The Prehistory of Central Mexico

Prehispanic Settlement Patterns in the Southern Valley of Mexico. The Chalco-Xochimilco Region. JEFFREY R. PARSONS, ELIZABETH BRUMFIEL, MARY H. PARSONS, and DAVID J. WILSON. University of Michigan Museum of Anthropology, Ann Arbor, 1982. xvi, 504 pp., illus. Paper, $16. Memoirs of the University of Michigan Museum of Anthropology, no. 14.

Twenty years ago a group of archeologists initiated a long-term project of systematic settlement reconnaissance in the Valley of Mexico. Since that time this project has done more to shape our understanding of pre-Hispanic society than any other single research effort in central Mexico. Perhaps no other investigator has logged more pedestrian miles in directing these settlement surveys than Jeffrey Parsons. In this volume he and his colleagues discuss the results of their reconnaissance in the Chalco-Xochimilco region. It is in many respects an exemplary volume in demonstrating how archeological method and theory successfully can be combined with ethnohistoric and historic data to produce a synthetic, diachronic statement on pre-Hispanic adaptation and development.

The authors begin with a review of relevant background data, and in five separate chapters they present the general project objectives, the natural environment, and the fieldwork methodology as well as synthesize available information on ethnohistoric and post-Hispanic settlement patterns and demographic trends. When they compare their archeological data with ethnohistorically known settlement patterns they make the important discovery that several documented centers of social and political influence during the 16th century are not manifested archeologically as large nucleated sites with major ceremonial architecture. The authors do a superb job in discussing the relationships between pre-Hispanic, colonial, and present-day settlement patterns, and the study is an excellent example of how present-day and historic information can be used to interpret the continuity and change in regional population organization. In part, the ability of the authors to use 19th- and 20th-century settlement data for interpreting the past is based upon their concern for site visibility vis-à-vis ongoing natural and cultural site destruction processes operating at the regional level since the 16th century.

The volume discusses regional settlement dynamics that cover nearly three millennia of settled village life (1300 B.C. to A.D. 1521) and groups it into five major phases. The first of these is called the Pioneering Stage (1300 to 300 B.C.) and is characterized by population growth, a preference for settlement location in the well-watered piedmont zones, and the appearance of regional social hierarchies by the end of the period. An episode of settlement contraction characterizes the period between 300 B.C. and A.D. 200. The forces operating during this period include the growth and destruction of the major site of Cuicuilco and the complete abandonment of the study area during the Tzacualli phase when Teotihuacan became a major urban center in the northern Valley of Mexico. The authors discuss both the methodological and the theoretical issues associated with postulating regional abandonment during the Tzacualli phase. It is significant to note, however, that Tzacualli-phase ceramics have been recovered by this reviewer in both surface and stratigraphic contexts in eastern Morelos. The shortest and most likely route these materials could have traveled to reach Morelos is along the Chalco-Amecameca corridor. The presence of Tzacualli ceramics in Morelos supports the abandonment hypothesis, since it is unlikely that Teotihuacan trade wares could have passed through the Chalco region without leaving a trace if the area was occupied. A period of settlement recolonization occurred between A.D. 200 and 750; although the area was clearly under the control of Teotihuacan, settlement density is too low to suggest that it was actively involved in the production of agricultural surplus for urban consumption. A period of localized population growth occurred between A.D. 750 and 1350 after the decline of Teotihuacan's pan-Mesoamerican power base. The authors document a significant shift in population location into the lacustrine zone, which they suggest marked the beginning of chinampas (marsh reclamation) agriculture throughout the region.

This volume contributes greatly to Aztec archeology, a subject long neglected because of the precocity of the ethnohistoric record and the interest of investigators in the origins and development of complex society in Mesoamerica. It was during the final, or Late Postclassic, period that the Chalco-Xochimilco region became the breadbasket of the Aztec empire, a development that the authors correlate with the intensification of large-scale chinampas agriculture. This is a period (A.D. 1350 to 1520) of dramatic demographic growth with regional population densities equaling those of the early 20th century. Community-focused population clusters disappear during this period, and the authors suggest that this occurred as landless tenants (mayeque), introduced onto the private estates of powerful nobility, began to compete with the calpulli as the main land-holding unit in society.

The volume is well balanced in the description and analysis of the basic data obtained during the survey. It includes thorough descriptions of all sites and associated architecture encountered. Investigators who have conducted settlement surveys elsewhere in the world will appreciate the summary of ceramic criteria used to date the sites, since surface materials are often heavily weathered and hard to characterize. The description of the Acalpixcan monuments by Joyce Marcus is a valuable contribution to Aztec-period iconographic studies. All aspects of the settlement discussion are accompanied by a lavish array of tables, figures, and maps that help guide the reader through discussions of demographic trends and the effects of both natural and cultural variables on the configuration of settlement. It would have been helpful, however, if the authors had provided some measure of colinearity among the independent variables used to examine settlement regularities, since the strength of causal relationships is not always clear.

As part of the analysis the authors generate relative population estimates for sites in the region on the basis of a correlation of site size (in hectares) with subjective estimates of artifact densities. Though the derivation of population estimates has been the subject of lively debate among archeologists, this reviewer finds them to be appropriate for the following reasons: (i) the population estimates are relative indices of occupation activity and are presented as bracketed figures of minimum and maximum densities; (ii) the estimates are conservative approximations of settlement activity the uppermost limits of which are 20 percent lower than population estimates produced by the use of ethnohistoric documents; and (iii) although all methods of site comparison currently used suffer

from the same shortcomings, the estimation procedure used by the authors provides them with a means of differentiating degrees of dispersed and nucleated residence.

