The New Star of 1912—Nova Geminorum II.[1]

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THOUGH new stars are of comparatively rare occurrence, several have appeared during the past few years, and much attention has been devoted to their study. Many observatories which have now taken up the spectroscopic examination of celestial objects, and are therefore equipped with spectroscopic apparatus of various kinds, have together secured a great amount of material which was lacking for the study of the earlier novæ.

Such was the case with the new star which was discovered by Enebo in Norway on the evening of March 12, 1912. This star appeared in the constellation of Gemini and is known as Nova Geminorum II., since it is the second nova that has shown itself in that constellation.

The star was, fortunately, discovered before it had attained its greatest brilliancy, as was also the case with the most recent new star, Nova Cygni III. (1920). On March 10, 1912, Nova Geminorum was less than a star of the eleventh magnitude, and it attained its maximum on March 14, being then of magnitude 3·37. After that it faded very rapidly, diminishing with fluctuations which were irregular in both period and amount.

The Solar Physics Observatory at Cambridge was fortunate enough to secure a very fine series of photographs taken by Mr. Stratton during the months of March and April, 1912—so good a series, in fact, that it required only a few photographs from other observatories to fill up the gaps. Most of these were supplied from the Allegheny and Bonn Observatories. Other photographs were taken of the later stages of the nova's career, but longer intervals between these only were required, as the spectral changes were slow. The measurement of all the photographs was completed in 1914, but owing to the outbreak of war the work of discussion could not be taken up until Mr. Stratton's return to the observatory in February, 1919. His discovery of the identification of many lines in the nova's spectrum with nitrogen, oxygen, and helium lines, which were greatly displaced from their normal positions, facilitated the work.

A discussion of all these photographs has now been published, and Mr. Stratton, who undertook it, has presented us with a work which gives a valuable insight into the nature of the changes which the spectrum of this nova underwent. The volume will thus greatly assist other workers who are discussing their observations of later novæ, and will possibly give them clues as to what kind of changes may be expected or how to look for them.

Since the spectrum of a nova is changing constantly, and sometimes with very considerable rapidity, especially about the time of maximum brilliancy, every photograph of its spectrum, wherever taken, may prove useful in the elucidation of the nova problem. Since the puzzling changes in the spectra are much more likely to be understood if the time interval between successive spectrograms can be greatly reduced, the author puts forward the view that for a complete elucidation of the problems involved all the spectra secured for any one nova should be placed at the disposal of a single investigator. There should be no difficulty in carrying out such a suggestion, provided that each observatory which takes some of the photographs and wishes to discuss them may do so prior to handing them over for the final inquiry.

One marked feature of this research is that it deals with photographs of the nova taken with instruments giving both large- and small-scale spectra. As the spectra of novæ at some stages consist of a mixture of broad, diffuse bands, together with very sharply defined lines, the former are seen and measured at their best in the small-scale spectra, while the latter are practically seen only in the large-scale spectra.

The discussion of the observations has led the author to differentiate between seven different stages in the spectrum of this nova. One cannot do better than quote from p. 9 the summary he gives of the different stages, as space forbids one to elaborate the information:

"(1) An absorption spectrum of type A5 displaced, with weak radiations undisplaced (1912 March 13).

"(2) An absorption spectrum of type A2*p* (α Cygni) displaced, with radiation spectrum undisplaced and with many absorptions doubled (1912 March 15–21).

"(3) Superposed absorption spectra of types A2*p* (α Cygni) and B2 (γ Orionis) displaced by separate amounts, together with an α Cygni radiation spectrum undisplaced. The γ Orionis absorption spectrum increases in strength compared with the α Cygni absorption spectrum, and accompanying bright bands of γ Orionis type gradually appear and increase in strength (1912 March 22–31).

"(4) α Cygni and γ Orionis radiation spectra undisplaced (1912 April 8).

"(5) γ Orionis and nebular radiation spectra undisplaced (1912 April 22).

"(6) Nebular radiation spectrum (1912 December 6).

"(7) Nebular and Wolf-Rayet radiation spectra (1914 February 22)."

The author enters fully into the method he adopted for differentiating between the types of spectra referred to in Nos. (1) to (3) above, and shows how by employing a displacement factor from known lines he was able to tie up lines of other elements, the displacement factor varying according to the date of the photograph examined. Thus, to take one instance, out of 108 strong lines in α Cygni, 79, according to this method, appeared displaced in the nova on March 15; reasons are given for the absence of many of the remaining lines.

As to the cause of the outburst of the new star, based on the spectroscopic evidence here brought together, the author does not commit himself, for he says that a final theory of novæ cannot yet be written. With regard to the most hopeful theory at present put forward, suggesting the collision of a star with a dark nebula and the consequent terrific action causing a tremendous outstreaming of glowing gases from the central body and the final formation of a planetary nebula with a Wolf-Rayet star as nucleus, the author says we "must await modification as further facts come to light."

In his preface Prof. Newall states that this vol. iv. of the Annals will be followed by memoirs on Nova Persei (1901) and on Nova Aquilæ III. (1918). The latter star, he says, "seems likely to afford more insight into the nature of the outburst of a nova than all the other new stars that have been studied with the help of the spectroscope."

While reference has only briefly been made to some of the main points in this volume on Nova Geminorum II., there are many other features in the nova's spectrum which Mr. Stratton has discussed very minutely, such as the undisplaced calcium lines, the structure of bright bands, etc. Two plates accompany the volume illustrating the spectra both as a whole and in parts.

[1] Annals of the Solar Physics Observatory, Cambridge. Vol. iv., part i.: "The Spectrum of Nova Geminorum II." By F. J. M. Stratton. Under the direction of Prof. H. F. Newall. Pp. viii+71+ii plates. (Cambridge: At the University Press, 1920.)