quoting, for the discomfiture of the geophysicist, Kelvin's celebrated 'proof' that the age of the Earth was only some tens of millions of years. While rejecting this, they seem notwithstanding to have swallowed whole Kelvin's idea of a cooling Earth. Only in recent times does this idea seem to have been effectively challenged.

S. K. RUNCORN

NON-LINEAR OSCILLATIONS

Nonlinear Oscillations
By Dr. Nicholas Minorsky. Pp. xviii + 714. (Princeton, N.J.: D. Van Nostrand Company, Inc.; London: D. Van Nostrand Company, Ltd., 1962.) 107s.

THIS encyclopædic volume, of more than seven hundred pages, is the most extensive treatment so far published in book form on the theory of non-linear oscillations. It will undoubtedly become the standard reference work on the subject and no applied mathematician can afford to be without it. The book, containing thirty-one chapters, is divided into four parts and only a brief outline of the contents can be given.

In Part 1 (eight chapters) topological methods are discussed, and the theory is based largely on that of Poincaré. The theory of stability is developed, especially in relation to the ideas of Liapounov. Part 2 (nine chapters) deals with quantitative methods and is largely concerned with the classical theory of approximations. The asymptotic methods of Krylov–Bogoliubov–Mitropolsky, both for autonomous and non-autonomous systems, is presented in detail. The highlight of Part 2, however, comes in Chapter 16, which is concerned with the stroboscopic method. This method was developed by the author himself who, in 1953, was awarded *Le Prix Montyou* by the French Academy of Sciences for this work. Part 3 (eight chapters) is given to the study of the oscillations of nearly linear systems, and it is based almost entirely on the stroboscopic method. There are chapters on synchronization, non-linear resonance, parametric excitation and oscillations caused by retarded actions. The next chapter introduces the concept of a parameter space and discusses, in this space, the topology of Lienard's equation:

$$\ddot{x} + f(x)\dot{x} + g(x) = 0$$

where $f(x)$ is a polynomial. Part 4 (six chapters) is concerned with relaxation oscillations, a subject where a wide departure from the near-linearity of Part 3 frequently holds. Because of this departure entirely different methods from those of analytic approximations are necessary. The discontinuous theory of relaxation oscillations is presented and it is applied both to electrical and to mechanical problems. Asymptotic methods are then discussed, including that of Cartwright–Littlewood and that of Dorodnitzin. The book concludes with a chapter on piecewise linear idealization.

A feature of the present work is the detailed exposition of the outstanding Russian contributions to the subject over recent decades. There are many references to the original papers and every research student in this field will need to use this book. The applications of the theory are chiefly in mechanics and electricity, fields where an immense amount of experimental evidence has been brought to bear on the theory. It has happened that the mathematical models that have been constructed in these fields have been particularly robust. This has not so far been the case with model making in the fields of biology and econometrics, where many non-linear phenomena also occur. However, the applications of the theory to biological fluctuations and to econometric recurrent processes are discussed and the limitations of the models are pointed out.

L. S. GODDARD

ENGINEERING ASPECTS OF SUPERSONIC AIRCRAFT

Supersonic Engineering
A Symposium held at the Royal College of Advanced Technology, Salford. Edited by J. T. Henshaw. Pp. viii + 264. (London : William Heinemann, 1962.) 63s.

IN this book Heinemann, with the assistance of Mr. J. T. Henshaw, who has edited the contributions, have bound within one volume a series of lectures delivered at a conference which was held in May 1961 at the Royal College of Advanced Technology, Salford. Having myself spent tedious hours trying to obtain scientific papers presented at similar conferences and made available only to those present, I am always pleased when I see that a publishing house has been bold enough to make a book from this kind of material.

The subject-matter of this book is far more specific than its title would suggest, for it deals almost exclusively with the engineering aspects of the supersonic transport aircraft and, so far as one can expect within its 264 pages, provides a comprehensive survey of as widely varying topics as the basic aerodynamics, the structure and materials likely to be used in its design, the noise problem, the systems engineering, the safety and airworthiness and the power plants and their aerodynamics. The book is introduced by a chapter which outlines the problems posed by the supersonic transport and there are sections dealing with the stability and control and with the economics of operation. To my knowledge it is the first work to be published which attempts to cover the complete subject in this way.

In preparing this book, no attempt has been made to produce an academic text-book, something clearly impossible within the few pages, but rather its objective has been to present a synopsis of the many problems facing the engineer and by so doing, to stimulate the interest of those, as the book says, "experienced graduates", who are at present in the aircraft industry. This it probably will do quite successfully for the book is very readable and is almost devoid of mathematical analysis. However, I would criticize it on the grounds that it probably has gone too far in its attempt to make the exceedingly complex problems appear simple if tackled with sufficient common sense. I also find that the lack of rigour in most of the contributions makes it very hard to decide when an author is stating a well-established fact or his own point of view, valuable though that may be. To this end, liberal use of references would have been most welcome, but unfortunately they are completely absent from more than half the contributions. This is even more regrettable when one considers that the aim of the volume was to stimulate the interest of engineers, which implies that they will follow up with a more detailed study in their own field if they know where the information can be found.

J. K. HARVEY

HISTORY OF VISCOSE RAYON

The Beginning of Rayon
By Edwin J. Beer. Pp. 206 + 13 plates. (Paignton, Devon: Phoebe Beer, Shorton Manor, Shorton, 1962.) 20s.

VISCOSE rayon was the first man-made fibre to reach the mass market. The pioneering work, which made this possible, began 60–70 years ago and is associated with the names of Cross, Bevan, Stearn, Beer, Topham, Tetley and many others. With the exception of Beer, these pioneers have vanished from the stage, and such accounts of the beginnings of viscose rayon as have appeared are based on the recollections of the generation