paramagnetic gas, the Debye crystal, electrons in metals, black-body radiation, and diatomic molecules.

One of the most striking—and satisfying—aspects of this text is the emphasis Professor Morse places upon various types of work other than PV work. At the outset he notes the contribution made to a change in internal energy by magnetic and electric forces, by tensions, and by chemical changes. He drives this home repeatedly with examples, such as the paramagnetic gas.

The author constantly emphasizes motivation: what is the physical meaning of the Legendre transform? why introduce enthalpy, free energy, and the other potentials? Always some physical example, pertinent (though not always familiar) to physicists, precedes the introduction of a new concept. (The Gibbs function first appears quite naturally in a discussion of the superfluid properties of liquid helium.) This makes the arguments remarkably easy to follow. The author took care to write clearly and physically, yet precisely. His style is informal and casual, yet not lax; the result is an excellent text for learning basic thermal physics.

Laminar Boundary Layers. L. Rosenhead, ed., 687 pp. Clarendon Press, Oxford, 1963. Cloth, $14.50.
Reviewed by Lawrence Talbot, University of California, Berkeley.

The decision of the Fluid Motion Panel of Great Britain in the middle thirties to make available an up-to-date account of fluid dynamics resulted in the splendid two-volume *Modern Developments in Fluid Dynamics*, brilliantly edited by Sydney Goldstein. Later, in 1953, the effects of compressibility on fluid flow were considered in the two additional volumes, *High Speed Flow*, edited by Leslie Howarth. However, at the same time the Howarth volumes were being written, the British Aeronautical Research Council resolved that a new series of volumes on fluid dynamics, *Fluid Motion Memoirs*, should be prepared. The first in this new series, *Incompressible Aerodynamics*, edited by Bryan Thwaites, appeared in 1960. The present volume is the second in this new series, and a third volume on turbulence is in preparation.

By all standards, *Laminar Boundary Layers* is a worthy successor to the Goldstein volumes. The present volume covers essentially all the subject matter on laminar incompressible flow which first appeared in *Modern Developments*, plus many new topics. The title does not in fact convey all that is contained within, because although boundary-layer problems receive the greatest attention, most of the important properties and exact solutions of the Navier-Stokes equations are discussed as well, as are many wake and internal flows. The book consists of ten chapters, representing the contributions of twelve authorities. The uniform excellence and harmony of the exposition throughout must surely attest to the efforts of Editor Rosenhead. A remarkable quality of the exposition is that, without exception, every contribution shows clear evidence that the authors have made a conscientious effort to give their subjects a fresh look. The volume so abounds with novel ideas that even the most experienced fluid dynamicist cannot fail to be stimulated into rethinking about some old problems.

The first two chapters, authored by M. Lighthill, present the physical and aerodynamical background of the subject. After the relevant fluid properties and dimensionless parameters are exposed, a detailed and lengthy discussion is given of basic fluid-dynamic phenomena which are observed in all fluid flows, with special attention given to the role of vorticity and vorticity transport. This discussion must rank as a high point of the book.

Chapter 3, by G. Whitham, contains the derivations of the fundamental equations, similitude considerations, and a discussion of some exact solutions. Following this is C. K. Illingworth's chapter on flow at small Reynolds number. Here is presented much of the material on Stokes and Oseen flows which is more recent than *Modern Developments*, such as the method of inner and outer expansions, and the use of Stokes and Oseen variables.

Chapter 5, on two-dimensional boundary layers, by C. W. Jones and E. J. Watson, and Chapter 6, on approximate solutions, by G. E. Gadd, Jones, and Watson, contain a complete and very well integrated account of boundary-layer theory and the many solutions, exact and approximate, which have been obtained for the various boundary-layer problems. Workers in boundary-layer theory will undoubtedly find this material of great value.

Following are two lucid chapters by J. T. Stuart on unsteady boundary layers and hydrodynamic stability, and a well-written contribution by L. F. Crabtree, D. Küchemann, and L. Sowerby on three-dimensional boundary layers. The volume ends with an informative chapter on experimental methods by R. C. Pankhurst and N. Gregory. It is worthy of mention that in addition to the material on experimental techniques contained in the final chapter, one finds throughout the entire volume the conscientious blending of theory and experiment which is so essential to success in the study of fluid mechanics.

Supplementing the text is a reference list containing some 1150 entries arranged in author alphabetical order; each entry contains the complete title of the reference and the pages in the volume on which the referenced article is discussed. This reference list by itself is almost worth the price of the volume.

Inevitably, in a single volume which attempts to cover so vast a subject as viscous flow, some selection of material must be made. It was decided at the outset to restrict the coverage essentially to incompressible flows. This decision is understandable, though in this reviewer's opinion regrettable (see review which follows). Within the domain of incompressible theory, probably the most important topic which is not extensively treated in the present volume is the exact numerical solution of flow problems using modern high-speed computing equipment. Significant advances have been made in this area, some in fact too recent to have been included in this book. Perhaps this will be the subject of a future Memoir.

