books

In their own words: The color pioneers.

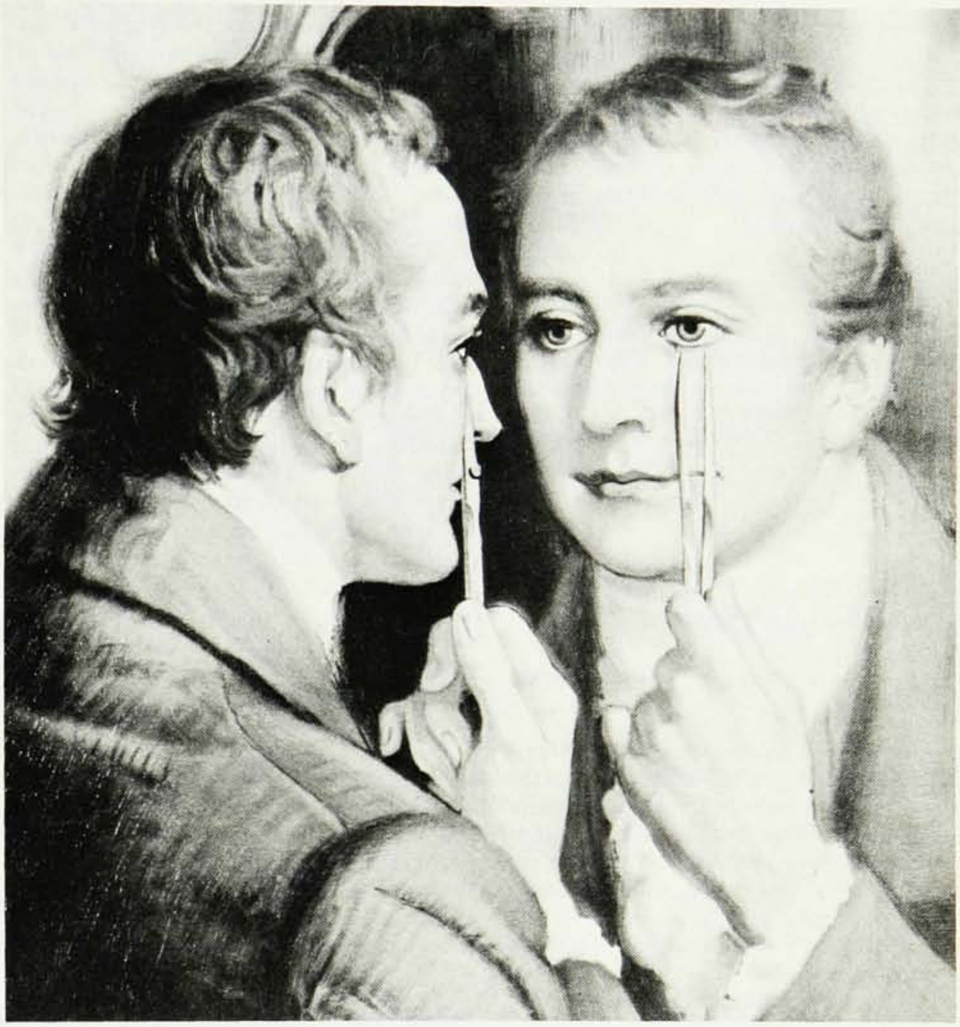
Sources of Color Science
D. L. MacAdam, *ed.*
282 pp. MIT Press, Cambridge, Mass., 1970. $12.50

Reviewed by A. R. Robertson

This book consists of a collection of writings by pioneers in the theory of color. David MacAdam, senior research associate at Eastern Kodak Research Labs, is a distinguished scientist who, over the past 30 years, has published many papers in the field of color metrics. In this volume, he has brought together extracts from many historically significant works, which he has edited freely to make them comprehensible to today's readers. In many cases, modern terminology is substituted for the original wording, allowing the reader to follow the development of theories of color without becoming confused by differing and obsolete terminology. A purist might object to this, but I found that it helped to make the book more readable.

