same time it is too small and random in scope to be considered as a comprehensive reference work. Moreover, most of the papers in the fields I am familiar with have appeared in similar form elsewhere, and I suspect that this may be true of the majority of the contributions. Thus, although many of the papers are well worth reading, few people are likely to be interested in more than a small fraction of them.

The one feature of the volume that might widen its appeal is the section on epistemology. It is obvious that the organizers attached great importance to this part of the symposium; Karczmar devotes almost half of his 20-page introduction to a discussion of the philosophical contributions, for example. Even so, the section on epistemological aspects contains only four of the 20 papers in the book, and of those the first, by the neurophysiologist Ragnar Granit, consists of a relatively brief appeal to investigators not to lose sight of the purpose of mechanisms they study in an excessive worship of causal relationships. Thus a small tail attempts to wag a very weighty dog. Not that the simile is very exact; the tail ignores the dog almost as completely as the dog ignores the tail, and on the one occasion when a philosopher did borrow a concept from one of the psychological offerings he misunderstood it, apparently under the impression that Barnett had stated that only man and guinea pig synthesize ascorbic acid, when he had in fact stated the reverse. The error made no difference to the point being illustrated, that biochemistry, in its application to human behavior, must be considered not in isolation but in the light of many factors ranging from the physiological milieu to the evolutionary history of man, but it is symptomatic of the communication difficulties at interdisciplinary meetings.

I was interested and somewhat surprised to discover that two of the three philosophers believe that the "will" is still an insurmountable barrier to the acceptance of any materialistic or reductionist explanation of behavior. Toulmin expresses this belief in the blatantly dualistic statement that the brain is only "our" servant in carrying out our desires. McMullin says the same thing rather more subtly, lumping conscious decisions with other forms of conscious awareness as being outside the scope of physics. He does not consider the possibility that the decisions may take place independently of consciousness and that the reasons we give for an action may be no more accurate than those of a well-informed observer.

I tend to Taylor's view (that is, if I understand him) that the reasons we may give for our actions, when called upon, are always in a sense rationalizations, reactions of a verbal cognitive system to the results of decision processes taking place in parts of the brain not accessible to consciousness.

For me the mind-body problem resolves itself to the difficulty of reducing immediate awareness, or "raw feel," to physical processes. McMullin, in his excellent analysis of scientific reductionism, deals with this problem along with many others with great clarity, but his conclusion that "to tell one what it is like to hear" is not a function of science, although I cannot disagree, is not very helpful metaphysically, and leaves the basic problem, as far as I am concerned, as insoluble as ever.

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Nuclear Probe

Mesic Atoms and Nuclear Structure. Y. N. KIM. North-Holland, Amsterdam, and Elsevier, New York, 1971. xii, 250 pp., illus. $20. A North-Holland Research Monograph in the Field of Nuclear Physics.

The principal concern of this book is with what mesic atoms have been able to tell us about nuclear structure. We recall John Wheeler's remarkable paper "Mu meson as a nuclear probe particle," which he circulated privately in 1949 and then published in 1953. This paper illuminated in considerable detail many of the ways in which measurements of mu-mesic x-rays could reveal the structure of the nucleus. In a certain sense, this book may be regarded as a 20-year progress report on Wheeler's program.

The book tells what has been learned from mu-mesic x-ray measurements about the size and shape of the nuclear charge distribution, about the distribution of magnetism in nuclei, about nuclear quadrupole moments, and about nuclear polarization. Separate sections deal with isotope shifts, isotone shifts, and isomer shifts as well as a number of other related topics. There is a chapter on the atomic physics of mesic atoms and chapters on other exotic atoms such as pionic atoms, kaonic atoms, Σ-hyperonic atoms, and others. The work on muonic molecules and muonum is also reviewed. Altogether, the book is a careful and orderly distillation of some 300 or so papers that have been published since Wheeler's.

The book is written with very little appreciation of the experimental problems. In all the 132 pages devoted to muonic atoms there is little to indicate where the muons come from or how they are detected. Nothing is said about how many muons are available and what the resolution capabilities are. There is no indication of what the future holds in store.

In the main, the tables of experimental results have been simply lifted from the original papers. The author has made no attempt to compile the results of different measurements. There is, for example, no comprehensive table of nuclear radii as determined from muonic x-rays, although measurements of these have been reported by many authors. Thus, the table given by Acker *et al.* (1966) is reproduced, but no mention is made of later and more precise work. The author has added very little to what has already been printed in the original papers and earlier reviews. There is selection but no digestion.

Relatively little is done in the book to compare what has been learned about nuclear structure from muonic atoms with results obtained by other techniques. Thus, in comparing muonic atom results for root-mean-square nuclear radii with those obtained by electron scattering, the author is content to review a paper on this subject by Elton in 1967, and other methods of determining nuclear radii go without mention. If you wanted to know the value of the quadrupole moment of the thorium-232 as measured by muonic x-rays, you would find a value in a table taken from DeWit (1967), but you would have to go to the literature to learn that McKee (1969) measured the same thing more accurately a little later. Moreover, you would have no indication that the same quantity had also been measured by Coulomb excitation methods.

The book is a useful collection of a great deal of information on mesic atoms. It is not a definitive work, however, and cannot be relied upon to be the last word on any aspect of the subject.

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