

programmes concerned with technology/society relationships should receive continued support. But the essential task, as M. Kranzberg notes in his introductory essay, is not simply study and reflection, but to embark on the difficult job of developing more precise conceptual, theoretical and methodological frameworks that allow the codification of diverse results from many fields of inquiry. Specifically, I would add that we need to work on higher level theories of social and technological change which can better explain how we got where we are, and where we might be headed in the future. This means, among other things, reaching basic conceptual agreement on key terms often used loosely and broadly — terms like “rationality”, “automation”, “efficiency”, “social change”, “science”, and the very concept of “technology” itself. Many of the essays in the book outline ways we may begin to tackle these important tasks.

Second, and I believe quite correctly, several papers put forth the theme that society must develop better moral and ethical perspectives on the control and improvement of technology, and that scholars of technology have a key role in the effort to produce better and more humane technologies in the years ahead. The job cannot be done simply by politicians, technocrats and administrators, but must be informed by the arts, humanities and the social and natural sciences as well. The task is truly interdisciplinary in character; and greater levels of improvement will not emerge without broadly based action which ranges far beyond the efforts of historians and philosophers working alone.

In sum, this compilation of essays will be useful to specialists as well as to general readers wishing to grasp the broad contours of the study of technology. It is well documented and mostly clearly written, although the lack of a subject index is annoying and hampers its value as a research tool; this, I believe, should be a major function of such a book. Nevertheless, I think anyone seeking an understanding of the full range of perspectives on technology and society will find time invested here worthwhile. The book's essays illustrate well how technology affects, both positively and adversely, social and political institutions, and how the human psyche — those ways in which we think, act, and relate to each other and the world — are influenced in directions that we are only beginning to foresee. It is to be hoped that such historical and philosophical materials can inform policy objectives, and help us decide on future technological choices as individuals and societies. □

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Understanding non-crystalline materials

D.C. Licciardello

Electronic Processes in Non-crystalline Materials. Second edition. By N.F. Mott and E.A. Davis. Pp.590. (Clarendon/Oxford University Press: Oxford, 1979.) £29.

THE second edition of this enormously successful book is faithful to the Mott and Davis style. The authors expand on their laudable attempt at unifying the vastly growing experimental literature in this field within the framework of some very general theoretical concepts. The book represents the single work which provides a focus to a field which, before Mott and Davis, had a divergent breadth.

The task is particularly monumental for at least two reasons. Firstly, the theoretical foundation on which the treatise is based is not well established. Indeed, the current literature is rife with new calculations which are at variance with some of the more fundamental ideas on which the exposition depends heavily, such as the minimum metallic conductivity. Secondly, the experiments being reported give results which still vary, to some extent, from laboratory to laboratory. This is partly due to the substandard quality of early experimental work, since only recently has enough attention been brought to the subject (largely through this book) to attract the interest of the world's best solid state physicists. Mostly, however, non-crystalline materials add a new dimension to the experimenter's problem in that materials must be characterized by method of preparation in addition to chemical makeup, e.g. one does not describe the generic properties of amorphous silicon.

The book describes the basic theory in the first four chapters. Care is taken, in traditional solid state format, to separate the non-interacting problem (Chapters 1-3) from the interacting one (Chapter 4). The basic theoretical problem, in the first case, concerns the behaviour of an electron in a random potential. The theory was first illuminated by P.W. Anderson in 1958, and Mott and Davis consider the Anderson mechanism for electron localization fundamental to the understanding of the properties of non-crystalline systems. The theory is discussed in some detail within the context of application to real systems. Thus, the exposition is much less formal than the original Anderson treatise and attempts are made to recast the concepts within a descriptive band theory. Herein lies the real value of this work for the solid state experimentalist.

The important problem of conduction in random media is discussed at length. The book demonstrates within fairly simple

analysis the absence of conductivity for Anderson localized electrons. The transition to conducting behaviour when the randomness is reduced or the electron density is increased is treated and Mott's notion of the minimum metallic conductivity is described.

