

PREFACE

Sir E.T. Whittaker, F.R.S. wrote (1953) in the Preface of the second volume (covering 1900-1926) of his well known book 'A History of the Theories of Aether & Electricity' : "My original intention was to give an account of the history from 1900 to 1950 in a single volume; but the wealth of material made this undesirable; and the period from 1926 to 1950 must be reserved for a third book". This indicates that a whole volume would be needed to do justice to the developments that took place during the quarter century ending in 1950.

My original plan was to give, in a single dissertation, an analytical history of the theories of elementary particles and their interactions from 1930 to 1956, i.e. the period which began with a belief in the existence of only two 'elementary' particles, proton and electron, and ended with the overthrow of parity. But Whittaker's prefatory remarks made me conscious of the overambitiousness of my intention of writing such a broad survey.

At that opportune moment Professor Leon Rosenfeld, Nordisk Institut for Teoretisk Atomfysik, Copenhagen, with whom I was fortunate enough to be in correspondence in connexion with my humble scientific enquiries, referred to the possibility of an "analysis of the development of meson theory from Yukawa's first paper until Powell's discovery of the distinction between what are now called the pi-meson and the mu-meson", and added that : "A synthetic account of this development does not exist, and would certainly be very valuable". This inspired me to study this course of development from the viewpoint of an historian of science.

The difficulty is evidently considerable in historically reviewing the trend of highly sophisticated investigations into one of

the most fundamental questions of the physical world —what holds the atomic nucleus together ?— from a distance of only three decades or so. And one may feel whether such a review is at all necessary when specialized reviews on this question appear periodically for assessing the degree of progress achieved. But the chief object of the specialized reviews is to describe the logical development of the subject from a viewpoint, in which the historicity of the development is obviously secondary in the sense that the obsolete and impactless theories and inferences are disregarded, and those of immediate conceptual interest are discussed. In contrast to this, an historical review should follow the logical development of the subject without disregarding the roles played once by the obsolete theories and inferences, so that the account of the gradually maturing concepts at different stages of the development may perhaps reveal a trend, which is likely to interest the historians of microphysics as well as some specialists. An acquaintance with such an historical account or review may perhaps serve to give the working physicists some methodological and philosophical insight into the immediate problems of microphysics —a kind of insight beyond the capacity of the historical reviewer himself.

The reason for extending the reviewed period up to 1952 is explained in the Introduction. Although Dr Henry Small^{*} of the Center for History and Philosophy of Physics, American Institute of Physics, feels that professional historians of science would lose interest in topics going too far beyond the 1930's, the subject reviewed here calls for a chronological extension for the sake of a meaningful completeness of the matter discussed.

The advantage of the square-bracketed dates in the REFERENCES would be evident from the following specific example :

(89) Brulin & Hjalmar: Ark.Mat.Ast.Fys.33B(1946),No.4 [24.10.1945]7.

* At present in the Institute for Scientific Information, Philadelphia.

This indicates that the paper was completed before the end of 1945, when considerable uncertainty prevailed (see Sec. 15) regarding the mass value of the cosmic-meson, but the paper was published sometime in 1946, in course of which year the cosmic-meson mass was accurately determined. When a reader somewhere comes across the statement that the meson mass was uniquely measured in 1946, the year of publication would not create any chronological confusion, because the bracketed date would indicate the time of transition from uncertainty to certainty about it.

The source material, on which I have based this historical review, is chiefly the foreign scientific journals and standard books available in our country. Besides, I have also depended on many inaccessible valuable paper reprints which Professor Rosenfeld has very kindly provided ~~me~~ me. Moreover, his letters to me evidently constitute a very important source material, for which I remain immeasurably grateful to him.

I must also thank Professors S. Hjalmar ~~s~~ & O. Brulin of the Royal Institute of Technology, Stockholm, for providing me with many useful reprints as well as the copies of two very valuable letters of Pauli addressed to Oskar Klein regarding meson-pair theory.

I cannot forget the help extended to me by Professor Shoichi Sakata (of SAKATA-model fame) from his death-bed. Prof. Y. Fujimoto of Waseda University, Tokyo, was requested by him to help my study "as much as possible".

I express my gratitude to Professor N. Kemmer, F.R.S., University of Edinburgh, for his very kind letter and an article-reprint, both of which I have utilized in the main text and in the appendices for describing some interesting features of the history reviewed.

I am thankful to Professor V.F. Weisskopf (M.I.T., Massachusetts) for putting me into contact with Dr Henry Small, who has very kindly tried to communicate to me some information from the Niels Bohr Library, New York, but some "regulation restrictions" have prevented the archivists of that library from helping me further with copies of documents and MSS that might have enhanced the documentary value of this review.

This dissertation is an elaboration of my articles (referred to hereafter as I & II) published in the Indian Journal of History of Science Vol. 6, Nos. 1 & 2 and a note accepted for publication in Vol. 7, No. 2 of the same journal. Enclosed are I & II.

I am grateful to Professor H.A. Bethe, Cornell University, for his critical perusal of my articles I & II and his recent letter. I have been greatly benefited by his critical and explanatory comments, which I have utilized in my dissertation. I now agree with his following criticism of my "repeated reference to the American Physical Society" :- "The Society as such never takes any stand on any subject in physics. It merely gives its members an opportunity to report their new papers. It would be more correct to speak of the American physicists community. You are, on the other hand, entirely correct that American physicists were very slow in accepting the Yukawa Theory." (See Sec. 1 and 7). Professor Bethe has commented in his letter that Eddington's fundamental theory (see Sec. 8) is hardly worth discussing in the history of the development of meson theory. Although Eddington's theory did not play any positive role in this history, the purpose of discussing it at some length is to indicate how Yukawa's theory was seized upon favourably from diverse viewpoints just after the initial scepticism about it had been dispelled. For the sake of the historicity of the development reviewed here the

discussion of even an impactless theory such as Eddington's is perhaps not quite out of place.

I am thankful to Professor H. Fröhlich, ^{F.R.S.} University of Liverpool, for his recent letter in which he has made some useful observations regarding his pioneering work on meson theory in a joint paper (1938) with Professors Kemmer and Heitler.

Thanks are due to Professor M.K. Banerjee, University of Maryland; Professors H.N. Bose, S. Datta-Mazumdar, G. Bandyopadhyaya and Dr. S.T.H. Abidi, Physics Department, Indian Institute of Technology, Kharagpur; Professor S.K. Sen and other colleagues of the Department of Humanities & Social Sciences, Indian Institute of Technology, Kharagpur; Shri S.N. Sen, Indian Association for the Cultivation of Science, Calcutta; and Professor M.K. Pal, Saha Institute of Nuclear Physics, Calcutta for their kind interest in my work.

REMARK ON ABBREV. SYMBOLS : I have used the symbols ev & sec. (with a period) for 'electron volt' & 'second' in accordance with those used in Annual Review of Nuclear Science up to Vol.12 (1962). From Vol.13 onwards we find ev & sec (without a period); even in later vols. like 18(1968) we find sec and not s, which has been standardized somewhat recently. In view of the recent standardizations, one should read all ev & sec. in my text as eV & s respectively (not however in Marshak's passage quoted in p.78 ; he used ev & sec in the book quoted from).