

To a large extent this has happened. In the past twenty years there has been only one really striking advance—Selberg's proof that at least a finite proportion of the zeros lie on the critical line—and even this falls far short of Riemann's, or even Lindelöf's hypothesis. But is Riemann's hypothesis true? Twenty years ago it was generally believed that it was. Now doubts have crept in. Functions are known which have functional equations and many other properties similar to those of the zeta-function, but for which the analogue of the Riemann hypothesis is false. Very powerful methods of computation are now available, and Riemann's guess may possibly be disproved in this way.

There is a chapter on Vinogradoff's method of treating exponential sums. This has had great triumphs in number theory, but so far the applications of it to the theory of the zeta-function have not been of comparable importance.

Prof. Titchmarsh treats his subject with his accustomed mastery, and his new book will be a necessity for all who seek to do research in number theory, as it contains the only adequate account of exponential sums. But in other respects it does not quite take the place of his Cambridge tract. This latter presented the main theorems of the subject in a very attractive way in less than a hundred pages and was an ideal approach to the subject. Another twenty pages would have sufficed to bring it up to date. Yet the present work is nearly three times the resultant length. The treatment is perhaps too thorough, and it cannot be denied that the book has a somewhat forbidding aspect. But then so have most mathematical books nowadays. The young are brought up to expect it.

J. M. WHITTAKER

INTERACTIONS OF THE FUNDAMENTAL PARTICLES

Elementary Particles

By Enrico Fermi. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xii+110. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1951.) 12s. 6d. net.

THE data necessary before a coherent account of the elementary particles of Nature can even be attempted did not exist until the discovery, in 1947, of the π -meson (or, following Prof. E. Fermi, the "pion"). Five years later the experimental physicist, at least, has turned the spearhead of his investigations towards the more elusive members of the family, and already some of these, the V^- , κ^- , τ^- particles, have become moderately familiar. In the course of this rapid advance, the position of theoreticians is less enviable. For, so long as they are dependent upon the results of experiments for a description of the particles which are the units with which they must work, they work in the near-certainty that the material given them is incomplete: nothing is more striking in the history of elementary particle physics during the past few years than the way in which the particles that have been discovered are those which our leading techniques are best adapted to discover, and speculation is continually being made as to how, rather than whether, further elementary particles will be identified.

In this short book, based on the Silliman Memorial Lectures at Yale University for the year 1950, Prof.

Fermi is more concerned to sketch, at a level which will be intelligible to a fairly large body of physicists, the broad application of field theory to problems involving massive field particles, the mesons, than to comment on the tentative conclusions which might be drawn at the moment of writing from rapidly developing material.

"Elementary Particles" begins with an admirable summary of the quantization of the electromagnetic field and of the absorption and emission of photons, which serves as a model against which is sketched the equivalent theory for quanta with mass. This leads to the general problem of interactions and to the Yukawa-type interaction of meson theory. It is here that the real difficulty of maintaining the perspective of the approximate treatment which is followed throughout, against the uncertainties and divergences of the more complete analysis, assumes importance, and it is a great merit of the book, even if it is only what we have come to expect of its author, that the value of the "order of magnitude" estimates in this section, and in those which follow, is so clearly apparent.

In the following sections the interaction constants and transition-rates for π - μ decay, β decay, μ - e decay and μ^- capture are derived. Here, the summary of β -decay (p. 39) is perhaps the least successful, for the treatment is condensed to the point when it is likely to help only those to whom the main lines of the problem are known in considerable detail. The second half of the book covers rather less familiar ground, dealing with the production of π -mesons in nucleon collisions and by γ -rays, using normal methods, and giving a brief outline of the statistical approach to meson formation, including multiple production, in nucleon encounters at very high energy. The status of antinucleons and their annihilation properties are also considered in a short but effective section.

This is a book which will date only slowly until the critical developments of meson field-theory come. Until then—and so, perhaps, for quite a long time—it will offer an admirable introduction, for workers in nuclear physics and cosmic-ray physics, to the general methods of approach to the interaction problems of the fundamental particles.

J. G. WILSON

TREATISE ON ZOOLOGY

Traité de Zoologie

Anatomie, systématique, biologie. Publié sous la direction de Prof. Pierre-P. Grassé. Tome 10: Insectes supérieurs et hemipteroïdes. Fascicule 1. Pp. ix+978. 6500 francs. Fascicule 2. Pp. iv+974-1948. 6500 francs. (Paris: Masson et Cie., 1951.)

IT is a pleasure in these times of general austerity to handle such well-produced books as those here under review, and it is not simply that they appear good in contrast with many contemporary publications but that they stand comparison with any similar works produced in this century. Perhaps it would have been better if, from the commencement of the series, a much darker binding had been chosen, for the pale creamy white, suggesting vellum, while pleasing in appearance, soon becomes soiled, and the tables and benches on which they are used in laboratories are far from immaculate.