The collection begins with extracts from Plato and Aristotle and continues with selections from the immensely important writings of Isaac Newton in which he showed so clearly that all colors are composed of the "homogenous colors" of the spectrum. This is followed by George Palmer's explanation of his trichromatic theory and by Thomas Young's better known statement of his version of this theory. Young is given only one page, compared to eleven for Palmer, probably because Palmer's papers, only recently rediscovered, predate Young's by 26 years. However, as James Clerk Maxwell writes in a later chapter, "Young was the first who, starting from the well-known fact that there are three primary colors, sought for the explanation of this fact, not in the nature of light, but in the constitution of man." Palmer thought that light itself contained only three types of ray, analagous to the three types of receptor.

The development of color theory during the second half of the 19th century is illustrated by extracts from the work of Hermann Grassmann, James Clerk Maxwell, and Hermann von Helmholtz,



Thomas Young examining his own eyes in the course of his experiments on color perception. His results are included in *Sources of Color Science.* Photo courtesy of Bausch and Lomb.

who were able to develop the laws of color mixture more clearly and explain the relationships between color-mixture diagrams and visual sensations. The explanation of chromatic adaptation by Johannes von Kries and the clear exposition by Frederic Ives of the principles of color photography then show that, by the beginning of this century, understanding of color vision had really become quite extensive.

The mathematical formulation by Erwin Schrödinger of the facts of color vision occupies 60 pages, more than is alloted to any other author; this section of the book, because of its mathematical nature, is the most difficult to read. Its inclusion is justified because this is the first readily available English translation of this work, which, despite its importance, has been previously available only in the original German. Nevertheless, readers without a sound knowledge of mathematics will probably omit this chapter.

Two papers by John Guild and one by Lewis Richardson discuss the extent to which it is possible to try to measure and quantize visual sensations, and the book finishes with Stephen Polyak and

Sir Wilfried Le Gros Clark's 1949 articles on the structure of the retina and the lateral geniculate nucleus. In all these there is much that is as valid and stimulating today as it was when it was first written.

MacAdam has assembled an excellent collection of writings. Every worker in the field of color will find it fascinating and instructive to follow the development of the foundations of spectrophotometry and colorimetry and of visual theory, which we so often take for granted today. It is a pity that several important works, notably those of Goethe and of Hering have been omitted, but translations of these are available elsewhere. But it is not only historical interest that this book provides. The research worker of today will find, too, that there are many stimulating ideas that may provoke him to new lines of research.

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The reviewer, a physicist, has worked in the fields of color measurement and color vision since 1962, first at the Imperial College of Science and Technology, London, UK, and since 1966, at the National Research Council of Canada in Ottawa.

Equations of Mathematical Physics

By V. S. Vladimirov

418 pp. Marcel Dekker, New York, 1971. $19.75

A member of Moscow's Steklov Institute of Mathematics, Vasilij Vladimirov is well known in mathematical physics for his important monograph on analytic functions of several complex variables and for his work (with Nikolai Bogoliubov and with A. A. Logunov) on analyticity questions in quantum field theory.

His present book, one hastens to add, is of a much less forbidding nature. "Mathematical physics," as Solomon Mikhlin claims in his own recent book on related topics, "can be regarded as an aspect of the general theory of partial differential equations." (And what can't, after all?) Much in the same spirit, Vladimirov's *Equations of Mathematical Physics* primarily deals with the wave equation, the heat equation and the Laplace, Poisson and Helmholtz equations. They figure, respectively, as representatives of the hyperbolic, parabolic and elliptic types or, in physics terms, of vibrational, diffusion and steady-state problems.

After a short but very readable review of material related to Lebesgue integration and a few remarks on linear operators there is an introductory section on linear second-order partial differential equations, their classification by types and the corresponding boundary-value problems. There also is a short discussion of correctness classes, within which solutions exist uniquely and depend continuously on the data, thus ensuring stability with respect to small variations or uncertainties in, for example, the source term or the boundary conditions.

