Sociocultural Evolution in Mesoamerica

The Basin of Mexico. Ecological Processes in the Evolution of a Civilization. WILLIAM T. SANDERS, JEFFREY R. PARSONS, and ROBERT S. SANTLEY. Academic Press, New York, 1979. xiv, 564 pp., illus., + boxed maps. $49.50. Studies in Archaeology.

Mesoamerica is a place where civilization arose not once but in several environmentally diverse locations. This book by William Sanders, Jeffrey Parsons, and Robert Santley focuses on its manifestation in the Basin of Mexico, scene nearly 2000 years ago of the New World's first urban state of Teotihuacán. As recently as 1960, when Eric Wolf gathered a dozen of the most prominent Mesoamerican scholars for a conference at the University of Chicago, very little was known about Teotihuacán or, for that matter, about the Basin cultures that preceded or followed it. A participant in the meeting, Sanders recalls that its main purpose was "to foster research leading to an understanding of the role of the Basin of Mexico in the cultural development of Mesoamerica as a whole" (p. 3). Responding to that petition, Sanders announced his immediate intention to begin a settlement-pattern survey of the Basin, a task he initiated in June 1960 with an investigation of the Teotihuacán region. It has taken 15 years to complete the survey, which has profited along the way from the participation of two new generations of archeologists, Parsons and Santley among them.

The project began as one of several archeological field studies inspired by the success of Gordon Willey's surface survey of the Virú Valley in Peru. With a more comprehensive list of research goals than the Peruvian study, the collaborators faced a multitude of logistic problems in their attempt to define chronological, demographic, ecological, and functional parameters for all prehistoric occupations on the basis of visible surface remains. In the end an awesome 3500 square kilometers were traversed by foot, the Basin of Mexico survey thereby ranking as one of the most enterprising undertakings in Mesoamerican archeology. Because the project has been an important model for other settlement-pattern studies in both the Old and the New Worlds, several early chapters in the book that present a descriptive, historical account of how the survey was carried out are particularly interesting. The authors' straightforward, unreserved critique of their research design, methodology, and approach to data analysis should be required reading for every graduate student in archeology. Other chapters are more interpretative, synthesizing the massive amounts of data collected on temporal changes in settlement patterns, population, resource exploitation, socioeconomic integration, and ceramics.

Not all methodological issues have been resolved fully, a fact due in large measure both to the relative newness of systematic survey as a major research tool and to some inherent limitations of the surface record as a data base for the questions put to it. The authors explicitly recognize the kinds of errors that are introduced into their study by a necessary reliance on long phase durations that distort site contemporaneity, by the failure to detect sites or assess properly their extent in areas of deep alluviation, extensive erosion, or dense modern urban growth, and by the subjectivity involved in estimations of artifact density attributable to each of several occupational phases at a single site. While factors such as these influence the precision of a settlement-pattern survey, they should not detract from the general picture of settlement history in the Basin of Mexico except where their effects are measured disproportionately at archeological sites of a particular phase, class, or ecological zone.

The project's commitment to 100 percent coverage of the survey area has had both advantages and disadvantages. An obvious drawback, the great expenditure of research time and funds for this extensive foot survey, might have been mitigated by implementing an appropriate sampling strategy from the statistical procedures that have gained currency in regional survey. Santley, in an appendix to the book, found that none of the statistical methods he tested experimentally could provide reliable estimates of total population size, although other parameters of settlement pattern were reproduced satisfactorily. Increasing the sampling fraction from the 20 percent figure he used might have overcome this inadequacy.

As the authors themselves lament, some important areas of the Basin have been lost to archeological analysis because of the rapid urban growth of Mexico City while their survey was concentrated elsewhere. For the estimated 75 to 80 percent of actual arable land covered, however, the skillfully drafted settlement-distribution maps included with the text and the detailed site descriptions found in earlier publications of Sanders, Parsons, and Blanton afford rich sources of data for interpreting settlement history in the Basin. Already scholars other than the collaborators in the original project have submitted settlement-distribution data from the survey to statistical analyses designed to test specific hypotheses about processes of community growth and regional development. Among such studies can be noted the linear regression analysis employed by Brumfiel to explore the relationship between village size and availability of agricultural land and Earle's use of the nearest-neighbor statistic to chart changes in settlement pattern and their implications for political centralization.

