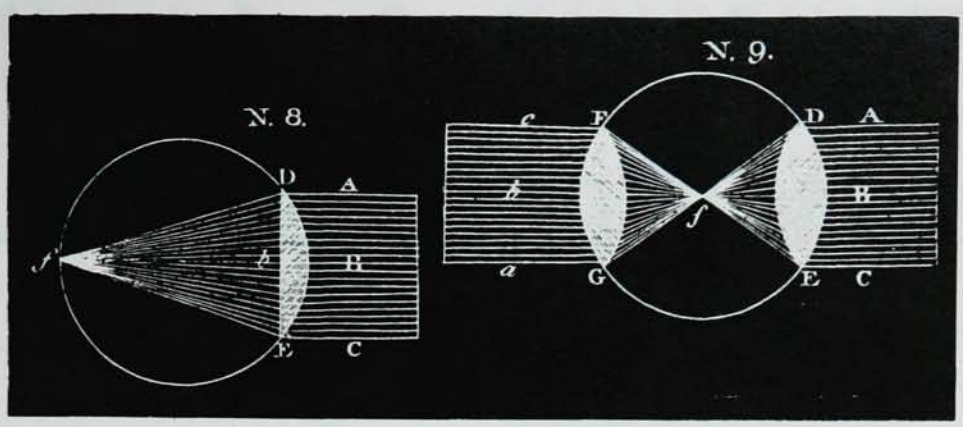
great theoretical generality although the author's proof of Irving Langmuir's thermal limit, given in the appendix, clears up many points that have given a generation of students difficulty and should be much more widely known. Moreover the book presents the best and most complete description of a successful semiëmpirical approach to a difficult engineering problem for which the scientific foundation is incomplete and, as such, presents an interesting "case study" for a course in methods of applied physics.

The book should be in the collection of anyone working in applied electron optics and on the shelf of any reasonably complete electrical-engineering library.

* * *

J. Arol Simpson is chief of the Electron Physics Section, National Bureau of Standards. He says that he has "been trying to design electron guns with only mixed success for the last 20 years."



200 YEARS AGO ***Encyclopedia Britannica*** **showed with figures how light passed through plano-convex and convex-convex "glasses" to converge and form optical images.**

Image watching

IMAGES OPTIQUES. (4th Edition) By Pierre Fleury, Jean-Paul Mathieu. 614 pp. Eyrolles, Paris, 1968. 110 F

by JACQUES ROMAIN

Pierre Fleury is the head of the Institut d'Optique, and Jean-Paul Mathieu is a professor at the Faculté des Sciences of Paris. Their *Physique Générale et Expérimentale*, an eight-volume textbook, is one of the leading general physics treatises, at the university level, in the French language. Of the eight volumes, two are devoted to optics. The second of these, titled "Lumière" (Light), deals in detail with a qualitative and quantitative study of light, with its propagation conditions in various media, with emission and absorption spectra and with the optical phenomena pertaining to geophysics and astrophysics. The present book, which is meant as the first of the two volumes on optics, has to do with all the aspects of image formation, understood in a broad sense.

It begins with fundamental notions on light beams, reflection, refraction, light waves and the nature of light and on the perception of images. The text is then divided into three parts: The first deals with the elemental optical systems, plane refracting interfaces, prisms, thin lenses, thick optical systems, aberrations, birefringence and the polarization related to it. Light rays at a small angle with the optical axis and the contrasting large aperture are both studied.

The second part is devoted to interference and diffraction and their application to image-forming problems, for example, interferometry, phase contrast, gratings and holography (a noteworthy addition to this new edition). The last part deals with the various optical instruments, including photography, and ends with short notes on the construction of optical apparatus. Two more features of the new edition are an exposition of convolution relationsips between object and image and the use of Fourier transforms in the theory of diffraction gratings.

The emphasis is on the interrelation rather than the differences between "geometrical" and "wave" optics, and the approach is decidedly experimental even though elaborate formulas are derived when needed. The exposition is profusely interspersed with descriptions of experiments, both for the classroom and simple ones for every reader without specialized instruments.

These experiments are either experimental demonstrations of properties mentioned, or illustrations of the descriptions in the text. Also mentioned, at every possible occasion, are examples of practical uses of the properties or systems considered. The exposition is quite clear, precise, and concise.

A generous supply of figures and plates makes the text self-explanatory, and a satisfactory subject index is provided. Each chapter concludes with a good many exercises, the answers to which are collected at the end of the book.

* * *

The reviewer taught general physics in highschool and theoretical physics at the University of Elisabethville in the Congo.

Cryostat design

EXPERIMENTAL TECHNIQUES IN LOW-TEMPERATURE PHYSICS, (2nd Edition) by Guy Kendall White. 397 pp. Oxford U. Press, London, 1968. $12.00

by HARMON H. PLUMB

In the preface to the first edition, Guy White states that his purpose was "to meet the need for a book which gives details of designing cryostats, filling them with liquid helium, maintaining and measuring various temperatures." The author, in an exemplary fashion, has conveyed most of the important experimental cryogenic techniques. With the reader in mind, White has clearly expressed the techniques and the basic ideas involved without delving into intricate details of specialized apparatus. Appropriately he has provided pertinent references for those who may desire to pursue experimental or apparatus details. The first edition was published in 1959, and this second edition is sufficiently up to date to cite literature of 1966 and

