37. STAR CLUSTERS AND ASSOCIATIONS
(AMAS STELLAIRES ET ASSOCIATIONS)

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1. INTRODUCTION

This triennium has been quiet but industrious. Information and understanding about star clusters and associations have advanced in a quantitative way, on a broad front that encompasses all their aspects. The tabulations given below refer to many of the well-known objects, for which improved data are now available, plus an impressive number of objects that heretofore have been little more than catalogue entries. Clusters and associations have always been the source, the stage, and the touchstone for the investigation of star birth, stellar evolution, populations, and galactic structure, and the data of the 1976 report of Commission 37 will figure in the scientific advances reported in 1979 by several other IAU Commissions.

Two trends are worthy of note. One is common to all of observational astronomy: the increase of telescope power – in the total number of effective telescopes, in the number of large telescopes, and in the effectiveness of their utilization. Particularly in the southern sky, we are in the midst of a period of rapid advance.

The second trend that I would single out is the broadening of the concept of stellar populations to include a range of abundance parameters. For the globular clusters this ghost has been knocking at the door for more than a decade; and we can now hope that studies currently under way will show us, as clusters have done again and again in the past, what physical variables control the bewildering array of differences that we see between – and sometimes within – the HR diagrams of individual clusters. For open clusters the new parameters are really a new dimension: along with age, we must give direct consideration to chemical abundance factors, so that 'solar' abundances are only a norm against which each individual cluster is to be measured. Of particular interest is the use of open clusters, both in the Milky Way and in the Magellanic Clouds, to delineate the apparent abundance differences that are being found within and between galaxies.

Also noteworthy are the discovery of X-ray sources in globular clusters, the advance in the understanding of dynamics, particularly with regard to the cores of clusters, and the appearance of several important catalogues or compilations of data. These will be discussed in the individual sections below.

This report has been assembled by the President of the Commission, but other members have made important contributions. The discussion of stellar associations was prepared by Dr. Larsson-Leander, the discussion of globular clusters by Dr. White, the summary of astrometric work by Dr. van Altena, and the discussion of dynamics by Dr. Wielen. I am especially grateful to them, to Drs. Barkhatova and Kuz'mina, who collected information for the USSR, and also to the dozens of astronomers who responded to my request for information about their current work.

As usual, an important part of the report consists of the tables of associations, open clusters, globular clusters, and other galaxies (with respect to work on their clusters), which list recent and current work in each object. For these I have relied primarily on responses to my inquiry but have also attempted to supplement the tabulations by reference to *Astronomy and*

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Astrophysics Abstracts (*AAA*). In accordance with IAU procedure, published work is referred to, wherever possible, by its *AAA* number.

Non-*AAA* references that occur in the text are numbered and collected at the end. Those that occur only within the tables are lettered within each table and appear at the end of that table.

If a name appears without a reference, this means that the work is not yet published. In that case the author's location is given in parentheses.

Contrary to the practice of the previous report, which listed objects in the order in which they appear in the *Catalogue of Star Clusters and Associations* (04.153.051), the listing here is by standard designation – NGC, IC, followed by other types of nomenclature in an order that I hope will be obvious.

2. SYMPOSIA AND COLLOQUIA

The following conferences dealt with topics of interest to the Commission:

(1) IAU Symposium **69**, 'Dynamics of Stellar Systems,' Besançon, France, September 1974. The Symposium was cosponsored by Commissions 37 and 33; the proceedings were published by Reidel in 1975, in the regular IAU series.

(2) IAU Colloquium **33**, 'Observational Parameters and Dynamical Evolution of Multiple Stars,' Oaxtepec, Mexico, October 1975. The proceedings, which included papers on associations, small clusters, and binary stars in clusters, will be published in the *Revista Mexicana de Astronomia y Astrofisica.*

(3) Conference on 'Multicolor Photometry and the Theoretical HR Diagram,' Albany, USA, October 1974 (13.012.008).

