by Chalonge *et al.* (*Haute Provence*, **10**, no. 9). This is the first of a series of such investigations on unstable stars. Bartaya (*Astrofizika*, **2**, 249) also obtained spectrophotometric observations of SS Cyg during flares. Kraft *et al.* (*AJ*, **73**, S21) find Z Cam to be a short period double lined binary (sdBe + G(?)) with both stars of about solar mass. Lortet-Zuckermann (*Budapest*, p. 381) finds broad H absorption during a stillstand of this star which she attributes to Stark broadening in the atmosphere of a dwarf G star.

BL Lac has been studied intensively since Shmitt (*Nature*, **218**, 663) pointed out that it coincided with the peculiar radio source VRO 42·22·01 (*ApJ*, **155**, L133; **156**, L41, L135; *IAU Cir.*, 2170). The spectrum appears to be continuous and may be a continuation of the radio synchrotron radiation. The continuum is highly polarized. As the star brightens the continuum reddens. A possible (unidentified) emission line has been found by Oke *et al.* It is not yet clear whether the object is galactic or extragalactic.

APPENDIX II

REPORT OF THE COMMITTEE ON VARIABLE STARS IN CLUSTERS

(prepared by Mrs. H. B. Sawyer-Hogg, Chairman)

Committee Members: M. W. Feast, G. H. Herbig, L. Rosino

Because of space restrictions, this report on the variable stars in clusters differs in form from those in earlier IAU reports, and is more condensed. Not all of the papers which have appeared since the last IAU General Assembly can be mentioned.

A definite trend is apparent in this field. A few years ago the aim of many programs was to detect new variables or to determine the periods of those known. While this is still being carried on, especially for the clusters in the far south, the emphasis has subtly changed to an avid pursuit of information about individual variables. For many variables, much more is known now than just the periodicity of their magnitude variations in photographic light. The number of observers studying these stars and the number of telescopes used in the program have greatly increased.

1. *Variables in globular clusters*

(a) *Catalogues*

The number of clusters searched for variables has now crossed the hundred mark. Of approximately 130 clusters considered to be globular, in and around our galaxy, 102 have now been examined to some degree. In these, more than 1900 variables have been found, but 10 clusters have no variables. The Atlas y Catalogo de Estrellas Variables en Cumulos Globulares al sur De $-29°$ by Fourcade, Laborde and Albarracin (Cordoba, 1966) appeared about the time of the last IAU and is of inestimable value for these little known southern clusters. The third catalogue of variables for all globular clusters by Sawyer-Hogg with references should appear in the *David Dunlap Publications* at about the same time as this report. A summary was given at the IAU IVth Colloquium on Variable Stars, Budapest, 1968 and appeared in this publication (*Budapest*, p. 475).

(b) *Discovery of new variables*

A cluster near the south celestial pole, IC4499, has come into prominence with the announcement by Fourcade and Laborde (*MAI*) that they have found 128 variables in it, with 42 other stars suspected of variation. This places IC4499 on the list of clusters richest in variables, exceeded only by M 3 and Omega Centauri. Most of the variables are of short period, and are probably RR Lyrae stars. IC4499 is a loose globular cluster, class XI, ang. diam. 6′.2.

In addition to this cluster, Fourcade and Laborde have found a few variables in each one of a

long list of little known southern clusters, with the data given in their catalogue. New variables reported by other observers include the following: Omega Centauri (Wesselink, 2), NGC5897 (Sandage and Katem, 3), 5927 (Osborn, 1), 6266 (Gascoigne and Ford, 6), 6304, 3 and 6638, 3 (Terzan), 6656 (Hoffleit, 1), 6864 (Rosino and Coutts, 9), 7492 (Barnes, 3), 7089 (Margoni and Stagni, 4), 7099 (Terzan, 8).

Substantial numbers of variables are being reported and investigated in the surroundings of clusters. Published investigations include those of Terzan (*Publ. Haut-Provence* **9**, no. 24, 1968) in NGC6304 (22 variables) and Palomar 6 (28) and 6638 (16), and Kurochkin (*PZ*, **16**, 460, 1968) in 6779 (20). There is need to formulate a rule, perhaps based on cluster radii, as to when a variable will be considered within the cluster region and when in the field. Rosino reports that with the 67-cm Schmidt telescope he is searching the vicinities of the rich globular clusters NGC5024, 5272, 5904, and 6121 to determine if RR Lyrae variables sometimes escape from clusters.

