Book Reviews

Formalism and Reality

Quantum Theory and Beyond. Essays and Discussions Arising from a Colloquium, Cambridge, England, July 1968. TED BASTIN, Ed. Cambridge University Press, New York, 1971. x, 346 pp., illus. $16.

A student introduced to quantum theory invariably encounters puzzling questions which the formalism of the theory demands remain unanswered. Often he is initially bewildered and severely uncomfortable. Subsequently he finds he can use the theory quite fruitfully to predict experimental results. His discomfort is thus forgotten, usually without resolution of the original problems. Indeed, quantum mechanics is spectacularly successful in predicting experimental results. But at the same time it requires its practitioners to work with a jumble of conceptual elements, drawn from various incompatible frameworks, none of which is adequate to model the known facts. Thus quantum mechanics has a unique position in modern science: from a practical viewpoint it is regarded as a finished product, but from a conceptual viewpoint it is unsatisfactory and often disputed by the experts.

Recently the unsettled aspects of the theory have been the subject of renewed consideration, as *Quantum Theory and Beyond*, the proceedings of a colloquium on the subject, attests.

The participants in the colloquium were concerned with the following two questions: Are the present foundations of quantum theory satisfactory? And if, as most contributors believe, they are not, what avenues are open to render them so? Few doubt that the quantum mechanical formalism adequately describes the atomic domain. But questions remain concerning the limits of the formalism's validity. In particular, can it be extended to provide a framework for a complete, self-consistent description of reality?

Such a discussion, naturally, requires an acceptable definition of reality, including a clarification of how we are to view space and time. A related question arises whether any such definition can be consistent with classical notions of reality. Bohr has insisted that any measuring apparatus and observer be amenable to classical description. However, a quantum mechanical treatment of the measurement process transfers quantum interference effects into the classical realm, contradicting Bohr's requirement and everyday experience. This difficulty seems to be manifest in any quantum mechanical description of the measurement process, where a confrontation between the quantum and classical domains is inescapable. The difficulty is probably most acute in the Wigner's friend paradox, for which Wigner has shown that the formal range of validity of Schrödinger's equation may not extend to include the observer himself.

Quantum Theory and Beyond devotes a chapter each to a review of Bohr's notion of classical reality and a discussion of the measurement process. Bub in his criticism of the Daneri-Loinger-Prosperi measurement theory evidently recognizes the magnitude of the difficulty discussed above, but some of the other authors appear to underestimate or sidestep it. The colloquium preceded much of the recent discussion of the Everett-Wheeler-Graham scheme for alleviating this problem, and the book contains no discussion of this important suggestion. The papers do, however, serve to exhibit the wide range of ideas prominent on the subject.

What then are suitable avenues to render the foundations of quantum theory satisfactory? Any revision of the formalism must naturally be consistent with existing experimental data, although one is free to consider schemes with different predictions in areas not yet tested experimentally. Such schemes in many respects are preferable to those with identical predictions, since the residual differences may allow experimental tests.

Bohm discusses a possible revision in this direction through the introduction of hidden variables. He also reviews von Neumann's famous work on the compatibility of hidden-variable theories with the predictions of quantum theory, and contrasts von Neumann's views with Bohr's. It is unfortunate that the book could not include a large number of more recent advances made in the understanding of hidden variables as a result of a recognition of the significance of Bell's theorem.

Various contributors review the experimental verification of quantum theory, as well as the elementary phenomenology of measurement processes. Whiteman's paper is noteworthy in demonstrating just how stylized much of the discussion of observations has become, despite claims to a phenomenological orientation. Thus it is not definite that present experimental data compel a reevaluation of our classical notions of macroscopic reality, space and time. These notions are very elegant, desirable, and coherent views to hold, and one should scrutinize very carefully any data and arguments instructing us to abandon them.

One may, however, eventually be compelled to revise these concepts, and the participants consider how such a revision might be effected. They suggest that it may be accomplished either in a manner which is consistent with, but richer and deeper than, our present understanding of reality and geometry or in a manner which severs the parentage of quantum theory from classical notions of reality. Proposals of the first type involve a revision and reinterpretation of the spinor calculus. Proposals of the second type concentrate on a reconciliation of the discrete character of atomic systems with the continuous nature of space and time. One such scheme calls for a quantization of space using cohomology theory. Another is an imaginative proposal by Penrose to construct the continuous concept of space from the discrete concepts of angular momentum using only commutation relations and combinatorial rules for angular momenta.

The book open-mindedly presents many problems but, sad to say, few solutions. It does leave a number of avenues open for consideration. Nat-

urally any collection of papers cannot have the unity attainable by a single author. Thus many gaps can be attributed to format. Bastin's editorial comments are welcome additions in this respect. The book's greatest merit is that it reveals the wide range of suggestions currently under consideration relating to a field long thought by many to be closed.

