

I THEORETICAL CONSIDERATIONS

1 An introduction to the study of ancient New World road networks

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The study of ancient roads, in both the Old World and the New World, is possibly best conceptualized under the theoretical orientation of landscape archaeology. Simply stated, landscape archaeology is the study of civilization's imprint on or modification of the natural environment. Its basic premise is that the cultural landscape reflects the interplay between technology, environment, social structure, and the values of the society that shaped it. The cultural landscape includes such features as roads, agricultural terraces, hydraulic works, field systems, settlement patterns, and any other man-made alteration of the natural terrain (Armillas 1971:654). This approach was refined by British archaeologists between about 1920 and 1950 primarily as a result of increased feasibility of aerial survey and technological advances in aerial photography developed during the two world wars. Roads are the focus of this particular facet of landscape archaeology because they are the only tangible evidence of a prehistoric population's structural organization across geographical space.

Although some data have accumulated on Old World roads, comparatively little attention has been paid to those of the New World. Part of this may be due to a very early realization that precolumbian technological development was markedly different from that of the Old World. Thus in the history of technology relating to transportation, most emphasis has been placed on the development of the wheel and innovations to harness the energy of draft animals. Associated with this is perhaps a feeling that roads are synonymous with wheeled vehicles. Since vehicles were not used in the New World before European contact, it followed that the few known precolumbian roads would be of little real significance, or curiosities at best. We are now discovering that they

Fig. 1.1. Regions discussed in this volume.



were more widespread than previously realized and that in terms of construction techniques and engineering of comparable time periods, New World roads frequently showed a marked superiority over their Old World counterparts.

In this book we discuss New World road networks in a variety of regions (Fig. 1.1). One purpose is to delimit their underlying contexts in terms of political organization and social/economic complexity. In this sense we are attempting to identify regularities and peculiarities on a cross-cultural basis to account for functions and location, and to determine if (or to what extent) they can be used as an index of societal complexity.

The study attempts to go well beyond a simple classificatory scheme, however. Certain points on the landscape were connected by routes of one kind or another in all societies, regardless of complexity. What varies is the location of these routes and the social value that was placed on them at any given time. Seen holistically, the route system used by a particular culture or group should reflect something of its internal composition, value system (in terms of choosing to connect certain points and not others), and mode of adaptation to the cultural and natural environment. Thus if we are clever or fortunate enough to identify these routes as empirical entities, a potentially powerful tool will be at our disposal to decipher an important facet of regional prehistory.

Although it would be ideal to study an entire regional system, preservation does not permit this. We are therefore forced to deal with what is available as well as to seek innovative detection and analytical techniques. Thus while the following discussions deal primarily with formal prehispanic roadways, it is with the full realization that they are relatively rare, local or regional in scope (except for those pertaining to empires), and specialized instances of the overall spectra of transportation routes. As such they cannot be construed to be representative of a particular region's entire transport system, for as we shall see in the following chapters the formal systems, when present, almost invariably coexisted with the informal.

Formal and informal routes

There is a basic dichotomy between formal and informal routes. Formal routes are those that show evidence of planning and purposeful construction.¹ This is often reflected in straightness and non-duplication as well as construction of associated elements such as roadbeds, curbs, pavements, sidewalls, drainage culverts or bridges. Formal road systems, then, are characterized not only by evidence of labor in construction, engi-

neering,² and maintenance, but by an organizational apparatus responsible for their implementation. They are defined as tangible, physical evidence of a route of travel serving as a means of communication between points or activity areas. As such they usually have three basic characteristics: 1. a definable width, usually on the basis of architectural features such as border elements or roadbed preparation; 2. more than casual construction; and 3. normally, a failure to deviate in direction for minor topographic obstacles (*see also* Roney 1983:9). These may include a span or several aligned segments that may or may not have obvious termini; a network, consisting of a group of non-aligned linked segments; or a system consisting of a series of interconnected networks. There are two primary subdivisions of formal land routes: roads and causeways. This is based on structural criteria in that both retain the same definition given above, but causeways are roadbeds that are artificially raised above ground level.

Contrasted with this are informal routes that have minimal or no labor directed to their creation or maintenance. These for the most part would consist of paths, trails, and trade routes. As Earle points out, paths are usually highly redundant in that many have alternative routes and are usually the result of necessity. They also tend to be highly irregular in layout owing to their avoidance of natural obstacles.

