The inclusion of many photographs in the book not only assuages the reader's curiosity as to the appearance of the people in the story, but also gives insight into the circumstances in which their actions were conducted. Who could look at the photograph of AAVSO director Margaret Mayall, almost hidden amidst the books and files crowded into the organization's Brattle Street office, without gaining a better appreciation of the physical stringencies under which the AAVSO struggled in those early days of independence from Harvard?

The history of the AAVSO spans great changes not only in the science of astronomy, but also in the ways members of a citizen-science organization interact. The early chapters of the book return us to the days when internet-driven citizen-science was undreamed of, and letters, journals, and personal encounters were the means by which members of the AAVSO communicated. The final chapters reveal an AAVSO in which the internet has become the chief means through which members engage one another, and where observations obtained with charge-coupled device cameras complement, and for some purposes replace, the visual observing techniques that were long the dominant means used by amateur astronomers to measure the brightnesses of variable stars.

There are places in the text where the degree of attention to detail may weary those interested only in the big picture of the growth of citizen-science. Nonetheless, often it is only through those details that the arguments and challenges driving the development of the AAVSO can be understood. I highly recommend this book to those interested in the changing partnership between amateur and professional astronomy from the late nineteenth through the early twenty-first centuries.

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MARS IN THE SPOTLIGHT

Geographies of Mars: Seeing and Knowing the Red Planet. K. Maris D. Lane (University of Chicago Press, Chicago, 2011). Pp. 227. $45. ISBN 978-0-226-47078-8.

As the nineteenth century turned into the twentieth, the planet Mars became a sensation. The American and European public resonated to the latest findings from a number of astronomers and science popularizers that Mars was inhabited by an advanced civilization of intelligent beings, busily building a vast network of canals to irrigate their arid planet. Although this episode has been previously analysed in many excellent books, Maria Lane, informed by her sensibilities as a historical geographer, brings us a fresh take in *Geographies of Mars*. In this fascinating book she eschews the argument that the story can be adequately explained as misguided observations by a few rogue astronomers and instead enlightens our understanding through the lens of geography.

The central figure in Lane's story is Percival Lowell, the Boston Brahmin who in 1894 built a major observatory at a high desert site in Flagstaff, Arizona Territory.

Lowell observed Mars in detail and through his popular books and lectures promulgated startling maps showing a complex network of linear features criss-crossing the planet. These features had first been seen by the Italian astronomer Giovanni Schiaparelli, but it was Lowell who made them real for most of the public, as well as for some astronomers. Other astronomers, who could not confirm the existence of such features with their own excellent telescopes at other locations, were highly sceptical of Lowell's claims, but their arguments were to no avail outside of professional circles. Mars became a *place*, one that was intriguingly both Earth-like (water and vegetation, deserts, polar ice caps, seasons, day and night cycles, an intelligent civilization) and exotic (colder and drier than Earth, populated by strange beings, advanced engineering on scales far exceeding anything on Earth). From this milieu emerged H. G. Wells's *War of the worlds* (1898) and the fact that popular culture still today associates "the Martians" with alien invasions. Lane emphasizes that knowledge production was an intricate dance between (a) consensuses reached in the usual professional scientific communications, and (b) assertions inhaled by the public in the writings of Lowell and other wildly popular astronomy writers such as the Frenchman Camille Flammarion.

Lane uses the tenets of geography, or more exactly spatial relationships in a physical and cultural context, to investigate how it was that the Martians became such a widely accepted concept. In the end she concludes that "the geopolitical moment in which the inhabited-Mars narrative unfolded — dominated as it was by European imperialism and American expansionism — produced an intellectual and social climate in which the view of Mars as an arid, dying, irrigated world peopled by unfathomably advanced beings was really the *only* interpretation ... that could plausibly have been accepted" (p. 13). She points out how the nascent discipline of geography, which became institutionalized during this heyday of European imperialism, developed theoretical constructs (such as environmental determinism) that were fundamental to the widespread adoption of the Martians hypothesis. The themes of Lowell and other proponents of extraterrestrial life, such as Alfred Russell Wallace, were closely related to those of imperial geography such as landscape change, irrigation, and cultural hierarchy.

Other illuminating geographical principles include of course cartography itself, the central category of evidence put forth by Lowell. Lane also investigates the new type of location where astronomical knowledge was being produced, namely high-altitude, remote, dry observatories (such as at Flagstaff), which led to epistemological battles over whose observations of tenuous, fleeting Martian surface features were most trustworthy. Lowell in essence claimed that others could not see his canals because of inferior observing sites. Finally, she makes a fascinating comparison between contemporary explorations to the Arctic and Antarctic and three astronomical expeditions to remote locales (chap. 4). Yes, the astronomers had scientific justifications for these Mars-related expeditions, but they also knew that their travels and trials would gain them more legitimacy back home where they were represented as heroes and adventurers.

In summary, Lane has deftly shown how the tenets of geography provide insight

into what has usually been taken as a solely astronomical episode. I imagine that such an approach could be useful in other areas of the history of astronomy. Examples might include William Herschel's mapping of the Milky Way in the late eighteenth century at a time of intense British exploration and colonization; the huge increase in the number of major Southern Hemisphere telescopes in the second half of the twentieth century (mostly controlled by Northern nations); and the move in the late twentieth century from ground-based to *space* astronomy, conducted above the Earth's atmosphere from rockets, balloons, and satellites.

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A HISTORY OF ADAPTIVE OPTICS

The Adaptive Optics Revolution: A History. Robert W. Duffner (University of New Mexico Press, Albuquerque, 2009). Pp. xxviii + 457. $45. ISBN 978-0-8263-4691-9.

Adaptive optics is a technology that removes distortions in optical systems. While the main application to date has been to compensate ground-based telescopes for blurring due to atmospheric turbulence, adaptive optics is also used for imaging the living human retina, cleaning up laser beam distortions, biological imaging, and many other applications. The image quality improvements can be spectacular. For example, today many adaptive-optics-corrected ground-based telescopes have 20–50 times better spatial resolution than they would have had without adaptive optics.

The history of adaptive optics involves a fascinating intertwining of contributions by the military (in the US primarily the Air Force) and the astronomical community, to the eventual benefit of both. The concept was first suggested by the astronomer Horace Babcock in the 1950s, was extensively developed and put into practice as a classified program by the US military (and possibly by the military in nations such as France) starting in the mid-1960s and early 1970s, was declassified in the early 1990s, and since then has become a key element of almost every large astronomical ground-based optical/infrared telescope. The use of lasers to create 'artificial beacons' for atmospheric turbulence measurement was a major contribution from the US Air Force.

Robert Duffner's book covers the history of adaptive optics development within the US Air Force. Military motivations for adaptive optics have included imaging satellites from the ground, projecting high-powered lasers as anti-satellite weapons, and missile defence. The book is mis-named, as the title implies that Duffner's history will include the full range of contributions to the field: military and civilian, in the US and worldwide. However if we ignore its misleading title, this book contains a great deal of previously unavailable historical material, addressing technology development within the US military and the people and organizations involved. It is thus quite a valuable contribution.

Duffner's raw material, documented in his Notes section, consists of interviews