THIS volume is the first of a series which is to include the complete scientific correspondence of Wolfgang Pauli. Pauli played a central role in the development of quantum mechanics in the 1920s, and in its interpretation and acceptance by the physics community. Among his achievements during the period covered by this volume were his writing of the classic exposition of relativity theory as a lad of twenty; his development of the Pauli or exclusion principle, for which he later won the Nobel Prize; his proof of the mathematical equivalence of matrix and wave mechanics, worked out independently of the better-known proof by Schrödinger; and his work with Jordan and Heisenberg on the foundations of quantum field theory. Weisskopf, in his Preface, tries to characterize Pauli’s approach:

Pauli had a special way of doing science. He created a unique style of thinking and research, which has deeply influenced and guided physics. It is a style that emphasizes the essential and the symmetrical in the laws of nature, and captures it in mathematical formulas without many words or empty talk. In the minds of all physicists, his mode of thinking and his whole nature stand as something ideal, clear and pure.

Something of the awe in which his intellectual powers were held may be surmised from the nickname bestowed upon him in the German-speaking physics community: ‘Zweinstein’ (or ‘two-stone’), second only to ‘Einstein’ (or ‘one-stone’).

Many stories about his formidable personality do not suggest a similar comparison with the popular saintly image of Einstein, and this volume certainly provides some documentary evidence to reinforce the Pauli legend (see the letter to Einstein quoted on p. xxxvi of the Introduction, for example), though also many examples of his helpfulness to those in difficult circumstances (see p. xxii of the Introduction, for example). In his Preface, Weisskopf gives some brief insights into Pauli’s personality. On the whole, however, the annotations are rather reticent on the subject of his personal life. I could find no reference anywhere in the volume to Pauli’s Jewish ancestry. The valuable chronology through 1929 on pp. 536–541 confines itself to his scientific activities and travels, avoiding such matters as the date of his marriage, with one curious exception: the date on which he left the Roman Catholic Church is given. Perhaps this reticence befits a critical edition of his letters, which provides indispensable material for a critical biography but cannot take the place of such a biography.

In his valuable Introduction, Professor Hermann rightly stresses the importance of such collections of scientific correspondence.

The communications system of the ‘scientific community’ in the twentieth century is based upon periodicals and letters. Periodicals publication is strictly regulated. Therefore the supplementary information value of letters is considerable. ‘Informational value’ means in the first place informational value for the recipient of the letter, therefore for contemporary physicists, but also means informational value for present-day historians of science. Historical writing which only utilizes contemporary publications can only be considered as a first beginning. Collections of letters facilitate scientific-historical work at a higher informational level.

I would add that another major source of scientific communication in this century is verbal — either the private (face-to-face or on the telephone) or public forms (such as lectures and discussions). The former is almost always irretrievably lost, unless preserved in letters, contemporary notes or later memoirs; the latter is more often preserved in the form of conference proceedings — often altered in form by the time they reach print. Still, these are precious sources of information which should not be neglected by the historian of science.

Quotations from later letters in the course of Hermann’s discussion of Pauli’s role in the development of modern physics may well be altered to fit the modern physicist. A few of Hermann’s comments may raise some eyebrows, for example (p. xix): ‘Intellectual creation is something peculiarly human and consequently independent of time’. If this were taken literally, it would be hard to see what the function of the historian of science could be.

The book proper consists of the texts of 241 letters to and from Pauli, together with running commentaries linking groups of letters and extensive annotations of the letters. Texts and commentary are in German. The letters give a fascinating picture of the interactions between Pauli and a few of the handful of physicists who were re-making theoretical physics in the 1920s. In spite of the title, only three of the letters are to (two) or from (one) Einstein; over half the letters are to or from Bohr and Heisenberg, in roughly equal number. Others with an exchange of over ten letters are Ehrenfest, Kronig and Landé. If one wants to derive the full value from their scientific content, the letters are best read in conjunction with Pauli’s published papers, available in one of those facsimile collections which too often substitute for complete, critical editions of the writings of a scientist (Collected Scientific Papers by Wolfgang Pauli. Edited by R. Kronig and V.F. Weisskopf. Interscience: New York, 1964. 2 volumes). Fortunately, the extraordinarily rich and detailed annotations (which I understand are mainly the work of Dr von Meyenn) make reference to these papers, as well as to other contemporary writings and later historical studies, very simple. The reader will also be most grateful for the commentaries and annotations explaining the context of the letters, and various references to persons and events which otherwise would send him/her
Thinking of the mind


The last infirmity of noble minds is the desire to create a grand synthesis of everything. Even such a down-to-earth physiologist as Sherrington succumbed by writing in his old age the impenetrable Man on His Nature. At the age of 76 Gregory Bateson, one of the pioneers of social anthropology, has produced his own contribution to this genre. The collocation of words in the title, Mind and Nature. A Necessary Unity, is sufficient warning of what to expect in the contents.

The core of Dr Bateson's book is his list of six criteria for regarding something as a mind, as follows: (1) A mind is made up of interacting parts — thought could not be carried out by an entity not composed of parts, if only because there would be no way of representing external states of affairs within it. (2) Mental processes are triggered by differences or by changes — information can only be carried by difference. (3) Mental processes require energy generated from within the system — they are not simply reactions to an externally applied force, unlike the motion of a bullet fired from a gun. (4) They contain circular chains of causation often involving negative feedback. (5) In mental processes, the effects of a difference detected by the system are to be regarded as a coded version of the difference itself — Dr Bateson seems to mean by this that mental structures represent aspects of the external world. (6) Mental processes involve a hierarchy of logical types — this would appear to mean that one mental process can serve as the input to another and that minds are capable of reflecting on aspects of their own activity.

Although some of the criteria are obscurely expressed, most people would probably be prepared to grant that they are necessary conditions for the existence of mind. Unfortunately, Dr Bateson does not discuss whether they are sufficient conditions. They are in fact all met by a computer programmed to perform an intelligent task and although one would be happy to regard such a machine as working in an analogous way to mind, there is little temptation to think of it as actually possessing a mind. Dr Bateson deliberately ignores the problem of consciousness and indeed appears to attribute mind to plants and to the evolutionary process. But the differences between the workings of the evolutionary process and those of the mind may be more interesting than the similarities. He has in fact omitted from his list of criteria for mind the one that many would regard as the most important, namely, the characteristic of acting by intention, something that clearly distinguishes the blind forces of evolution from the human mind. One way of putting this is that minds contain explicit representations of their own goals in the light of which the representation of the external world can be manipulated in order to formulate a suitable course of action. The representation of future states of