1978, *Astron. Astrophys. Suppl.* **34**, 383-385.

MORE WOLF-RAYET STARS IN 30 DORADUS

J. MELNICK
European Southern Observatory, Geneva, Switzerland

Received May 2, 1978

Six new Wolf-Rayet stars have been discovered in the central cluster of the 30 Doradus nebula of the Large Magellanic Cloud thus doubling the number of Wolf-Rayet stars known in this cluster. All the newly found stars belong to the nitrogen sequence.

Key words: Magellanic Clouds – nebulae – Wolf-Rayet stars

1. INTRODUCTION

The 30 Doradus complex in the Large Magellanic Cloud (LMC) contains the largest concentration of Wolf-Rayet stars in the LMC.

Out of 9 WR stars of the nitrogen sequence (WN stars) previously known in 30 Doradus, 6 are associated with the central cluster of this gigantic HII region.

In this short note, the discovery of six new WN stars in the central cluster of 30 Doradus is reported, bringing up to 12 the number of WR stars known in this cluster. All these stars belong to the nitrogen sequence.

2. OBSERVATIONS AND RESULTS

The WR stars were observed as part of a spectroscopic study of the stars brighter than $m_V \sim 14^{m}.5$ within 2 arcmin of the central cluster of 30 Doradus carried out using the Echelec spectrograph at the Coudé of the 1.52 m telescope at La Silla. The equipment has been adequately described by Baranne and Duchesne (1976) and the reader is referred to that paper for further instrumental details.

The spectrograms were recorded on Kodak Industrex-A electronographic emulsion and cover a useful spectral range of about 900 Å centered at λ4450 Å at a dispersion of 62 Å/mm widened to 200 microns.

Table 1 presents the relevant parameters of the newly found WR stars along with the corresponding values for the WR's previously known within 2 arcmin of the centre of 30 Doradus (R 136) from the work of Feast *et al.* (1960).

The visual magnitudes for the newly discovered Wolf-Rayet stars have been estimated by eye on a short exposure plate by making reference to nearby stars with published photoelectric magnitudes. The estimated magnitudes are probably accurate to $0^{m}.5$.

Spectral types for all the new stars and for four of the stars identified as WR by Feast *et al.* (1960) were determined following the classification scheme of Smith (1968) using the strengths and relative widths of the He II λ4686 and N III λλ4634–4641 lines as type indicators. The results are presented in the last column of the table.

A finding chart for all entries to table 1 is presented in figure 1.

3. DISCUSSION

The newly discovered WR stars in the central cluster of 30 Doradus represent more than one-third of the total number of stars brighter than $m_V \sim 14^{m}.5$ observed spectroscopically within 2 arcmin of R 136 (the central "star" of 30 Doradus). This result suggests that the catalogue of Wolf-Rayet stars in the LMC compiled by Fehrenbach *et al.* (1976) may not be as complete down to $m_V \sim 15$ as these authors indicate and moreover, that it may be particularly incomplete in regions of recent and strong star formation such as 30 Doradus or the giant HII regions N 11 and N 44 (Henize 1956) which, in turn, extrapolating from the present results may contain the largest concentrations of WR stars the the LMC.

Smith and Weedman (1972) have discussed the effects that stellar winds driven by the WR stars in the central regions of 30 Doradus could have in the kinematics of the gas in the HII region. If all WR stars actually have such winds, their conclusions are further strengthened by the present observations. In particular it has been pointed out in a previous paper (Melnick 1976), that the giant loops that characterize the 30 Doradus nebula may be due to stellar winds from Wolf-Rayet stars (for other examples see Smith 1968).

To conclude, it is interesting to remark that all the WR stars known so far in the central cluster of 30 Doradus belong to the nitrogen sequence. Roberts (1958) first pointed out that most of the WR stars in clusters and associations belong to the WN sequence and interpreted this result by suggesting that WN stars evolve into WC stars.

Smith (1968)[1] has further investigated this suggestion and has presented evidence showing that WN7 and WN stars in binaries are the youngest members of the Wolf-Rayet class.

Eight out of the 12 WR stars known in the central part of 30 Doradus are either WN7 or binaries. Furthermore, of the remaining 4 stars, 2 are classified as WN6 which follow WN7 in Smith's age sequence, and 2 are WN5 which also class among the youngest of the WR stars.

These results indicate that star formation in the central region of 30 Doradus has occurred simultaneously as opposed to the sequential formation discussed for galactic OB associations.

It is interesting to note, in this context, that the stellar wind mechanism proposed to explain the observed motions of the ionized gas in the 30 Doradus nebula requires, in order to meet the kinetic energy requirements (about 10^{51} ergs), that all the stars driving winds must form and turn on their winds essentially at the same time (Dyson 1978).

REFERENCES

Baranne, A. and Duchesne, M.: 1976, Adv. in *Electronics and Electron Physics,* **40B**, 641.
Dyson, J.: 1978, *Astron. Astrophys.*, in press.
Feast, M., Thackeray, A. and Wesselinck, A.: 1960, *Monthly Notices Roy. Astron. Soc.* **121**, 337.
Fehrenbach, Ch., Duflot, M. and Acker, A.: *Astron. Astrophys. Suppl.* **24**, 379.
Henize, K.: 1956, *Astrophys. J. Suppl.*, **2**, 315.
Melnick, J.: 1976, *Ph. D. thesis*, California Institute of Technology.
Roberts, M.: 1958, *Liège Symposium on Emission Line Stars*, p. 76.
Smith, M.G. and Weedman, D.: 1972, *Astrophys. J.*, **172**, 307.
Smith, L.F.: 1968, *Monthly Notices Roy. Astron. Soc.* **140**, 409.
Smith, L.F.: 1968, in Gebbie and Thomas (eds.), *Wolf-Rayet Stars*, NBS Special Publication 307.
Westerlund, B. and Smith, L.F.: 1964, *Monthly Notices Roy. Astron. Soc.* **128**, 311.