This study underscores the contributions that settlement reconnaissance and the regional perspective can make to unraveling human prehistory. The authors have done an excellent job in producing a technical yet highly readable reconstruction of demographic processes in the southern Valley of Mexico that will be a valuable reference for many years to come.

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The Rotation of the Earth

Tidal Friction and the Earth's Rotation II. Proceedings of a workshop, Bielefeld, Germany, Sept. 1981. P. BROSCHE and J. SÜNDERMANN, Eds. Springer-Verlag, New York, 1982. xvi, 346 pp., illus. Paper, $28.

To emphasize the fascination of the subject of tidal friction is to risk the charge of banality. Yet it needs to be done, for few subjects in the earth sciences require that such a breadth of disciplines be mastered before a complete understanding can be approached. This volume attests to the continuing appeal of an old problem: the search for an understanding of the orbital evolution of the moon and the spin history of the earth. But, one may ask, why one more volume on the subject? What, for example, has been learned since the publication of its predecessor in 1978 or, for that matter, my own book on the subject in 1980?

Evidence for the tidal acceleration of the earth's spin and the moon's orbital motion comes from quite diverse and even unexpected sources: from telescope observations of relatively recent times, from ancient and medieval records of times or places of astronomical phenomena such as eclipses and occultations, and, further back in time, from the paleontological clocks. All sources have been much explored in recent years, and all point to a day that was shorter in the past than it is now and a moon that was closer to the earth than it is now. Dispute lies not here, but in exactly where the moon was at specified times in the geological past. If present-day values are used to extrapolate the motion back in time—there is a useful review of this problem by F. Mignard in this volume—the unpalatable conclusion is reached that the earth and the moon must have barely escaped from a collision course some 2 to 1.5 billion years ago. This close encounter is sometimes referred to as the Gerstenkorn event. (Incidentally, this book is dedicted to Gerstenkorn.) The event conjures up planet-disrupting tides (W. Munk, *Q. J. R. Astron. Soc.* **9**, 352 [1968]) in which, to borrow a phrase from the Prayer Book of 1662, "the earth shall melt away." Yet the moon escaped unscathed. If the event occurred, it must be pushed back to the darkest ages of the solar system. Still, the Gerstenkorn event pervades the volume, possibly because it is an event that can be evaluated to a degree by celestial mechanicians, possibly because the book has a startling lack of discussion of chemical considerations of the lunar origin. Only one paper, by H. Wänke and G. Dreibus, discusses the lunar chemistry, and it is tucked away at the end of the volume. Yet the chemical evidence that the moon formed near or out of the earth at a very early stage (A. E. Ringwood, *The Origin of the Earth and Moon*, Springer-Verlag, 1979) must form the essential boundary condition on spin and orbit evolution calculations.

How then is the mathematics reconciled with the chemistry? That the bulk of the tidal energy is dissipated in the oceans is now established beyond any serious doubt. But with "continental drifters and pole twisters" ruling the earth sciences, unpredictably changing the ocean's tides, the assumption of constancy of tidal friction can hardly be sustained for any length of time. The problem of time scale cannot be solved unless we can establish geological markers of the moon's journey in space or past tidal patterns on earth.

Paleontological time keepers, the growth rhythms of corals and bivalves, heralded a new set of such markers, but after the initial enthusiasm no new results have appeared. The growth habits of even ordinary cockles are more complex than initially thought, as is emphasized by T. Ohno. Several authors refer to the stromatolite evidence for past tidal cycles. But here the evidence is tenuous indeed. Certainly the living Hamelin Pool algal mats do not appear to obey the tides in their growth habits.

To reconstruct ocean dissipation models back in time, the mechanism by which dissipation occurs must be known and past configurations of the oceans must be charted. Surprisingly little attention is given in this volume to the actual manner in which energy is dissipated. Common wisdom still has it that it is by bottom friction in shallow seas. But mathematical solutions rely on linear friction models or on internal friction laws to maintain numerical stability. This contradiction is largely ignored in the search for quantitative estimates of past dissipation. Two approaches have been used. D. J. Webb demonstrates with a simple geometrical model how the resonance frequencies of the oceans can change with the shifting of the orientation of much simplified ocean basins relative to the lunar orbit. The essential result is that there is little difficulty in keeping the moon away from the earth. More ambitious models are proposed by J. Krohn and J. Sündermann, who attempt to model the tides from paleo-ocean reconstructions, although two papers warn about the inadequacy of the paleogeographic maps. Perhaps the final subsection of a long and otherwise mostly irrelevant paper by J. D. A. Piper is a useful reminder that the present ocean-continent configuration is unusual, that for long time intervals the continental crust was concentrated in high latitudes and characterized by restricted shorelines. Such a geometry will lead to much reduced dissipation, as is emphasized by Webb. Quite clearly, protagonists of an early formation of the moon near the earth need not lose sleep over the implications of this volume.

On the shorter time scale, of millennia rather than eons, the evidence for tidal friction comes from the myths, literature, and history of humanity. The debate here deals with which category a particular record falls into. F. R. Stephenson and L. V. Morrison discuss this in what is, in my mind, the outstanding paper in the volume. They note that Fotheringham's classic analyses are based on eclipse records that are now believed to fall into the category of myths, or are based on erroneous interpretations of the date and place. Yet the irony is that Fotheringham's result for the accelerations is not that different from that obtained by these authors. Have we all been fooled by a classicist? Stephenson and Morrison contribute some important new data in the form of timed lunar eclipses for the period 700 to 50 B.C. They also report on some new observations for the period A.D. 1620 to 1860 to supplement the older analyses of telescope observations. On these time scales tidal friction is not expected to undergo any significant change. Rather, these observations point to changes in the earth's rotation on the time scale of centuries and decades. Some indirect reference to the geophysics of this prob-