

Starry-Eyed Entrepreneur

Building institutions and telescopes, George Ellery Hale advanced the frontier of American astronomy.

By Marcia Bartusiak

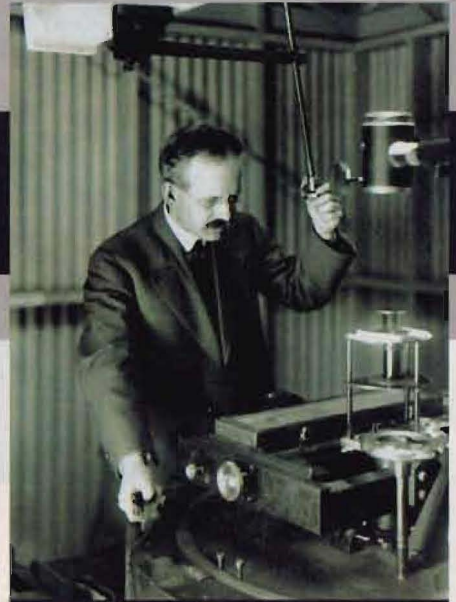
Among the many scientific accomplishments of the noted solar astronomer George Ellery Hale (1868–1938) was his discovery of magnetic fields in sunspots—the first magnetic fields detected beyond Earth. But Hale made his most valuable contributions to astronomy as an administrator. He cofounded the *Astrophysical Journal* and helped build the California Institute of Technology. And he almost single-handedly orchestrated the construction of four great telescopes in the United States, each larger and more advanced than the one before. That colossal endeavor allowed the astronomers who followed to reveal the true vastness of the universe and the amazing diversity of its celestial inhabitants.

George was a precocious, curious boy, always devising new ways to study the natural world. His father, William, had secured a sizable fortune by manufacturing hydraulic elevators during the dawning age of skyscrapers. As a teenager, George was able to construct his own spectroscopic observatory in the attic of the family's Chicago mansion. There he avidly studied the Sun's spectrum in the company of his books, laboratory equipment, and fossil collection. His home observatory grew more elaborate over time, and there, shortly after his twentieth birthday, in 1888, he confirmed that the Sun contains carbon, then a

matter of great debate. Before Hale even graduated from college, he developed a new instrument—the spectroheliograph—that enabled astronomers to photograph the Sun's surface as never before.

Upon graduation from the Massachusetts Institute of Technology, class of 1890, Hale married his childhood sweetheart and took an extended honeymoon trip across the U.S. He stopped at the Lick Observatory, near San Jose, California, and was mightily impressed. Hale never forgot his first glimpse of the 36-inch refracting telescope, then the world's largest. Within two years of his return home, Hale became an associate professor at the newly founded University of Chicago. The university promised future funding for a large telescope; in return, he and his father donated to the university the instruments in his personal observatory, by now a freestanding building next door to the family mansion.

Thanks to Hale's resourcefulness, the prospect of a larger telescope arrived sooner rather than later. In 1892, Hale learned of two 40-inch lenses that had been made for a planned observatory in southern California whose funding had dried up. A lens forty inches wide had nearly 25 percent more surface area than the Lick's 36-inch lens, and so would gather 25 percent more light, a treasured gain. Hale convinced Chicago's



George Ellery Hale with the spectroheliograph he invented

streetcar magnate, Charles Tyson Yerkes, to fund construction of the giant instrument.

With great pomp and circumstance, the Yerkes Observatory opened in 1897, in Williams Bay, Wisconsin. Hale, at the age of twenty-nine, was appointed its director. At a time when other observatories strictly took images, Hale made sure Yerkes had photographic darkrooms, spectroscopic labs, and instrument shops devoted to examining the chemistry of the heavens.

Hale was the astronomical equivalent of an industrial entrepreneur, always on the lookout for new technologies. Before the Yerkes's magnificent dome was even finished, Hale had already persuaded his father to buy the optical components for yet another telescope, this time a large reflector. A lens any larger than the Yerkes 40-inch was unfeasible; to go bigger required a mirror.

After a visit there in June 1903, Hale selected Mount Wilson, near Pasadena, California, as "the place" to erect his 60-inch scope. With

the University of Chicago unwilling to fully finance a California outpost, the young astronomer sought other funding sources. Fortuitously, Andrew Carnegie had just established the Carnegie Institution of Washington, with a generous endowment of \$10 million to fund scientific projects. Hale began lobbying for a grant without delay, but funding was not immediately forthcoming.

That didn't hamper Hale one bit, and in late 1903 he moved his family to Pasadena. The following spring, Carnegie offered a small grant to co-sponsor, with the University of Chicago, the relocation of a solar telescope from Yerkes to Mount Wilson—and so work on the mountain began in the summer of 1904. When that grant ran out, Hale dipped into his own pocket. Finally, just before Christmas, the Carnegie Institution agreed to sponsor his grand plan for the 60-inch reflector atop the mountain. Hale promptly resigned as Yerkes director to devote his full attention to the Mount Wilson Solar Observatory of the Carnegie Institution of Washington. ("Solar" was later dropped from the name.)

Construction took a Herculean effort. Hundreds of tons of material were hauled up by mules and by a generator-powered, mule-assisted truck. The tensest moment was the transport of the nearly two-ton mirror itself; one misplaced wheel and it would have plummeted to the canyon floor. To everyone's relief, the mirror arrived intact in late August of 1908. Once the telescope was operational, in December, astronomers could see stars one hundred million times fainter than the brightest stars in the sky.

Meanwhile, Hale was thinking ahead to an even bigger telescope, one with a mirror one hundred inches wide that would gather nearly three times as much light as the 60-inch. No glass that large had ever been

made; it was uncertain whether it could be cast, polished, or mounted. When the giant glass blank arrived from France in December 1908, it was seriously flawed by numerous entrapped bubbles. A new disk was ordered, but the best candidate broke while cooling. Then the Los Angeles businessman who had pledged the money to construct the mirror balked at any new expenditure. With his funds exhausted and facing multiple struggles, Hale experienced the first of many nervous breakdowns. Yet eventually a 9,000-pound mirror made from the original glass was installed on Mount Wilson. It saw first light on November 1, 1917, performing exquisitely despite its defects.

George Ellery Hale died of heart trouble at age sixty-nine in

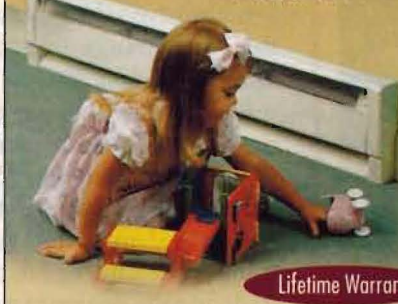
1938, a decade after beginning efforts to erect a 200-inch telescope atop Palomar Mountain, outside San Diego. To venerate his leadership in the telescope's design and construction, as well as his achievements as the Mount Wilson Observatory director from 1904 to 1923, the new instrument was named the Hale Telescope at its 1948 dedication. Six decades later, it continues to make major contributions to astronomical research.

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In recognition of 2009 being the International Year of Astronomy, this article is the third of several on the events and scientists that have advanced our understanding of the cosmos during the last hundred years. This article was adapted from *The Day We Found the Universe*, by Marcia Bartusiak, © 2009. Reprinted with permission from Pantheon Books. All rights reserved.

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