BOOK REVIEW

Gauge theories of weak interactions. By J. C. Taylor, Cambridge University Press, 1978, pp. xvii + 166. Price £3·75.

The field of gauge theories has become one of the hottest topics of research in theoretical physics in the last two decades.

It is well known that there are four types of basic interactions in nature, namely, gravitational, electromagnetic, weak and strong interactions. While gravitation (developed by Newton and Einstein) unified the behaviour of macroscopic objects (both terrestrial and celestial), electromagnetism (devised by Maxwell) embraced both electricity and magnetism. Both these interactions are long range and are believed to be mediated by massless bosons. The weak (developed by Fermi, Sudarshan and Marshak) and strong (Yukawa) interactions, operate at the nuclear and elementary particle levels and are extremely short range involving mediation by massive bosons.

In the past, there have been several attempts to unify some of these interactions. In fact, for a long time Einstein attempted, rather unsuccessfully, to unify gravitation and electromagnetism. Starting with Schwinger (in 1957) there has been sustained efforts by many theorists to unite electromagnetism and weak interactions. In this development, the gauge theory invented by Yang and Mills (1954) has played a very important role in that it contained the essential ingredients of three spin-1 bosons. But the question of giving mass to some of these vector bosons and leaving the photon massless remained.

Fortunately, developments in condensed matter physics (notably the theory of superconductivity 1957, 1958) had immediate impact on the relativistic physics of particles. Thus the idea of symmetry breaking imported from condensed matter physics gave the necessary breakthrough in giving masses to some vector bosons. In this background Salam and Weinberg (1967, 1968) put forward the gauge unification of weak and electromagnetic interactions. Some crucial and clever work since then, particularly by 't Hooft, has led to the formulation of a respectable theoretical framework—the predictions of which have found experimental support (neutral current processes, parity violation in electron proton scattering, etc.). These have encouraged Salam to come to the verdict (1978) "the case is closed—there are only three basic interactions in nature." And attempts to unify all basic interactions continue.

The book under review gives the principles and field theoretic techniques of gauge theories as are currently accepted. What the reviewer likes, in particular, is that within 18 chapters totalling only 166 pages the author has clearly and concisely presented the essentials of modern gauge theories and covered a wide range of topics: weak interactions, Yang–Mills fields, symmetry breaking, topology and symmetry breaking, hadronic weak interactions, path-integral formulation of quantum mechanics, quantization of gauge fields, regularization and renormalization of gauge theories, gauge theories and strong interactions, etc. With the basic background of quantum field theory a research student will find the book easily comprehensible. The monograph ends with a list of references which will prove useful to persons wanting to study in detail some specific problems. It was first published in 1976 and in its 1978 paperback edition the author has wisely added a brief note on some recent developments.

The pace of research work in this field is very fast, and a short book like this whose mastery will enable a researcher to follow current publications is extremely welcome. The price of £3.75 is modest from the present level of pricing of books.

The reviewer strongly recommends this to researchers in this active area of theoretical physics.

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