(c) *Determination of periods*

It is to be expected that most of the newly determined periods are those of RR Lyrae variables. New periods have been published in the following clusters: NGC3201 Kukarkin (14), 6205 Osborn (2), 6402 Sawyer-Hogg and Wehlau (20), 6626 Deery and Hoffleit (1), 7006 Rosino and Ciatti (49), 7089 Kukarkin (4) and 7492 Barnes (3). Of these, the non-RR Lyrae stars are one or perhaps two Cepheids and a long period variable in NGC6402, a red semiregular in 7006, and a red giant in 7492.

Clusters under continuing investigation for determination of new periods are NGC6864, (Rosino and Coutts), 6366 and 6638 (Terzan and Sawyer-Hogg), and a group by Sawyer-Hogg and associates, 6626 (with Moorhead) 5897, 6093, 6402, 6656, and 6934 (with A. Wehlau).

(d) *Determination of period changes*

Extensive work on period changes have been carried out in the following clusters: NGC3201 Kukarkin, 34; 5024, Margoni, 17; 5139 Wilkens, 100; 5904, Coutts and Sawyer-Hogg, 66; 6341, Kheylo, 10 and Bartolini, Battistini and Nasi, 12; 7089 Sawyer-Hogg and Poole, 20. Szeidl has extended his work on the O-C diagrams in M 3 to 15 more RR Lyrae stars, bringing his total to 129 now. Miss Barlai continues her work on M 15, and Lovas is working on M 5. The paper on NGC5904 mentioned above (*David Dunlap Pub.*, **3**, no. 1, 1969) gives a summary of period changes in various clusters. There is no pronounced trend. Some periods remain constant, while others may be increasing or decreasing.

(e) *Color studies*

Substantially more work is being done to determine the position of variables on the color-magnitude diagram of a cluster, and to determine the light curves of variables in two or more colors. Clusters in which work on the color magnitude diagrams contributes significantly to our understanding of the variables are NGC 5024 (Margoni, *Padova Contr.*, 198, 1967), 5897 (Sandage and Katem, *ApJ*, **153**, 569, 1968), 6637 (Hartwick and Sandage, *ApJ*, **153**, 715, 1968) and 7006, (Sandage and Wildey, *ApJ*, **150**, 469, 1967).

Color studies of population II Cepheids have been made in Omega Centauri by Dickens and Carey (*ROB*, 129, 1967), with light curves in two colors for seven cepheids. This yields a period luminosity relation for population II Cepheids as

$$M_B = +0^m.2 - 1{\cdot}74 \log P, \quad \text{and} \quad M_V = -0^m.13 - 1{\cdot}90 \log P.$$

They note that these cepheids in globular clusters appear somewhat redder than the polulation I Cepheids. Omega Centauri is also the basis of a continuing color study by Geyer (*ZfA*, **66**, 16, 1967; *AA* **4**, 40, 1970, with Szeidl) with *U*, *B*, *V* observations for 62 RR Lyrae stars and photoelectric for 12, including the cepheids and eclipser.

In M 2, Demers (*AJ*, **74**, 925, 1969) has established a photoelectric sequence and determined light and color curves on the *UBV* system for the three cepheids and the RV Tauri variable, and has obtained similar material for M 13 and M 14.

Clusters in which color studies of the RR Lyrae variables are being made include M 5 (Coutts, Margoni and Stagni) and M 2 (Margoni and Stagni, 1969). Woolley and Stoy (*Qu. J. RAS*, **10**, 114, 1969) report that *UBV* curves for 22 variables in NGC6171 have been obtained. Sturch (*ApJ*, **148**, 477, 1967) has made three color observations of a few variables in M 3, M 5, M 92 and NGC 6171 with the particular aim of determining absorption values for the clusters.

