

Spectrograms of Nova Cygni 1975, obtained with the 24-inch reflector of Sommers-Bausch Observatory in Boulder, Colorado, by P. Barker, B. Bohannon, O. Cardona, and P. Massie. The spectral region shown extends from violet at left to blue-green at right. As elsewhere in this article, the Universal times of observations are expressed in decimal parts of a day. Note how the spectrum of the nova after September 1st is dominated by extremely broad emission lines of hydrogen, labeled at the bottom. The original dispersion was 37 angstroms per millimeter. University of Colorado photographs.

More About Nova Cygni

REPORTS continue to arrive from still more independent discoverers of Nova Cygni 1975, which peaked at visual magnitude 1.8 on the night of August 30-31. A star so conspicuous that it altered a very familiar constellation must have been noted by every amateur or professional astronomer who looked at this part of the sky around that date. The concept of discovery breaks down in such a case; instead of being "discovered," the nova may be said to have "revealed itself."

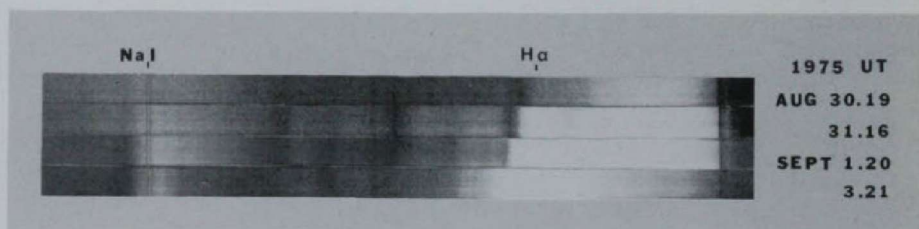
The light curve of the nova on this page is an up-dated version of the one published on page 229 last month. Visual magnitudes from nearly 40 correspondents have been added; photoelectric magnitudes have been provided by K. Güssow, Leverkusen, Germany; H. Louth of Sedro Woolley, Washington; D. Merritt, Santa Clara, California; V. Piirola, Helsinki, Finland; and astronomers' reports in *Circulars* of

the International Astronomical Union.

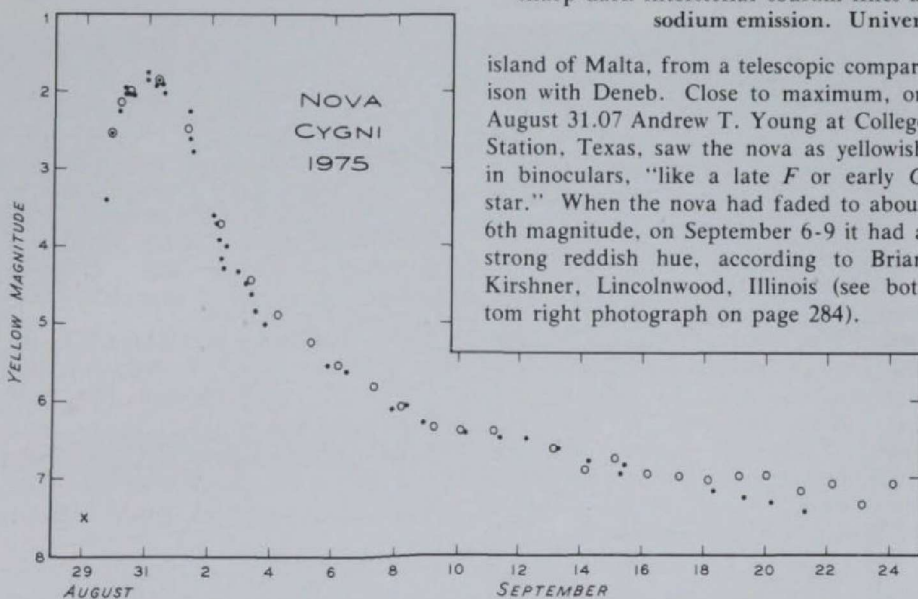
This curve shows how the initially very rapid fading of the star slowed down. By late September the nova was slightly fainter than magnitude 7.

Many viewers commented on the dramatic change in the visual color of the nova. Before maximum, on August 29.85 it appeared blue to Frank Ventura on the

This behavior is explained by the star's spectral changes. Before maximum, its light came largely from the continuum spectrum, which resembled that of a hot supergiant star. Later, the continuum faded, while more and more of the star's light came from its emission lines, of which red hydrogen-alpha was especially intense.



The red end of the spectrum of Nova Cygni, as seen in Sommers-Bausch Observatory spectrograms with an original dispersion of 56 angstroms per millimeter. Note the great width of the hydrogen-alpha emission, and the pair of sharp dark interstellar sodium lines at *Na I*, superimposed on the nova's broad sodium emission. University of Colorado photographs.



In this light curve of Nova Cygni, the open circles are means based on 445 visual estimates, and the dots are photoelectric measurements in yellow light. The cross on the rising branch is a predisccovery photovisual observation made by P. Garnavich, Bowie, Maryland.

island of Malta, from a telescopic comparison with Deneb. Close to maximum, on August 31.07 Andrew T. Young at College Station, Texas, saw the nova as yellowish in binoculars, "like a late *F* or early *G* star." When the nova had faded to about 6th magnitude, on September 6-9 it had a strong reddish hue, according to Brian Kirshner, Lincolnwood, Illinois (see bottom right photograph on page 284).

