

Author and augur in theoretical physics

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Wolfgang Pauli: Scientific Correspondence with Bohr, Einstein, Heisenberg a.o. Vol. II: 1930–1939. Edited by Karl von Meyenn. Springer-Verlag: 1985. Pp. 783. DM 298, \$112.

LIKE its predecessor (Vol I: 1919–1929), this book is indispensable reading for anyone seriously interested in the history of theoretical physics in this century. In addition to his own very significant theoretical contributions, Wolfgang Pauli was one of the “augurs”, as Einstein called them, whose judgement of new ideas is so important for their acceptance or rejection by the physics community. Indeed, Pauli came more and more to assume the role of the “conscience of physics”, now denied Einstein because of his heretical views on quantum mechanics (Pauli’s nickname — “Zweistein” — bears witness to this transfer of *mana*). “No form of approval could be more precious to physicists, not excluding Bohr, than Pauli’s benevolent nodding” Leon Rosenfeld recalled. Not that Pauli’s judgements were always definitive. In 1931, for example, he wrote to Peierls: “About semiconductors, one shouldn’t work on them, it’s a filthy mess [*Schweineerei*], who knows if semiconductors even exist” (p.94). More often, however, his views prevailed, even when he opposed other “augurs”. His prompt rejection of Bohr’s attempt to explain the continuous energy spectrum of electrons in β -decay (“The idea of a renunciation of energy conservation in the β -spectrum is and remains in my opinion a cheap and quite clumsy philosophy!”, p.4) helped lead Pauli to his greatest triumph: the prediction of the neutrino.

While the first volume of correspondence centred around discussion of the foundations of non-relativistic quantum mechanics, this collection focuses on relativistic quantum mechanics, quantum field theory and what we now call elementary particle physics. Almost half of the 362 letters are exchanges with Heisenberg. Other major correspondents (over ten letters) include Bohr, Dirac, Ehrenfest, Kemmer, Klein, Peierls and Weisskopf. (There is also a 15-item supplement to Vol. I.) Many of the letters deal with technical developments in the evolving quantum theory of fields and should be read in conjunction with the relevant published papers of Pauli and others. Editorial notes to the letters provide references to the papers; the facsimile edition of Pauli’s *Collected Scientific Papers*, and a similar edition of Heisenberg’s *Gesammelte Werke* now being issued, facilitate such comparisons, though one hopes that in future coordin-

ated editions of writings and correspondence will provide cross-references.

The extensive discussion of Dirac’s hole theory makes the absence of an edition of Dirac’s papers keenly felt. Pauli’s unhappiness with the hole theory seems to have been a driving force behind his attempts to develop a quantum field theory in which pair creation would emerge naturally. When he and Weisskopf were able to provide such a theory for scalar bosons, Pauli referred to it as their “anti-Dirac paper” (p.333). Another area in which Pauli was stimulated by dissatisfaction with Dirac’s work was the theory of higher-spin particles. Working with Fierz, Pauli first believed he had shown that such a theory was impossible for particles of spin greater than one, but then realized how to do it.

The only major discussion of the foundations of quantum mechanics in this volume is in response to Einstein’s challenge, in the well-known Einstein–Podolsky–Rosen (EPR) paper, to the completeness of the description of physical reality offered by the theory. Pauli informed Heisenberg of the paper with a characteristic example of his *politesse*: “Einstein has once again expressed himself publicly on quantum mechanics. As you know, this is a catastrophe every time it happens” (p.402). Yet Pauli immediately grasped the importance of the issue of non-separability raised by the paper: “Quite independently of Einstein . . . in a systematic foundation of quantum mechanics, one should start more from the composition and separation of systems . . . This is indeed—as Einstein has *correctly* sensed—a very fundamental point . . .” (p.404). Pauli encouraged Heisenberg to reply to the EPR paper, which he did in a previously unpublished manuscript printed on pp. 409–418.

While Pauli functioned well as a “conscience of physics”, he never took over Einstein’s role as “conscience of humanity”. His letters are notably shallow in their references to political events of a decade that spanned the world economic crisis, the advent of fascism in Germany and the crises in the Rhineland, Spain, Austria and Czechoslovakia which led to the outbreak of the Second World War. Pauli is clearly opposed to the rise of fascism, as well as the totalitarian turn taken by the Russian Revolution; but his references to such events primarily concern attempts to mitigate the personal difficulties (for some, like Heisenberg) and tragedies (for others, like Kottler) of fellow physicists or relatives, rather than any broader political perspective. The outbreak of the war caught him by surprise: “I didn’t believe in this war up to the last moment . . .” (p.678). His response is revealing of his sense of obligation and his priorities: “I think it is *my* job to take care for the continuation of the spiritual life in a time like the present one” (p.679).

A sampling of the letters suggests that

there are a large number of misprints, including garbled formulae which make certain letters (for example No. 541) difficult to read. There are also numerous misprints in the annotations, particularly in the transcription of English texts which are sometimes unintentionally humorous (Pauli’s broken arm comes from “slipping on a swimming dock” on p. 85; it is soon moved from a “splint into a cling” on p.92).

A great deal of effort has gone into the editorial annotation, much of it to good purpose. However, some questions must be raised. Detailed information about specific references in a letter is often included in an introductory note. This re-

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Star cast — Pauli (top, centre) at the Solvay conference of 1927 with Heisenberg on his left. Bohr and Einstein were also present.

quires frequent footnotes to letters directing the reader back to headnotes. One wonders whether it would not have been better to avoid such annoying interruptions by putting the necessary information into the footnotes in the first place. The sheer quantity of annotation shows a curious decay law. In each of the published volumes, about one-half of the pages in the early part is devoted to introductions and footnotes (since these are printed in smaller type than the main texts, this means the ratio of commentary to text is well over one to one). The number of pages of commentary falls off steadily as the volumes progress, until it reaches about 15 per cent of the total near the end. Did the editor’s enthusiasm slacken, was he under pressure to finish off each volume or is there some other explanation? In any case, the total amount of annotation seems excessive, and much could be pruned without great loss to the reader. An editor is under no obligation to share the fruits of *all* his or her research with the reader. One does not really admire a museum where the descriptions furnished by the staff begin to divert attention from the objects to be studied. □

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