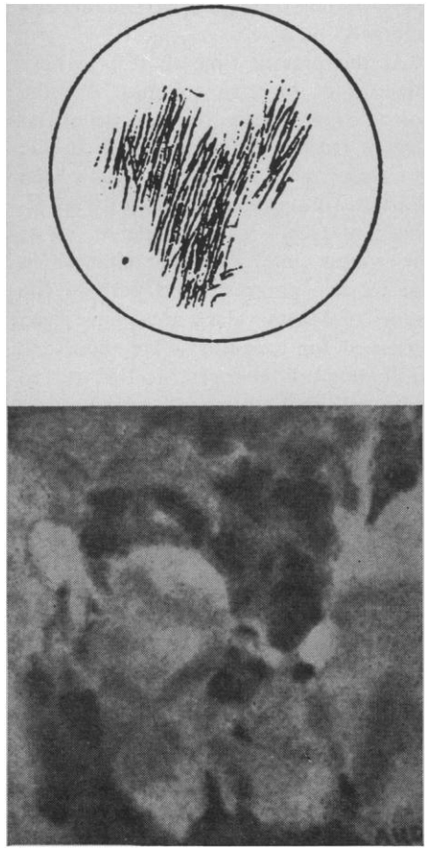
possibilities, from a total absence of prebiological organic compounds and signs of past life, through advanced extant life forms. At the present time there is no good evidence as to where Mars lies on this continuum.

The Book of Mars is an engaging, thorough, and exceptionally clear discourse by the well-known writer of scientific textbooks and more popular works Samuel Glasstone. The book begins with an excellent historical introduction to Mars marked by intriguing reproductions of early attempts at Martian cartography. This is followed by a quite well done descriptive section on the orbital motions of the planet; here, as in the rest of the book, the discussion is semiquantitative. Glasstone proceeds in a workmanlike manner to discuss the physical environment, the Martian atmosphere, surface, clouds, and haze. With no perceptible difficulty he then successfully changes disciplinary gears and discusses modern ideas about the nature and origin of life, the formation of prebiological organic molecules, and the possibility of life on Mars. The last three chapters are concerned with the present plans for the exploration of Mars and for the avoidance of contamination by terrestrial microorganisms inadvertently delivered to the planet by spacecraft. The illustrations are generally clear and illuminating, with only the reproduction of the Mariner IV photographs being of low quality. The discussion is very up-to-date, references to works published as late as mid-1968 appearing throughout. There is a balanced discussion of a number of controversial issues, for example, the carbonaceous chondrites. There are only occasional conceptual failures, as for example on page 111 where the apparent absence of a 0.88-micron feature in the Martian reflection spectrum is used to argue against the presence of ferric oxides on the planet. There is a gentle but deft critique of the sureness with which previous conclusions, for example, about the surface pressure and about the composition of the polar caps, were enunciated. Errors in fact are extremely rare, perhaps the most serious being the implication on page 222 that the oxygen produced by green plant photosynthesis derives from carbon dioxide rather than from water. The book is graced with a knowledgeable foreword by Homer Newell, the Associate Administrator of NASA.



Early and modern drawings of Mars, showing the dark area Syrtis Major. *Top*, by Christiaan Huygens, 1659. This is the earliest known drawing of Mars that shows an identifiable surface feature. As a result of having observed this feature, Huygens was able to derive the obliquity of Mars and to calculate its period of rotation. *Bottom*, by A. Dollfus, 1948, representing the planet as viewed through a 60-centimeter refracting telescope under "perfect" seeing conditions. Under such conditions features which ordinarily appear to be continuous are resolved into disconnected fine mottling. Forthcoming spacecraft observations of Mars should improve the resolution of the planet by a factor of about 100. [Reproduced in *The Book of Mars* from C. Flammarion, *La Planète Mars*, vol. 1, and G. P. Kuiper and B. M. Middlehurst, Eds., *The Solar System*, vol. 3, respectively]

The Book of Mars is such an excellent book that it's a pity it's virtually unavailable for purchase. Thinking to use it in a freshman seminar at Cornell, we ordered the book from the Government Printing Office more than three months ago. As of this writing copies for class use still have not arrived. This is a pervasive problem concerning many documents issued by the Government Printing Office; to check into it for this review I called Carper Buckley, the Superintendent of Documents. Buckley indicated that the basic problems were congressionally imposed employee ceilings and space limitations. It seems ironical that the Government Printing Office has the facilities to produce so excellent a book but not to arrange for its distribution. At the rate at which our knowledge of Mars is improving, this book may be obsolete by the time orders for it are filled; but it is an invaluable record of our knowledge and speculation about the planet early in the era of Martian exploration.