In the present volume the settlement-pattern survey serves as the primary means of realizing two major objectives expressed at the inception of the project: to examine sociopolitical institutions as they developed in the Basin of Mexico's prehistoric past and to test the ecologically based model of cultural evolution that has interested Sanders for many years. In meeting these objectives the authors point out how their research design has suffered from a lack of appropriate general models from which to interpret the settlement pattern data they generated. Although some very sophisticated locational models that describe sociopolitical institutions in terms of hierarchical spatial relationships between communities have been developed by economic geographers for industrialized nations, the authors reject the applicability of such analyses to prehistoric societies in which market rules did not govern economic interaction. Thus, lacking alternative models from the anthropological literature, their detailed reconstruction of sociopolitical relationships relies largely on intuitive reasoning. In general the historical picture they have drawn seems credible, but specific interpretations often have little supporting archeological evidence or have an

ethnographically naïve basis. Measurement of politicization by monumentality of temples (p. 303) and inference of profit-oriented urban-rural market transactions from the superiority of Teotihuacán's architecture and artifacts (p. 357), to cite two particularly grievous examples, are convenient but hardly convincing as behavioral analogs of archeological remains. Had the research design called for more empirical testing of specific hypotheses about sociopolitical institutions through problem-oriented excavations, such as those conducted by Santley and Rosa Reyna at Loma Torremote, or by intensive, systematic surface collecting at selected sites, the conclusions to be drawn from it might have been more decisive.

The book is also a work of general theoretical interest, for the authors use its chapters to promulgate their views on the processes of social and cultural evolution. Those already familiar with the materialist evolutionary paradigm that Sanders has espoused for years can expect few surprises in this latest presentation. Its strength lies in the comprehensiveness with which the model is treated and in its attempt to accommodate or refute past criticisms that have been directed at it. Structured around the framework of Julian Steward's culture core concept and Karl Wittfogel's theory of despotism in hydraulic societies, the dynamics of the model have more recently been buttressed by economist Ester Boserup's ideas about the causal relationship of population pressure to agricultural intensification and by the hypothesis of Robert Carneiro dealing with the effects of environmental or social circumscription on political centralization and state formation. The authors propose that these hypotheses can all be subsumed under a trinity of "lawlike generalizations": the "law of biotic potential," the "law of least effort," and the "law of minimal risk." In a chapter written by Sanders (chapter 9), the theoretical paradigm is applied to the Basin of Mexico survey data to explain the development of that region's pre-Columbian settlement patterns and sociopolitical institutions. According to the model, sociocultural change originates as an outcome of ecological disequilibrium brought on by a population that has exceeded the effective carrying capacity of its environment. With respect to the semiarid Basin of Mexico, the cultural response to an impending food shortage was the initiation of a process of agricultural intensification that led to the development of irrigation technology. Irrigation extended an otherwise short growing season and provided a more secure and abundant harvest, albeit at a higher per capita work effort. To integrate the larger population supported by irrigation agriculture required socioeconomic, political, and ideological adjustments, among which were more formal and ultimately coercive systems of political control, socioeconomic stratification, full-time occupational specialization, population nucleation, and a religious system that justified the new social order. The culminating manifestation of this evolutionary process was Teotihuacán and the other urban states succeeding it in the Basin of Mexico.