(4) Royal Greenwich Observatory Tercentenary Symposium, 'The Milky Way and the Local Group.' Herstmonceux, England, July 1975. The proceedings will appear as an RGO publication.

3. CATALOGUES AND COLLECTIONS OF DATA

The *Catalogue of Star Clusters and Associations* (04.153.051) is now being maintained by Balázs, Ruprecht, and White. It is hoped that copies of the First Supplement to the Second Edition will be available for distribution at the time of the General Assembly. Work on a third edition is in progress.

Kukarkin published *The Globular Star Clusters* (12.003.082), which collects data of all types for 129 globular clusters and reduces them to homogeneous tabulations. Sawyer Hogg published *A Third Catalogue of Variable Stars in Globular Clusters Comprising 2119 Entries* (10.120.005). Alcaíno published his *Atlas of Galactic Globular Clusters with Colour Magnitude Diagrams*, which gives color-magnitude arrays, tables of individual magnitudes, and finding charts for 42 globulars for which photoelectrically calibrated *B* and *V* can be derived. White is keeping up his bibliography of c–m diagrams for globular clusters (last published as 03.154.014) and can make the list available as requested. Philip is preparing a set of computer-generated c–m and 2-color diagrams, for all globulars for which *UBV* data were available in December 1975.

Mermilliod has collected, for 200 open clusters, a catalogue of *UBV* magnitudes and MK classifications of more than 10,000 stars. These will be published as an *Astron. Astrophys. Supplement*, and the catalogue will remain available on magnetic tape at the Centre de Données Stellaires at Strasbourg. A valuable adjunct is a set of cross-identification tables for the various systems of numbering and nomenclature of individual stars. Mermilliod plans to keep his catalogue current and to issue an up-date every year or so.

Weaver reports that the Trumpler velocities of individual stars in open clusters are ready for publication, for which he hopes to secure financial support.

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4. ASSOCIATIONS

Stellar associations are generally connected with gas and dust clouds, out of which the stars have formed; and the stellar and interstellar ingredients interact in a complicated way. Associations are studied by a variety of techniques, and combined observations in optical, infrared, and radio wavelengths have proved particularly rewarding.

Individual studies are listed in Table 1 (p. 125), but several areas and aspects are worthy of special note. Expanding gas shells in associations were studied by Sancisi *et al.* (12.131.075, 12.152.009). The kinematics of the young stars in associations continue to be of great interest. Garmany's study of Cep OB3 shows that the two subgroups of the association are separating from each other in longitude. Expansions continue to be controversial, however. Steffey (10.152.009) questioned published evidence for rapid expansions of OB associations in general. On the other hand, Strand (09.031.002) rejected the arguments forwarded by Vasilevskis (06.132.003) that the expansion found for Ori OBld should be due to instrumental effects. Clearly, many more studies of internal motions in associations are necessary, both to separate non-member stars and to obtain a more convincing picture of the kinematical patterns, and hence more accurate kinematical ages.

The problem of circumstellar obscuration of OB stars was critically examined by Bohannan (**1**), who rejects Reddish's conclusion that obscuration is correlated with luminosity. Of 15 groups carefully examined, only one, Cyg OB2, was found to retain an indication of the effect. The higher reddening for the most luminous stars in this association may be due to their being situated in the densest parts of the dust cloud.

T associations received considerable attention. Grasdalen *et al.* (13.152.002) found Chamaeleon T to be at 115 pc, which makes it the nearest dark cloud. They suggest that it is intermediate in character between a normal T association and an OB association. For the ratio of visual to selective absorption, they find $R = 5.5$, a value similar to that of several other regions with high content of gas and dust. Gieseking studied Cyg T1 extensively and found that its associated dust cloud is 300 to 500 pc from us. The young stellar group around T CrA, also seems to be a T association (Knacke *et al.*, 09.152.002). Glass and Penston (**2**) studied infrared colors in the region and confirmed that the 6 known infrared excesses are due to circumstellar shells. In addition, several additional stars behind the dust cloud appear to have a visual absorption of about 8 magnitudes.

