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structor for teaching it. He will probably have more enthusiasm for it if he has had some share of responsibility in creating it." Elizabeth Wood may not have personally penned these words, but she certainly could have. The enthusiasm with which she talked about science during our recent interview is the same enthusiasm with which her own book, *Science for the Airplane Passenger*, was written.

"People want to know what relevance physics has for their everyday experiences," says Dr Wood, "and my book is meant to be a response to that question. It was written for fun, to be read for fun. When you look out the window of an airplane and start questioning the 'whys' of what you see, there is no time to be afraid of flying, no time to be bored, no time to watch the movie."

Science for the Airplane Passenger uses the air as prime vantage point to survey and answer various questions about geology, oceanography, meteorology, biology, optics and aerodynamics. The chronology of the book follows that of an airplane trip from takeoff to landing. Both day and night flying are discussed and the text is adequately enhanced with line drawings and graphs as well as black-and-white and color photographs. Concepts that may be relatively unfamiliar to the nonscientist are discussed cogently and simply. There is even a "bookback goniometer" for measuring angles to determine the length of a lake, elevation, order-of-

magnitude estimate of the size of an aurora and the angle of roll of the airplane. Dr Wood gives the airline industry a polite hint as she suggests, in relation to aerial photography, "On the side away from the sun the window will cause you much less trouble unless it is very dirty. (Some airlines keep their windows clean and some do not.)"

In the chapter on clouds the author leaves no doubt in the mind of big-city readers about the relevance of physics to "everyday experiences." "From the thousands of cars of the greater New York area, from power plants and factories and chemical plants of all sorts, waste products are poured out into the air. When the wind is blowing or when the usual convection currents are operating and the warm air is rising into the cooler atmosphere, this atmospheric refuse is carried away. When a temperature inversion takes place, the city sits in a pool of its own waste, risking death by asphyxiation."

Dr Wood recently "took to the air" in yet another way when she appeared as a guest on the NBC television "Today" show to discuss her new book. Here again she found herself explaining science to the nonscientists, and "Everybody had a delightful time," she said. The main topic of conversation centered around various lake formations.

"One observation from the air that would be particularly interesting to the physics community," said Dr Wood during our interview, "is the fact that

a very small lake far below you, in just the right position to reflect the sun's rays most brightly, brings to your eye a narrow bundle of rays from the sun. In this way it behaves as though it were a pinhole, letting through the sunlight from a long way off on the far side. If you watch closely as the lake gets brighter and brighter, approaching the optimum reflecting position, you will see briefly, as it flares up with maximum brilliance, a set of irregular dark and light bands surrounding the central beam from the lake. Sometimes you may see a 'rainbow' of colors in the diffraction bands. This arises because diffraction results from the wave nature of light, and light of longer wavelength such as red light, is diffracted at a greater angle to the central beam than is light of shorter wavelength such as blue light."

Science for the Airplane Passenger sold over 2000 prepublication copies, and the number has been increasing steadily since the book officially went on sale a few months ago. To both the reader on the ground and the passenger in the air, it will be immediately obvious that Dr Wood's choice of subject matter is appropriate in view of the questions her audience is likely to ask. The style is generally lucid and the book, like its author, is full of the enthusiasm a nonscientist wants, appreciates and ought to have.

Legacy of a leader

EXPLORER OF THE UNIVERSE: A BIOGRAPHY OF GEORGE ELLERY HALE. By Helen Wright. 480 pp. E. P. Dutton & Co., Inc., New York, 1966. \$10.00

by Charles Weiner

1968 marks the centennial of the birth of George Ellery Hale, whose colossal impact on 20th-century science ranged from his own pioneering studies of solar magnetism, through the promotion of astrophysics as a research field, to the planning, financing and building of a series of astronomical telescopes of increasingly unprecedented size, and to the conception and organization of institutions that are now central to the life of science in the US and throughout the world. Hale's legacy to the scientific community is still very much in evidence 30 years after his death in 1938.

Dramatic photographs of distant spiraling galaxies, star clusters, solar

flares and other astronomical phenomena are commonplace today in published scientific works and popular expositions, and in the offices of scientists themselves; the ubiquitous credit line is invariably "Mount Wilson and Palomar Observatories." These photographs have become symbols of 20th-century science, revealing at once the growth in our knowledge of the universe, the enormity of the gaps in our understanding and the complexity and power of the instrumentation that makes possible such explorations. An insight into the processes involved in obtaining this knowledge and in developing the instrumentation and the accompanying institutional forms is one important by-product of Helen Wright's fascinating, well-documented biography of George Ellery Hale.