In this reviewer's opinion, *Laminar*

Boundary Layers is a monumental achievement. It deserves a place on the desk of every student and worker in the field of fluid mechanics.

The Theory of Laminar Boundary Layers in Compressible Fluids. By K. Stewartson. 191 pp. Clarendon Press, Oxford, 1964. Paper $10.10.
Reviewed by L. Talbot, University of California, Berkeley.

Although a book ought to be reviewed on its own merits, it is difficult to resist the urge to consider the present volume in the light of *Laminar Boundary Layers* (see above review). The reason is that Stewartson's monograph contains almost precisely the kind of material on compressible boundary layers which would be required to round out the treatment of boundary layers given in the Rosenhead volume. Since both books have come from the same press, and within so short a period of time, it is inevitable that one should wonder if they could not somehow have been combined. The unity and economy of treatment which might thus have been achieved is so apparent that it hardly needs saying. What is really surprising, however, is that nowhere in Stewartson's monograph is the Rosenhead volume mentioned.

The first two chapters of Stewartson's monograph are concerned with fluid properties and the basic equations of flow. Real-gas effects are mentioned briefly, but throughout the remainder of the book only ideal-gas flows are considered in detail. The same is true for rarefaction effects.

The third and fourth chapters deal with boundary-layer flows without and with pressure gradients, respectively. Both exact and approximate solutions of the boundary-layer equations are discussed. The exposition is clear and concise, and the coverage quite comprehensive. Chapter 5 is concerned with three-dimensional layers, and the sixth chapter covers some unsteady problems. In the latter, particular attention is given to the shock-tube boundary layer and Rayleigh problems. Hydrodynamic instability theory is not discussed. The final chapter contains discussions of a number of interesting interaction problems involving shock waves and boundary layers; the reviewer found this chapter to be the most stimulating in the book.

There is ample evidence that Professor Stewartson has done some considerable thinking about the subject matter of which he writes. In many instances he brings a fresh viewpoint, both to the latest problems and to topics which by now are regarded as almost classical. His own original contributions to laminar boundary-layer theory are large in number, and he has the tendency to emphasize these more than other work on the same topic. This is not intended as a criticism but rather as an indication of the personal nature of the book, in which the views of Professor Stewartson are clearly in evidence.

There are in the book nearly 300 cited references. They are given by source, titles being omitted, and they are numbered consecutively at the end of each chapter rather than being collected together.

The omission of several topics, such as instability theory and some consideration of compressible Oseen flows is regrettable, but as always, some selection of topics is inevitable. All in all, this volume probably represents the most complete account of compressible laminar boundary layers at present available within the covers of a single book. In this case, the covers are paper, which make it a rather expensive item by comparative standards.

The Role of Science in Civilization. By Robert Bruce Lindsay. 318 pp. Harper & Row, New York, 1963. $6.50.
Reviewed by Phyllis A. Richmond, University of Rochester.

This is a thought-provoking, well-written book. The view of the scientist as a passive observer of nature is replaced by that of the scientist as a creator who "chooses the kind of experience he desires to create". Lindsay avowedly aims in part to defend science from those critics among the humanists who see it as grossly materialistic and destructive of those values in life considered most significant. On the whole he is successful, and in the process he shows that the use of creative imagination in some areas of science is as vivid as in the arts. His appreciation of nonmaterial aspects of science is refreshing.

There is no denying the breadth of Lindsay's viewpoint. Thomas Browne's *Religio Medici* comes to mind as a comparable work. A good attempt is made to answer the school of thought represented by philosophers like Karl Jaspers, who write of science as a limited and incomplete vision of the totality of experience. This is not entirely successful because Lindsay tends to see more science in the social sciences and humanities than probably exists or should exist in these fields.

The book discusses what science is and then explores its relationship to the humanities, to philosophy, to history, to communication, to technology, to the state, and to human behavior. The description of science is primarily from the vantage point of physics and chemistry. A few biological and geological examples are included, but medical ones are absent. This is, perhaps, unfortunate, because it is possible to discern several distinct scientific methods when all the sciences are taken into account.

The section on the logical structure of a scientific theory is rather unusual. It is limited to deductive reasoning without reference to inductive reasoning; that is, it is Euclidean, not Baconian, and in essence ignores the 17th-century revolution in scientific thought. "Primitive, intuitive, undefined notions" are axioms rather than hunches. Observations or experiments are undertaken to *verify* a collection of deductions. There is no suggestion that conclusions can be derived from a collection of observations and verified by accurate prediction, though prediction is discussed as part of theory elsewhere in the book. When one considers that Newton wrote the *Principia* in classic deductive form, though he used the inductive method to arrive at much of its content, Lindsay's section is doubly interesting. It suggests that in some areas of scientific endeavor there has been a return to the rigorous argument of the classic era. This needs to be investigated. Have we come full circle in some areas of physical science? Does the *method* of the theo-