As presented, the processual model portrays an essentially linear trajectory of change. Despite references made to feedback between the various components of an evolving cultural system, population pressure is treated as the underlying cause of increasing technological and social complexity. Explaining why such pressure should arise in the first place, the authors "strongly favor the position that population growth is a general phenomenon and human reproductive behavior generally is unlike that of most other species only in its tendencies towards sustained growth" (p. 364). The overall increase in population from Pleistocene times the authors call attention to cannot be ignored. There is little agreement, however, among anthropologists and demographers that such growth is characteristically sustained to a point of ecological stress. Others have argued with equal cogency that population disequilibrium, where observed, needs to be explained and not accorded some sort of teleological inevitability. The factors that account for population growth in any specific situation may be much more complex and particularistic than is suggested by the treatment of the process in this book as simply part of the human condition under an agricultural system of subsistence. Besides the possibly stressful demographic consequences of environmental change, we might consider specific economic adaptations, modes of political integration, and ideological constraints as variables that influence population growth. Historical demography provides numerous examples in which factors such as these create conditions that alter peoples' perceptions of the relative social and economic advantages of bearing large numbers of offspring. Unfortunately, such situations are difficult to trace archeologically.

Arguments in favor of a more comprehensive model of causality are quite familiar to the authors, who here reject them with the caveat that "useful theory must be simple theory" (p. 360). With Occam's razor they want to isolate the few variables that best explain most of the sociocultural complexity and at the same time circumvent the mechanical problems involved in operationalizing a larger number of variables. This goal is seen to be best approached through a simplified form of "multilineal paradigm" in which population growth is the independent variable that initiates and sustains the process of evolutionary change. Falling victim to the seductive elegance of parsimony are such potentially significant factors as ideology and interregional exchange, factors that elsewhere in this volume are considered by the authors to have been important integrative mechanisms. Indeed, excavations at Loma Torremote suggested to them that competition among Basin polities for control of the supply, production, and distribution of obsidian, rather than population pressure, may have "provided the principal impetus for large-scale habitation of the Teotihuacán Valley" in the last centuries B.C. (p. 334). If commodity procurement considerations could have figured so importantly at that time, surely they ought not to be ignored during other phases of the Basin's development. Yet Sanders, Parsons, and Santley reject out of hand any processual role for interregional trade in the model of sociocultural evolution presented in their chapter on theoretical implications of the survey.

In our view this narrow regionalism is the spatial dimension of the reductionist approach the authors have taken to theory. No effort is made to place the prehistory of the Basin of Mexico within the context of developments elsewhere in Mexico. Just as we learn little about the impact Basin cultures had on their contemporaries outside of Central Mexico, so we are left largely ignorant of the role other cultures may have played in the course of local events. In the Basin's early settlement history, for example, outside pressures manifested in an intrusive Olmec presence could have accelerated the pace of sociocultural development, but the only mention made of the Olmec is in passing reference to the art style they inspired (the word Olmec does not even appear in the index of the book).

But a study as far-reaching as this inevitably leaves itself vulnerable to those who would harp on its methodological and theoretical shortcomings. We may have fallen into that trap in this review, leaving an unbalanced impression of what is a very important book. Let us at-

tempt, in closing, to redress that injustice. *The Basin of Mexico* is, in our opinion, a landmark study of sociocultural evolution, a synthesis of grand scale dealing with a phenomenon of intimidating complexity. The reader may agree or disagree with the reasoning concerning how and why civilization arose in the Basin, but one cannot help admiring the vision and doggedness that led the collaborators in this research endeavor to acquire the massive amount of information upon which their interpretations rest. We finished reading the book feeling that the authors intended to both enlighten and provoke their colleagues with the model of evolution they argue. There is no doubt that they have succeeded in both respects and that future research into the processes of evolution in the Basin of Mexico and elsewhere will benefit from the rich store of data and ideas they have given us.

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Nuclear Collective Motion

Interacting Bosons in Nuclear Physics. Proceedings of a symposium, Erice, Sicily, June 1978. F. IACHELLO, Ed. Plenum, New York, 1979. x, 192 pp., illus. $29.50. Ettore Majorana International Science Series, vol. 1.

We have known for more than a quarter of a century that complex nuclei can have nonspherical shapes and rotate like a (quantum) top. Almost independently their relatively well defined surfaces can be set into definite modes of vibration. Such restricted states of motion, representing only a tiny fraction of all the conceivable motions of such complex systems, were first described phenomenologically by the famous Bohr-Mottelson theory of collective motion, which continues to this day to be a serviceable vehicle for the interpretation of a wide range of data. From the outset, theorists took up the challenge of deriving the model from the more fundamental shell model of neutrons and protons, an enterprise that has generated a number of qualitative and even quantitative successes.

