AMERICAN MUSEUM of NATURAL HISTORY

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SCIENTISTS RECOVER NOVA FIRST SPOTTED 600 YEARS AGO BY KOREAN ASTROLOGERS

NEW STUDY PROVES THAT NOVAE HAVE LONG-TERM LIFE CYCLE WITH MULTIPLE STAGES

On a cold March night in Seoul almost 600 years ago, Korean astrologers spotted a bright new star in the tail of the constellation Scorpius. It was seen for just 14 days before fading from view. From these ancient records, modern astronomers determined that what the Royal Imperial Astrologers saw was a nova explosion, but they had been unable to find the binary star system that caused it—until now. A new study published today by the journal *Nature* pinpoints the location of the old nova, which now undergoes smaller-scale "dwarf nova" eruptions. The work supports that idea that novae go through a very long-term life cycle after erupting, fading to obscurity for thousands of years, and then building back up to become full-fledged novae once more.

"This is the first nova that's ever been recovered with certainty based on the Chinese, Korean, and Japanese records of almost 2,500 years," said the study's lead author Michael Shara, a curator in the American Museum of Natural History's Department of Astrophysics.

A nova is a colossal hydrogen bomb produced in a binary system where a star like our Sun is being cannibalized by a white dwarf—a dead star. It takes about 100,000 years for the white dwarf to build up a critical layer of hydrogen that it steals from the sun-like star, and when it does, it blows the envelope off, producing a burst of light that makes the star up to 300,000 times brighter than the sun for anywhere from a few days to a few months.

For years, Shara has tried to pinpoint the location of the binary star that produced the nova eruption in 1437, along with Durham University's Richard Stephenson, a historian

of ancient Asian astronomical records, and Liverpool John Moores University astrophysicist Mike Bode. Recently, they expanded the search field and found the ejected shell of the classical nova. They confirmed the finding with another kind of historical record: a photographic plate from 1923 taken at the Harvard Observatory station in Peru and now available online as part of the Digitizing a Sky Century at Harvard (DASCH) project.

"With this plate, we could figure out how much the star has moved in the century since the photo was taken," Shara said. "Then we traced it back six centuries, and bingo, there it was, right at the center of our shell. That's the clock, that's what convinced us that it had to be right."

Other DASCH plates from the 1940s helped reveal that the system is now a dwarf nova, indicating that so-called "cataclysmic binaries"—novae, novae-like variables, and dwarf novae—are one and the same, not separate entities as has been previously suggested. After an eruption, a nova becomes "nova-like," then a dwarf nova, and then, after a possible hibernation, comes back to being nova-like, and then a nova, and does it over and over again, up to 100,000 times over billions of years.

"In the same way that an egg, a caterpillar, a pupa, and a butterfly are all life stages of the same organism, we now have strong support for the idea that these binaries are all the same thing seen in different phases of their lives," Shara said. "The real challenge in understanding the evolution of these systems is that unlike watching the egg transform into the eventual butterfly, which can happen in just a month, the lifecycle of a nova is hundreds of thousands of years. We simply haven't been around long enough to see a single complete cycle. The breakthrough was being able to reconcile the 580-year-old Korean recording of this event to the dwarf nova and nova shell that we see in the sky today."

This study was based on observations from the Southern African Large Telescope (SALT), and the Las Campanas Observatories' Swope and Dupont telescopes.

Other authors on this study include K. Ilkiewicz, J. Mikolajewska, and K. Drozd from the Polish Academy of Sciences; A. Pagnotta, J. Faherty, and D. Zurek from the American Museum of Natural History; L.A. Crause from the South African Astronomical Observatory; I. Fuentes-Morales and C. Tappert from the Instituto de Física y Astronomía; J.E. Grindlay from the Harvard-Smithsonian Center for Astrophysics; A.F.J. Moffat from the Université de Montréal; M.L. Pretorius from the South African Astronomical Observatory

and the University of Capetown; and L. Schmidtobreick from the European Southern Observatory.

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The American Museum of Natural History, founded in 1869, is one of the world's preeminent scientific, educational, and cultural institutions. The Museum encompasses 45 permanent exhibition halls, including the Rose Center for Earth and Space and the Hayden Planetarium, as well as galleries for temporary exhibitions. It is home to the Theodore Roosevelt Memorial, New York State's official memorial to its 33rd governor and the nation's 26th president, and a tribute to Roosevelt's enduring legacy of conservation. The Museum's five active research divisions and three cross-disciplinary centers support approximately 200 scientists, whose work draws on a world-class permanent collection of more than 34 million specimens and artifacts, as well as specialized collections for frozen tissue and genomic and astrophysical data, and one of the largest natural history libraries in the world. Through its Richard Gilder Graduate School, it is the only American museum authorized to grant the Ph.D. degree and the Master of Arts in Teaching degree. Annual attendance has grown to approximately 5 million, and the Museum's exhibitions and Space Shows can be seen in venues on five continents. The Museum's website and collection of apps for mobile devices extend its collections, exhibitions, and educational programs to millions more beyond its walls. Visit amnh.org for more information.

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