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Telescope Makers

Alvan Clark and Sons. Artists in Optics. DEBORAH JEAN WARNER. Smithsonian Institution Press, Washington, D.C., 1968 (available from the Superintendent of Documents, Washington). vi + 122 pp., illus. $1.75. U.S. National Museum Bulletin 274.

The metal dinner bell at Phillips Academy at Andover broke in 1844, and Alvan Clark, a professional portrait painter who was also a successful inventor and a superb sharpshooter, supervised his son George in putting the pieces to use to construct a telescope—their first. Thereafter, Alvan, with his two sons George Bassett Clark and Alvan Graham Clark, five times made the objectives for the largest refracting telescopes in the world; the fifth of their efforts, the Yerkes 40-inch lens, has never been surpassed. Their optical work was unexcelled anywhere in the world and was the first significant American contribution to astronomical instrument making. The secret of their success was, in addition to their incredible patience and urge to perfection, their use of local correction (figuring) to obtain the sharpest possible focus rather than mathematically true curves. This technique was better because optical glass discs were inhomogeneous. Alvan Clark and Sons undoubtedly stimulated the great flowering of astronomy in this country that began in the latter half of the 19th century and that later reached full maturity with the spectacular successes of the great reflectors on Mount Wilson and Palomar.

The Clarks became, somewhat inci-

dentally, observational astronomers. Their greatest discovery, a classic case of serendipity, was of the white dwarf companion of Sirius. The Clarks were trying to ascertain how long the light of Sirius was perceptible before the star itself came into view from behind the corner of a building. Alvan Graham noticed the Pup for 3 seconds before the appearance of its much brighter companion.

This slim volume is meaty, interesting, and copiously annotated. A short introduction is followed by a 35-page biographical outline of Alvan Clark and his two sons. Part 2 (74 pp.) is a catalogue of astronomical instruments made and remade by the trio. An appendix lists Alvan Clark's paintings. The book is strongly recommended to professional and amateur specialists in telescopes and in the history of astronomy.

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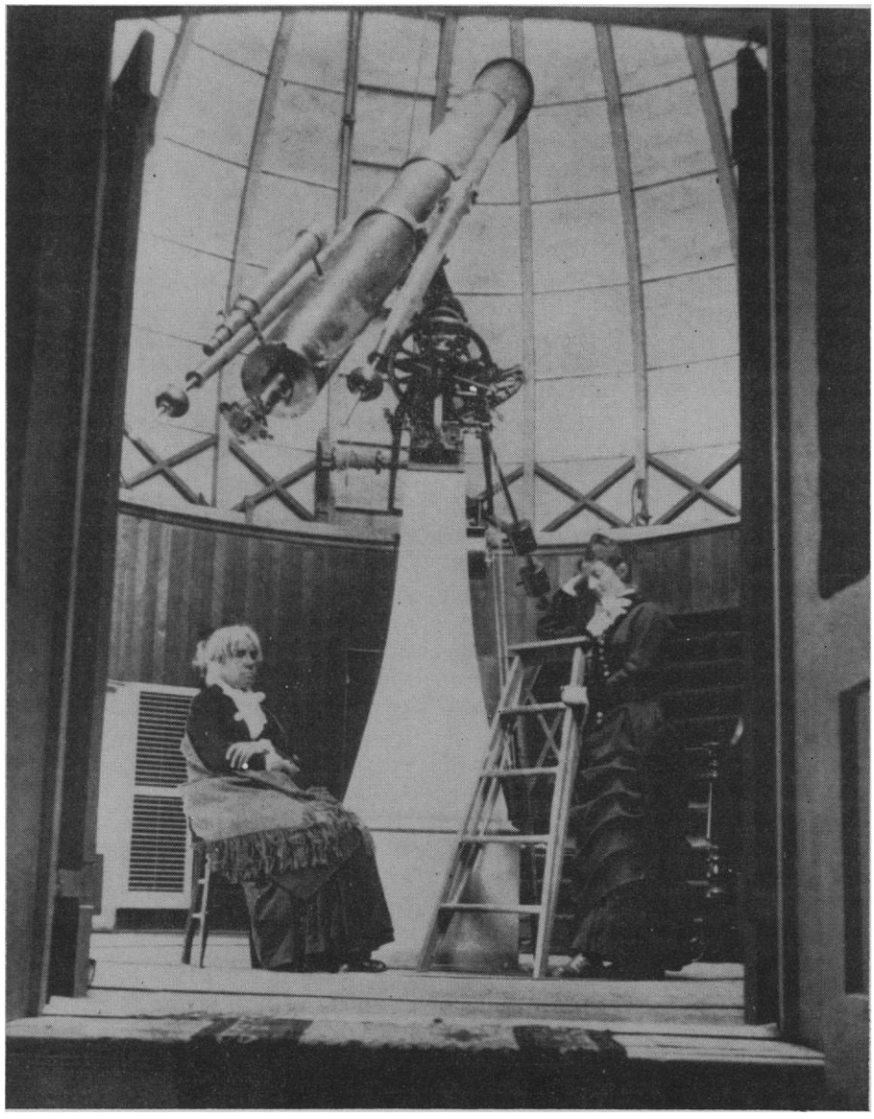