The effect of correlation on transport and localization (Mott transition) persists and is expanded upon in the second edition. The term Fermi glass is used to denote a system of localized electrons in which localization may be due to randomness (Anderson) or electronic correlation (Mott). Mott and Davis discuss, as a class, those systems which undergo transitions from the Fermi glass state to metallic behaviour. To be sure, the two phenomena are distinguished, although the extent to which they are fundamentally different is again a current theoretical research topic. The discussion (Chapter 4) on metal-insulator transitions is unusual for the text in that the canonical examples of these effects are crystalline. Thus, Mott and Davis discuss doped semiconductors and narrow band transition metals.

The book, however, is mainly concerned with amorphous semiconductors. These are divided somewhat arbitrarily according to the local valence requirements of their constituents. Selenium and tellurium, however, are treated separately from the compound chalcogenide glasses. Mott and Davis make an invaluable contribution by extracting the most relevant details of the vast literature on these materials and by describing the basic electronic measurements in comparison. This kind of contribution defines the field and makes it particularly amenable to the newcomer.

Any treatise which ventures into a synthesis of a rapidly advancing subject runs the risk of being dated fairly quickly. The problem is even more serious when the authors engage, as is done here, in an explication of many measurements in terms of a general theoretical framework which, as pointed out above, is still controversial. For example, it is fair to say that at this writing, current renormalization group calculations give a conductivity at the Anderson transition with no minimum value. Much is made, in the second edition, of experiments on conduction in an inversion layer at the semiconductor/glass interface. The authors use this to support the notion of a universal minimum metallic conductivity in two dimensions. Again, there are recent calculations which suggest the absence of diffusion altogether in two dimensions. More recent experiments (not included in the book) tend to support this, although the mechanism for localization is still unclear.

The basic model presented for understanding non-crystalline semiconductors is a picture of an ideal structure into which the authors imbed a certain concentration of “defects”. The concept of a defect

within a random structure is difficult to define; however, the idea is that the electronic properties of the ideal structure would be similar to that of the corresponding crystal (if one exists). Thus, the defect, in this sense, is important in determining the specific electronic properties of the amorphous semiconductor. This is a rather extreme point of view for the structure of glass, in my opinion, yet the authors are able to cast much of the data within this framework. It is fair to point out, however, that models do exist which minimize the effect of local

structural inhomogeneities but do enjoy similar success in explaining much of the data. These theories invoke a strong lattice interaction and, indeed, Mott and Davis discuss the simple negative-U model first introduced by Anderson but narrowly interpreted here. Thus, the basic electronic structure for glassy semiconductors is not universally agreed.

The reviewer with the broad view may dismiss much of the current controversy as detail and indeed it is somewhat inconsequential when the contribution is taken as a whole. It is certainly true that some of the

analysis given in this book will be finally shown to be incorrect. This is the risk the authors boldly took in attempting to characterize and define a new branch of solid state physics. It is fitting that the Nobel Prize in physics was awarded to Sir Nevill Mott for contributions to this field, many of which are included in this book. □

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Heavy stone circles

R.J.C. Atkinson

Rings of Stone: The Prehistoric Stone Circles of Britain and Ireland. By Aubrey Burl, with photographs by Edward Piper. Pp.280. (Frances Lincoln/Weidenfeld and Nicolson: London, UK, 1979.) £9.95.

AUBREY BURL'S position as the leading authority on stone circles was established by the publication of his *Stone Circles of the British Isles* (Yale University Press, 1976), a work for scholars which is not likely to be superseded within the present century. *Rings of Stone* is a companion volume for the layman, extensively and admirably illustrated, but unencumbered by the *apparatus criticus* of scholarship. There is a glossary, a reading-list confined to books and monographs, and an index. The reader who is stimulated to seek primary sources must consult the bibliography and gazetteer of his earlier book.

Apart from its weight (1.2 kg) and its 27 colour plates on art paper, which are at the mercy of the fine soft rain which falls so

frequently on stone circles, this is an excellent vade-mecum for the holiday traveller with a purpose, whether it be specifically archaeological or aesthetic. The amateur prehistorian will find it useful in guiding him to the best-preserved and most easily visited sites. The traveller bent, in the Romantic tradition, upon viewing these rugged and enigmatic works of man against their landscape background will be well served also, provided that he remembers that the rocky and treeless terrains which now surround many stone circles are themselves the product of man (and indeed of the builders of the circles themselves), and not of nature alone.