Work is also directed toward the absolute magnitudes and other properties of the RR Lyrae variables. Clube (*ROB*, 136, 1968) has used his comprehensive study of the proper motions of 227 RR Lyrae variables to compare the properties of these variables in globular clusters with those in the general field. Jorgensen and Petersen (*ZfA*, **67**, 377, 1967) have applied their model to the RR Lyrae stars in globular clusters, to show that in M 3 the masses of the *ab* and *c* type variables are equal. Christy has discussed the luminosities of the RR Lyrae stars in the richest clusters in his Darwin lecture (*Qu. J. RAS*, **9**, 13, 1968). Thänert (*MVS*, **4**, 123, 1967) has extended his earlier paper on the correlations of characteristics with age in seven globular clusters. He finds that with increasing age the mean values of amplitudes, colors and luminosities decrease, while mean periods increase.

Kukarkin, Kurochkin and Kukarkina are studying the RR Lyrae stars in several globular clusters as well as examining the variability of horizontal branch stars near the instability band.

(f) *Proof of cluster membership*

A gratifying trend is the increasing emphasis on the determination of cluster membership for variables by the position of the variable on the color magnitude diagram, the radial velocity, or the proper motion. Ideally the proof comes from a combination of all three, as carried out by the Herstmonceux observers for Omega Centauri. In NGC5897, Sandage and Katem note that one of their three new variables is a red star near the top of the giant branch. Combining photometric results with a study of proper motions, Zhukov (*Soviet AJ*, **13**, 3–6, 1969) lists variables in M 3 and M 5 whose membership might be questioned, but the great majority of the RR Lyrae stars in the region belong to the clusters and are genetically related to them.

(g) *Variables of special interest*

In Omega Centauri. Attention has been called to two unusual stars. The first is Var. 1, the brightest variable in the cluster. D. H. P. Jones (*MN*, **140**, 265, 1968) reports that this variable (with period 58^d) is intermediate in characteristics between the population II Cepheids and the RV Tauri stars, though it is hotter than most stars of the latter class. The median spectral type of the metal lines is F 0 Ib, and the mean radial velocity is $+210 \pm 2$ km/s, with an amplitude of 25 km/s. The second is Variable 78, shown to be a cluster member by the Herstmonceux observers. According to Sistero (*IB*, **316**, 1968) it is the brightest known eclipsing binary of extreme population II. Woolley gives its V magnitude at maximum as 14·15, which compares with the mean V of 45 RR Lyrae variables in the cluster, by Dickens and Saunders, 14·52. The light curve is a typical EA, with a period of $1^d.16812879$. From a shape depth relation and a nomographic solution, Sistero has derived photometric orbital elements for the binary.

In NGC6637 the radial velocity observations needed to rule on cluster membership have been carried out for Rosino's variables 4 and 10 (with periods around 200^d) by Catchpole, Feast and Menzies (*Obs.*). Hartwick and Sandage from their color work showed these stars to be probable members. Harding at the Cape is monitoring this (as well as some other clusters) to determine periods. For Var. 10 Radcliffe observations give an emission velocity of $+58$ km/s, and an absorption velocity of $+67$; for Var. 4, the emission is $+30$ and the absorption $+39$. Mayall's velocity for the cluster is $+95$ km/s with a standard error of 30 km/s. The investigators conclude that, despite the spread in the determined velocities, there is no good reason for rejecting either variable as a member, noting that the three Mira stars in 47 Tuc have a spread similar in velocity. No Mira stars with periods greater than 220^d have yet been found as members of globular clusters.

In NGC5024 Wachmann (*Abh. Hamburg* VIII, 114, 1968) has shown that Var. 30 is a star with a Blashko effect, with a short period of $0^d.53548466$ which is changing, and a secondary period of

37.0317, as derived from very high maxima. As observations of variables in clusters become more numerous, probably more stars of this type will be found.

2. *Variables in open clusters and associations*

Searches continue to add to the number of variables known in open clusters and associations, but the total rises rather slowly. Because the variables in open clusters are relatively few, investigators tend to study them as a class, grouping them together from various clusters. Cepheids seem to have the major share of interest still, but eclipsing binaries and small amplitude irregular variables are getting more attention. So far no RR Lyrae stars have been found to be members of open clusters. No complete catalogue of open cluster variables exists.

