PECULIARITIES IN THE DISTRIBUTION OF GALACTIC WOLF-RAYET STARS: CONSTRAINTS ON EVOLUTIONARY SCENARIOS ?

Ana GOMEZ, Marie-Claire LORTET and Alain PITAULT
Observatoire de Meudon, France

Summary : The re-examination of the spatial distribution of 158 Wolf-Rayet stars in the Galaxy may help to define different breeds of Wolf-Rayet stars and put constraints on possible evolutionary scenarios.

We have re-examined the problem of the galactic distribution of Wolf-Rayet stars, using the 6th Catalogue of Wolf-Rayet stars by Van der Hucht et al (1980), which contains 158 stars with improved spectral types and a new calibration in absolute magnitudes and intrinsic colors. We have analysed both the distributions of stars projected on the sky and on the galactic plane.

Former conclusions (Smith, 1968 ; Stenholm, 1975) have been confirmed : absence of Wolf-Rayet stars in the anticentre direction ($140° < l < 240°$) ; fairly good spiral tracers ; concentration in a small range of longitudes toward the inner regions of the Galaxy for subtypes absent from the Magellanic Clouds.

New additional peculiarities have been found, both at the scale of a cluster or an association and at a larger scale.

For stars associated with clusters and (or) associations, the following remarks apply :

- Stars of the same subtype are often found close to each other : two WC5 stars as well as two possible pre Wolf-Rayet stars in Cyg OB2, two WN5 stars in Cyg OB1 (fig. 1) ; three WN7 stars in Car OB1.
- Stars of the WN7 and WC5 subtypes do affectionate the youngest clusters or associations, yet they never fall close to each other.
- WN7 stars are not associated with WC9 stars either, while they may be met close to WC6 stars (Car OB1) or WC7 stars (Sco OB1).
- WN6 stars are met close to a large number of subtypes. Besides, they are found in two out of the four stars (or systems) classified WN+WC (HD 313846 in Tr 27, HD 62910 in Anon Pup OB), though the binarity of these stars has not been established.

If we now consider the Wolf-Rayet-stars distribution at a larger scale (100-1000 pc), taking into account error bars due to uncertainties in the absolute magnitudes calibration and intrinsic dispersion, it can be stated that the distribution depends on the position in the galaxy and along the spiral arms as well as on the distance to the galactic

