reviews

Prehistoric standing stone sites

E. MacKie

Sun, Moon and Standing Stones. By J. E. Wood. Pp. 217. (Oxford University Press: Oxford, 1978.) £6.95.

FOR some time now there has been a clear need for a book which presents the findings of the 'archaeoastronomers'—and this means mainly Professor Alexander Thom and his family—on the British prehistoric standing stone sites to the informed general public (an audience which, in this particular case, includes much of the archaeological profession). Thom's discoveries are among the most important and controversial to have confronted prehistorians for many decades: they concern the intellectual qualities which, he claims, lie behind the design and positioning of the stone circles and standing stones and are of a kind which, if accepted, must completely alter our picture of Neolithic British society. Thom's work is, however, couched in highly technical and mathematical terms and can be hard going even for those reasonably competent numerically—though the rewards for perseverance are great.

Dr Wood has succeeded admirably in his task. Here is a lucid, carefully composed and balanced account of the findings of the archaeoastronomical school which makes even the most difficult of these ideas reasonably plain. After reading chapter 7 the reviewer found himself for the first time—after eleven years of experience of this field—with a fair grasp of Thom's theory of the use of the fan-shaped stone rows. This is that they were ancillary apparatus at some lunar observatories which could be used to determine the moon's extreme monthly declinations by extrapolation from the actual observations.

Dr Wood has many sensible things to say about the fallacy of equating the modern skills needed to unravel traces of ancient geometry and astronomy with the prehistoric skills involved. As he says, twentieth century man easily forgets how simple and effective the techniques of the pre-scientific age can be and tends to assume that the ancients must have been phenomenally wise to have done with Stone Age equipment what we use theodolites and electronic calculators to do. In its extreme form, this false premise leads to the belief that all powerful extraterrestrials must have been involved. And a milder form of this naive belief leads even some archaeologists to maintain that Thom's deductions are simply not credible because Neolithic man could not have possessed the advanced mathematical and astronomical knowledge that he possesses. Of course they did not, but the same results could still have been achieved from a much simpler technological and intellectual base.

Particularly useful is Dr Wood's careful description in chapter 3 of the methods by which the various geometrical shapes Thom believes were incorporated in stone circle designs—true circles, ellipses, flattened circles and egg-shapes—could have been laid out on the ground using only simple equipment like loops of rope, pegs and measuring rods. This exercise provides a further illustration of why one should not attribute too much abstract knowledge to the megalith builders.

There is little doubt that right-angled triangles were the basis of many of these geometrical shapes and it is easy to conclude that the attraction to the circle-builders of the perfect ones found—the 3 : 4 : 5, 5 : 12 : 13 and 8 : 15 : 17 triangles—was the relationship between the squares on their sides thought to have been discovered by Pythagoras in the sixth century BC.

The idea that the Neolithic circle-builders of Britain anticipated Pythagoras by two millennia or more is compelling and would, if true, considerably alter our ideas on the history of intellectual thought. Dr Wood points out, however, that the fact that some not quite perfect triangles were used—such as $8^2+9^2 \simeq 12^2$ (actually 12.04)—almost certainly means that these numbers were used because they gave 90° angles when laid out on the ground. We certainly cannot assume that the circle-builders also knew the Pythagorean theorem.

Dr Wood brings the same lucidity and common sense to his review of the astronomical qualities claimed to exist in the standing stone sites and gives us, for example, a useful and up-to-date account of the various theories current about how Stonehenge might have been used as an observatory. Anyone wanting a reliable guide through what sometimes seems like a maze of theory and speculation about this site cannot do better than this.

Prehistorians will not be satisfied with the relatively meagre amount of space given to the more traditional kinds of archaeological evidence and some will feel that their objections to the ideas of the archaeoastronomical school are not adequately covered (though it is true that little of this is actually in print).

Dr Wood is clearly much more at home with the technical and mathematical evidence than with the historical and archaeological. This shows, for example, in his discussion of the concept of the prehistoric unit of length termed the Megalithic Yard; the statistical uncertainties sway him against the idea but the parallel, historical evidence published by the reviewer—which provides striking independent support for the existence of this unit—is not mentioned. However, the book is intended primarily to be a guide through the complexities of archaeoastronomy and archaeogeometry and it succeeds extraordinarily well. □

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Catastrophe theory

Catastrophe Theory and Its Applications: Surveys and Reference Works in Mathematics. By T. Poston and I. Stewart. Pp.491. (Pitman: London, 1978.) £25.

HERE at last is the first connected account of catastrophe theory written for people who are not pure mathematicians but who want to understand the applications of this new branch of geometry. Previously there has been only Thom's classic *Structural Stability and Morphogenesis,* often as deeply obscure as it is stimulating, and Zeeman's *Collected Papers 1972–1977,* often brilliantly clear but necessarily disconnected.