(a) *Types of variables in open clusters and associations*

A summary and discussion of the types of variables in open clusters, with special emphasis on their place in the scheme of stellar evolution has been given by Čugainov for stellar associations (*PZ*, **16**, 107, 1967) and by Efremov for open clusters (*ibid.*, p. 176). Čugainov notes that stellar associations contain variables of the following types: eclipsing, variable supergiants, Be stars, type II supernovae, Beta Cephei stars, classical Cepheids, variable red giants, RW Aurigae stars, and flare stars. Variables of these types have ages from 10^6 to 10^7 yr, and associations contain only those variables whose age does not exceed this. Efremov reviewed the data on the different types of variables in open clusters, RW Aurigae, eclipsing stars, magnetic variables (Ap stars), Cepheids and red supergiants. He explains the occurrence of variability at certain stages in the evolution of a star. Later, Breger and Sanwal announced the discovery of the first Delta Scuti type variable in a cluster (*ApL*, **1**, 103, 1968).

(b) *New variables*

The Delta Scuti type variable just mentioned is star HR 4864 = Tr 60, shown by Trumpler to be a member of the Coma cluster. Its variability was found in a systematic search of B, A and F stars. Its period is 80 min, and amplitude 0·02 in visual light. According to Breger and Sanwal, it has the earliest color of any Delta Scuti type known, spectral type A5V from a classification by Morgan, and $M_v = 1{\cdot}89$. Breger suggests that the ultra short period variations found by other observers in 21 Com may indicate pulsations similar to those of Delta Scuti. Although NGC752 was systematically searched by Breger, (*ApL*, **3**, 67, 1969) no other Delta Scuti stars were found, and the only variable noted in it was the eclipsing star DS And.

Hill (*ApJ Supp.*, **14**, 301, 1967) has found 20 new variables in open clusters and associations, including 7 eclipsing stars in the latter, and one eclipsing system each in NGC7160 and 7380. Bakos (*JRAS Can.*, **62**, 193, 1968; *Budapest*, p. 475, 1969) reported four probable new variables, one in NGC129 (the cluster with DL Cas) with a period of 30^d, two in NGC1502 with periods of 90^d and 2^d respectively. A suspected variable in NGC6705 brightened by one magnitude in the course of 30^m. He has announced (*Budapest*, p. 159) an unusual variable, HD 160202 in NGC 6405. Results on NGC1502 have formed a thesis by Kim at Waterloo. Bakos is also investigating NGC663, 1528, 2682, 6871 and 6913, by means of an image orthicon system at the Dearborn Observatory. In NGC6819 Barkhatova and Vasilevsky (*IB*, 374, 1967) report a possible variable. Small fluctuations are also reported by Barblishvili for Star no. 98 in NGC2360, noted earlier by Becker, and by Eggen, and Jackisch observed a possible outburst of HD108486 in the Coma cluster. Thackeray (*Radcliffe Repr.*, 67, 1968) reports that Lloyd Evans has found several variables in IC2581, including one Be star and a suspected eclipsing binary. In NGC6381 he has observed several stars near $V = 18$ with rapid variations and UV excesses. Percy (*Dunlap Obs.*) is testing for light variations those stars in h and χ Persei which seem to be rapidly rotating.

(c) *Cepheids in open clusters and associations*

The number of such objects known is not increasing very rapidly, but the analysis of them is

becoming more and more detailed, with photometric measures in several wavelengths, as well as spectroscopic observations. Lindoff (*Arkiv f. Astr.*, **5**, 23, 1968) listed clusters with Cepheids and discussed their absolute magnitudes. Sandage and Tammann (*ApJ*, **157**, 683, 1969) have done extensive work on the double Cepheid CE Cas in NGC7790. The cluster NGC7790 is a remarkable one with three Cepheids (CF Cas, CE Cas *a*, CE Cas *b*) and two eclipsing binaries (QX Cas and V822 Aql). Sandage and Tammann think it likely that the 5^d and 4^d Cepheids which are components of the double star CE Cas form a physical pair. At a distance of 3200 pc their separation is 8000 A.U. As an outgrowth of this work, Sandage and Tammann derive the following *P-L-C* relations from 13 Cepheids in open clusters,