As tidy as this dichotomy may seem at first glance, there is actually a substantial shadow zone between them. For example as several authors here note, roads built during one construction epoch may later degenerate into paths for lack of maintenance or change of purpose. Or, as Hyslop shows for the Inka, a route could vary from a road to a simple path on the same course within a few kilometers. Similarly, a question is raised as to whether simple route markings such as stakes or cairns constitute a path or a road. Denevan notes that a path or trail through a forest might involve construction in the sense of clearing foliage. It might also have to be maintained to some extent to keep it clear of subsequent growth. Thus although the dichotomy is usually quite clear, the reader should be aware that there are some cases where a simple distinction might not apply.

The evolutionary perspective

One of the primary reasons for distinguishing between roads and trails is that both may be seen in an evolutionary context. Earle, for example, shows that roads are generally only found in chiefdom and state-level societies while paths were used throughout all levels of the sociopolitical hierarchy. The crucial factor here is that

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roads were added to the cultural inventory to solve new needs of political integration while still retaining the informal routes for their previous purposes. Hassig, however, cautions that societal sophistication was not the only factor involved in the creation of specific types of routes. In this sense roads found in regions of easy terrain could be the products of societies possessing less developed technical skills because construction and maintenance costs would be within the means of a wider range of societies. Conversely, in mountainous or other difficult terrain, roads would be feasible only for a much narrower range of societies. Thus the presence of a road network in a given region does not automatically indicate a high level of societal complexity.

Schreiber and Hassig likewise remind us that not all polities had formal transport systems. Given this fact it is impossible to predict a road system on the basis of a polity's sophistication. This is amply brought to our attention by Charlton in his discussion of Teotihuacan. This center, probably the largest and most elaborate in the northern hemisphere of the New World, seems to have had very little in terms of a formal system outside of the city. At present, compared to other road networks discussed in this volume, the formal routes identified linking Teotihuacan with its hinterland seem quite insignificant.

Form and function

The evolutionary dimension is only one aspect of a formal route system. Also important is the role that a particular system played and what it can tell us of the regional organization of the people who built and used it. Insights in this regard come from an interplay between two perspectives: the particularistic or micromorphological and the holistic or macromorphological. The former involves examination of specific elements in route construction that may have had cultural significance. Some of these elements include road width, roadbed preparation, architectural detail, continuity or discontinuity of construction style, and directness.

The macromorphological dimension, on the other hand, provides information on a different scale. It is focused on the extent of the network within or beyond a particular region, the function of points it connects (i.e., general habitation sites, administrative centers, way-stations, defensive positions), the contemporaneity of connected points, and the overall configuration of the system. The macro category is therefore concerned not so much with the physical attributes of the road as with inferences derived from syntheses of more multifaceted research. The two dimensions are complementary in that

neither can give reasonably productive insights without the other.

Micromorphology

Aside from symbolic or ritual considerations, implicit throughout much of this volume is the fact that the form of the routes is greatly influenced by their use. An examination of some attributes found regularly among all formal routes may be particularly rewarding. One of the most basic is road width. Here there is a wide range of opinion on how much reliance should be placed on this criterion for forming valid inferences. Hassig takes the position that while local topography may dictate the maximum road width, actual use defines the minimum. He shows the differences between roads that would be used primarily for commerce and those that would be used for military purposes. Roads for the rapid deployment of an army, for example, would need to be much wider than those for commerce where traffic would probably not be more than about two individuals abreast and labor minimization would assume much greater importance. A military function for many wide roads also fits neatly with Earle's observations that roads were needed to solve new needs of more extensive integration in highly stratified societies.

Hyslop, on the other hand, cautions that at present the question of road width is both complex and poorly understood. For example, he mentions that with the Inka network the same road could vary considerably within a short distance. Some of the determining factors include natural topographic features such as steep slopes or rock surfaces. Others are cultural variables such as attempts to avoid valuable agricultural land, and accessibility of construction areas to laborers. Adding to the complications of using road width as an index of traffic volume is the fact that contemporaneous parallel road segments are found occasionally in some geographic areas. In certain respects, however, the distinctions between Hyslop's and Hassig's positions may not be so great. For example, a road 12 to 18 m wide with a variation of 6 m could still be used quite effectively by a small army as opposed to a road that was 2 to 3 m wide with a variation of 1 m. The most important factor in considering width would probably not be the range of fluctuation, since that would be expected to vary according to conditions mentioned previously. Rather, the average width in relation to the distance between the narrowest points would seem to be of primary importance since this would be a corollary to Hassig's maxim that actual use defines minimum width. The real issue, it seems, is in trying to distinguish between symbolic and

other functions such as economic or military uses on the basis of micromorphology.