The Hale story is well told by Helen Wright (and indeed, by Hale himself) for she has artfully woven his letters, diaries and autobiographical notes into a biographical account that portrays the man, his motivations and his relationships with his contemporaries. It is a difficult task to write the biography of someone who has accomplished so much, because the tendency is to enumerate his achievements and show his significance without providing the contextual background for these developments, exploring the below-the-surface motivations and manipulations, and relating the accomplishments of an individual to the larger societal and cultural complex. Hale's biographer has managed to strike an appropriate balance: she not only paints a portrait of Hale but also provides the necessary background. There is no romanticizing here. Hale emerges as a real person faced with real problems. The author presents all dimensions of the man and has not tried artificially to separate the "scientific" from the "human."

Here one can see Hale as a Chicago teenager whose budding interest in science soon encompassed observations of the microscopic life in ditch water, physical and chemical experiments in his home laboratory, timing a transit of Venus with his 4-inch telescope and building a spectroscope that he used to study the solar spectrum. Scarcely more than a decade later, in 1897, the Yerkes Observatory was dedicated; the observatory is the first great monument to Hale's ability to conceive, plan, secure financing and build a new type of research institution

HALE SYMPOSIUM AND EXHIBIT

The Centennial of the birth of George Ellery Hale will be the occasion for a special full-day symposium on 27 Dec. at the 1968 annual meeting of the American Association for the Advancement of Science at the Statler-Hilton Hotel in Dallas. The symposium, organized by Charles Weiner of the AIP, is part of the program of the Astronomy Section of AAAS and is cosponsored by the History of Science Society. Speakers and their topics are: Ira S. Bowen, former director, Mount Wilson and Palomar Observatories: "Astronomical Instrumentation in the 20th Century"; C. Donald Shane, former director, Lick Observatory, University of California: "The Development of Large Astronomical Telescopes since the 1890's"; Lee A. DuBridge, President, California Institute of Technology: "George Ellery Hale and the Role of Modern Scientific Institutions"; Bengt G. Strömgren, Director, Universitetets Astronomiske Observatorium, Copenhagen University: "The Development of Astrophysics as a Research Field in the 20th Century," and Robert Howard, Mount Wilson and Palomar Observatories: "Research on Solar Magnetic Fields from Hale to the Present."

An exhibit of documents and photographs relating to Hale's life and work has been prepared by AIP's Center for History and Philosophy of Physics and is currently on display in the Niels Bohr Library at AIP. A special version of this exhibit will be on display at the Sheraton-Dallas Hotel, 26-31 Dec., and it will subsequently be available from AIP for display at other institutions.



GEORGE ELLERY HALE using his spectroheliograph. The instrument records solar flares photographically. (Courtesy of Mount Wilson and Palomar Observatories).



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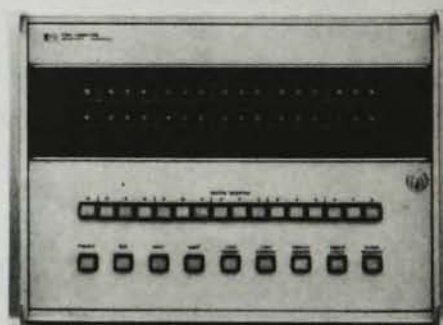
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that would combine astronomical telescopes of unprecedented size with a modern physics laboratory. Hale's remarks at the dedication stressed the Observatory's role in "strengthening the good will and the common interest which are ever tending to draw astronomers and physicists in closer touch. . ." For the next 40 years he followed this theme. Before the Yerkes telescope was completed, Hale was planning and gathering support for a still larger installation on Mount Wilson in California. Miss Wright deftly follows Hale through the maze of obstacles that he skillfully surmounted on his way to the now famous series of reflecting telescopes—the 60 inch, 100 inch, and finally the mighty 200 inch that was dedicated atop Mount Palomar 20 years ago, a decade after Hale's death.