J. Melnick

European Southern Observatory
c/o CERN
CH–1211 Geneva 23, Switzerland

[1] I thank the referee for calling my attention to this and Roberts' papers.

Table 1 Wolf-Rayet stars in the central cluster of the 30 Doradus nebula

Star	m_V	Sp. type
R 134 [1]	12.36 [2]	WN-5
R 135 [1]	13.15 [2]	WN-7 [1]
R 136 [1]	9.44 [2]	WN+O [3]
R 139 [1]	11.87 [2]	WN7+O
R 140 [1]	11.82 [2]	WN-6 [3]
R 145 [1]	12.16 [2]	WN-5 [4]
J	13.5	WN-5
E	12.5	WN-6
C	13.5	WN+OB
H	13.0	WN-7
A	12.5	WN-7
G	14	WN+O [5]

Notes: 1. Feast et al. (1960).
2. Westerlund and Smith (1964).
3. Same classification by Feast *et al.* (1960).
4. Classified as WN-7 by Feast *et al.*
5. Spectral type uncertain.

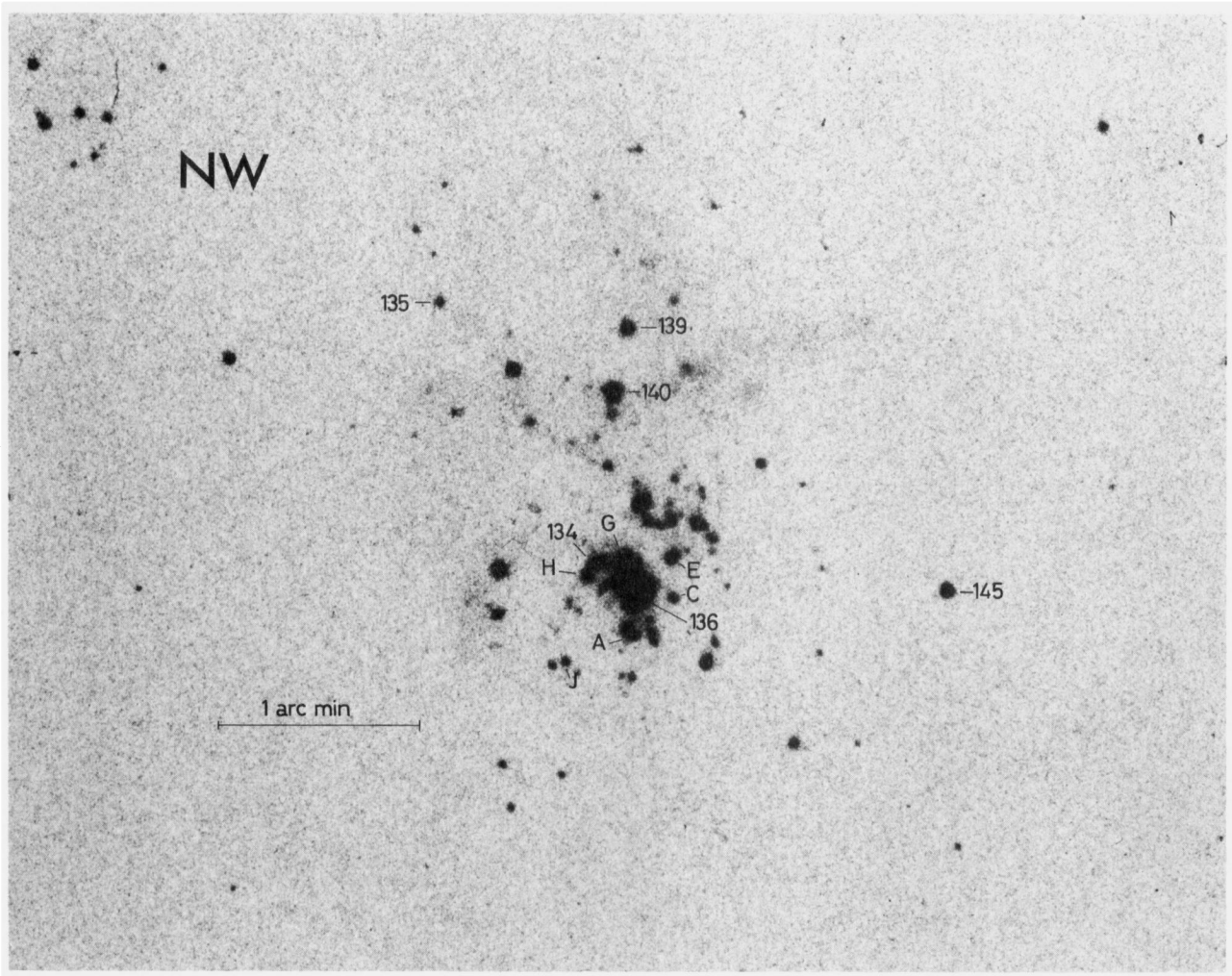

Figure 1 Known Wolf-Rayet stars in the central cluster of 30 Doradus identified on a negative enlargement of a blue plate exposed for three minutes on the 1.0 m Swope telescopes at Las Campanas.