These changes can be traced in the 10 days covered by the University of Colorado spectra at the top of the page. Bruce Bohannon gives this description of them: "The earliest spectrum shows broad, very weak Balmer emission lines, with violet-displaced absorption components. This so-called P Cygni line profile is typical of stars surrounded by an expanding shell of gas. In the following spectra the hydrogen lines increase rapidly in brightness and width, while metallic lines (principally of singly ionized iron, singly ionized calcium, and neutral sodium) appear in both absorption and emission. The sodium lines show a P Cygni profile. From day to day, the absorption components of the P Cygni profiles become shifted more and more toward the violet, while the continuum weakens. After September 2nd, the spectra show multiple narrow absorption components superimposed on the broad hydrogen emission features; this phenomenon is enhanced in successive spectra."

Amateurs who obtained spectra of Nova Cygni include Kari Kaila, Helsinki, Finland, who attached a small objective prism to his 8-inch Newtonian, and Robert Fried, Atlanta, Georgia, who used a homemade prism spectrograph on a 16-inch reflector. See page 284 for a spectrum by P. Michaud, Yucaipa, California.

There are rapid variations in spectrum and light superimposed on the progressive changes described above. For example, at David Dunlap Observatory in Canada, the emission peaks of the hydrogen-alpha lines were found by B. Campbell to vary on a time scale of one hour.

Moreover, a brightness variation with a period of about 6.6 hours and an amplitude of only about 0.11 magnitude in yellow light has been detected by R. H. Koch and C. W. Ambruster of Flower and Cook Observatory. This phenomenon was discovered simultaneously by P. Tempesti, Collurania Observatory, Italy. As Harvard-Smithsonian astronomer Luigi Jacchia points out, this is just the kind of variation to be expected if Nova Cygni is, like all well-observed former novae, a very close binary system. Even if such a binary is not eclipsing, the elongated shapes of the components produce small-amplitude rhythmic variations in brightness.

According to G. de Vaucouleurs, Nova Cygni at maximum light was of visual absolute magnitude -10.25 , making it the intrinsically most luminous nova on record. The University of Texas astronomer arrived at this conclusion from the fact that 15 days after maximum all novae seem to be of about absolute magnitude -5.2 , irrespective of the rate of decay. The observed light curve shows that on that date the star had faded by 5.05 magnitudes from maximum (when the apparent magnitude was 1.8). Thus the absolute magnitude at maximum was $-5.2 - 5.05 = -10.25$.

If the nova had not been dimmed by interstellar dust, it would have appeared about as bright as Procyon, according to Dr. de Vaucouleurs. He calculates a distance of 1,300 parsecs or about 4,200 light-years. At this distance, the adopted expansion velocity of 2,000 kilometers per second implies that within a year the nova may look like a nebula 0.5 second of arc in diameter.

An independent calculation by D. R. Florkowski and J. P. Oliver, at Rosemary Hill Observatory in Florida, gives a distance of 1,300 to 2,300 parsecs. They predict that the expanding shell may have a diameter of 0.1 second in five to nine months.

As noted on page 229 last month, Nova Cygni was fainter than photographic magnitude 21 on photographs taken about 1950 at Palomar Observatory. Confirmation that the brightening by at least 19 magnitudes took place in two steps has now been provided by Soviet astronomers. On August 5.91 (about 25 days before



Nova Cygni (top left) and the North America nebula (below center) are seen in this composite of two eight-minute exposures, taken on the same evening with an 8-inch f/1.5 Celestron Schmidt camera by Dennis and Cheri di Cicco at Keene, New Hampshire. Both photographs were on GAF 200 film. The exposure for the nova was on September 1.11, when Mr. di Cicco estimated the star's magnitude as 2.2. Only a day past maximum, the nova was not yet red.



The spectrum of Deneb (above) and Nova Cygni, as photographed by amateur astronomer Pat Michaud, Yucaipa, California, on the evening of August 31st. He used a diffraction grating and 50-mm. lens, which rode on an 8-inch telescope for this guided 10-minute exposure. The emulsion was Fujichrome, copied on Tungsten High Speed Ektachrome. The broad hydrogen lines appear as bright beads on the spectrum of the nova.

maximum), the yellow magnitude was 15.95 on a Riga Observatory photograph, and on August 8.01 the blue magnitude was 17.6 on another Riga plate. On August 12.98, the blue magnitude derived by N. N. Samus from a Sternberg Institute plate has now been revised to 17.0. Finally, on August 24.94, a Riga red plate gave 13.5. Making allowance for the different colors, all these observations are roughly consistent with a yellow magnitude of 16. It follows, therefore, that the nova lingered near this magnitude for at least 18 days before its sudden spectacular rise.

An inspection of Harvard patrol plates taken between 1898 and August 10, 1975, did not show any previous outburst to as bright as magnitude 15.5, according to N. V. Vidal and W. Liller.

Another unusual aspect of Nova Cygni is that it briefly served as a brilliant pole star for Mars, being only about five degrees from the Martian north celestial pole.



At left, the Northern Cross stands upright, with the nova near top center and directly above Deneb, in a 15-minute exposure on Fujichrome taken on September 1.05, by George East, Jr., Randolph, Massachusetts, with a 55-mm. $f/1.7$ lens. On September 4.14, Dennis Milon at Harvard, Massachusetts, used a 10-minute exposure, the same film, and a nearly identical lens for the matching view above. Note how the nova has faded (to magnitude 4.8) and become reddish.