Considerable interest has been given during recent years to R associations, i.e., stellar associations connected with reflection nebulae. Van den Bergh and Herbst (**3**) identified 20 new R associations in the southern Milky Way, and Herbst (**4**–**7**) studied them in detail. These objects appear to be useful for study of the local spiral structure.

Observations of stellar associations are closely related to problems of their birth out of compressed interstellar clouds, rich in dust and molecules, and to problems of pre-main-sequence evolution. Reviews in this area have been given by Wynn-Williams (**8**), Mezger and Wink (**9**), and Strom *et al.* (**10**). A formation mechanism was suggested by Mouschovias (11.151.048); it involves a magnetic Rayleigh–Taylor instability initiated by the passage of a galactic shock. Sancisi (12.152.009) attempted to explain the gas and dust shells in some associations by supposing that they are old supernova shells.

The stellar-ring controversy appears to be ebbing. Isserstedt (11.113.010, **11**) defended the original concept, whereas it was opposed by Baars (12.141.026), Hahn and Haupt (**12**), Kolesnik *et al.* (10.152.001), Lindemann and Burki (**13**), Vidal and Bern (10.152.007), and Voroshilov *et al.* (12.152.002). Uranova (10.152.003,004) listed 88 new rings, but in a later study (12.152.010) she was unable to confirm the reality of these or of Isserstedt's rings.

5. OPEN CLUSTERS

In every sense of the word, open clusters are the broadest concern of the Commission. They are the most numerous class in our catalogue, and their number is still increasing at a considerable rate. They show the full range of ages, and it now appears that the range in their chemical abundance is also becoming an important question. Dynamically, their time scales are such that a proper study of them must consider all of the processes that are relevant anywhere in stellar dynamics, and their star numbers span the range from small to large values of log N.

Table 2 (p.126) lists work carried on since the last Commission report. (There may be some small overlap with the previous report, especially where work was not yet published 3 years ago.) There are entries for 280 objects. It is impressive that about half the entries include contributions by Moffat, Vogt, and FitzGerald (Bochum). The number of clusters studied by Clariá and Osborn is also noteworthy.

An exciting development has been the discovery of metal deficiencies in some of the older open clusters. McClure, Forrester, and Gibson (11.153.023) found that NGC 2420 has an age of 3×10^9 years and [Fe/H] = – 0.5 with respect to the Hyades. Hawarden (**13a**) finds for NGC 2243 an age of 5×10^9 years and a similar metal deficiency. Both clusters are in the anticenter hemisphere and far from the galactic plane. Hawarden (**14**) has also given a list of old clusters, and we may hope that more of these will soon be investigated for abundance properties.

On the other hand, it now appears that the anomalous line strengths in the giant stars of M 67 and NGC 188 are not due to abnormal metal abundances (11.153.001, 015, 024).

At the lower end of the age range, clusters serve both as calibrators of luminosities of cepheids and supergiant stars and as tracers of spiral structure. For the latter problem two studies were made by Vogt and Moffat (09.155.015, 13.155.029), and a finding list was published by Sanduleak (11.153.010). Searches have been made for cepheids, by Moffat and his collaborators and by Hagen-Harris and van den Bergh. It is distressing to note one disagreement, however: Hagen-Harris reports, 'We confirm the membership of TW Nor in Lyngå 6,' whereas Moffat and Vogt (13.153.018) report this group as 'no cluster'.

The discovery of new clusters continues, especially in the southern hemisphere. Van den Bergh and Hagen, in a uniform survey of the southern Milky Way (13.153.001), listed 63 new clusters. Lodén (09.153.016) gave a list of 44 suspected clusters. The work of Moffat and Vogt included 14 newly discovered clusters (listed in Table 2 as Bochum 1–14). On the other hand, Table 2 contains about 15 reports that a supposed cluster does not exist.

