26. NOTE ON THE VARIABLE OR NEW NEBULAE POSSIBLY CONNECTED WITH FU ORIONIS, AE AURIGAE AND NOVA AURIGAE 1891

By G. Shajn and W. Gase. (*Presented by* O. Melnikov)

In the problem of the relation between variable stars and diffuse matter it is important to study not only the case in which the star is involved in the nebula, but also that in which nebula is far from the star, and particularly the effect of the light signal.

A treatment of the problem is interesting from two standpoints: (1) The variability or even the apparition of a nebula can be connected with great changes in the far ultra-violet radiation beyond the limit of the Balmer series in the spectra of novae, nova-like and variable stars. (2) The study of the apparition or variability of a nebula allows us to get information on the ejected shells, as well as on the distribution of interstellar matter, particularly for a three-dimensional picture of the distribution of interstellar matter.

A light signal simultaneously illuminates all nebulous matter on the surface of an ellipsoid of rotation, in the focal points of which are situated the star and the observer. Probably the only case in which a light signal has been observed is that of Nova Persei 1901.

In our study of the nebulae carried out during the last two or three years we had no special intention of studying nebulae near novae, nova-like and variable stars. Nevertheless, it is worth recording that we encountered three cases which probably are related to this problem.

(1) We have found recently, in addition to the small reflecting nebula around the nova-like star FU Orionis discovered in 1939, a new nebula in form of a parabola distant about 10′ from this star (Fig. 1). It is not excluded that we have here a light signal. The nebula was photographed twice under poor winter conditions. Undoubtedly the nebula is at least partly filamentary. It is of interest to observe the spectrum of FU Orionis and to follow the further development of the nebula.

The star FU Orionis itself (type *cF* 5) increased in brightness in 1937–39 by more than six magnitudes (Wachmann). The reflection nebula and spectrum of the star were studied by Dieckvoss, Struve, Elvey, Linke and others. FU Orionis lies in a rather strong emission region around λ Orionis.

(2) We have recently found in the position (5^h35^m, $+27°$, 1900) at a distance of 3·8 degrees from Nova Aurigae 1891, a marvellous system of filamentary nebulae reminding us in their aspect of the tracks produced by positrons in the Wilson camera (Fig. 2). Very faint small filaments are also observed in the neighbouring region lying outside the field (Fig. 2), and one may generally suggest that the filaments encircle a part of a circumference of 3 degrees diameter. Although the nebula in Fig. 2 can scarcely be interpreted as a light signal from Nova Aurigae 1891, it will be possible to decide upon this in the future. Seven exposures made during the three months from December 1951 to March 1952 show the nebula unaltered.

(3) W Gase found striking differences in the shape of the nebula IC 405 (flaming star) when comparing our photograph in the light of H_α with the formerly published ones (Mount Wilson, de Kerolyr, Wolf). The nebula will be photographed in different wavelength regions to decide whether these changes are real, or whether they are due to differences in the distribution of various elements. The exciting star is the variable AE Aurigae of class O9ss. We should watch for possible changes in its spectrum.

27. ON THE SPECTRA OF THE R CrB STARS AND RELATED OBJECTS

By W P Bidelman. (*Presented by* H. F. Weaver)

The abnormal weakness of the hydrogen lines in the spectra of the stars of the R CrB type has been long known. Berman's work on the spectrum of the prototype established the presence of strong high-level absorption lines of neutral carbon and of weak bands of C_2, and his analysis of the spectrum, carried out by the method of curve of growth, led

Fig. 1. Parabolic nebula near FU Orionis

Fig. 2. The nebula in Auriga.

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him to conclude that carbon is by far the most abundant element in the atmosphere of R CrB, and that hydrogen is greatly deficient. Recent work at the McDonald Observatory has shown that in addition to the high-level lines of neutral carbon, other lines arising from very high levels of neutral oxygen and neutral nitrogen are also present in unusual strength in the visual region of the spectrum of this star. The presence of these other high-excitation lines strongly suggests that reliable values of the relative abundances of the elements C, N, and O in the R CrB stars must await detailed studies using the method of model stellar atmospheres.

Other peculiar stars which seem to be lower temperature analogues of R CrB are those like HD 182040, which again shows abnormally weak hydrogen lines and strong lines of C I, but which exhibits in addition very strong bands of C_2 and CN, and which are not known to be variable. A notable feature of HD 182040 and the three stars which have been found to be similar to it is the absence of bands of CH in the spectrum, further, the $C^{12}:C^{13}$ ratio is larger than 30·1 instead of being of the order of 3 1 as is customary for normal carbon stars, as McKellar has shown. Thus these peculiar 'carbon' stars are to be distinguished from the normal carbon stars both by their abnormal weakness of features due to hydrogen and by their differing carbon isotope ratio.

It is a remarkable fact that the spectra of these apparently hydrogen-deficient stars bear a considerable resemblance to those of slow novae near maximum light. At this phase, certain slow novae have shown a nearly pure absorption spectrum which differs from those of normal super-giant stars in showing abnormally strong absorption lines of neutral nitrogen, oxygen, and especially carbon. The hydrogen absorption lines have been observed to be considerably weaker with respect to the lines of the ionized metals than in normal super-giant stars. Further, DQ Herculis (N Her 1934) showed at one stage very strong bands of CN, while much weaker bands of C_2 were also present.

McLaughlin suggested some years ago that the R CrB stars may be related to the novae, and the possibility that the atmospheres of the peculiar stars discussed in this paper may be in a state similar to that of a nova of very low expansion velocity near maximum light, seems an attractive one to the writer. One may ask whether the rapid decline in the light shown by the R CrB stars may not be due to the same cause as that which was responsible for the deep minimum in the light curve of DQ Herculis. The magnitude of the decrease in light in the two cases is surprisingly similar.

It is apparent that if these peculiar stars actually do possess an atmospheric structure similar to that of slow novae, any conclusions concerning the abundances of elements in their atmospheres must be drawn with considerable caution.