

Settlement Patterns and Their Meaning

Heartland of Cities. Surveys of Ancient Settlement and Land Use on the Central Floodplain of the Euphrates. ROBERT MCC. ADAMS. University of Chicago Press, Chicago, 1981. xx, 362 pp., illus. \$35.

Archeology, like cultural anthropology, has traditionally focused on the community (site or village) as its locus of research. The inadequacy of this approach is to be found in the simple observation that communities are almost never effective isolates but are articulated with larger-scale phenomena both spatially and temporally. The community cannot be understood in isolation from the larger system, nor can the characteristics of that system be extrapolated from the community. These problems are particularly acute in the study of complex systems.

What now seems a mundane observation has had a significant impact on archeological research design only in recent years. Robert McC. Adams has long been interested in processes of stability and change in complex social systems and has been a pioneer in expanding the spatial frame for their analysis.

Heartland of Cities is the third in a series of major studies by Adams on changing patterns of human settlement and land use in Mesopotamia. He presents a core of data on more than 1600 archeological sites and extensive associated irrigation features from an area of 6250 square kilometers of the central alluvial plain of the Euphrates. He draws additional data from his earlier work on the lower Diyala Plains east of Baghdad and from a study of the southern Euphrates area by Henry T. Wright, which accompanies the present volume as a valuable appendix. Within this large spatial frame, Adams traces developments over a span of more than 6000 years into the mid-13th century A.D.

Adams focuses on urbanism as one underlying and unifying theme of discussion. He does not see urbanism as a specific constellation of attributes or processes, but uses the concept as a descriptive device to characterize spatially and temporally varying patterns of population aggregation. He operationally

defines urban centers as settlements greater than ten hectares in size, perhaps corresponding to populations in excess of 1000 persons. He often refers to settlements in excess of 40 hectares as cities and to those in excess of 200 hectares as political capitals.

Urban centers, so defined, were present in the area by at least the latter portion of the fifth millennium as the result of poorly attested processes beginning with initial agricultural settlement perhaps as early as the sixth millennium. Uruk, a major center in the southern portion of Adams's core area, had grown to cover 400 hectares by the mid-third millennium, and fully 90 percent of the population of the region was urbanized.

Adams sees cities as the most stable component of the Mesopotamian social landscape. Multiurban political entities could be maintained for varying periods but exhibited marked fluctuation generated by external competition and internal dissension. Much of Mesopotamian history is thus characterized by the repeated failure of high-order regulators to maintain the integration of polycentric systems.

Given a largely urban power base, large urban size was an advantage in attempting to either forge or resist inter-urban relationships of dominance and subordination. A high degree of population aggregation had, however, a destabilizing effect on agricultural production. High aggregation under primitive transport conditions implied an intensification and localization of cultivation. Over-irrigation to ensure short-term yields led to salinization and long-term deterioration of productivity. Decreasing yields and increasing seeding levels reduced seed: yield ratios from 1:86 to 1:20 between the height of relative population aggregation in the mid-third millennium and a period of regional population increase in the early second millennium. This reduction of productivity was associated with increasing dispersal of population into smaller communities, a trend that continued into the ninth century B.C., when only 36 percent of a much reduced regional population was resident in settlements greater than ten hectares in size.

While great urban centers continued to flourish with their long traditions of literacy, arts, and Machiavellian politics, this increasing proportion of rural settlement emphasizes the importance of rural-urban relationships, another of Adams's main themes.

Chronic unpredictability of water availability made agricultural settlement of the Euphrates alluvium an exercise in decision-making under high uncertainty. Urban storage could dampen fluctuations in rural food supply and rural producers could contribute to the support of urban aggregates, but rural-urban relationships were highly unstable. Simply by their distance from the loci of urban power and authority, rural populations were much less easily controlled than urban ones.

Adams portrays a rural strategy of resilience, and the comparative temporal instability of such communities is seen as the product of response to shifting environmental or urban-generated social pressures. A mixed strategy involving both cultivation and animal husbandry was a key element in rural life, and Adams sees the ability to shift emphasis along a continuum between sedentary cultivation and mobile pastoralism as central to the maintenance of resilience. That the rural-urban relationship was one of varying mutual dependence did not imply coterminous interests, and rural populations were ever ready to take advantage of periods of urban political weakness.

Adams feels that full central authority was only seldom impressed on the rural landscape. The evidence from irrigation systems, for example, suggests that canal work was largely a local affair throughout most of Mesopotamian history. Evidence of extensive, centrally planned systems is particularly impressive in Sassanian times (A.D. 266-637) and must have had antecedents, but Adams sees little indication that these extended very far into earlier periods.

Expanding the spatial scale of analysis allows Adams to detect previously unexpected variability in settlement system spatial organization. The northern and southern portions of his core area, for example, exhibit striking differences in the fourth millennium that must reflect substantial variation in political and economic organization that would not have been evident from previously available data. Behavioral disjunctions or boundaries are observable in other periods and at a variety of scales, emphasizing important general problems of boundary formation and permeability that have yet to be the object of systematic study.

Although working at a large spatial scale has countless advantages, it requires acceptance of a substantial reduction in data quality in a field where several lifetimes could easily be devoted to the study of a single community. Adams acquired most of his data by surface survey and examination of air photographs. Uncertainty about the possibility of continuing fieldwork led him to employ a low-intensity survey method in order to maximize areal coverage. These data are supplemented by reference to the complex historical materials initially available from the early portion of the third millennium.