The advent of generalized functions meant dramatic progress in the field of differential equations. Freed from all kinds of bothersome smoothness and growth conditions one now has a well defined framework for the consideration of singular sources and boundary values, of solutions exhibiting sharp wavefronts or otherwise nondifferentiable in the classical sense and so forth. Consequently Vladimirov devotes much space to a careful exposition of basic distribution theory, after which the discussion of fundamental solutions and of the classical and generalized Cauchy problem for the wave and heat equations becomes elegant and simple.

The solution of the Dirichlet or Neumann problem for the Laplace equation is complicated by the fact that only the function *or* its normal derivative are given on the boundary. Therefore Green's formula cannot be used directly because it would require the knowledge of both. For smooth (Liapunov) boundaries the problem may be reduced to an integral equation for the density of a double or single-layer potential. Vladimirov backs this up with a chapter on Fredholm equations and a nice introduction to classical potential theory.

Finally, the method of energy integrals is applied in a short discussion of classical and generalized solutions of "mixed" problems—hyperbolic and parabolic equations with initial conditions and spatial boundary values.

Since it is well written and because of a very careful selection of the material, this book should present no problem to the first-year graduate student. Based on equations from physics, it is a text of modern mathematics and will be welcomed as such especially by those who are annoyed with the practice of having to study the same mathematical structures twice, three times or more with slowly increasing rigor in the application-oriented courses of various levels.

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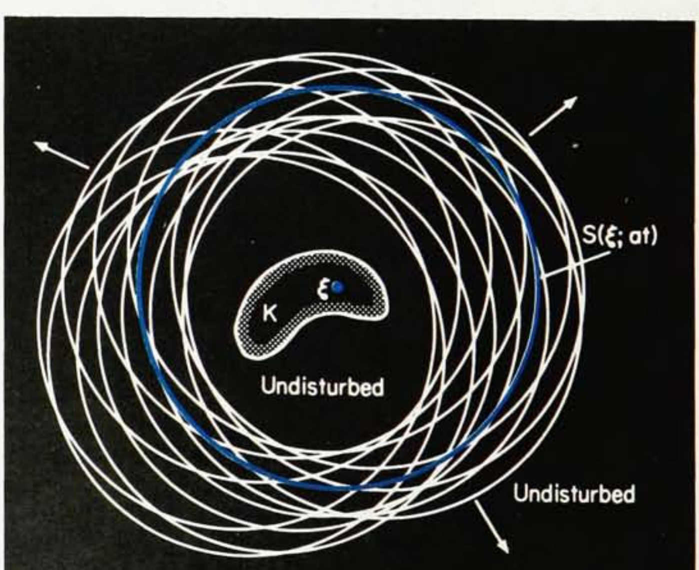
Physics Demonstration Experiments, Vol. 1: Mechanics and Wave Motion, Vol. 2: Heat, Electricity and Magnetism, Optics, Atomic and Nuclear Physics.

H. F. Meiners, *ed.*

1394 pp. Ronald Press, New York, 1970. $30.00

The last 30 or 40 years have seen dramatic changes in the undergraduate physics curriculum, most of them for the better. The obvious examples are provided by the migration of relativity and quantum mechanics from the second year of graduate school to introductory and intermediate-level undergraduate courses. Lectures at all levels are much more sophisticated than in former years. But one has the feeling (backed up by no questionnaires) that along with these changes, our undergraduates do fewer laboratory experiments and that they see many fewer lecture demonstrations.

Obviously new material must crowd out old; there isn't time for everything. And yet one may ask whether something has been lost. Most of us became physicists because we were intrigued as children by the way things work, by rainbows and radios and dry cells and thermometers. Later we were equally



Wave disturbance generated by a solid source. The colored wavefront originated at the point ξ; from *Equations of Mathematical Physics.*