Books

Optical Image Evaluation (Proceedings of NBS Semicentennial Symposium, 1951). NBS Circular 526. 289 pp. U. S. Government Printing Office, Washington 25, D. C., 1954. $2.25. *Reviewed by W. T. Wintringham, Bell Telephone Laboratories.*

The era of black magic, or of art, in lens design is slowly coming to an end, and the symposium on optical image evaluation during the NBS semicentennial in 1951 was one indication of its passing. The formal papers and the discussion at this symposium have been published in *Optical Image Evaluation.*

A list of those represented in this symposium is an impressive roster in itself. Papers were presented by: A. Arnulf of the Institut d'Optique (Paris); James G. Baker of the Harvard College Observatory; H. S. Coleman of the Bausch & Lomb Optical Company; Arthur Cox of the Farrand Optical Company; G. Toraldo di Francia of the Istituto Nazionale di Ottica (Arcetri); Donald P. Feder of the National Bureau of Standards; Max Herzberger of the Eastman Kodak Company; R. E. Hopkins, Howard Kerr, Thomas Lauroesch, and Vance Carpenter of the University of Rochester; L. E. Howlett of the National Research Council (Ottawa); Erik Ingelstam and Per J. Lindberg of the Royal Institute of Technology (Stockholm); R. Kingslake of the Eastman Kodak Company; Duncan E. MacDonald of Boston University; André Maréchal of the Institut d'Optique (Paris); Harold Osterberg and Robert A. McDonald of the American Optical Company; O. H. Schade of the Radio Corporation of America; E. W. H. Selwyn of Kodak Limited; R. V. Shack of the National Bureau of Standards; A. C. S. van Heel of the Technical University (Delft); F. E. Washer of the National Bureau of Standards; and F. Zernike of the Natuurkundig Laboratorium (Groningen).

An introduction by Irvine C. Gardner of the National Bureau of Standards serves to set the perspective for the entire symposium. He ends his statement as follows: "This brief resume gives an idea of the large field of engineering knowledge concerning image evaluation that remains to be filled in. The papers of this symposium touch upon most aspects of the problem in more or less detail but, like most useful scientific work, the papers also suggest the large amount of work that remains to be done." All of the papers reflect this same judicious tone.

One might reasonably expect T. Smith to have been a participant in this symposium. Unfortunately he was unable to be present and to submit a paper. But he addressed a letter to the symposium which, printed at the end of the present volume, serves as a fitting capstone for the whole proceedings.

Thirty years ago, image evaluation was carried out by examining the image on a lens bench and by expressing the results in terms of the appearance of the image. However, interpretation of the results of lens bench testing in terms which were significant to the user of a lens was only moderately practicable. The introduction of resolution testing patterns about twenty years ago was a step forward in helping the user evaluate lens performance. But, these early test charts were made with high contrast, and the objects to be imaged in practice usually were of low contrast. Test chart observations were brought closer to practice about ten years ago through the use of charts having limited contrast. Only a little later, somewhat more objective measures of resolution were introduced, where scanning techniques were used to obtain a numerical expression for the reduction of contrast produced by an optical system imaging a test chart.

Many of the papers in this symposium were concerned with the correlation of the results of these laboratory tests with the performance of imaging systems in the field. And unfortunately, the correlation is none too good. We still are none too well aware of exactly what characteristic it is of a star image or of the image of a resolution test chart which should be examined to permit us to say with assurance that we have the most economical design for some specific application.

Other papers treated the calculation of the distribution of energy in images from the physical properties and the dimensions of the components of an imaging system. It has been found here that geometric optics generally does not have sufficient power to yield enough information about the image. But the availability of modern high-speed computers allows image calculations through the methods of physical optics, so that there is some hope of bringing design and measurement into agreement.

Optical Image Evaluation is as much a record of lack of knowledge as it is a report of principles and of methods. As such, it should prove to be a powerful spur to the imaginations of all optical workers.

Actions of Radiations on Living Cells (Second Edition). By the late D. E. Lea. 416 pp. Cambridge University Press, New York, 1955. $6.00. *Reviewed by P. Morrison, Cornell University.*

This is a well-made offset re-issue of Dr. Lea's book, changed only in the correction of a few numerical tables, and by adding several pages of brief notes made by Dr. Lea himself. The clarity and compact power of this book, both on the physical and the biological side, still commend it to all who want to gain an entry into the subject. Its enthusiasm for target theory and naïvete in general, while they still stimulate, look to-