have been identified in Nubia. Their Egyptian records may be best displayed in the Fayum Depression. Setting aside Pleistocene gravels of uncertain origin, the first unambiguous record of a Nile-fed lake (Paleomoeris) may be contemporaneous with Arkin aggradation in the valley. A succeeding series of lake stages may reflect younger episodes of high flood stages on the Nile. Associated archeological sites allow the inference, based on radiocarbon dating, that the shift from Terminal Paleolithic (Qarunian) to Neolithic (Fayum A) occurred between 5200 and 4000 B.C. The magnitude of the change and the short span of time argue for introduction of the Neolithic by outsiders.

Those specialists who are competent to sift the compendious data and to make their own evaluations of the central thesis will be deeply indebted to the authors of *Prehistory of the Nile Valley* for bringing together so faithful a record of the data. And they will surely admire them for cutting vistas through the dense thicket of data toward an overview of Late Paleolithic occupation in the Nile Valley.

Early Hydraulic Civilization in Egypt is a reexamination of the interplay between a dynamic floodplain environment, technological development in floodplain management, and population growth.

The origins of civilization in the agricultural settings of the Near East have long been a matter of interest and speculation. In the context of older views of climatic history, the Nile floodplain was seen as inhospitable to settlement when "pluvial" climates made the deserts habitable. Only "postpluvial" desiccation led people first to the floodplain margins and, finally, to the difficult task of reclaiming the bottom lands. Stabilization of food production required the development of artificial irrigation. The difficulty and complexity of both reclamation and irrigation required cooperation and the development of new social orders.

In fact, the natural environment of the floodplain was never inhospitable. As we now know, the Nile floodplain was continuously occupied during Late Paleolithic time. Intensive gathering activities are documented as early as 12,500 B.C., and indigenous domestication may well have begun before 5000 B.C. The "Neolithic revolution" was introduced by outsiders to an environment occupied by peoples who had long experimented with the necessary elements. The question may be why it was so long delayed.

Agriculture in Egypt began in an environment already suited to its practice. Extensive "reclamation" was not necessary. Artificial irrigation, or flood basin management, was practiced by the first dynasty. The existence of monumental architecture indeed suggests an already stratified society. Nevertheless, irrigation probably long continued to be administered through continuing local traditions, by a predynastic organization of nomes (floodplain districts) rather than by a centralized bureaucratic authority. That authority arose for reasons other than floodplain management.

Even though traditional views of the origins of civilization may be simplistic, the influence of environmental factors in the development of Pharaonic Egypt need not be depreciated. Development of central authority may have made it possible to expand from the smaller, more easily managed flood basins of the early nomes into the larger basins of the middle reaches of the valley and northward into the delta. An ability to modulate the disastrous effects of excessive floods or flood failures led to gradual extension of central authority. Maximum development and peak population were achieved only after introduction of the waterwheel in the first century A.D.

Butzer's rich and provocative discussion of these phenomena holds reward for a broad spectrum of readers interested in man and his environment, as well as for Egyptologists. It is a pioneering study. May studies of other floodplain environments be done with such sophistication and skill.

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Archeological Inference

Spatial Analysis in Archaeology. IAN HODDER and CLIVE ORTON. Cambridge University Press, New York, 1976. x, 270 pp., illus. $19.50. New Studies in Archaeology.

How can we make trustworthy inferences about past human activities from the durable remains that are accessible to us? This is the central problem of archeological method, and the possibilities for creating and testing archeological theory depend on our success in dealing with it. Hodder and Orton have produced an intelligent, reasonable, and timely book addressed to a major aspect of the key problem. Their concern is with deducing spatial processes, such as colonization movements or modes of exchange, from the evidence provided by spatial distributions of artifacts, settlements, or other archeological data.

The chapters deal systematically with methods of objectively assessing departures from random distribution in point patterns, settlement pattern studies, the distribution of single artifact types, associations between distributions of two or more types, and relationships between sites and other features. The kinds of techniques discussed include quadrat and nearest-neighbor methods of point pattern analysis, regression analysis (including single-log and double-log distance decay functions), random walk simulations of artifact dispersal, trend surface analysis, spatial autocorrelation, central place theory, gravity models, and techniques for expressing associations between spatial distributions.

A number of difficulties are discussed. These include uneven survival of evidence, sketchy or spotty research coverage of most parts of the world, and doubts that can be raised about the applicability of statistical significance tests in many commonly encountered archeological situations. I believe that although these difficulties are troublesome they are conceptually straightforward. We should (as Hodder and Orton urge) take account of regional factors that affect data survival, we should plot locations where there is clear evidence that phenomena are absent as well as locations where they are present, we should make much greater (and more costly) efforts to study whole regions in a thorough and uniform way, and statistical naïveté must be avoided.

But the more fundamental problem is, as Hodder and Orton put it (p. 239), "that different spatial processes may produce the same spatial form." Therefore, even a very good fit between archeological data and the spatial pattern that would be produced by a specific postulated process is not in itself strong evidence that something close to that process actually took place. It is necessary also to compare the fit of the data to patterns implied by alternative processes, and it is vital to identify (if possible) minor differences in superficially similar patterns, where these minor differences are diagnostic of different generating processes.

