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feasible in any material system. He squeezes the available numerical data hard until only speculation remains. In another phase of living things, L. Brillouin examines "Information and Imagination Theories", in an assessment of the limitations of thought and of imagination.

I recommend this book for its presentation of many new ideas. Those readers not familiar with the subject may need to learn some new words necessary to describe new concepts. The expert will find here an excellent summary, as of 1962, of a flourishing science. The format is excellent, but there is no index.

Relativistic Kinematics. A Guide to the Kinematic Problems of High-Energy Physics. By R. Hagedorn. Part of the series Lecture Notes and Supplements in Physics, John D. Jackson and David Pines, eds. 166 pp. W. A. Benjamin, Inc., New York, 1963. \$8.00
Reviewed by Ernest P. Gray, *Applied Physics Laboratory, The Johns Hopkins University.*

Here is a book that should be on the shelf of anyone who has ever struggled through relativistic coordinate transformations—so simple and elegant in principle, yet often so involved and tedious in practice. The key virtue of Hagedorn's refreshingly informal volume is his ability to drive home to the reader the most important trick of the trade: the great economy to be derived from a determined use of relativistic covariance and invariance whenever feasible. The usefulness of applying these concepts is well known, of course. But in no other book known to the reviewer are they applied so consistently and with such manifest relish.

The book is an edited and slightly enlarged version of a set of lecture notes for an informal course given by the author at CERN, Geneva, during 1961-62. The author states in the preface that his aim was to provide "an aspirin for the kinematic headaches" of experimental high-energy physicists, and to impart the know-how to "prevent a recurrence". In meeting these objectives the author has succeeded handsomely.

Hagedorn starts out with the development of standard relativistic kinematics. Even here he takes a some-

what unusual approach by his immediate emphasis on the central position of relativistic invariance. Thus the Lorentz transformation is derived from the form of the invariant line element, itself a direct consequence of the constancy of the velocity of light in all inertial systems. After this introduction, he proceeds to illustrate the manifold uses of invariants by means of numerous interesting examples worked out in detail. Among these are center-of-mass transformations, the transformation of cross sections, and the change of the shape of a momentum spectrum under a Lorentz transformation.

One interesting chapter is devoted to coordinate systems and variables. The three systems most convenient for the usual collision and particle production problems—the laboratory, center-of-mass, and "brick wall" systems—are described and interrelated through the use of invariants. The s , t and u variables—each the square of the center-of-mass energy for a different observer—which are used, for example, in formulating the theory of Regge trajectories, are introduced, and interpreted graphically and through physical examples.

In another chapter, some of the uses of invariant phase space are described, and illustrated by a consideration of the mass distribution of groups of particles resulting from high-energy collisions. This distribution will be governed, in general, partly by the dynamics of the collision (i.e., the matrix element) and partly by the kinematics. In many situations the kinematical factor dominates, leading to a "pure phase space" distribution. Thus it was through the appearance of sharp peaks above the background of "pure phase space" in the mass distribution of certain groups of reaction products that the ω -meson and some of the other recently discovered resonances were first identified. Another illustration of the power and utility of this type of phase space averaging is the Dalitz plot for the energy distribution of three reaction products, which has been used, for example, to determine the spin and parity of the ω -meson.

Perhaps the most interesting chapter is the last one, where Hagedorn

departs from pure kinematics and presents the covariant formulation of the precession of a spinning particle. The existence of a polarization four-vector is first demonstrated, expressions for the various components are derived and interpreted, and the equation of motion is discussed. The existence of such a four-vector is by no means obvious, since the ordinary polarization (three-) vector is an axial vector whose relativistic generalization would be expected to be a skew four-tensor. In fact, a polarization four-vector can in general be defined unambiguously only for a group of spinless particles. The relation of this four-vector to the angular momentum four-tensor is utilized for the covariant separation of the intrinsic angular momentum of a group of spinless particles from their orbital angular momentum. The relation of this classical calculation to the corresponding quantum mechanical problem of a particle with spin angular momentum is touched on all too briefly. What a shame that a discussion of spinors could not have been included.

In spite of the relative compactness of the text, the exposition is extremely lucid throughout. Many of the questions that would be expected to occur to the reader are brought up and answered at once. However, let no one be deceived into believing that the material can be digested without effort. In this connection, the reader is advised to look up the very apt biblical verse referred to on p. 137 (St. James 1:22) and apply its admonition to the entire book.

Gesammelte Schriften and Vorträge. By Max von Laue. Vol. 1, 548 pp.; vol. 2, 513 pp.; vol. 3, 265 pp. Friedrich Vieweg & Sohn, Braunschweig, 1961. \$35.00 per set. Vol. 3 sold separately as *Aufsätze und Vorträge*, \$4.80. Reviewed by W. M. Elsasser, Princeton University.

The late Max von Laue (1879-1960) had himself planned this collection of his papers and lectures just before his death. If it is true that as the French say, "le style, c'est l'homme," this applies certainly to the famous physicist whose papers are reprinted here. Reproduction is by a photolithic method with the original page numbers deleted

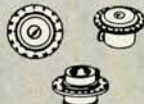


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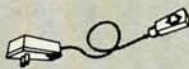
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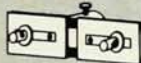
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