applications. Not since G. Placzek published his *Rayleigh-Streuung und Raman-Effekt* in 1934 has a text dealt in a systematic way with the basic topics necessary for a thorough understanding of the physical phenomenon itself. Suschinskii's main purpose in writing this text was to fill this void, and he has done an admirable job. The first quarter of the book treats the general theory in a clear and concise manner, suitable for reading by anyone with a basic knowledge of quantum mechanics. Of particular interest is the theoretical discussion of resonance scattering phenomena. Unfortunately the few brief words the author writes concerning the experimental status of resonance scattering are sadly out of date. But because of the publishing time involved, this situation will never be remedied by a textbook as long as the field of Raman spectroscopy continues to grow as rapidly as it has for the past decade.

A secondary objective of the author was to highlight the various possible applications of Raman spectroscopy to the study of molecular and crystal structure. This aspect of the book broadens its potential audience considerably. In addition to the standard discussions of molecular symmetries, the text also includes a section on the structural analysis of various organic substances which should prove quite useful to organic chemists and biophysicists. Besides covering selection rules for first- and second-order scattering from perfect crystals, the author brings us more exotic subjects such as scattering near structural phase transitions and scattering from powders. Indeed, most of the material covered in major review papers on Raman scattering is discussed at least briefly. Stimulated Raman scattering is also covered in some detail. Although the discussion of stimulated scattering is quite complete, it is hard to find material that has not been treated extensively in a number of other texts.

Perhaps the greatest value of the book lies in its bibliography. It includes over 500 references, the majority of which are from Russian journals. These references should assist greatly in informing the English-speaking scientist of the vast amount of work being done with Raman spectroscopy in the Soviet Union.

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Quantum Mechanical Ideas

Perspectives in Quantum Theory. Essays in Honor of Alfred Landé. WOLFGANG YOURGRAU and ALWYN VAN DER MERWE, Eds. M.I.T. Press, Cambridge, Mass., 1971. xl, 282 pp., illus. $17.50.

About half of the 19 papers in this volume are on miscellaneous applications of quantum mechanics. No attempt will be made to review these here. The remaining papers are on fundamental questions, appropriately so in a book dedicated to Alfred Landé, who is among those pioneers of quantum mechanics who became increasingly critical of the orthodox line on the subject.

The most iconoclastic of the authors are Park and Margenau. In an analysis of the measurement of "incompatible" observables they conclude that it is the quantum mechanical axioms of von Neumann which are incompatible. However, this turns out to be largely a question of the semantics of the words "measurement" and "observation." It illustrates the danger of using as technical terms words in common use with rather wide meanings. Narrowing down the issue, Margenau and Park end by posing a fairly well-defined question: can one find, assuming conventional quantum mechanics, a procedure which (for an arbitrary state of the system) will yield a joint probability distribution $\rho(p, q)$ such that integration over q or p yields the conventional probability distributions for the other of the pair of incompatible observables? Margenau and Park illustrate procedures which work in this way for special states of a system, but leave the question open for arbitrary states.

As it happens just this question (it seems to me) is answered by Wigner in his elegant contribution "Quantum-mechanical distribution functions revisited." This includes a proof (previously unpublished) that there is no such positive distribution bilinear in the wave function and its complex conjugate. Assuming that all possible statistical predictions about a system are contained in the density matrix, the question of Park and Margenau is then answered in the negative.

The nonlocal nature of quantum mechanics is a source of unease for many people. There is an analysis of this by Karl Popper, writing on the Einstein-Podolsky-Rosen paradox. He emphasizes that it is more the instinct for locality than determinism which makes for the feeling of paradox here. It can indeed be shown that the quantum mechanical correlations cannot be reproduced by a hidden variable theory even if one allows a "local" sort of indeterminism. For example, one could imagine that the indeterminism might be introduced by throwing dice at every space-time point and allowing the result of each throw to influence physical events in the future light cone of the point in question. This would not work; the quantum mechanical correlations are too perfect to permit any such local statistical slop. Popper remarks that he does not find this point manifest in my own paper on the subject, but it is there—very briefly.

The least iconoclastic authors in the volume are Bondi and Rosenfeld. Landé, it seems to me, has been less troubled by the content of ordinary quantum mechanics than by its orthodox presentation. Bondi follows him in this, urging a serious attempt to find how quantum mechanical ideas may be most economically and convincingly inferred from everyday phenomena like the stability of solids. He feels that "if one percent of the effort spent on physics were devoted to clarification, we could soon teach the basic concepts of quantum mechanics to the general run of nine-year-olds." He is supported in this, in perhaps an unexpected way, by Rosenfeld, who describes some experimental investigations on human perception. Rosenfeld finds that some of the stages passed through by the child, in his notions of causality for example, are more in harmony with quantum ideas than with those of classical theoretical physics.

In addition to several other scholarly discussions of puzzles of quantum mechanics and the papers on applications already mentioned, there is some historical material. This includes some reminiscences of Born and a survey of Landé's work by Yourgrau and van der Merwe. Both of these articles include the following remarkable story, not previously known to me. Born and Landé worked together on the bulk properties of crystals according to the old Bohr quantum theory. For a time they were quite unsuccessful in getting agreement with experiment. Finally they succeeded, by giving up the idea that the orbits of electrons in an atom are coplanar. This "caused quite a stir" because "the mere analogy of Bohr's orbits with those of the planets around the sun, repeated over and over in the literature, served as a psychological block, for a half dozen years, to a consideration of the possibilities of three dimensional systems." There is a moral here—not the only one in this book.

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