The treatment of the material forming the central core of this tract is masterly. The writing is clear and concise, and rendered particularly stimulating by the introduction of recent work—only sketched, but in context for the first time in a systematic survey. Coverage is also good, especially in the approach from differential equations. The most material omission is that of the part played by Lagrange's theorem in developing full asymptotic expansions of functions expressed as integrals.

The chapters on Mathieu functions and on wave problems in three dimensions are illuminating, though possibly too highly condensed for all the individual topics to be clearly grasped.

It must be made clear that this tract deals almost exclusively with techniques for deriving asymptotic expansions, particularly the first few terms, and scarcely at all with such problems as what partially illicit processes cause series of this divergent type to appear, the structure of the later terms, whether such series are inherently approximate or exact but formalistic, and instability in form when all terms are of the same sign and phase. Consequently, the short sections on topics partly linked with such aspects—for example, the discussions on the definition of an asymptotic approximation, on the Stokes phenomenon, and on the estimation of the remainder—do not quite match up to the high standard of elucidation otherwise maintained throughout the text.

R. B. Dingle

TRANSIENTS

Introduction to Transients

By D. K. McCleery. Pp. xi+232. (London: Chapman and Hall, Ltd., 1961.) 42*s*. net.

THE author of this book believes that Heaviside's operational methods provide a better introduction to transients for students of limited mathematical attainments than the more rigorous approach provided by the Laplace transform. It is quite clear that this subject is very near his heart, and his twenty-years experience as a teacher makes him well qualified to produce a book which is sure to have a great appeal to students starting on this difficult subject. It is not necessary to agree entirely with his method to appreciate the merits of this book. He expounds his subject clearly, and his numerical problems are well chosen to develop the student's understanding of what he has read. The Laplace transform is banished to the last chapter. His introductory chapter is a masterpiece of the art of making a difficult subject look easy, in order to engage the interest of the reader, before introducing him to the great advances made by Heaviside.

Rather unexpectedly in an elementary work, the author expounds to his readers the deficiencies of Fourier's method of analysis when applied to periodic waves with a discontinuity, such as a square wave. It is all too seldom in modern engineering books that Gibbs's spike is discussed. A perfunctory note may be given about the mathematical limitations of Fourier's analysis; but the student who takes the trouble to plot a few terms of Fourier's series for a square wave is likely to be surprised at the very poor resulting approximation. If his curiosity leads him to evaluate a few more terms he is likely to be still more surprised at the apparent lack of improvement.

Now in mathematical works it is proved that, notwithstanding these limitations, a Fourier approximation for a given number of terms provides a better approximation to a square wave than any other series of sine waves—yet it may very easily be verified that an infinite number of different sine waves series may be developed which will approximate as closely as is desired to a square wave and show not a vestige of Gibbs's spike. It is only necessary to develop a Fourier series for any periodic wave with no discontinuities which approximates closely to a square wave.

This appears to suggest that the mathematical criterion for a good approximation is unsatisfactory since it is unable to detect any error due to Gibbs's spike, although this spike is quite unacceptable in practice. It would be very interesting if the author could develop a new criterion for judging the closeness of approximation of a sine wave series to a square wave which would make it possible to decide on the best series which was free of Gibbs's spike. This might be a powerful weapon for him in his war against mathematicians.

One possible criterion is that the distance of that point on the approximate curve which is farthest from the nearest point on the square wave should be reduced to a minimum.

A. H. M. Arnold

VIEWS OF A GEOLOGIST ON THE ORIGIN OF LIFE

The Geological Aspects of the Origin of Life on Earth

By Prof. M. G. Rutten. (Elsevier Monographs: Geo-Sciences Section. Subseries: Geology.) Pp. vii+146. (Amsterdam and New York: Elsevier Publishing Company, 1962.) 25*s*.

THIS is a small but very important book. Theories of the origin of life have been much debated in recent years, but almost exclusively by physicists and biochemists with a sprinkling of astronomers. Here is a work by an experienced geologist who has martialled the evidence which can actually be found on the Earth and in its rocks. He has taken the evidence and used it to examine the theories on the origin of life which have been put forward on other grounds.

The major thesis centres around the evidence for an early atmosphere not containing oxygen. Hitherto, this has been postulated in order to account for the first formation of simple organic compounds, by means of ultra-violet light from the Sun unstopped by the present-day ozone layer, itself derived from molecular oxygen. What evidence there was for this reducing atmosphere was derived from the spectroscopically proved presence of the hydrogenated compounds such as ammonia and methane on the larger planets, and from the difficulty of finding any concentration of oxygen on the minor planets. It is also *a priori* probable on account of the high reactivity of molecular oxygen; but this is a weak argument.

The other type of argument is the chemical experimental argument which shows that, from a mixture of these gases with water vapour, it is possible to synthesize, by the use of various radiations, elementary biogenic compounds of the type of amino-acids and purines. Is there more evidence of a more definite character for this early period? Prof. Rutten thinks there is and expresses it on two lines of evidence, both of them geochemical: one, the presence of easily oxidizable pyrites (FeS_2), in sands of a sufficiently early date, of the order of two thousand million years,