Two other morphological traits on this level include directness and roadbed preparation. The former, especially when it involves projecting a straight route alignment over topographic features that are not visible from one point to another, requires considerable planning and coordination of labor. If there is one attribute that characterizes New World road systems, it is straightness. Unlike roads in the Old World, those in the western hemisphere did not need to take into account problems of gradient that might have impeded vehicular traffic. The latter, roadbed preparation, is not only important in assessing the amount of labor, engineering and organization behind any given linkage, but in certain cases indicates the amount of energy a society or polity would expend to maintain year-long contacts within or between regions. This is especially evident if bridges or other support systems such as way-stations or garrisons were built. The causeways in the Llanos de Mojos region of eastern Bolivia and in the Barinas region of Venezuela discussed by Denevan are excellent examples of this. Here tremendous effort was expended in connecting settlements and other points in low-lying seasonally inundated areas. Beck likewise mentions causeways built near Chan Chan to protect roads from irrigation water as well as to make people (and presumably their intent) visible as they approached. Causeways need not always have been used to connect points on a year-round basis. At La Quemada, a massively fortified citadel on the northern Mesoamerican frontier, some of the more elevated causeways seem to have been designed as much for defensive advantage as to connect two points.

There are a number of construction styles that can vary both within and between regions. These are usually very general and include features ranging from simple clearing to pavements and retaining walls. As research on roads continues these may prove useful for analysis when taken into account with other data classes. At our present level of knowledge, however, it appears unlikely that they can aid in deciphering chronology or function. Beck underscores this point by listing five styles of road construction in the Moche valley that have an unbroken continuum of use for the last 2,000 years.

Architectural detail, however, holds somewhat more promise. This category of data includes features directly associated with the alignments but which are not necessarily considered termini or destinations of them. Some of these include ramps, bridges, drainage culverts and sidewalls. They may in some cases be minimally accept-

able for seriation, but their main use, when they show diagnostic criteria, is to confirm contemporaneity of the route with the points they connect. The usefulness of this class of data is demonstrated by Schreiber in identifying associations of architectural detail with known polities and distinguishing between "royal" and ordinary roads.

Macromorphology

As we see from the above, the microlevel data class provides information on specific form and potential function of any given road segment. It is from the macro or holistic perspective, however, that we begin to gain an understanding of their role in society. In this sense emphasis shifts from a focus on individual linkages to what they connect, where they lie in relation to what they connect and, beyond that, to the configuration of the entire system. When considered as a whole, two standards must be met. First, the routes must be contemporaneous with the points they connect. This criterion is often deceptively difficult to establish because of problems sometimes created by periodic disuse or reuse. Hassig mentions that although roads had the potential for change to reflect new political, social, or economic situations, quite often they did not do so simply because it was usually more efficient to continue using a pre-existing route than to build another. Schreiber also notes that in some cases construction of a road may pre-date a period of political domination and although various empires built new roads, in most cases they upgraded previously existing ones. Similarly many continued in use after the fall of a particular polity. In this sense Hassig notes that those heavily invested with labor tended to have an inertial effect on changes in settlement pattern in that societies possessing more formal routes were proportionately "locked into" a particular network structure.

The second criterion is that the location of all or most segments of the network for a given geographical region must be known before meaningful analysis can begin. Individual isolated occurrences, though interesting, contribute little toward understanding the makeup of the system. This is especially evident when various locational models are employed such as those discussed by Gorenflo and Bell, Santley, and Gorenstein and Pollard.

Within this larger perspective the general purpose or importance of a route can often be gauged by what it connects. Schreiber again emphasizes this line of evidence in establishing associations between certain roads and states. A series of roads that connect sites representing political authority, for example, would probably

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be more representative of royal roads than roads connecting ordinary settlements of the local populace.

