Books

Theory of Relativity. By W. Pauli. Translated by G. Field from 1921 German article, with 25 pp. of supplementary notes by Pauli. 241 pp. Pergamon Press, London & New York, 1958. $6.00. *Reviewed by Freeman J. Dyson, The Institute for Advanced Study.*

PAULI wrote this review article on relativity in 1921 as a contribution to the German Mathematical Encyclopedia. It immediately became a classic, and was published in Germany as a separate book. Now after nearly 40 years it appears in translation. Luckily the translation was done before Pauli died, and he had the opportunity to add to it his impressions of the later development of the subject. He decided, "in order to preserve the character of the book as an historical document", to reprint the old text in its original form, and to make his comments in the form of notes at the end. This decision was wise. There is astonishingly little in the original text that needs now to be unsaid or seriously qualified. And it is convenient for readers who are experts in the subject to have Pauli's later comments collected together in the last 25 pages.

Reading the book now, one is impressed first of all by the depth and coherence of the thinking that resulted in the creation of the theory of relativity. When Pauli wrote, general relativity was only 5 years old. It was then the fashionable field of research for ambitious young physicists, just as the study of strange particles is now. Pauli does not oversimplify the many abortive attempts and unsuccessful guesses that complicated the birth of relativity. His 394 footnotes contain references to an even larger number of research papers and books, each of which is summarized or criticized as the case may be. But in spite of all the wealth of detail, one has the impression that the physicists of 1920 were less confused and less superficial than the physicists of today. Partly this impression results from Pauli's unequaled gift of clarity. Partly it results from the fact that our elders had a tighter intellectual discipline than we have.

I quote from a recent paper by Sakurai a remark made to him by Salam. Salam and Sakurai are both experts in the newer style of strange particle physics. "Classical physical theories are profound. Take the second law of thermodynamics, for instance: Heat cannot flow spontaneously from a colder to a hotter body. Compare this to what you have been doing. You propose some symmetry, and ten seconds later you are already trying to figure out how to break it." The feeling, which Salam so vividly expresses, of the contrast between the profound insights of the classical physicists and the shallowness of our present-day imaginings, is well known to all of us. This feeling will be experienced even more acutely by any practitioner of modern theories who comes now to read Pauli's book. Therein lies the timeless value of a scientific classic. Let us hope the English translation will bring the book many new readers.

The notes added by Pauli at the end include a brief account of the various types of "Unified Field Theory" which have been proposed by Einstein and others in later years. The avowed purpose of such theories was to explain the whole gamut of physical phenomena, including gravitation, electromagnetism, and matter, in a single coherent scheme. This aim never came close to achievement. Pauli's judgment is that the various schemes are empty mathematics, without any discernable relation to physics. "A leading physical principle, like the principle of equivalence in general relativity, which is based on general empirical evidence, is entirely missing in unified field theory."

In the end, reading these final remarks of Pauli, one is left with a question. How did it happen that the theory of general relativity, after such a brilliant and profound beginning, lost contact after 1921 with the main stream of physics? For this one cannot blame the inferiority of a later generation of physicists. It was the great intellectual giants, Einstein and Weyl and Pauli himself, who tried and failed after 1921 to save general relativity from becoming sterile. The blame for their failure must be laid on Nature herself. For some reasons which even Einstein could not fathom, the style of thinking which led to so deep an understanding of gravitation does not come to grips with the other forces of nature. Nature's other manifestations seem to be organized in some altogether different fashion. So the mystery remains, that the view of the world which is recorded in Pauli's book, a supremely logical and intellectually compelling view, has remained since 1921 almost totally sterile, while the explosive growth of atomic physics has moved further and further out of touch with it. Whoever undertakes to solve this mystery, and bring general relativity back into physics, would do well to learn from Pauli a style of deep and exact thinking which the physicists of today have largely forgotten.

Analytical and Canonical Formalism in Physics. By André Mercier. 222 pp. (North-Holland, Holland) Interscience Publishers, Inc., New York, 1959. $6.75. *Reviewed by R. Bruce Lindsay, Brown University.*

IT is well known that present-day quantum mechanics and in particular quantum field theory lean rather heavily on the Lagrangian and Hamiltonian formulations of classical mechanics. In fact the greater part of the formalism of quantum mechanics is already present in these classical presentations, the quantum aspect being in a mathematical sense merely a kind of supplementary restriction, though of course of enormous