For example (pp. 86–97), a negative binomial distribution is generated by a "contagious" process of settlement spread, in which each occurrence increases the probability of further occurrences nearby. But a negative binomial distribution can also be generated if settlements are located by a random process with random variations in the local probability density of occurrences. This "spurious contagion" process may be distinguishable from true contagion by

observing how estimates of distribution parameters change when quadrat sizes are systematically varied. Hodder and Orton test this approach with data on three phases of early Neolithic settlement in Poland. For the two earlier phases, the data fit a true contagion model distinctly better than they fit the spurious contagion model, while for the third phase there is little to choose between the two models. There is, thus, some evidence for an initial stage of contagious growth leading to the expansion of clusters of settlement and finally to a more dispersed pattern of sites with local variation in density.

Hodder and Orton give a number of further examples of successful, or at least encouraging, results in their discussion of other techniques and other data sets. But in other examples they candidly conclude that, at least with the data and techniques available to them, the results are about equally compatible with two or more quite different spatial processes. The impact of this is not disheartening. Rather, it makes their successes all the more convincing and impressive. Their method stands in sharp contrast to the embarrassing tendency, shared by many "avant garde" as well as more traditional archeologists, to treat a fairly good fit (or sometimes even a fairly poor fit) of data to a single hypothesis as strong confirmation of the hypothesis, without considering the fit of the data to alternative hypotheses. I believe that Hodder and Orton are on the right track and that their strategies are a model of the approach we need for creative and solid advances in archeological method. We are still far from exhausting the possibilities for reliable inferences about ancient activities.

The book is not so strong on theory. The processes envisioned for testing have mostly been suggested by economic geography, economic anthropology, and ecology, but they seem to reflect a less rich set of ideas about human behavior than can be found in those disciplines. Some are downright simplistic, such as the suggestion that "objects of high value and/or low local demand might be expected to cover a wider area than objects which were of lesser value or which were used frequently" (p. 186). This is probably a consequence of the tendency for British archeologists to be trained without much emphasis on sociocultural anthropology or other social sciences. For the present book it is not a crippling defect, but it does mean that the value of the book is squarely in the domain of method. Users will mostly have to supply their own theory.

The discussions of the procedures seem technically sound, and a wide range of useful techniques are covered. The mathematics requires only high school algebra, but many sections will be hard going for readers without at least an introductory semester of statistics. No other book deals so comprehensively with archeological applications of formal methods of spatial analysis, and archeologists should find it extremely valuable. It will also be of interest to geographers, ecologists, geologists, and others concerned with spatial analysis.

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Analytic Techniques

High-Resolution Laser Spectroscopy. K. SHIMODA, Ed. Springer-Verlag, New York, 1976. xiv, 380 pp., illus. $39.80. Topics in Applied Physics, vol. 13.

Since the invention of the first ruby laser in 1960, a number of new techniques for high-resolution laser spectroscopy have been developed. The new methods were originally used only on a few atoms and molecules that happened to match the limited tuning range of the available lasers. However, in recent years rapid progress in the development of widely tunable lasers has opened up possibilities for widespread application of these techniques. Hence the publication of this book is timely.

The book consists of eight chapters by nine authors, including ones from Japan and the Soviet Union. Each author has been instrumental in developing the technique he discusses. Five experimental methods are covered in the book: atomic-beam laser spectroscopy, saturation spectroscopy, three-level laser spectroscopy, quantum-beat spectroscopy, and two-photon spectroscopy. These techniques often yield a spectral resolution of one part in 10^8 or better. Hence, the book has a discussion of the fine details of various line-broadening processes that might limit resolution or be of interest in themselves. These topics do not encompass all the recent advances in high-resolution spectroscopy, but, in my opinion, the editor has done a remarkable job of choosing the most important ones and the appropriate researchers to discuss them and of integrating the material into a coherent monograph. The lack of consistent notation between chapters is slightly disconcerting although in some places the authors have tried to compare their notations.

The book provides comprehensive information about the subject for both beginners and experts. The expert will find details that are not present in the many shorter publications on the subject and may also find ideas for new experiments. In addition, the perspective provided by the book may help a researcher decide on a technique to be used in a specific situation.

The presentations are sufficiently elementary and complete to enable the beginner to understand many of the details of the new techniques although he or she may want to have a general work on quantum electronics handy, as the derivations of theory are often sketched rather than rigorously developed.

Professors teaching courses in quantum electronics could also use this book. No adequate textbook for such courses exists, and supplementary material must be used. This book is the place to go for reference material on high-resolution spectroscopy. In particular, Shimoda's treatment of line broadening and narrowing effects is a good supplement to that in the standard textbooks, with information for students at all levels of expertise.

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Advances and Technical Standards in Neurosurgery. Vol. 3. H. Krayenbühl and eight others, Eds. Springer-Verlag, New York, 1976. x, 154 pp., illus. $29.60. *To order this book circle No. 398 on Readers' Service Card*

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