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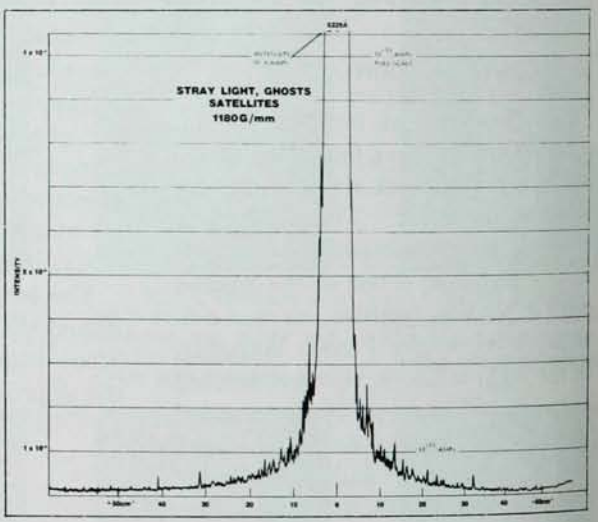

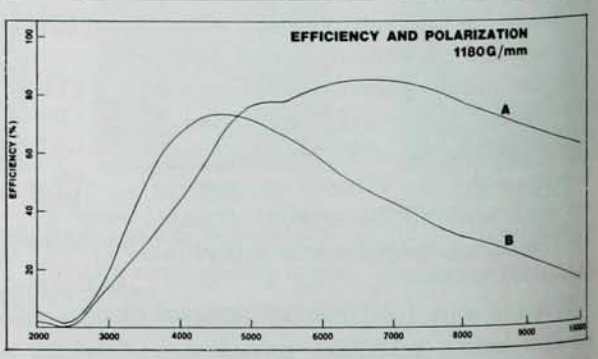

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The photo above is an interferogram obtained with a Twyman-Green interferometer. The flat, parallel fringes indicate all grooves are positioned within one tenth of a wavelength which insures a resolving power in excess of 90% of the theoretical limit.

Curve (top right) – Observed diffraction pattern of the 1st order 6328A He – Ne line, measured with a 1.0 meter Czerny-Turner Monochromator (15 μ slits). The total intensity due to scattered radiation, ghosts and satellites is 0.0009% of the peak intensity 10 $Cm^{-1}_{/}$ (4A) away from the parent line.

Curve (bottom right) – First order efficiency in plane polarized light. Curve (A) polarized perpendicular to the rulings. Curve (B) polarized parallel to the rulings.

For additional technical data and a complete listing of all Jarrell-Ash gratings, write for Bulletin #61.

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1967. Chapter 5, "Cooling with Helium-3," is the principal subject material that was not included in the first edition; several other additions to particular chapters were both appropriate and included.

White's insertion of actual calculations (involving design problems that are frequently encountered) as a basis for constructing cryogenic experimental apparatus is undoubtedly of great assistance to the experimentalist who may be relatively inexperienced in fundamental cryogenic design.

My particular speciality in cryogenics is temperature measurement (chapter 4), and I compliment White's treatment of the subject. The chapter is intentionally mentioned in this review to call the prospective reader's attention to a new "International Practical Temperature Scale (1968)" that exists and will shortly be in use. It extends down to 13.8 K and employs the platinum-resistance thermometer as an interpolating instrument in its lower range. The thermometry "fixed" points below 90 K (chapter 4, table 8) require slight modifications and the experimentalist who is concerned with the most accurate determination of temperature should refer to forthcoming publications, for example *Metrologia*, April 1969, for the definition of IPTS-68 (PHYSICS TODAY, July, page 71). This information was not available to White before the second edition was in press but he makes a note that presages such a scale.

White has accomplished his primary purpose in writing the book, and I heartily commend it to the experimentalist who finds himself involved in cryogenic techniques. I do suggest, if a third edition is produced, that it include a chapter in the general category of electrical instrumentation and measurements below 4 K—perhaps cryoelectronics would be a more descriptive expression.

* * *

Harmon H. Plumb, chief of the Temperature Section, National Bureau of Standards, has been involved in cryogenic experimentation for 17 years.

Classical–modern synthesis

MATHEMATICAL PHYSICS. By Eugene Butkov. 735 pp. Addison-Wesley, Reading, Mass., 1968. $17.50

by GARRISON SPOSITO

The most recent textbooks on mathematical physics have tended to fall rather distinctly into one of two categories. Either they are reverent descendants of the classic tome by E. T. Whitaker and G. N. Watson or they pay homage to the new pantheon erected in the name of functional analysis. To one group the Sturm–Liouville problem suggests a differential equation whose worthwhile solutions are special blends of certain kinds of polynomial and convergence factors, but to the other the problem brings to mind a Hermitian operator that generates a basis in a Hilbert space.

It is not surprising that the disparity of language between these two approaches should have partitioned the mathematical audience in physics. What is surprising is that anyone might attempt a synthesis of the two. But this is just what Eugene Butkov, a professor at St John's University, has done in *Mathematical Physics*.

The book comprises 16 rather long chapters that automatically present to anyone who would teach from it the possibility of an eclectic choice of subject matter. On the classic side, there are chapters on complex variables, differential equations (including Green's functions), Fourier transforms and certain orthogonal functions. On the side of soft analysis are chapters on the theory of distributions and on linear spaces of arbitrary dimension. The latter, however, are not isolated from their companion chapters in any way. Rather they are introduced and developed in the vernacular of the classical paradigm. For example the theory of distributions is brought in through a discussion of impulsive forces and switching processes and is described in terms of weakly convergent sequences of admissible functions, with no mention of linear functionals on the space $D(\Omega)$.

Undoubtedly this kind of linguistic perturbation is the best way to bridge the mathematical generation gap. Moreover the idea of permitting physical problems to suggest the mathematics—a notion that is adhered to in