

spinor by $\sigma \cdot \mathbf{V}\zeta = 0$, it is clear (for $\zeta \neq 0$) that this requires $\mathbf{V}^2 = 0$. This is Cartan's starting point: The spinor ζ is associated with the isotropic vector $\mathbf{V}$, that is, a (complex) vector of zero length. From this geometrical view, he develops all the familiar results of spinors, including the charge conjugation matrix C .

The particular advantage of this view is that it generalizes directly: Spinors in a euclidean space of odd dimension $n = 2\nu + 1$ are associated with totally isotropic subspaces of dimension ν . This leads very directly to the Clifford algebras and to linear representations of the general orthogonal group.

The exposition and organization of the lectures are remarkable; the style is precise and economical but very clear and a pleasure to read. Physicists will probably find the viewpoint and method slightly unfamiliar, but the work is quite accessible and is recommended primarily for broadening and enriching one's viewpoint, rather than for a first treatment.

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Sound in the sea

CHARACTERISTICS OF SEA REVERBERATION. By Victor V. Ol'shevskii. 159 pp. Trans. from Russian. Consultants Bureau, New York, 1967. Paper \$19.50

by Peter G. Bergmann

Underwater acoustics has been cultivated by all naval powers ever since the French physicist Paul Langevin developed some echo-ranging gear toward the end of the first world war. Underwater sound has also been employed as an oceanographic research tool for locating commercially valuable schools of fish and for determining the depth of the ocean as part of navigation. Typically, research in underwater sound proceeds partly as a branch of acoustics, partly as an oceanographic specialty.

Reverberation occurs when a beam of underwater sound emitted to observe a reflector (such as a submerged object, or the ocean bottom) is scat-

tered, usually incoherently, back into the receiving equipment, so that the desired reflected signal is obscured and contaminated by the back-scattered sound energy, whose frequency characteristics will differ from those of the signal only insofar as the Doppler effect may shift signal and scatter by different amounts. Obviously, reverberation cannot be overcome by increasing the power of the emitted beam in contrast to background that is independent of the emitted sound power.

Victor Ol'shevskii's survey is concerned primarily with the mathematical treatment of reverberation, which lends itself readily to the application of such standard theorems as the Wiener-Khinchin relationship between correlation function and power spectrum. The treatment given appears concise, without omitting any of the important techniques of statistical analysis now available. In a concluding section Ol'shevskii also summarizes experimental procedures suggested in the taking of data on reverberation.

On the whole this book appeals primarily to the reader who is himself engaged in underwater acoustics or at least in a neighboring discipline. The presentation is clear though this reviewer suspects a few lapses, perhaps unavoidable, on the part of the translator. The half-tone reproductions of sound traces lack the sparkle possible with a superior photoengraving technique but are probably adequate to demonstrate the principal characteristics of underwater sound signals and of reverberation. The absence of an index is probably not too serious in a relatively brief survey, and there is a bibliography with a total of 58 references, selected from both Soviet and US journals.

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Bohr and the new theory

SOURCES OF QUANTUM MECHANICS. (Reprint collection) Edited with historical introduction by B. L. van der Waerden. 430 pp. North-Holland, Amsterdam, 1967. \$14.00

by Robert L. Weber

In a 59-page introduction, B. L. van der Waerden presents a valuable his-

torical study and an interpretation of the importance of the papers selected for this source book, from the years 1917 to 1926. These papers are divided into two sections. The first part, "Towards Quantum Mechanics," includes papers written before July 1925 judged necessary to an understanding of the discussion of matrix mechanics. These papers are by Albert Einstein, Paul Ehrenfest, Niels Bohr, Ladenburg, H. A. Kramers, John Slater, Max Born, John Van Vleck, Werner Heisenberg and Kuhn. In the second part, "The Birth of Quantum Mechanics," are papers written from June 1925 to January 1926; they contain the complete development of matrix mechanics. These papers are by Heisenberg, Born, Jordan, Paul Dirac and Wolfgang Pauli.

The editor has added considerable interpretation, with benefit of hindsight, through his conversations with the authors and by inclusion of correspondence among the principals. One might wish that this correspondence were given in English translation, as are the papers. This volume is devoted strictly to the development of matrix mechanics. As stated in the preface, papers on other topics, Zeeman effect, spin and statistics, quantum field theory, as well as papers by Peter Debye, Arnold Sommerfeld and John von Neumann, were omitted. Papers on wave mechanics are said to be reserved for a projected second volume. Van der Waerden's own authorship of a quantum theory of wave fields gives promise that the study will be continued.

The theme of this collection is that Bohr's correspondence principle was the guideline in the transition from the old to the new quantum theory. This thesis has governed the selection of papers, quotation from correspondence, and even those areas of Bohr's work that are examined.

Editor and publisher are to be commended for making available in attractive form these important papers.

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NEW BOOKS

ELEMENTARY PARTICLES & FIELDS Muons. By A. O. Weissenberg. Trans. from Russian. 347 pp. North-Holland,