$$M_{\langle V\rangle} = -3{\cdot}425\log P + 2{\cdot}52\,(\langle B\rangle^\circ - \langle V\rangle^\circ) - 2{\cdot}459,$$
$$M_{\langle B\rangle} = -3{\cdot}425\log P + 3{\cdot}52\,(\langle B\rangle^\circ - \langle V\rangle^\circ) - 2{\cdot}459.$$

This compares with a *P-L-C* relation derived by Fernie (*AJ*, **72**, 1967) from galactic Cepheids, and tested on Cepheids in clusters and binaries, $M_v = -2{\cdot}55 - 2{\cdot}85\log P + 2{\cdot}73\,(B-V) - 1{\cdot}60\,(B-V)^2$.

Breger (*MN*, **136**, 61, 1967) has discussed the velocity, radius and light variations of U Sgr in M 25, and found a radius of 53·8 solar radii by the Wesselink method. The distance modulus for the star, 9·15, is in good agreement with that of the cluster, 9·08. Latyshev (*AZ*, 473, 1968) derived a radius for $52{\cdot}1 \times 10^6$ km for S Nor.

In the field of NGC6649 Kholopov and Efremov (*AZ*, 437, 5, 1967) have shown that the Cepheid found by Roslund, Cuffey no. 64, has a 6-day period with a Blashko effect. Grubissich (*ZfA*, **68**, 176, 1968) thinks that AG Pup may be a member of the association II Puppis. However, Tammann (*IB*, 351, 1969) questions the reality of the cluster NGC6664 of which the 3-day Cepheid EV Sct is supposed to be a member.

(d) *Eclipsing stars*

The contact binaries in many clusters have been investigated and documented in great detail by Eggen (*Mem. RAS*, **70**, 111, 1967) in his massive paper on these stars. Kraft (1967) in a paper on the structure and evolution of the W Ursae Majoris stars gives the physical properties of TX Cnc, a member of Praesepe, which he finds to be very close to the average for all W U Ma stars. He notes the star is several magnitudes below the cluster break off, suggesting that some W UMa stars are essentially on the zero age main sequence. Kholopov and Sharov (*AZ*, 426, 452, 1967) have given new elements for the W UMa stars ES Cep and FQ Cep in NGC188, earlier thought to be RR Lyrae variables.

D. S. Hall (*PASP*, **79**, 630, 1967) reported observations of V 822 Aql in NGC7790 which confirmed a spectroscopic finding by Fitzgerald that its period is twice the previously assumed 2·6 d. From spectroscopic observations of QX Cas he finds a value of Δm between the two components of $0{\cdot}0 \pm 0{\cdot}3$. He considers this confirms Sandage's assumption that this binary is an actual member of NGC7790. Further observations on QX Cas were given by Sandage and Tammann in their cepheid paper already mentioned. Hall reports recent work on BM Ori in the Trapezium, and on V 729 Cyg in the Cygnus VI association. He has a *UBV* light curve of BS Sct, a star which may be a blue straggler in M 11, and has discovered (Hall and Mallama, *IB*, 383, 1969) that BD − 6°4932 is variable, with a range of $0{\cdot}1^m$ and a period of 0·1591 d. It is in the region of M 11, but probably not a member.

(e) *Red stars*

Stothers (*ApJ*, **156**, 54, 1969), in a discussion of the pulsation hypothesis for massive red supergiants, lists 13 known variable M supergiants in galactic associations, with spectral types, magnitudes and periods. He thinks, the mechanism of pulsation is suggested by the observed and computed properties of these stars.

(f) *Shell stars*

Pleione has long been a fine example of a shell star, and Henriksen (*AA*, **1**, 457, 1969) has

developed a model to explain the instability (1938–1951) of its extended atmosphere. Feast and Lloyd Evans (*Obs.*, **87**, 286, 1967) have found that HD170682 in M 25, discovered as variable by Mitchell, is a Be star that has undergone a shell episode like Pleione. Abt and Morgan (*AJ*, **74**, 813, 1969) consider the spectrum of star no. 41 in NGC2516 to be a superb example of a shell star.

