relations between archaeology and ecology.