Debating astronomy in Victorian newspapers

News from Mars: Mass Media and the Forging of a New Astronomy, 1860–1910. , Joshua Nall, U. Pittsburgh Press, 2019, $50.00

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gins with the long-term behavior of 2 × 2 systems in terms of eigenvalues and eigenvectors, then introduces methods of solving systems of linear first-order equations. That is a novel approach; most textbooks first discuss general techniques for solving systems and only examine long-term behavior after arriving at the solution. Struthers and Potter do a good job of starting with simple examples of linear systems, showing how to analyze those systems, and then generalizing the analytical techniques to arrive at concrete theorems.

A detailed discussion of beats of resonances is the highlight of chapter 4, "Higher-Order Differential Equations." The authors analyze damped-harmonic-oscillator equations with periodic forcing functions through a series of intelligently crafted examples. That section caters nicely to students with backgrounds in physics and engineering.

Laplace transforms are introduced in chapter 5 as tools that allow us to solve differential equations whose forcing functions are discontinuous. They also can be used, as the authors show, to deal with impulses. That approach gives instructors and students a clear motivation for studying Laplace transforms. The authors build up to solving second-order linear equations with Dirac delta force through a series of examples.

Chapter 6 is a good synopsis of the most commonly used numerical methods—including Euler's, Taylor's, and the Runge–Kutta—for solving differential equations and systems. In chapter 7, titled "Series Solutions for Differential Equations," the authors spend considerable time on the Hermite, Laguerre, and Bessel equations. However, all three are introduced rather abruptly, and the chapter could have benefited from a discussion of why those equations are important.

Except for the first chapter, all chapters contain a section called "For Further Study." That material deserves a special mention. Each section reads like a single long exercise problem but is in fact a step-by-step analysis of interesting problems coming from different scientific fields. The problems tie together techniques and concepts developed throughout the chapter, while at the same time teaching some new material. I will soon begin teaching an undergraduate class on differential equations and I think those sections will come in handy as a source of assignments. For example, the "For Further Study" section in chapter 3 leads students to the formal definition of matrix exponentials and gives them the opportunity to explore how the exponentials can be used to solve systems of first-order differential equations.

I am very happy to have been introduced to this excellent textbook. I plan to use it as an additional resource in the upcoming semester.

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In 1881, in a series of essays titled *The Poetry of Astronomy*, astronomer and popularizer Richard Proctor argued for the value of imagination in the practice of astronomy. He wrote that no one "who studies aright the teachings of the profoundest students of nature will fail to perceive that [they] have been moved in no small degree by poetic instincts, and that their best scientific work has owed as much to their imagination as to their reasoning and perceptive faculties." Comparing astronomy to poetry was no mere rhetorical flourish for Proctor–it was imagination, in his view, that transformed dry scientific data into knowledge. Imagination gave the astronomer access to causes and meanings that were not physically evident.

Proctor had no small stake in debates over how astronomy should be practiced and who had authority to produce astronomical knowledge claims. As historian Joshua Nall recounts in his book *News from Mars: Mass Media and the Forging of a New Astronomy, 1860–1910*, Proctor made his living publishing astronomical texts for public consumption. When writing for the public, Proctor drew authority from his own bona fides as a practicing astronomer. When addressing his peers in the scientific community, he argued that his ability to reach wide audiences and support himself with his scientific writing made him a true professional.

Mars was at the center of many of Proctor's debates

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PERCIVAL LOWELL at his observatory in Flagstaff, Arizona in 1914.

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with other astronomers. At the end of the 19th century, astronomers and the public were fascinated with the red planet, and both knowledge of and speculation about Mars seemed to be growing by leaps and bounds. In 1877, the same year American astronomer Asaph Hall discovered that Mars had two moons, Italian astronomer Giovanni Schiaparelli published hand-drawn maps reflecting his observations of the planet's surface. Schiaparelli's maps indicated that the surface of Mars was criss-crossed by a system of channels that he labeled *canali*. A public controversy ensued about whether those canali were built by an intelligent civilization.

Proctor's writings enthusiastically described canals and civilizations on the surface of Mars. He and his fellow canal enthusiast Percival Lowell, founder of the Lowell Observatory in Arizona, have been dismissed in hindsight as out of sync with professional astronomy during that period. Proctor and Lowell published in newspapers and in cheaply produced publications, not in the professional journals of the "real" astronomers, and that choice has led historians to mark them as amateurs or outsiders. But in characterizing Proctor and Lowell as discredited popularizers, historians have mostly relied on the words of their critics, the victors in the Mars debates. Nall invites us to reconsider Proctor's position through a careful examination of his writings. Nall's analysis suggests that historians should rethink debates about what constituted professional astronomy in the late 19th century and reexamine astronomy's relationship with the emerging mass media of the day. Newspaper and book publishers were eager to cash in on public desire for news about Mars. Meanwhile, astronomers were interested in the popular press's ability to spread their ideas and bolster their authority.

Proctor harnessed the press to sell his vision of scientific practice. His approach was multidisciplinary, anti-elitist, and populist in character, but was not "amateur," as modern readers understand that term. He used what Nall describes as an "imaginative astronomy," a set of methods that employed analogy to link his readers' familiar, lived experience with the concepts he described and with the scientific evidence gained through astronomical observation of the planets. In Proctor's view, his approach to astronomy was entirely professional.

Proctor and Lowell's opponents, on the other hand, advocated a very different kind of astronomical professionalism. Chief among them were the astronomers of California's Lick Observatory, whose first director, Edward Holden, attempted to frame their speculation about life on Mars as newspaper sensationalism. Holden and his peers also sought to make a living from their science and to wrest scientific authority from gentlemen astronomers whose reputation stemmed to no small degree from their social station. The new generation of astronomers distinguished themselves from the older generation by their physical instruments; they incorporated spectroscopy and other new methods to make claims about the composition of stars and planets.

The so-called new astronomy upset the field's existing power structure at exactly the moment when the rise of mass media created a new venue where astronomers could fight for disciplinary authority. Proctor and Lowell represented threats to the new astronomy, not because they were wrong, but because they were popular. Proctor had a talent for writing for the public, and Lowell frequently issued press releases about his latest maps of Martian canals. Holden's opposition was based in a fear that not only did the canal headlines bring bad science to the public, but they were crowding out the reports about Mars that were coming from his own observatory.

Nall's nuanced account of how astronomers attempted to discredit and compete with Proctor and Lowell shows that the disciplinary norms of professional astronomy emerged during, not before, the canal controversy. The victors in the debate won by forging alliances between observatories and the press and thus establishing which astronomers and observatories would be considered reliable sources of news from Mars. Nall shows that Proctor and Lowell were not led to wrong conclusions because they were amateurs, but that they were marked as amateurs because they failed to fall in line with the emerging norms of the new astronomy.

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