

This handy volume is ideal as an introduction to the subject for research workers and engineers; and, while no attempt has been made to provide a complete bibliography, a short list of useful books and references is appended for readers who wish to pursue the subject in more detail.

Two pulse-operated thermionic devices were described in 1919 and must to-day be regarded as classical advances in electronics technique. Prof. W. H. Eccles and F. W. Jordan, in a paper read before the British Association, described a one-stroke relay: this was a combination of two triodes with resistance coupling which, when operated by a small electrical impulse, changed from one condition of equilibrium to a second, in which it remained until reset by the application of a pulse of the opposite sign. This device is commonly referred to as a 'flip-flop' circuit or perhaps, more elegantly, as a bi-stable multivibrator.

The term 'multivibrator' was, however, more appropriately applied to the device described in the same year by H. Abraham and E. Block. They used a somewhat similar combination of valves, but with capacity coupling, so that the flip-flop action was maintained, and the arrangement became a source of oscillations rich in harmonics, and therefore suitable for frequency measurement.

During the past decade or so, these multivibrator circuits have found wide application in the field of computer development and pulse-counting technique. In the book under notice, the author directs attention to the fact that all previous work on the design of such circuits has considered only the stability of the static condition. Prompted by a practical problem, a thorough investigation of the dynamic behaviour of the bi-stable multivibrator was undertaken and is presented in this book. Consideration is given to the overall sensitivity in relation to valve characteristics; to the triggering speed and to the fundamental principles of design. Some numerical examples have been worked out to illustrate the application of the theoretical treatment, the results of which have been used in the development of special valves for multivibrator operation. The book should be very useful to designers of electronic computers, counters and allied devices.

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## ATMOSPHERIC ELECTRICITY

### Atmospheric Electricity

By Dr. J. Alan Chalmers. Pp. viii+327. (London and New York: Pergamon Press, 1957.) 63s. net; 10 dollars.

ATMOSPHERIC electricity, as a subject for research, is passing through a rather difficult transitional stage. No longer really viable as a separate field of study, it has yet to become integrated into meteorology in general, and cloud physics in particular, in a manner which may prove necessary to its future advancement. The electrical behaviour of the atmosphere in fine weather, to which so much effort has been devoted in the past, is now fairly well understood; although there are still interesting problems to be investigated, they are not currently in favour or fashion. Attention is now focused on the thunderstorm, for here the central problems, which are still essentially those which troubled

Franklin two hundred years ago, remain unsolved. But recent researches make it increasingly clear that the origin of the electric charge in thunderstorms and the mechanism of the lightning discharge are matters closely associated in clouds with the complex physical and dynamical processes which lead to the development of precipitation, and it seems only sensible that they should be studied in this wider setting. Such an orientation is already perceptible, and one feels that the atmospheric electrician of the future may find it increasingly difficult to manage with occasional self-conscious references to convection, *Austausch* and turbulence as though they were passwords to a secret society. He must break down his resistance to meteorological indoctrination or risk finding himself insulated at infinity with no conducting path either to earth or reality.

The feeling that such a change is almost inevitable is strengthened after reading Dr. J. A. Chalmers's "Atmospheric Electricity", a revised and considerably enlarged version of his book of the same title published in 1949. Although the intervening period has been one of steady consolidation rather than of spectacular new advances, a large number of new papers has appeared, many of which describe work carried out during the Second World War. An up-to-date account of the subject is therefore to be welcomed, and little of the material published up to the end of last year has escaped Dr. Chalmers's attention.

The book opens with a short historical introduction; this is followed by a chapter of some forty pages summarizing basic principles, concepts and known facts which will prove helpful to the newcomer to the subject. Here the author introduces the MKS system of units which he uses throughout the text. The next four chapters, which describe various aspects of the fine-weather field with the proper emphasis on experimental techniques and results, are probably the best in the book. There follow three chapters dealing with point-discharge currents, precipitation currents, and the transfer of charge between the atmosphere and the Earth. Only forty-five pages are devoted to the thunderstorm, including chapters on the lightning discharge and the theories of charge generation and separation; this seems rather inadequate in view of the importance of this part of the subject.

The treatment throughout is sound and clearly written, and will be useful both as a text-book and a source of reference. But I feel that some topics might have been discussed in greater depth and in more detail. It is a pity that the author has divided the text into so many short paragraphs numbered serially throughout the book. The frequent appearance of heavy black headings, often three on a page, frequently breaks the flow in the argument, and gives the whole text the appearance of an expanded card index. There are times when Dr. Chalmers leans too far towards impartiality in mentioning every paper which bears some relation to the topic under discussion. For the benefit of his less-experienced readers one wishes he had been less modest in expressing his opinions of the work he describes so clearly. In being kind to everyone he has been less than fair to himself.

The book is well produced, has a good index and a splendid bibliography of some 600 papers (including titles), but even at present-day values its price is much too high.

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