The first half of Poston and Stewart's book presents the mathematics of catastrophe theory. They explain clearly Thom's listing of the ways in which critical points of functions (that

is, maxima, minima and saddles) of n variables can coalesce as k parameters vary. The central classification theorem is not proved, but the main ingredients of the proof (transversality, stability, and so on) are very fully described, to the point at which it becomes clear why the catastrophe hierarchy depends strongly on k but hardly at all on n. In applications one often encounters functions that are not in the form of one of Thom's standard polynomials; then intricate rules determine which catastrophe is involved. It is one of the pleasant features of this book that a whole chapter is devoted to these. The interplay between algebraic and geometric ideas is emphasised throughout with the aid of a large number of diagrams. Functions are considered in the modern way, as mappings between sets, and the corresponding notation is used abundantly. However, it is explained at the beginning, and there is sufficient reversion to the old-fashioned "f(x)" for traditionally educated scientists not to lose the thread of the argument.

The second half of the book describes some applications. These are mostly in the physical sciences, so that it is possible to state definitely what 'potential function' it is whose coalescing critical points give the catastrophes. In Zeeman's pretty theory of ship stability, for example, the potential is gravitational energy; in optical caustics it is the ray transit time (more generally, the action); in beam buckling problems it is elastic energy; in fluid flow it is the stream function; and in phase transitions it is the Helmholtz free energy. Usually the fold and cusp yield little not already known to specialists in these various fields; only with the swallowtail, umbilics and higher catastrophes does one start to generate surprising richness of behaviour and genuine applications to the theory as opposed to mere illustrations.

These authors are masters of advanced exposition, and they are to be congratulated on producing what I am sure will become a classic in its subject. The publishers deserve credit for the high standard of presentation, but not for the price.

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Molecular biochemistry

Electrical Interactions in Molecular Biophysics. By R. Gabler. Pp. 352. (Academic: New York, San Francisco and London: 1978.) $25; £16.25.

THIS text forms a very readable handbook which outlines the fundamentals of electrostatic and dielectric theory on the one hand and of chemical bonding and molecular biochemistry on the other. From the beginning, the chemistry is given in terms of organic macromolecules. The author stresses the electrostatic nature of molecular interactions and takes care to develop the concepts of dipole moments and dielectric constants.

A good chapter uses these foundations for a detailed account of the various types of charge and dipolar interactions encountered in real molecules togther with some idea of their relative importance. Even though the author uses tables to full advantage in attempts to give the reader a feel for the magnitudes of dipole moments, dielectric constants and polarisabilities in real bonds and molecules, the book lacks the ability to convey confidence and insight as to how the reader should treat, evaluate and really understand the complicated behaviour of say the nucleic acids, globular proteins or polysaccharides, for example. Three good chapters form condensed, readable but detailed resumés of Van der Waals forces, Debye–Hückel theory and the structure of water. Emphasis for these is again placed on biopolymer materials.

The final chapter on experimental electrical techniques is somewhat disappointing, however, in that it deals almost exclusively with electrophoretic methods. Nevertheless, this particular method is described very well. It is less fortunate that, even though the measurement of dielectric constants and dielectric dispersion data feature strongly in the book, they are tucked away in earlier theory chapters rather than in the experimental chapter. Other novel methods such as ion exchange chromatography, isoelectric focusing and precipitation get but brief mentions, and electro-optic phenomena are by-passed altogether.

In conclusion, the topics with which the book deals are treated well. The book provides a very readable and concise account of the electrical and interaction phenomena encountered in biopolymer solutions and makes a valiant attempt to link the fundamentals of electrostatics and biochemistry. However, it is perhaps a pity that, after all the theoretical and conceptual material, the author did not give examples of how the experimental data could be analysed, interpreted and related to the basic properties and functions of macromolecules. A very good handbook for graduate students and researchers in the field of molecular biochemistry in general and for those engaged in electrical or dielectric measurements in particular.

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British bryophytes

The Moss Flora of Britain and Ireland. By A. J. E. Smith. Pp.706. (Cambridge University Press: Cambridge and London, 1978.) £27.50.

FIFTY-FOUR years have elapsed since the publication of a comprehensive account of British bryophytes. Smith's new book is a worthy replacement for Dixon's *Handbook*, as it combines succinct detail of text with splendid illustrations. It is easier to use than the old *Handbook*, for illustrations are scattered throughout the text rather than being grouped at the end. In many respects it matches the more recent and most popular guide to mosses by E. V. Watson (*British Mosses and Liverworts; Cambridge University Press* second edition, 1968) but surpasses this book in its comprehensive coverage: 692 species are described and illustrated. It lacks the habit drawings, which were a valuable feature of Watson's book, especially for beginners, but this is not a serious deficiency.

Profuse taxonomic revisions have occurred since Dixon's *Handbook* and the new names will undoubtedly find more widespread acceptance as a result of this publication. *Mnium* now proliferates into *Plagiomnium* and *Rhizomnium*. *Acrocladium* is now *Calliergon* (though we are spared *Calliergonella cuspidata*), and so on. The treatment of that awkward genus *Sphagnum* (contributed by M. O. Hill) is excellent.

This is a book which will be greeted enthusiastically by amateur and professional botanists alike. The price is high but this should not deter the enthusiast; it is worth every penny.

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