There is a potential problem in over-inferring the function of a road on the basis of what it connects, however. Often many smaller settlements, shrines, or activity areas such as mines are located on or near roads. Thus when there are many termini, the primary purpose of a given network may become obscured. Possibly one way to resolve this would be to consider the types of activities contained by the largest or most prominent settlements in direct association with the network. These could then be compared with the types of activities contained by other sites both on and off the roads. Positive as well as negative evidence would then be effective in isolating road-associated functions. The success of this approach obviously depends on the degree to which the region is known archaeologically. Thus as Hyslop, Beck, and Schreiber note, a truly effective study of the road system can only take place after chronology, settlement pattern, and other detailed studies have taken place beforehand.

There are other inferences that can be drawn from the overall pattern of the network. Hassig mentions that multiple roads linking the same point may reflect local or multiple autonomous administrative bodies involved in construction. Likewise economic motivations may be a primary consideration both when roads link multiple settlements and when they utilize a minimum of labor and material. Political motivations for extending a road system may be evident, for example, when the hinterland of a particular administrative center is poorly connected or when roads are needed to connect widely dispersed regions. Interconnective road lattices between political centers may also be an indication.

Ultimately, however, the configuration of the system must be described and analyzed. This can be done to some extent verbally, but when quantitative factors such as distance, travel time, relative accessibility of termini, and other factors are involved, more explicit models become necessary. Most efficient from this standpoint are those that fall under the general classification of network analysis. Gorenflo and Bell provide an overview of the applications and potential of this approach in terms not only of networks, but of specific aspects of regional organization. Of particular importance in demonstrating various lines of investigation is their discussion of network simulation. Previously it was mentioned that form, particularly on the microlevel, was heavily influenced by function. On the macrolevel, however, the primary purposes of the routes are often not readily apparent because roads may link many

points containing a variety of activities. Thus on the macrolevel the same configuration could be generated by several different underlying processes. In the simulation studies discussed by Gorenflo and Bell we see that the researcher can propose underlying processes and compare the pattern that emerges to the empirically observed case. Although, as they point out, causality cannot be established through postdiction, probabilities of certain underlying factors can be ranked and subsequently tested.

While Gorenflo and Bell present an array of analytical techniques, Gorenstein and Pollard, and Santley use locational approaches to characterize specific systems. In the Tarascan core region, for example, Gorenstein and Pollard first analyze transport routes in relation to settlement role within the Lake Patzcuaro basin. For this they determined and ranked the relative accessibility of ninety-two settlements using matrix multiplication. The accessibility ranking was then compared to early ethnohistorical records to determine if a correlation existed between high accessibility and specific functions such as markets, administrative and/or religious centers, and elite settlements. The results, when compared with areas outside the core region, as well, showed that the Tarascan system was "solar" (see Fig. 16.1c) in that the direction of flow of goods and information was up the settlement hierarchy although horizontal flow, especially in the core region was more frequent. This situation both favored and consolidated Tzintzuntzan's role as primate center.

Similarly Santley examines Aztec regional economic organization at the time of the Spanish conquest. Unlike the Tarascan system, he shows that the Aztec system favored bulking and large-scale import-export enterprises. The system was dendritic in that it facilitated trafficking up and down the settlement hierarchy – not between centers of equal hierarchical rank. The latter he shows was possible, but generally only in close proximity to Tenochtitlan.

The symbolic dimension

There is one aspect of routes that at present defies rigorous analysis. This is the symbolic dimension. Not infrequently both cultural and natural landscape features were imbued with spiritual or abstract connotations. Forbes (1964:11), for example, mentions that when the modern Kpelle of West Africa wish to express the idea of an unused path becoming absorbed by the jungle, they say that "the road dies." Accordingly, if the route itself is represented by a spirit one might also expect ritual behavior to be directly associated with it,

such as insuring the well being of travelers or protection of villages against enemies.