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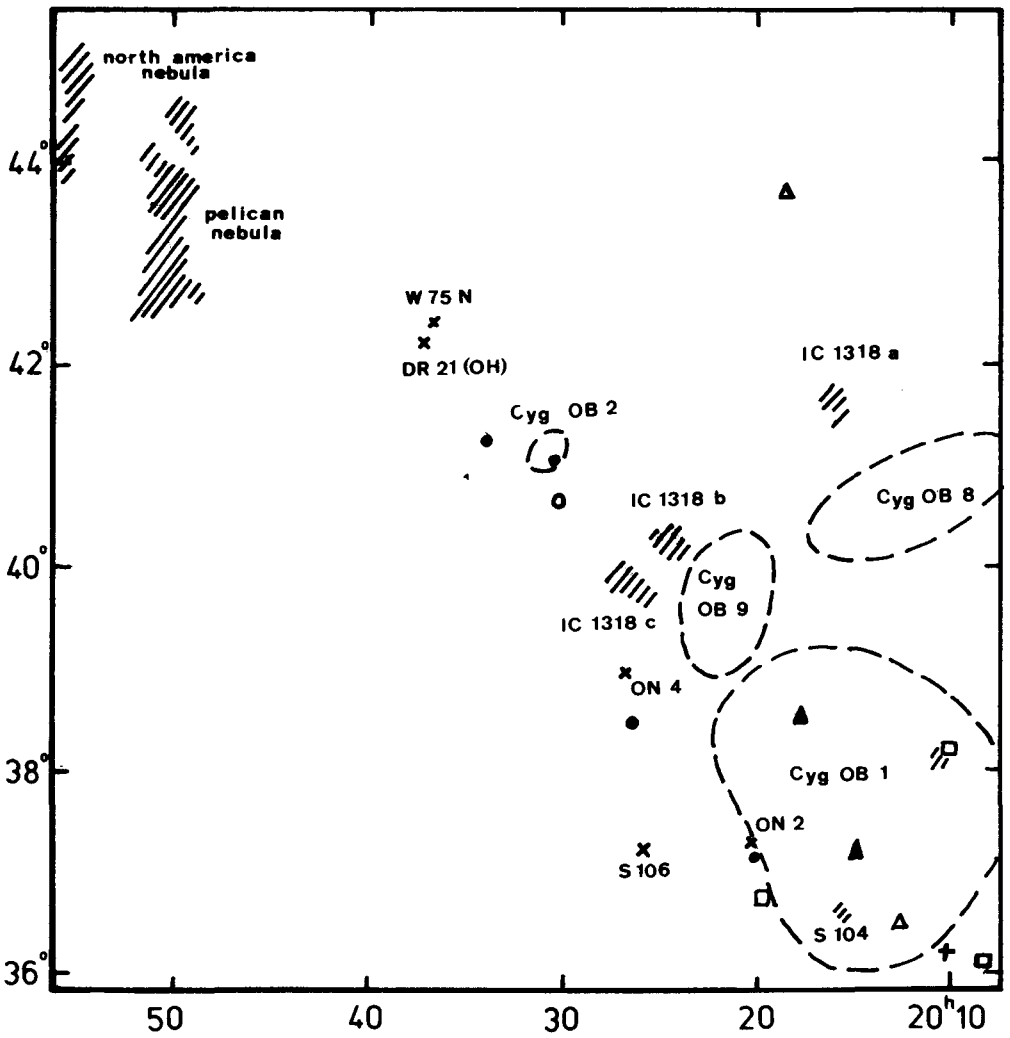

Figure 1. Distribution of Wolf-Rayet stars in the Cygnus region.

● WC5 ; △ WC7 ; + WC8 ; ○ WN+WC ; ▲ WN5 ; □ WN6 ;

DR 21 and the Associations Cyg OB2, Cyg OB1 lie at the same distance, 1.8kpc ; Cyg OB9 is foreground, Cyg OB8 and OB3 (to the bottom right of the figure) lie at 2.2kpc. Some other objects have been indicated for reference. The coordinates are for 1950 (adapted from Cong's figure 1, 1978)

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centre. The Cygnus region is rich in WC and WN5,WN6 stars, while along the Carina Arm, we notice a clustering of WC8 stars near the direction l=0°, WN7 and WC6 stars in Car OB1, WC5 and WN3 to WN4.5 stars farther away from the sun. The isolated position of WN8 stars is noteworthy (may be due to a selection effect, because these stars are intrinsically among the brightest ones).

These conclusions are even stenghtened by the study of subtypes distribution in the Magellanic Clouds (for instance, clustering of WN stars in the nucleus of 30 Dor as well as the large number of WC5 stars farther away from the nucleus).

A more detailed study of such peculiarities in the spatial distribution of Wolf-Rayet stars may help to define different breeds of Wolf-Rayet stars and put constraints on possible evolutionary scenarios. We would like to propose the following guidelines :

1. WN6 stars might have an evolutionary relationship with early WN stars (WN3 to WN4.5) and some WC subtypes.

2. Late WC stars (from WC7 on) as well as WC5 stars are physically related to dust-rich regions.

3. Up to now, WC6 stars seem the only WC stars able to display ring nebulae (HD 92809, Lortet et al, 1980 ; HD 157504, in NGC 6357).

4. WC5 stars have their own evolutionary scenario : may be they directly evolve from massive O stars, never going through the red supergiant state. The possible membership of the star Sand 5 (= ST3) (Sanduleak, 1971)in the region of star formation ON2 in Cygnus (fig. 1) has been discussed by Pitault (1980). A very interesting point will be to check whether all WC5 stars are really single stars.

5. It will be important to study locally the meaning of the ratio of the number of red supergiants to the number of Wolf-Rayet stars,which has been studied by Maeder et al (1980) and shown to depend very strongly on the galactocentric distance.

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