The sizes of the settlements occupied during the periods under consideration are the basic input to further analysis and interpretation. Adams reviews the many difficulties that beset estimation of areal, population, and functional size. These difficulties lead him to eschew utilization of a variety of location analytic techniques that have been applied by others to comparable data sets. He seems to be of two minds about the matter, however, in that he is willing to examine the implications of settlement rank-size distributions and other data manipulations that assume no lesser accuracy, or wishful thinking, in size estimation than do those he rejects as requiring greater data reliability than is currently available.

I suspect that this seeming analytical ambivalence is partially the product of a research strategy that focuses more on broad patterns of population aggregation and land use than on the organizational structure to which many location analytic techniques are sensitive. Yet it also reflects an unresolved problem in all studies of this kind. Regional-scale research is a comparatively new development in several fields of social science, and there is still little informed consensus on the constraints imposed upon analysis and interpretation by the necessary trade-off of data quality for spatial coverage. While some will find Adams's position on these matters to be fairly conservative, others are likely to think that he has already sorely strained the limits of reasonable interpretation.

Heartland of Cities is not a work without fault. Adams acknowledges that the organizing concept of urbanism he employs is of primarily descriptive utility. Systematic consideration of the organizational variables that facilitate or inhibit the integration of complex societies is notably lacking. Lesser matters that will be a source of specialist discussion abound, but this is inevitable in a study that ranges so widely. Yet for its scope in space and time, its synthesis of data from

disparate fields, and its articulation of research problems and results that are critical to our understanding of the development of complex societies, this volume will be of interest far beyond the often parochial confines of Mesopotamian scholarship.

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Unicellular Eukaryotes

Phytoflagellates. ELENOR R. COX, Ed. Elsevier/North Holland, New York, 1980. x, 474 pp., illus. \$50. *Developments in Marine Biology*, vol. 2.

Phytoflagellates are complex eukaryotic unicells, combining the common characteristics of photosynthesis by chloroplasts and motility by paired 9 + 2 flagella with a wide diversity of photosynthetic pigments, flagellar appendages, cell coverings, flagellar roots, cell symmetry, chromosomal and spindle organization, eyespots, photoreceptors, contractile vacuoles, chloroplast ultrastructure, storage metabolites, and Golgi and endoplasmic reticulum function, and having life histories involving spores, cysts, and a variety of sexual behavior.

These features are discussed for the major taxa of phytoflagellates by the contributors to this volume, with the main emphasis being placed upon ultrastructure in relation to cell function and phylogeny. The chapters on chlorophytes, prasinophytes, chrysophytes, xanthophytes, eustigmatophytes (the last two not phytoflagellate groups but included for their interest in relation to the others), prymnesiophytes, chloromonads, cryptophytes, and dinoflagellates provide modern reviews of the groups that will be valuable summaries for both teaching and research. The chapter on snow algae concentrates on ecological physiology, that on colonial chlorophytes surveys the group at the light-microscope level, that on euglenoids concentrates on research in progress on chloroplasts, eyespot pigments, and, especially, *Trachelomonas* envelopes, and most of the chapter on silicoflagellates is concerned with skeleton formation. Finally, the recurrent themes of origins, evolution, and relationships in the various groups are brought together in a concluding chapter by Stewart and Mattox on the phylogeny of phytoflagellates as a whole, and it is here that the

most controversial ideas are to be found.

Utilizing the mass of comparative data summarized by the 12 preceding authors, Stewart and Mattox postulate that phytoflagellates derive from zooflagellates rather than from photosynthetic prokaryotes. Early phytoflagellates would have been large, complex, predatory, non-walled (naked or scaly), asymmetric organisms, with these and other "animal-like" attributes (trichocysts, rhizoplasts, flagellar pits) being retained in many present-day forms. Origin of chloroplasts by symbiotic incorporation of prokaryotes into predatory zooflagellates is supported and the classical concept of origin of zooflagellates from phytoflagellates rejected (where evolution of heterotrophic from autotrophic forms is known, loss of pigments but retention of plastids is often found). It follows that the relationship between any two phytoflagellate groups is that between their respective zooflagellate ancestors. The characters that must be examined to establish the latter are types of mitotic spindle, the flagellar apparatus (the 9 + 2 axoneme assumed to be of common origin, with variations arising in root systems and flagellar appendages), cell surface and coverings, and mitochondrial type, the last emerging as the somewhat surprising key to the authors' basic phylogenetic solution. Characters are listed that are found in cells with either flattened mitochondrial cristae or tubular mitochondrial cristae but not both, Stewart and Mattox pointing out that chloroplasts of phytoflagellates with flat cristae always contain phycobilins or chlorophyll *b* whereas those with tubular cristae always contain brown or yellow pigments and lack phycobilins and chlorophyll *b*. This correlation is suggested to indicate that the type of mitochondrion present in the zooflagellate ancestor influenced the kind of photosynthetic prokaryotic endosymbiont that could become reduced and integrated to the status of chloroplasts.

On this precarious base, the authors erect a bifid phylogenetic tree with an ancestral flagellate without mitochondria or chloroplasts giving rise to organisms with (i) mitochondria with tubular cristae derived from endosymbiosed prokaryotes or (ii) mitochondria with flat cristae similarly derived. The same steps of spindle evolution occur in both lines, but type of prochloroplast symbiont is restricted. In the first line, "brown" symbionts lead to dinoflagellates, diatoms, chrysophytes, brown algae, prymnesiophytes, and xanthophytes, and the line also includes ciliates, myxomycetes, and oomycetes; in the second line, "phycosymbionts" lead to rhodophytes, cryptophytes, and chlorophytes.