Also worthy of mention are studies of H I in young clusters by Tovmassian *et al.* (11.153.003–007) and of dark matter in clusters by Wallenquist (13.153.032), and a catalogue of magnitudes in 14 young clusters by Moffat and Vogt (12.153.038).

6. GLOBULAR CLUSTERS

A new area of interest has developed for globular clusters with the discovery in them of X-ray sources (11.142.035, **15**, **16**, **17**,). The X-ray positions are still not accurate enough to allow the sources to be identified, but the error boxes of X-ray sources fall on the clusters NGC 1851, 6440, 6441, 6624, and 7078 (M15). It is interesting to note that these are among the clusters of highest central concentration, central density, and escape velocity.

At the same time, radio and infrared searches have set upper limits on the emission of globular clusters in those parts of the spectrum. Kerr and Knapp (08.154.006) examined 12 clusters for 21-cm radiation, and later Knapp, Rose, and Kerr (10.154.022) set more severe limits in 8 clusters. Knapp and Kerr (10.154.001) also examined 16 clusters for OH. Hills and Klein (09.154.002) failed to find 3.8-cm radiation from ionized gas in 5 clusters. Erkes and Philip (13.154.007) found no evidence for radio emission at 3 and 6 cm, in 10 clusters examined at both wavelengths, contradicting their earlier positive indication (08.154.005). At 10μ Cohen and Fawley (12.154.009) found a negative result in 8 clusters. A reported 10μ detection in M15 by MacGregor, Phillips, and Selby (10.154.007) remains unconfirmed. At 2.3 and 4.7μ Hansen and Hesser (**18**) scanned 8 clusters and found no indication of emission by dust. Finally, Smith, Hesser, and Shawl (**19**) searched 26 clusters for Hα emission, with completely negative results.

All in all, it appears that gas produced by evolving stars is generally lost from globular clusters (Knapp, Rose, and Kerr, 10.154.122; Scott and Rose, 13.154.005; Tayler and Wood, 13.154.014); but the X-ray sources may indicate that high-concentration clusters retain some gas, even though the mechanism responsible for the X-rays is far from clear.

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Internal motions are beginning to be observed in globular clusters in appreciable numbers. Illingworth (Stromlo, KPNO) determined velocity dispersions in 10 southern clusters (11.154.011, **20**, **21**) and has deduced masses from them. Griffin and Gunn (Hale) are observing 7 globulars (and 3 open clusters) with their photoelectric radial-velocity spectrometer. Cudworth (Yerkes) reports that his astrometry will yield an internal velocity dispersion in M 15.

In addition to the compilations mentioned in Section 3, several important collections of new data have been published: Peterson (orbital eccentricities of 41 clusters: 11.154.018); Peterson and King (observed radii and structural parameters in 101 clusters: 13.154.016); Lohmann (mean velocities of stars in 58 clusters: 13.154.001); Bingham and Martin (UV-excesses of 38 clusters: 11.154.004); Harris and van den Bergh (integrated *UBV* magnitudes and colors of 29 clusters: 11.154.007); Zaitseva, Lutyj, and Kukarkin (integrated *UBV* magnitudes and colors of 26 clusters: 11.154.005); Racine (reddening values for 86 clusters: 09.154.004); Burstein and McDonald (interstellar reddening from integrated *UBV* colors: 13.154.002); Kukarkin and Kireeva (integrated *UBVRI* colors and [Fe/H]: 11.154.010); Andrews and Evans (integrated spectral types of 17 clusters: 10.154.008); and Knapp and Kerr (H I column densities in the direction of 81 clusters: 12.155.038). In addition, IAU Colloquium 21 (10.012.006), dedicated to Dr. Helen Sawyer-Hogg, summarizes the present state of affairs regarding variable star research in the clusters.

