

and the publisher are to be warmly congratulated on making available this important survey of the theory of elementary reactions at a very reasonable price. All experimentalists concerned with reaction kinetics will derive great benefit from it, although they will have to ponder deeply over it and involve their theoretically minded colleagues in much discussion.

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CLIMATIC CHANGES IN HISTORIC TIMES

The Changing Climate

Selected Papers. By H. H. Lamb. Pp. xi + 236. (London: Methuen and Co., Ltd., 1966.) 45s. net.

TIME series of meteorological quantities show incessant variability, mainly non-periodic, and the analysis of phenomena on different scales of space and time is almost a definition of the science. Beginning at the high frequency end of the spectrum there is small-scale turbulence succeeded on time scales of minutes, hours, days and weeks with what in the metaphor we can call the weather band. At one year there is a strong spectral line which can be filtered out by taking yearly averages, leaving, however, a powerful band around a few years in length arising from interannual variability. We have very little understanding of the nature of these important fluctuations, but to a large extent succeeding years approximate to random series from a population whose averages and variances are well defined in a sample of about thirty years, and seem to change but little if we go back in time for hundreds of years. There is, in other words, a relatively dark band in the spectrum of time variations between a few years and a few thousand years when we run into the variability of glaciations in the present Ice Age.

It is the existence of this broad band of little power covering two or three orders of magnitude in time that has given rise to the concept of climate as something permanent, varying with place but not with time. Unless we are careful, we rarely take the trouble to specify any period of years when we speak of climate, and when we say what the climate of a place is, not what it was, permanence is implicit.

In the past few decades there has, however, been a growing realization that this part of the spectrum is not really dark, but that fluctuations in periods of tens or hundreds of years do exist in their own right, being clearly more than the statistical outcome of individual years randomly ordered. Climatologists, when being punctilious, are nowadays careful to specify the period of reference, although its relative unimportance is evident in official weather forecasting, which frequently refers to the normal or seasonal average as though it were something fixed and established. The magnitudes of the variations are, of course, not large, only 1°–1.5° C, according to one of the papers by H. H. Lamb recently reprinted, but they are quite large enough to be of economic significance.

The relationships between climatic parameters and economic effects may be highly non-linear, determined, for example, by threshold values or extremes rather than by averages. In this way the average growing season in England may have varied by as much as 15–20 per cent between the thirteenth and seventeenth centuries. To take another example, water supplies depend primarily on the difference between rainfall and evaporation, and where this is small a variation in either may be catastrophic. The freezing point of water is another obvious threshold for certain purposes.

Many general articles have appeared on this topic in recent years, and much more is sure to be heard about it

now that serious attention is being given to the possibility of deliberately modifying and controlling the climate by artificial means. A symposium on the subject was recently held by the Royal Meteorological Society, and the appearance of a report in a few weeks time might be the occasion for a further review. Meanwhile, attention is drawn to the new publication already referred to of papers by H. H. Lamb, who has done as much as anyone in this country to analyse and to draw attention to climatic changes in historic times. To anyone who has not seen the papers before, this publication in book form will be a welcome and worthwhile acquisition. Nevertheless, I cannot let the notice go by without a word of protest. The author is no doubt a very busy man and reluctant to devote time to putting a book together for the general reader. I can also believe that the compilation will be acceptable to workers in neighbouring fields who do not have ready access to the original publications. Nevertheless, I for one feel cheated when a new book turns out to be the facsimile reproduction of recent papers which I already possess.

The papers were invited articles or the records of lectures all given in the past few years, and although every one is worth the reading and none is without original work, there is, inevitably and quite properly, a good deal of repetition. The reader therefore has the disconcerting experience of meeting the same arguments, references and diagrams more than once in the same book. There is at least one case of a full-page diagram appearing three times. Almost any scientific publication by a specialist will meet someone's needs, and libraries can confidently be relied on to subscribe, but I hope the success of this venture will not be such as to encourage publishers to repeat the recipe.

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AN ELECTRICAL PIONEER

Inventor and Entrepreneur

Recollections of Werner von Siemens. Pp. 314. (London: Lund Humphries; Munich: Prestel-Verlag, 1966.) 54s.

THE name of Siemens recurs insistently in the early history of electrical engineering. Two sons of a German landowner, farming in Mecklenburg in the years after the Napoleonic Wars, contributed notably to the practical application of electricity, to engineering practice and to the development of electrical manufacture. Charles William Siemens, who had a distinguished career in England, became in 1871 the first president of the Institution of Electrical Engineers. His brother, Werner, pioneered electrical manufacture in Germany, made important fundamental contributions to electrical engineering and undertook some of the major projects involved in establishing worldwide telegraphic communication. He is perhaps best known for discovering the self-excitation of the dynamo electric machine.

Some three years before his death in 1892, Werner von Siemens began to write his *Recollections* and an English translation of the work was published in London in 1893. A new German edition was produced in 1956 and now a new edition of the translation has been published, the text being only slightly amended, but newly annotated and illustrated.

Werner Siemens's recollections, in a very real sense an autobiography, create a remarkably intimate picture of a closely knit German middle class family brought, by the sheer brilliance and energy of two brothers, into the leadership of industrial advance, both in Britain and on the Continent. Invention, scientific research, international co-operation in manufacture and in the carrying out of great constructional projects, such as the Indo-European Telegraph Line, brought Werner Siemens into