NEWS AND VIEWS

Archaeology using Mathematics

ONLY twenty years ago the notion that mathematics could play a significant part in archaeological or historical thinking seemed paradoxical. The book of nature might be written in the language of mathematics, as Galileo remarked, but history and prehistory concern themselves not with solid bodies or molecules but with human beings, and a quantitative approach was not considered appropriate or indeed proper. The newly published proceedings of the Anglo-Romanian conference, *Mathematics in the Archaeological and Historical Sciences* (edited by F. R. Hodson, D. G. Kendall and P. Tăutu, Edinburgh University Press, 1971) demonstrate very effectively how far archaeology has travelled since those days.

With the publication in 1951 (W. S. Robinson and G. W. Brainerd, *American Antiquity*, **16**, 293) of a numerical method for setting assemblages of archaeological objects in chronological order ("seriation") a serious effort was made to formulate explicit procedures for some of the tasks in archaeology formerly intuitively undertaken. More recently, and under the influence of developments in related disciplines summarized in works such as Peter Haggett's *Locational Analysis in Human Geography* (Arnold, London, 1965) and *Numerical Taxonomy* by Robert R. Sokal and Peter H. A. Sneath (W. H. Freeman, San Francisco, 1963), a wide variety of quantitative techniques has been applied in archaeology, with some measure of success.

The results, as well as providing a series of new insights into the past, have certainly proved controversial. On the one hand zealots have emerged who foresee the transformation of the whole subject of prehistory into an ordered hierarchy of law-like statements, many of them formulated in quantitative terms. They look towards the day when "archaeological general theory" will command the same wide respect as the logical organization of more developed sciences such as physics.

At the other extreme stand the recalcitrant innumerate, proclaiming themselves the last defenders of humanism. Some of the fears of this committedly "humanist" school of thought have been very cogently expressed in an article by Jacquetta Hawkes, "The Proper Study of Mankind" (*Antiquity*, **42**, 255; 1968), where, speaking of mathematics and the sciences in general, she sees a difficulty "in preventing the scientific and technological servant from usurping the throne of history".

The 1970 conference illustrates well how both these extremes are misguided. The occasion was the first time that such collected mathematical expertise has been brought to bear upon archaeological problems (with the possible exception of the conference papers published by the Centre National de Récherche Scientifique in 1970 under the title *Archéologie et Calculateurs*). The maturity in approach is best seen in the relatively restricted nature of the problems tackled. There is no tendency to grandiloquence, no attempt to set up widely or universally valid models for human behaviour in the prehistoric past. Nobody need feel that the throne of history has been usurped, nor that archaeology has been transformed overnight into one of the natural sciences.

Instead specific technical problems were considered, notably in the fields of taxonomy, multidimensional scaling, seriation and the study of evolutionary tree structures among written documents, languages and human evolution. As one contributor aptly remarked, "there exists no mathematical history and no mathematical archaeology but only history using mathematics and archaeology using mathematics". Naturally some of the approaches are novel—for example, the contribution using decision theory to construct "A Model of Michael the Brave's Decision in 1595"—and others, such as "A New Approach to a Problem of Chronological Seriation associated with the Works of Plato", seem at first sight (and without good reason) slightly incongruous for their use of numerical methods in what may be unexpected fields.

Probably of greater significance than these departures, however, is the success which numerical methods are now having in the classification and ordering of archaeological materials. Indeed it seems that many of the outstanding early problems in the sorting of artefacts into meaningful clusters, or in ordering them into chronological series, have now been solved. This is of fundamental importance to the palaeolithic period especially, where so much of the available evidence is in the form of assemblages of chipped stone tools. These can readily be compared using a number of measurable and comparable variables, often in terms of the concepts of "similarity" and "distance", central to numerical taxonomy. Techniques have been developed which allow of far better and more efficient classifications than could ever have been produced by traditional methods.

Mathematics, then, is proving useful in solving a number of problems in archaeology, and their range is bound to increase. There is nothing astonishing or threatening in this, nor is the whole nature of archaeology being transformed. The rather artificial boundaries sometimes thought to delimit the proper fields of interest of the mathematician and the archaeologist are disappearing, and there is a good deal of common ground. Now that the dusts of controversy are beginning to settle, it is possible to see that mathematical techniques are taking their place beside those of physics and chemistry as valued and indispensable aids to the archaeologist.—From our Archaeology Correspondent.

Plasmas and Lasers

IN the past decade the scattering of a laser beam from density fluctuations in a plasma has become one of the most reliable and respected techniques in plasma diagnostics. In this type of measurement the free electrons are the scattering agents and, in principle and often in