A scene at the Vassar College Observatory. Maria Mitchell (1818–1889), seated, was the first woman astronomer in the United States. She was the first professor of astronomy and director of the Vassar College Observatory and was a great and inspiring teacher there for more than 20 years. Mary W. Whitney (1847–1921), standing, was in the first freshman class at Vassar College (1865) and became director upon Maria Mitchell's death. She was the teacher of Antonia Maury, whose fundamental researches in spectral classification eventually resulted in the great Henry Draper Catalogue. The 12½-inch Fitz refractor in the picture had a wooden tube. Alvan Clark and Sons refigured the lens to such a degree that they considered the telescope one of theirs. This telescope was retired in 1963 to the Smithsonian Institution. [From *Alvan Clark and Sons: Artists in Optics*]

Tales of Astrophysics

Through Rugged Ways to the Stars. HARLOW SHAPLEY. Scribner, New York, 1969. 180 pp., illus. $6.95.

Starting with his boyhood on a farm in Missouri, Shapley tells his life story in whimsical style—how he worked as a newspaper reporter aged 16, tried to major in journalism at the University of Missouri, and took astronomy as a second, "blind" choice. Younger scientists will follow avidly his description of graduate work on double stars with Henry Norris Russell at Princeton in 1911 and his work on Cepheid variables at Mount Wilson in 1913. The stories of George Ellery Hale, Walter Adams, and the many others at Mount Wilson from 1913 to 1921 are full of warmth, but revealing in their descriptions of social behavior, scientific reliability, physical hardship, and other aspects of these men's lives.

Through these recollections, the enormous stride made in measuring distances of clusters and galaxies develops like a detective story with Shapley playing the part of Nero Wolfe. The story culminates in the "courtroom scene" of the Great Debate on the sizes of galaxies in Washington in 1920. Against the advice of Russell and others, Shapley then "gave up" his research career to become director of the Harvard College Observatory. With the principal exception of Annie Jump Cannon, the subjects of his Harvard stories are living astronomers, and Shapley rightly notes that during his tenure (1921 to 1961) Harvard was the most active astronomical training ground in the world. He describes Harvard's southern station, first in Peru, then in South Africa, and the strategy of moving it in 1927, the studies of the Magellanic Clouds, the cataloging of galaxies, the discovery of dwarf galaxies in Sculptor and Fornax, and the construction of two new 61-inch telescopes in Massachusetts and Argentina.

Other reminiscences cover Shapley's interest in flowers and ants, his part in establishing the National Science Foundation, UNESCO, and several observatories, his postwar visit to Russia, his help in rebuilding the Poulkovo Observatory, and his difficulties with the Un-American Activities Committee. No reader can help marveling at Shapley's extraordinary energy and activity.

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