be a smattering of knowledge in a great many fields and a tendency to dismiss with obloquy those disciplines which are particularly difficult to study. It is, I think, not an accident that the natural sciences have always been extremely cautious in choosing this approach to their own disciplines.

The great lack in this volume is of any mathematical and statistical approach to the study of society. The great advances in economics have come about largely through the applications of mathematical techniques, and this is equally true of other disciplines. There is in this volume a lack of model building illustrated as a technique in the social sciences, and an implicit dismissal of the understanding of statistical procedures. In this sense the bias of the volume is probably understandable but may be unfortunate. Nevertheless, with this one grave lack, the volume may be commended as an interesting guide for the interested and ignorant student who nevertheless wishes to undertake some work which is both stimulating and fairly rigorous. It resembles the great works of H. G. Wells and his collaborators on popularizing the social and physical sciences and mathematics, and for that reason it has a splendidly nostalgic flavour.

JOHN VAIZEY

SYMMETRY AND PARTICLES

Unitary Symmetry and Elementary Particles

By D. B. Lichtenberg. Pp. xiii + 239. (Academic: New York and London, May 1970.) 121s.

THIS book is definitely mathematical rather than physical, and possesses both the strengths and weaknesses of such an approach. On the one hand, the mathematics is fully (and relatively simply) explained, starting from the fundamental axioms concerning groups. Group representations in vector spaces are considered, first for Lie groups in general, then for $SU(n)$ and finally for $SU(3)$. The eight-fold way itself first appears on page 152, and departs on page 183. ($SU(6)$ and quarks occupy the rest of the book.)

On the other hand, there is a kind of mismatch between this mathematics and the physics it is supposed to describe. For example, the machinery for reducing an arbitrary product representation in $SU(3)$ is irrelevant, because only singlets, octets and decuplets actually exist. Again, $SU(6)$ does not actually apply to any physical object (except for $SU(6)_w$ which is not treated). And, of course, quarks, whether or not they exist, can hardly have the simple dynamics required in many applications of the quark model.

This mismatch is, of course, partly a feature of the subject, for which the author is not entirely responsible. The book is well written and may be useful as a reference book; but at the price it is hardly a good buy for the individual.

D. H. LYTH

PHYSICS OF COMMUNICATION

The Physics of Transmission Lines at High and Very High Frequencies

Vol. 1: Primary and Secondary Parameters, Travelling Waves, Pulses. By P. Grivet. Pp. xiii + 451. (Academic: London and New York, June 1970.) 150s.

A COMMUNICATION transmission line is often regarded as an important element of a communication system but a rather dull subject for a 450-page book. Professor Grivet destroys this view by providing an excellent treatment of the physical principles of the subject within a frequency band which embraces telephone lines and microstrip. The text is based on lectures delivered by the author in Paris and Orsay and, as such is unlikely

to fit the structure of a physics or electrical engineering degree course in Britain. Nevertheless, any lecturer planning a course in this field would do well to consult this book.

A successful attempt has been made to harmonize the field theory and circuit theory approaches to the subject. The calculation of capacitance, inductance and resistance is considered in some detail and 60 pages are devoted to methods involving the complex plane. The chapter on the quasi monochromatic wave includes a clear explanation of group velocity and the adequate discussion of delay equalization is typical of the extent to which the author has used practical systems to illustrate the theory. In this respect the text will also appeal to those telephone engineers who seek a perspective view of their subject, for the author has included an adequate historical background to the development of current practice. Pulsed operation of lines is discussed in some detail but the chief omission is an extensive treatment of matching techniques. This in part reflects a cut-off in the treatment at VHF.

The translation by Dr P. W. Hawkes seems uniformly excellent and the author's clear style of expression has been captured. The text can be unreservedly recommended and I await with interest further volumes in the series.

P. J. B. CLARRICOATS

AURORAL SUBSTORMS

Polar and Magnetospheric Substorms

By Suyn-Ichi Akasofu. (Astrophysics and Space Science Library.) Pp. xviii + 280. (Reidel: Dordrecht, 1968.) 55 florins.

THIS is an excellent reference book for research workers in auroral and magnetospheric physics, and good general reading for others interested in knowing of recent progress in the study of that fascinating and beautiful natural phenomenon, the aurora.

Over a hundred years ago it was realized that there was a connexion between strong auroral displays observed occasionally from well inhabited parts of the globe, "magnetic storms" (which occur on a world-wide scale on such occasions) and large sunspot groups and flares on the Sun's surface. It is now known that around the auroral oval (a narrow belt a few degrees of latitude wide near 70° magnetic latitude, with its centre displaced about 3° from the Earth's dipole pole toward the dark hemisphere) auroral displays occur practically every night, but the magnetic disturbances accompanying them are localized (hence the term polar substorm). Polar substorms occur with greatest frequency and intensity during world-wide magnetic disturbances.

Professor Akasofu pioneered the analysis of hundreds of all sky camera photographs of the aurora taken from many different places during the International Geophysical Year, and built up a large-scale picture of the sequence of events (as observed in the visible light portion of the electromagnetic spectrum) which occur during a polar substorm around the auroral oval. He showed that auroral substorms usually last an hour or so and occur every few hours, with maximum activity centred at those stations close to local midnight. He showed that different types of activity, and the direction of motion of the auroral forms observed at any one station, depend both on the local time of observation and on the phase of the substorm. It is now recognized that many other ionospheric and magnetospheric phenomena exhibit characteristic behaviour dependent on local time in and near the auroral oval or on magnetic field lines leading into it during polar substorms.

In his book Professor Akasofu summarizes and gives detailed references to observations both from the ground and from rockets and satellites of the sequence of events