Though not a restriction of principle, the phenomenology has emphasized the quadrupole degree of freedom of the nucleus, either "frozen in" as an ellipsoidal nuclear shape or alternatively taking the form of time-varying surface distortions, because these are the excitations that dominate the low-energy behavior of the nuclei in question. Because such nuclei have also been known since 1957 to be superconductors, it has usually proved convenient to incorporate in the working out of the fundamental theory methods borrowed from the theory of metallic superconductivity. Thus the (monopole) coherent motion responsible for superconductivity is differentiated sharply from the coherence manifested in the quadrupole degree of freedom, the former providing a substrate and the latter excitations on that substrate.

About five years ago Akita Arima and Franco Iachello suggested a new phenomenology in which the monopole and quadrupole degrees of freedom were treated on an equal footing, as interacting components of the nuclear fluid. In their model, as in the Bohr-Mottelson model it aims to supersede, the fundamental entity is the boson, but now there are two kinds, which interact and influence one another. In the interacting boson theory, as opposed to the previous theory, the finite number of particles plays an essential role because the bosons are identified with pairs of nucleons; we regain the Bohr-Mottelson model only as the number of particles is imagined to increase without limit.

The volume under review contains a complete and authoritative account of the status of the theory as of June 1978. The interacting boson model has gone through two versions during its short existence. The first model, by being couched in suitable group-theoretical language, was able to call attention to certain limiting "dynamical symmetries" of classes of nuclei, at least one of which had been completely neglected previously. Without losing sight of these symmetries, a second version, in which neutron and proton bosons are given separate recognition, led to improved quantitative agreement with experiment. The first half of the volume is devoted to a confrontation of these models with a wide range of experiments. The results are truly impressive and herald a new era in the theoretical interpretation of nuclear collective motion.

Once more theorists must face the challenge of tracing the genesis of the interacting boson model in more fundamental theories. As I previously remarked, in broad terms this genesis has been clear from the beginning; the constituent bosons are really pairs of neutrons or protons in one of several highly correlated states of relative motion. These pairs, acting as units, also interact with one another. The parameters measuring this interaction vary slowly from nucleus to nucleus and account for the gradual change of symmetry class, only a few nuclei exhibiting anything resembling a limiting symmetry in pure form.

In the second half of the volume a number of generally interesting and informative papers deal with these issues, with limited success at best. A fundamental, perhaps the fundamental, problem, that of deriving the observed bosons, remains unsolved. Remarkably, there is a similar problem in the interpretation of the Bohr-Mottelson model, where it has been dealt with more by fiat than by cogent deduction, though there too it is the heart of the matter. In the reviewer's opinion these difficulties are not insuperable, and one may soon expect substantial advances in the theory.

The beautiful new developments, well described in this volume, remind us that nuclear physics is still a young subject.

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Primate Socioecology

Primate Ecology and Human Origins. Ecological Influences on Social Organization. Papers from a conference, Burg Wartenstein, Austria, Aug. 1977. IRWIN S. BERNSTEIN and EUCLID O. SMITH, Eds. Garland STPM Press, New York, 1979. xviii, 362 pp., illus. $24.50. Garland Series in Ethology.

In 1957, Paul Fejos, the ingenious first director of the Wenner-Gren Foundation for Anthropological Research, Inc., negotiated the purchase and supervised the modernization of a 12th-century Alpine castle to which exclusive groups of scientists were invited and where they were incarcerated for a week or more while they intensively discussed a wide range of anthropological topics. The Burg Wartenstein conferences on human evolution were particularly successful. Some of them provided major impetus for paleoanthropological and primatological research over the past two decades.

The stresses of confinement in the castle were mollified somewhat by gracious hostesses, a substantial Viennese cuisine, an evening cocktail bar, and a Heuriger near the end of each conference. Bernstein and Smith must have struck the right balance between the