Folan, Wallace, and Hyslop take special notice of the symbolic or cognitive aspects of routes as does Earle of the ritual significance. Folan notes that in the area of the Northern Maya, specifically at Coba and El Mirador, sacbes (causeways) and their associated architecture may have been laid out to represent a celestial map. Individual sacbes, for example, could have been aligned to the rising or setting of specific constellations. Mythological sacbes are also present and these may have helped conceptualize or define local and long-distance associations between other centers and regions. Wallace provides evidence for the symbolic aspect of Chincha roads on the basis of macrolevel synthesis of ethnohistorical and archaeological data. The roads there provided dual perspectives: from the outside they reinforced the image of centrality and monumentality of a neutral port of trade, while from within they reiterated the prestige of a great ritual center that had links to other major routes outside the region. Routes associated with the great fortress/ceremonial centers of Xochicalco and La Quemada in Mexico almost certainly had considerable political and ritual symbolism. Among other functions, they may have been intended to impress both visitors and local inhabitants of military prowess as well as the legitimacy of their respective elites. Hyslop notes the potential variability in symbolic functions throughout much of Andean Peru. These routes were often used to define spatial divisions, conceptualize cultural geography, and reflect elite status, and, as with the Nazca lines, probably served ritual purposes. Despite our speculations, the cognitive or symbolic aspect without aid of ethnohistorical data will remain one of the more elusive aspects of routes. This realization should serve to make us more aware that roads were not always perceived as utilitarian in our present-day sense.

Discovery and verification

All the discussions regarding theory, analytical techniques and network configuration are quite useless unless the networks can be known empirically. Likewise there is little real value in discussion of "trade routes" unless their exact location can be described. It follows, then, that discovery and verification techniques rank high in the study of ancient roads and landscape archaeology in general.

One of the earliest and still most effective discovery techniques employed in landscape studies is the use of aerial perspective. Its systematic use was pioneered during World War I by O. G. S. Crawford who noted

distinctive patterns from the air that were not readily apparent on the ground. Subsequently as aerial survey and photography became more feasible, it rapidly became popular in archaeological studies in Europe (e.g. Crawford 1929, 1953; Deuel 1969; Bradford 1957), the Near East (e.g. Schmidt 1940), and the New World (e.g. Morley 1946; Willey 1953). That this tradition continues to be an integral facet of discovery procedures is shown by its extensive use by many of the present authors. Obenauf in particular devotes an entire chapter to describing the role of aerial photography in the discovery and mapping of roads in the Chaco Canyon region of New Mexico. The techniques she describes, some of them specifically geared to studies of low-relief features, are also applicable to a wide range of other geographic areas that are not obscured by vegetation. Possibly most important, these methods are highly cost-effective and within the means of most researchers.

Taking the aerial perspective further are two chapters, one by Sever and Wagner and the other by Sheets and Sever, dealing with digital remote sensing. The versatility of this approach is evident in dealing with two extremes of environmental conditions, especially when used in conjunction with complementary conventional black-and-white and color infrared photography. Although far less accessible to most researchers at present, recent developments in remote sensing as demonstrated here have the potential to revolutionize landscape archaeology on a scale equal to that of conventional aerial photography two or three generations ago.

The effectiveness of remote sensing in arid regions is demonstrated by Sever and Wagner. In chapter 6 they describe the results of a 1982 N.A.S.A. project in the Chaco Canyon region using T.I.M.S (thermal infrared multispectral scanning) and lineament enhancement. This technique, which measures heat differentials between subsurface features and the surrounding terrain, showed the locations of trash middens, subterranean walls, a prehistoric agricultural field, and roads. Many of these features would have been invisible or unrecognizable using conventional aerial photography and ground survey.

Contrasted with this is the use of remote sensing in a tropical rainforest of northwestern Costa Rica. Here Sheets and Sever used a combination of digital radar and color infrared aerial photography. Penetration of the tree canopy by radar permitted a precise definition of topographic relief, but it was through the use of color infrared photography that the various paths were discovered. Ground verification and dating through small-

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scale excavations involved a fortunate combination of volcanic ash deposition and erosional processes. Possibly the most important message of this chapter is to point out that even such frail features as prehistoric footpaths can be detected, verified, and dated given favorable conditions and innovative research strategy.

Verification

It is one thing to identify an alignment from the air, but quite another to verify it as a prehistoric feature on the ground. This is especially true if nothing visible remains from a surface perspective, as is usually the case. Where intact segments or linear concentrations of rubble link sites or activity areas known to be prehistoric, the problem of verification is not so acute. However, when little remains of the original roadbed and there is little or no associated architecture, the task is made much more difficult.