200-INCH SKY-CAMERA DEDICATED

Astronomer Who Had Idea for Giant Eye Paid Tribute

By ROBERT CAHN

PALOMAR OBSERVATORY, June 3. (Special to The Star-News) —One of the world's greatest scientific achievements officially came to life here today as the 200-inch telescope was dedicated formally and received a new name—The Hale Telescope.

Before a large group of scientists, newspapermen and photographers, California Institute of Technology's eminent president, Dr. Lee A. DuBridge, this afternoon announced in a dedicatory address that the world's largest telescope would bear the name of a Pasadena, the late Dr. George Ellery Hale, for many years director of Mt. Wilson Observatory, who originated the idea for the 200-inch and made possible its design and construction.

TELESCOPE DEDICATION reported by the Pasadena Star News, 3 June 1948.

Here, too, is told the story of Hale's efforts to provide new institutional forms that would nurture the growth of astrophysics, and of science in general. Astrophysical journals, international scientific unions, National Research Council Fellowships, California Institute of Technology—Hale played a central role in the establishment of all of these, as he acted on his plans for improving science education and research, and their relation to society. Thus, *Explorer of the Universe* is more than a first-rate biography; it also is an important source for the history of the processes of scientific change and of the institutional development of science in 20th-century America.

Hale was truly a remarkable man. He left a relatively complete record that has been studied and interpreted skillfully by Miss Wright. Hale's letters, preserved and organized for historical research at California Institute of Technology, and now available in microfilm at other institutions, including the American Institute of Physics Niels Bohr Library, should provide rich source materials for many historical studies in the future.

Miss Wright's book provides needed perspective on contemporary science and scientists. The story of Hale's life and work should be part of the education of all scientists, young and old.

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Modern Galilean scholarship

GALILEO: MAN OF SCIENCE. Eran McMullin, ed. 557 pp. Basic Books, New York, 1967. \$15.00

by David C. Lindberg

The quatercentenary of Galileo's birth in 1964 gave rise to innumerable commemorative volumes. But none, I believe, is quite as good or as useful as this collection of essays, most of which were presented at the Galileo Quatercentenary Congress held at Notre Dame in April 1964. The editor of the volume, Eran McMullin, has not assembled just another panegyric that loses its perspective while paying homage to a great man. Rather, McMullin has produced an unusually well balanced collection of essays dealing with every aspect of Galileo's life and

work. He supplemented the papers presented at the congress with a judicious selection of previously published papers written by such notable scholars of the past as Alexandre Koyré, Ernst Cassirer, Paul Tannery, and Leonardo Olschki.

The chief questions of modern Galilean scholarship are all treated in this book. For example, following Stillman Drake's valuable biographical sketch, A. Rupert Hall deals perceptively with the much debated question of Galileo's overall significance for the history of science. James A. Weisheipl and Alexandre Koyré discuss Galileo's relation to his predecessors. Carl B. Boyer, in a particularly useful essay, considers Galileo's use of mathematics and suggests ever so gently that Galileo's contributions to mathematics do not compare with his contributions to physics and cosmology. The rational (or conceptual) and empirical elements in Galileo's methodology are vigorously debated by Dominique Dubarle, Thomas Settle, Ernst Cassirer and Edward W. Strong. The question of Galileo's alleged Platonism is raised repeatedly in the volume, especially in the essays by Dubarle, Cassirer, and Strong, and in an attempted reconsideration of the whole problem by Thomas P. McTighe. Finally, Galileo's influence on the seventeenth century is discussed by Marie Boas Hall, Stillman Drake and Serge Moscovici. Although these essays by no means display unanimity of opinion regarding Galileo's contribution to natural science, the essays are, for the most part, perceptive and substantial contributions to Galilean scholarship; indeed, useful insights are so abundant that one could not begin to list them. If there is a bad article in the book, it is Vasco Ronchi's preposterous attempt to identify Galileo's use of the telescope as the crucial event in the development of modern science.

Important though these essays are, I would like to focus attention on two other features of McMullin's book. The first 50 pages are occupied by McMullin's introductory essay in which he attempts to summarize Galileo's achievement and meaning for the history of science. Past interpretations of Galileo have all too frequently clustered around certain extremes, but McMullin has sought middle ground with rare wisdom and insight. Although few scholars will agree with McMullin on every point, none can dismiss his major attempts at synthesis. Another