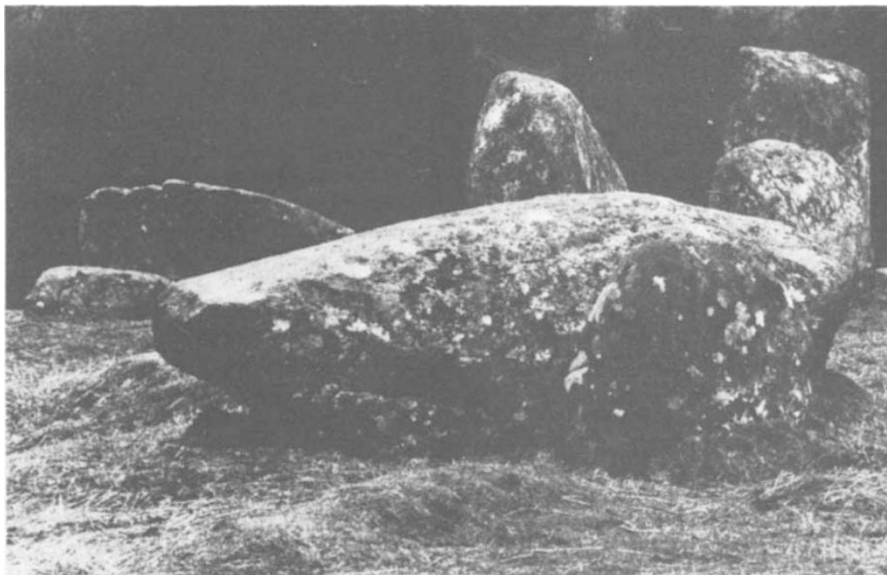
Readers with either purpose will be guided in their travels by the latter two-thirds of this book, which describes and illustrates fifty stone circles in Britain and Ireland which are well preserved and easily visited. For each region there is a map showing the sites and the main roads. For each site there is a map reference and a plan and photographs, as well as a textual description which will delight the reader by its aptness and sensitivity, either from his prior knowledge of the monument or after his first visit. It is a pity, however, that there are no figured scales for the plans, which vary widely in their ratio of

reproduction; but the principal dimensions are given in the headings.

The photographs, of which there are 106 in black-and-white as well as those in colour, are mainly the work of Edward Piper, who has inherited much of the genius of his father, the artist John Piper. Apart from one or two of the colour plates, in which the printers have achieved an overall hue which is displeasingly chlorotic, this is the finest set of pictures of prehistoric antiquities which has ever been assembled between one pair of covers. It is a picture-book in its own right, quite apart from the accompanying text, and it will stimulate the reader to see more of these sites than the photographs can show. For those who are unable, or unwilling, to venture far from the slippered comfort of their own firesides, the combination of visual and verbal description conveys very well the variety of size and character of stone circles, and readily explains their appeal to the antiquaries and topographers of the Romantic Age, which is still happily not dead.

This guide for the visitor is preceded by ten short chapters, in which Burl summarizes his unrivalled knowledge of the stone circles of the British Isles and gives his own views about their purpose and date. He begins with one of the principal regional groups, which is also morphologically and archaeologically the most coherent: the Recumbent Stone Circles of north-eastern Scotland. Here ten or eleven stones, rising in height towards a pair flanking a recumbent slab lying on edge and often with a top surface accurately horizontal, surround a low annular cairn of small boulders with a small central open space, in which excavation has frequently revealed signs of burning and small deposits of cremated human bone, accompanied significantly often by fragments of quartz.

The paucity of the human remains leads Burl to conclude, and doubtless rightly, that these were not cemeteries, but places of worship for a single extended family, sanctified at their inception by a token burial or burials, perhaps as the sequel to deliberate sacrifice. He notes, however, that although a single family could have



Edward Piper.