Ground verification of roads generally involves two procedures. The first is intensive survey to detect intact segments or to plot artifact scatters, sites or other cultural features that are in direct association with the alignment of the basis of aerial imagery. The second is subsurface testing. Naturally there are a variety of survey strategies depending on local conditions and degree of preservation. In the La Quemada region, for example, the entire area was intensively surveyed and all visible sites, terraces, roads and other features were plotted. Another intensive survey specifically to discover roads missed previously was then conducted between sites thought to have been road-associated on the basis of maps produced early in the nineteenth century. In the second, a survey corridor approximately 75 m wide, centering on and parallel with the projected alignment, was examined between suspected points. Initially survey teams zig-zagged between the limits of this corridor with the purpose of crossing any vestige of the road at a near right-angle. When an intact portion or linear concentration of rubble was encountered, the corridor perimeter could be narrowed accordingly. This method proved to be highly effective because it often showed differences in rubble concentrations and occasionally minor features that were missed during the first survey.

Studies in the Chaco Canyon region regarding verification problems have been especially innovative. Many of these were addressed by the U.S. Bureau of Land Management during the first phase of the Chaco Roads Project. They are noteworthy because the procedures developed there are also applicable to many other geographical areas where aerial identification of routes is

far easier than ground verification. The reader is encouraged to consult Kincaid (1983) for a detailed discussion of methods, descriptions, and suggestions for standardizing architectural and morphological terms.

Conclusion

Although many New World roads were noted and described by naturalists and prehistorians of the last century, it is only with the refinement of discovery techniques such as aerial photography and remote sensing that their value as an analytical tool is realized. Long viewed as an antiquarian curiosity, their importance now lies in the fact that they can provide tangible evidence of cultural links across geographical space. As links, they touch on a variety of cultural manifestations in both a physical and a figurative sense. Physically, they are evidence for the formalization of a particular space between two or more points. This formalization reflects both the value of joining these locations and the ability or willingness of a particular society to do so. Figuratively, the study of roads, as with archaeological studies anywhere, must touch on a variety of related fields, including architecture, chronology, settlement pattern, physical environment and ethnohistory. The study of ancient roads, then, provides a focus that can structure research around itself, yet at the same time contributes to the whole of regional archaeology.

We have outlined a number of factors to be considered in this study. Among these are the extent to which route formalization can be used as an index of sociopolitical complexity and the degree to which morphology on both the micro- and macro level might reflect the purpose of the network. Also reviewed are discovery procedures, verification and analytical techniques, and problems regarding symbolic functions. The purpose of discussing these represents an attempt to identify and address what we feel are key issues that should provide a foundation for future research.

Notes

- 1 Navigable canals might also fall into this category but will not be discussed in this volume.
- 2 There is a dichotomy between construction and engineering. Construction includes any intentional modification of the land for the purpose of creating a route of travel. Engineering involves planning, design, and technical implementation. This would also apply to any features such as curbs or walls found in direct association (Nials 1983:6–26).

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Excerpt

[More information](#)**References**

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2 Paths and roads in evolutionary perspective

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Paths and roads provide an unusual opportunity to discover archaeologically the structure and function of prehistoric society. To Wallace (chapter 21), road networks are a “tangible paradigm” of a prehistoric society. The networks on the landscape are both a physical print of repeated economic and sociopolitical interactions and a model of proper order in society.

A point made repeatedly in this volume is that road systems are multifunctional (see especially Hirth, Santley, Folan, Hyslop, and Wallace). Roads provide routes for the transport of goods and labor in economic systems of exchange and in political systems of tribute collection. They provide ways along which people move and interact. Furthermore, roads are important ceremonial ways which social and political institutions use to symbolize and to make manifest their structural charter.

Paths and roads combine economic, social, political, and ritual functions. But this should not be surprising to us. Organizations in non-industrial societies are by their very nature multifaceted (see for example Dalton 1977 and Earle 1987). While analytically we separate out the different functions for study, ultimately the intertwining and mutually reinforcing nature of the functions is a hallmark of such societies (Earle 1987).

A typology of human ways seems overdue in archaeology, and the contributors to this volume accept in large measure the dichotomy between paths and roads adopted recently by Hyslop (1985). Paths are informal routes beaten by repeated individual movements of people across the landscape. Such routes tend to be highly irregular in layout as they twist to avoid obstacles that would require large-scale construction. Paths are characteristically redundant, with many alternative routes, each of low volume; their construction is unplan-