the galaxy and the Large Magellanic Cloud, and others in the Cloud. The first contains at least three variables, two of which are RR Lyrae stars. The others have variables, which are perhaps not RR Lyrae stars. He thinks there are several hundred such clusters in the LMC.

APPENDIX III

REPORT OF THE WORKING GROUP ON FLARE STARS

(prepared by A. D. Andrews, P. F. Čugainov, R. E. Geršberg and V. Oskanian)

The Working Group was organized in order to promote and develop the cooperative studies of flare stars. Up to the present time our observation programmes were restricted to the UV Ceti-type stars only. Organizational activities followed the aims:

(1) To extend the existing network of photoelectric observers in order to provide 24-hour coverage of a star during selected sessions lasting usually 14 days.

(2) To collect data using standardized techniques in order to study frequency of stellar flares and secondary variations.

(3) To provide optical coverage for simultaneous radio, spectroscopic and polarimetric observations.

Optical observatories participating in the international programmes since 1967 have included: Abastumani, Armagh, Boyden, Budapest, Byurakan, Catania, Cerro Tololo, Crimea, Delaware, Lick, Mt. John (RASNZ), Odessa, Okayama, Smithsonian (satellite-tracking stations), and Steward, with collaboration from a number of amateur organizations. Radio observations were made by the Nuffield Radio Astronomy Laboratories at Jodrell Bank and by the CSIRO Radiophysics Division at Parkes and Culgoora. For recent joint programmes, references in parentheses to results published prior to October 1969 are summarized:

1967 YZ CMi (**1, 2, 43**)		UV Cet (**22–26, 43, 44**)
1968 YZ CMi (**3–9, 27**)	AD Leo (**16**)	UV Cet (**13, 27–33**)
1969 YZ CMi (**10–15, 34, 35, 45**)	AD Leo (**17–21, 45, 46, 48**)	

Up to 40% non-overlapping coverage throughout 14 day sessions has been achieved by combining photoelectric, photographic and visual observations. A full discussion of several hundred recorded flares must await the remaining unpublished material. During these sessions major flares (amplitude greater than 1·5 magnitudes in the blue spectral band, integrated intensity (**37**) of 10 minutes over the duration of the flare) were reported for YZ CMi (**1, 2, 3, 6, 10, 13, 14**), for UV Cet (**13, 22, 23, 25, 28, 31**), and for AD Leo (**21**). A number of flares were observed simultaneously by radio and photoelectric techniques. One particularly interesting result was the remarkable flare of YZ CMi observed by Kunkel, Andrews and Perrott during the night of January 18–19, 1969, which was observed simultaneously at two radio frequencies by Lovell (**35**). The radio emission in this flare has been discussed by Kahn (**36**) in terms of succession of shock waves in the expanding corona. Joint radiooptical observations of flares of UV Cet in September–October 1967 have been discussed by Higgins, Solomon and Bateson (**44**). Simultaneous photoelectric and polarimetric observations of YZ CMi and UV Cet have been obtained by Vardanjan (**27**), and of EV Lac by Efimov and Shakhovskoy (**47**). No measurable polarization of flare radiation has been detected.

The importance of long series of homogeneous observations of stellar flares for statistical studies has led in recent years to a change of emphasis from programmes purely designed to provide optical coverage for simultaneous radio observations to a variety of independent investigations which are, in fact, mutually inhomogeneous. Some of the problems of standardization of photoelectric technique in cooperative projects, and difficulties involved in the selection of standard parameters to describe flares have been discussed amongst observers (**37**). The majority of observers have selected the standard blue spectral band of broadband photometry for continuous monitoring. However, largely on the grounds that flares emit more strongly towards shorter wavelengths, the standard

U-band is favoured by some observers. Arguments against the use of the U-band are the low and erratic signal-to-noise ratio due to the intrinsic faintness of quiescent flare stars and the more serious atmospheric effects in the ultraviolet. Also, there are practical difficulties in defining and reproducing the standard U system. Astrophysical reasons for selecting a certain spectral band may, of course, out-rule this type of objection.

A preliminary survey of the available photometric material on flare stars shows that at least four kinds of light variations deserve further cooperative studies:

(1) The well-known, slow, secondary variations are again commented upon by several authors, for UV Cet (**22, 31**), V 1216 Sgr (**38**), and DO Cep (**39**), although, unfortunately, few accurate details are given. More thorough investigations are necessary. It is desirable to pay attention to a possible relation between these variations and flares.

(2) Possible secular variations of stellar brightness are to be examined. For this purpose standard comparison sequences have been measured for YZ CMi (**40**), EV Lac (**41**), AD Leo (**42**), DH Car (**49**) and V 1216 Sgr (**38**).

(3) Stellar flares. 24-hour patrolling of a flare star gives, in principle, the possibility to investigate the time distribution of flares. The departures from Poisson statistics of flare incidence first suspected by Andrews (**50**) are now confirmed by Čugainov (**51**) and Kunkel (**52**). Unfortunately, the last two investigations are based only on the part of cooperative observations.

(4) The long term variations of flare activity were suspected earlier by several authors. Possibly, we may believe each flare star to have its own cycle of activity analogous to the solar 11-year cycle. The present situation is still unclear owing to inhomogeneity of available material.

There are many other problems of flare stars which could be resolved using cooperative observations. The problem of the relation between flare stars of different kinds, from UV Ceti variables to the Orion population variables, is one of them. We hope to collaborate with persons interested in such problems.

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