JOHN CLAUSER
Department of Physics and
Lawrence Berkeley Laboratory,
University of California, Berkeley

Applying a Social Science

Development Anthropology. GLYNN COCHRANE. Oxford University Press, New York, 1971. xii, 126 pp. $5.

This book attempts to explain applied anthropology's lack of academic respectability and of policy successes and to prescribe a cure for both its theoretical and its practical weaknesses. Cochrane argues that academic training in "development anthropology" is poor and that anthropologists are overspecialized, having little sensitivity to the administrative context in which policies for the development of newly independent nations are embedded. Development, he says, is a national matter, and the anthropologist's efforts to achieve it in single communities are therefore not profitable. Rather, development should be defined and approached as a national problem with local dimensions. Anthropology stresses community development just because it is politically neutral. This explanation seems to me to miss the mark, however; it has been politically neutral because anthropologists have stressed community enrichment rather than community empowerment.

The serious practical problem raised is the conflict between anthropologists and administrators, which Cochrane attributes mainly to academic preciousness and utopianism. According to him, the hard reality is that work in development means acceptance of administrative directives about what to study and what to do. Though the only proposal he makes is that anthropologists accept these conditions, he has identified a reason why many anthropologists leave development work and why few are willing to embark on this career.

Applied anthropology also has long-standing ethical problems, for, as Cochrane recognizes, there is no set of scientific values to guide the development process. Also he points out that our ethics are overwhelmingly negative, stressing what we should not do and ignoring what our responsibilities for action are. However, he does not raise the issue of the anthropologist's responsibility to those he studies, nor does he follow through with a definition of development to clarify the ethical issues. He argues that development is painful but not that it may be inherently bad, thus blaming only our approaches to it, never the process itself.

Proceeding from this point of view, Cochrane suggests a reorientation of the field, chartered by his unexamined belief that anthropology's potential in development is yet unrealized, the potential lying in its knowledge of "culture" and "social reality." He rightly argues that development poses interdisciplinary problems requiring the practical collaboration of academics and administrators. Development requires a knowledge of local cultures, of many aspects of the development process everywhere in the world, and of the means to implement plans. So he suggests that we train anthropologists for this by a dual approach: First, we must create an academic development anthropology to deal with theoretical analysis, modeled on development economics or development administration. Then we must train a class of "general practitioner" anthropologists or "non-specialized specialists" with action orientations.

Though Cochrane's definition of the problems of applied anthropology is searching, it is very narrow, raising serious doubts about his remedial program. He accepts on faith that anthropology's potential is unrealized, when its utility in development is in grave doubt among both academics and administrators. Just what this potential is ought to have been explored, for invocations of "culture" are not convincing. His critique of anthropological utopianism is perhaps fair, but it misses the point. Anthropologists are aware that underlying all approaches to development is a vision of the kind of society we are striving to create. This is at variance with anthropology's relativistic philosophy and creates profound difficulties for the anthropologist working in this field. In a world of imperialistic forces, these misgivings cannot be discarded as merely utopian. Here again he fails to provide any definition of development and to face the real problems that definitions of it raise.

Moreover, in laying his charge against ivory-tower academia Cochrane shows no awareness of the existence in our colleges and universities of the fields of rural sociology, agricultural economics and engineering, extension education, communication arts, and nutrition, to name only a few. These also send workers into development. Often having more field experience than anthropologists, they are educationally equipped to deal with both research and administrative problems at local and national levels. Their approaches and their academic organization practice the program that Cochrane thinks he invented. Whatever anthropology has to say about development, it must be said to these workers, and they will not be patient with invocations of anthropology's unnamed potential.

The book does not mention the role of educated citizens of developing nations. Yet major efforts, in all the fields named above and in some anthropology departments, are being made to teach such people what we know, with the idea that they will make their own programs. Apparently Cochrane sees development as our message to an unenlightened world, a view that is intellectually antiquated and politically naive.

Finally, the book is polemical and so leads one to expect solutions more impressive than those offered. Like so many polemics it hides both the strengths and weaknesses of its views by repetitiousness. I do not find Cochrane's invective matched by a knowledge of the present development field, and though he is not beating down an open door his polemical strategy seems to have put him on the front steps of the wrong building.

DAVYDD J. GREENWOOD
Department of Anthropology,
Cornell University,
Ithaca, New York

Peaceful Uses

Man and Atom. Building a New World through Nuclear Technology. GLENN T. SEABORG and WILLIAM R. CORLISS. Dutton, New York, 1971. 412 pp., illus. $10.

The Atomic Energy Commission has been in existence for approximately 25 years. During this time it has had a number of ups and downs, and it is now being attacked by conservationists and others concerned with preserving the environment. This book, therefore,