

letters

large, ungainly volumes. This makes it difficult to obtain a flat copy of the page region closest to the binding. Particularly annoying is the distortion of pictorial information.

It would be very helpful if publishers not unamenable to limited, scholarly reproduction of their material would make the "interior" margins of pages broader, to obviate the problem above. At the least, it would be helpful to place graphs, diagrams, and so on in positions away from the binding, all other things being equal.

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7/17/78

Philosophy of particles

In his article "When is a particle?" (June, page 23) Sidney Drell draws a parallel between discussions concerning whether neutrinos, for a long time individually unobserved, really existed; and quarks, apparently essentially unobservable individually according to present theories. In 1948 S. Dancoff gave an essentially positivistic reply, that the debate was unnecessary as long as the neutrino formed part of theories that gave observable results. This point of view is perhaps best expressed by P.A.M. Dirac when he says: "Only questions about the results of experiments have a real significance and it is only such questions that theoretical physics has to consider."

Even in its heyday there were many varieties of logical positivism. At present few physicists would admit to being logical positivists, but many appear to be still "tainted" by its "legacy" (for example, see Eugene Wigner¹). In the problem of existence or non-existence of particles it is well to recall the half-humorous proposal of Von Neurath, a prominent member of the Vienna Circle, to compile an *Index Verborum Prohibitorum*, for such words as Existence, Reality, Truth. These words, which have a perfectly clear meaning in ordinary speech, have been taken over by metaphysicians, and have also penetrated into physics, generating more heat than light. In the above question: "Do neutrinos really exist?" can one reply: "Yes, but not really?"

In the latter part of his article, Drell uses the term "observation" rather than "existence." While this term has been subjected to philosophical analysis (Pierre Duhem² already started this), it has a much clearer meaning for most of us.

In my opinion,³ the clearest "positivistic" view of physical theory is given by contemporary model theory, essentially a form of instrumentalism.

As to whether particles smaller than quarks shall be observed or introduced into more sophisticated theories, only the future can tell, which seems to be the

main conclusion of Drell's article. Perhaps even the concept of "elementary particle" will be discarded, and continuum theories will take its place, unlikely as it seems at present.

References

1. E. P. Wigner, in *Proc. of the International School of Physics "Enrico Fermi,"* Course 49, Academic, N.Y. (1971), page 123, where Wigner says: "For a positivist (as most of us are)..."
2. P. Duhem, *The Aim and Structure of Physical Theory*, 1st ed. Paris (1906). Duhem asserts that any observation is only meaningful in terms of some theory (paradigm?) held by the observer.
3. A. V. Bushkovitch, *Philosophy of Science*, 41, 1, 86 (1974); also *International Logic Review*, 8, 23 (1977).

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Elsasser's memoirs

The review of my memoirs by Paul Hanle (August, page 55) misconstrues the intent of my book. It was written to show the historical background, the social and intellectual ambience, and the more human aspects of science in a great period of physics, with my personal experiences serving as the main connecting thread. The reviewer's standards seem to ask a lot of me: He is unhappy that, apparently, I "cannot advance [my] own achievements," and he thinks of my more detached attitude as implying "self-contempt." Because I have resorted to psychological arguments on occasion it does not follow that I can or even should indulge in character analysis of prominent physicists, as he seems to demand. He says that my early "achievement was much in spite of the social and physics environments." The "social" is largely true since my young manhood coincided with the growth of Nazidom, but addition of the "physics environment" seems an embellishment by the reviewer.

With respect to those physicists I have encountered he says that I have "drawn several dozen sketches . . . , most only a page or two of summary." Here are the names of those physicists to whom I devote an aggregate of about three pages each: Sommerfeld, Heisenberg, Einstein, Born, von Neumann, H. A. Lorentz, Pauli, von Laue, Wigner, Bethe; in addition five pages for Millikan. Oppenheimer occurs frequently, adding up to over six pages. There are seven pages for Schrödinger and seven pages for the Joliot-Curie couple, all of these from the scientific viewpoint together with personal recollections, and that in 260 pages (not 216 as the review says).

Again, I must protest the reviewer's distortion of history when he says: "Nuclear physics was born, at almost the

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