(g) *T Tauri and flare stars*

Rosino and Pigatto have continued the study of T Tau stars embedded in nebulosities and belonging to open clusters. Blue and infrared plates centered on the Trapezium cluster, on ζ Ori, M 8 and M 20, NGC7635, h and χ Per have been obtained mostly with the 67-cm Schmidt telescope at Asiago. The material is under advanced reduction.

MacConnell, in his study of the Cepheus IV Association (*ApJ Sup.*, **16**, 275, 1968), found a new flare star and faint variable Hα-emission objects which indicate that they are probably of T Tau type associated with the dark cloud.

Cesevič has completed a detailed investigation of 10 variables from the T-association in Taurus. Ševčenko prepared a Catalogue of T-associations (*Tashkent Tr series II*, 11, 1967).

Maffei found in the region of *NGC 2264* on Loiano and Asiago plates 40 variables. Estimates of the blue and infrared magnitudes of almost 200 variables are in progress. Bodolian and Erastova accomplished a series of three colour observations of stars in the field of the same association. This work resulted in the discovery of 20 new T Tau variables (*Byurakan Soob.*, **38**, 3, *AC*, 435, 436, 439, 1967). Götz at Sonneberg is also investigating this region.

The compact T association near *NGC7023* has been studied by Mirzoyan and Parsamian (*Budapest*, p. 165; *Byurakan Soob*, **40**, 31, 1969) on plates obtained with the Byurakan 40″ Schmidt telescope. 15 flare stars have been found.

Up to February 1969, Haro and Chavira detected flare-ups in 275 stars in the *Orion Nebula*. They will publish the finding charts of all these stars. There are two outstanding different kinds of flare stars in the Nebula: the fast and the slow ones. The slow flare stars seem to be confined to the Orion Nebula and possibly NGC2264. (Haro and Parsamian, *Tonantz Bol.*, **31**, 45, 1969). Rosino discovered 60 new flares in Orion during 135 hours of effective observations (*Low Luminosity Stars*, p. 181; *MAI*). Maffei and Blaghikh estimated more than 100 variables in the Nebula on 70 Hamburg plates from 1920–21. The behaviour of 56 of them during this period has been compared with that resulting from observations 1940–60 (*MAI*, **29**, 137, 1968). Roslund of Gothenburgh University has made at the Uppsala Station on Mt. Stromlo a 40 hour photographic search for flare stars in the Nebula and found 15 flares (*Ark Astr.*).

The observatories Alma-Ata, Asiago, Budapest, Byurakan, and Tonantzintla organized in 1968–69 a series of cooperative observations of flare stars in *Pleiades*. The immediate result of this work was an augmentation of the number of known flare stars in this cluster to 146. Two papers (Ambarcumjan, *Stars, Nebulae and Galaxies*, Yerevan 1969, in Russian; Ambarcumjan *et al.*, *Byurakan Prepr.*, 1, 1969) were devoted to a detailed analysis of the obtained data. A statistical study developed by Ambarcumjan shows that the total number of flare stars in Pleiades should be greater than 600. At $V = 13{\cdot}29$, there is a sharp border between the photographically observable flare stars and the non-flaring ones. The cooperative investigation of the cluster will be continued during the coming three years.

According to Haro and Chavira (*Tonantz. Bol.*, **31**, 1969) the relative intensity of the Ca II emission lines in stars as late or later than G 8–K 0 can be used as a good criterion for predicting that the stars can show or not the flare phenomenon.

3. *Variables in clusters of external galaxies*

Arp and Thackeray have published their comprehensive work on NGC1866 and its Cepheids (*ApJ*, **149**, 74, 1967). In this cluster near the Large Magellanic Cloud, seven Cepheids with periods from $2^{d}.6$ to $3^{d}.5$ have similar amplitudes, shapes of light curve, and color indices.

S. Gaposhkin reports that he has found some very small clusters (Mini clusters), one between

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