ON COMET-LIKE NEBULAE

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In this communication I mention some results of recent work, concerning the nature of the continuous emission observed in the spectra of some T Tauri stars and during outbursts of UV Ceti stars. As it is well known this continuous emission gives rise to the veiling of the absorption lines in the spectra of T Tauri stars. Our results are closely connected with the question of the origin of the luminescence of the comet-like nebulae.

1. Observational data about the continuous emission of T Tauri and UV Ceti stars suggest that this emission is of a nonthermal origin. On the other hand, the amount of energy generated during each outburst of UV Ceti stars and T Tauri stars at maximum brightness is so enormous, that we cannot explain these outbursts on the basis of the processes of energy exchange within the atmosphere of a given star only. Evidently they are caused by a transfer of considerable amounts of internal stellar energy into the outer layers of the star. This transfer differs from a usual transfer caused by thermal conductivity or radiation. The only possible explanation we may suggest at present is that a certain amount of

stellar energy sources is being transported from the internal layers of the star into the atmosphere and even perhaps outside the limits of the atmosphere. This amount of internal energy is then transformed in the outer layers of the star into energy of radiation and is then emitted in the form of continuous emission, veiling the absorption lines, or in the form of energy of ionization and excitation causing the appearance of bright lines.

2. The supposition that the emission of the comet-like nebulae (objects connected with T Tauri stars) in all cases consist of reflected stellar radiation, meets insurmountable difficulties. The most striking example of a discordance between the brightness of the nebula and the luminosity of the embedded star was studied by Struve and Swings. This comet-like nebula B 10, is connected with the variable star DD Tauri of the T Tauri type. The above mentioned authors showed that in order that the luminescence of this nebula should be produced by reflected radiation from DD Tauri, the latter had to be 7 magnitu- brighter than it is observed in reality. It must be noted that in the spectrum of DD Tauri strong continuous emission is observed. The second fact contradicting the simple reflection hypothesis consists in the absence of a direct relation between the variations of brightness of the comet-like nebulae and of the embedded stars. As an example we may name the star T Tauri itself and the variable nebulae discovered by Hind (NGC 1555) and O.V. Struve in Pulkovo (NGC 1554). This phenomenon is clearly present also in the case of other comet-like nebulae.

The fact that all known comet-like nebulae are connected with T Tauri type stars leads us to suggest that we are

dealing with the same phenomenon of continuous emission. This means that matter ejected from the internal layers of the stars, transferring internal stellar energy, reaches in certain cases the nebula where the energy is transformed into visual radiation.

3. The amount of internal stellar energy in a nebula requires for its emission a longer period of time (usually some years), than is needed for similar processes in stellar atmospheres. This proves once more that the time during which the emitted energy is radiated depends upon the conditions in the given volume of space.

4. The greater part of the known cometary nebulae is situated within the limits of dark nebulae of larger size. Thus for example, Hind's nebula, the nebula B 10 and some others are situated in the dark cloud of Taurus. They are physically connected with the members of T-association in Taurus. They appear to form some kind of inclusions in the dark nebula of Taurus.

A number of diffuse nebulae with continuous spectra contain numerous T Tauri stars. In these cases we say that the nebula is connected with a T-association. It is quite natural to expect that in this case some of the T Tauri stars may be embedded in small comet-like nebulae and cause the luminescence of the latter.

But it is evident that the discovery of small comet-like nebulae within the limits of large bright diffuse nebulae is much more difficult than the discovery of them within the limits of dark nebulae. Nevertheless there are evidences that in some bright diffuse nebulae we have comet-like inclusions which are connected with stars imbedded in these nebulae.

The paper by Haro, devoted to T Tauri type stars,

connected with the Orion nebula presents some facts which confirm this conclusion. Objects 7*a*, 8*a*, and 13*a* of his list are comet-like nebulae with continuous spectra. The luminescence of these objects can be explained by reflection of the radiation of these stars. It cannot be explained either by reflection of light emitted by the stars of the Orion Trapezium.

One may conclude that in this case also we meet with the phenomenon of continuous emission. It can be shown that some other diffuse nebulae also contain comet-like objects.

One of the outstanding examples of comet-like inclusion is found in the diffuse nebula IC 405 where the exciting star is AE Aurigae. On the photographs obtained by G.A. Shajn and V. Th. Hase at the Crimean Observatory we can see that the nebula IC 405 has quite different structures in Hα light and in the blue.

In the blue we observe a strong stream or jet which seems to be ejected from AE Aurigae. The existence of this jet is the reason why Wolf called AE Aurigae a flaming star. As it is shown by Blaauw and Morgan this star itself is ejected with high speed from the Orion association.

The presence of the jet in blue light is the evidence in favour of a strong continuous radiation from that part of the nebula. This shows that the jet is of the same nature as the cometary nebulae.