A great deal of interpretative and theoretical work has been published. Models of horizontal branch (HB) stars have been studied by Peterson (effects of He-flash mixing: 07.065.113), Hartwick and Vanden Berg (effects of CNO abundance variations: 09.154.018), while Elijgenson has made a comparative study of HB stars in the Galaxy, the Magellanic Clouds, and the Sculptor dwarf spheroidal galaxy (11.154.003). General problems concerning cluster He-abundance have been studied by Demarque, Sweigart, and Gross (08.154.012), and by Hartwick and Vanden Berg (isochrones for metal-rich clusters: 10.154.016). Kukarkin and Kireeva (11.154.019) discuss the use of *UBVRI* photometry in the determination of the interstellar reddening.

Recent and current work on individual globular clusters is summarized in **Table 3 (p. 132)**.

Some current observational programs are too extensive to be included conveniently in the table. D. H. P. Jones (RGO) has made integrated light measurements of 50 clusters in an intermediate-band photometric system (the system is described in 10.127.055), augmented by a G-band measure. Kron and Gordon (Mt. Stromlo) are using the four 'central' colors of the Stebbins–Whitford six-color system to measure the integrated light from 45 clusters. Chun and Freeman (Mt. Stromlo) have studied 20 clusters for radial variations in surface *UBV* colors and show that eight clusters exhibit a decrease of ~ 0.1 in $(B-V)$ and ~ 0.2 in $(U-B)$ from the clusters' centers outwards; the remaining 12 clusters appear to have radially uniform colors to within $\pm$ 0.02–0.03 mag. Peterson (DTM) is doing star counts in 24 clusters and has determined the limiting radii of 15 clusters for which values were not previously known.

7. CLUSTERS IN OTHER GALAXIES

Since this area overlaps with the concerns of Commission 28, this section will be brief, merely touching on problems covered.

A large amount of work has dealt with clusters and associations in the Magellanic Clouds. Alcaíno (**22**) collected and reproduced c–m diagrams for 30 clusters in the LMC and 6 in the SMC, along with the individual magnitudes and identification charts. He also tabulated basic data for the most conspicuous clusters, 162 in the LMC and 116 in the SMC. The photoelectric magnitude sequences in both Clouds also appear in this publication. New c–m diagrams were given for 96 associations in the LMC by Lucke (12.152.003), and for individual clusters by Hodge and Flower (10.154.015), Tifft and Connolly (10.159.001), and Walker (12.154.008). Penny (Herstmonceux) has studied NGC 1466 electrographically and finds its distance modulus to be 'significantly less than the currently accepted figure for the LMC.' M. Kontizas (Edinburgh) has determined c–m diagrams for 20 clusters in the SMC, using plates from the UK 1.2–m Schmidt. With the 4–m CTIO reflector Hesser, Hartwick, and Ugarte (**23**) have determined uncalibrated c–m arrays for 24 LMC clusters, 18 of which had been thought to be similar to galactic globulars. They report that 'very few . . . show features in their instrumental C–M diagrams reminiscent of galactic globular clusters'; they suggest that some clusters identified as red globulars are actually of intermediate age. Cannon and Gascoigne have taken plates of several clusters in both Clouds with the 3.9–m AAT and are working on faint photoelectric sequences.

Hagen and van den Bergh (11.065.097) have compared c–m diagrams for young clusters in the Magellanic Clouds and the Milky Way and suggest that the differences are due largely to lower metal abundances in the Clouds. Heckman (12.154.010) synthesized populations to represent the colors of young 'globular clusters' in the Clouds.

Danziger (09.154.010) made 11-color observations of the integrated light of 28 clusters in the Magellanic Clouds. Bernard and Bigay (11.153.025) measured 95 clusters in the LMC in *UBV*. Bernard (13.154.017) observed 35 LMC red globulars in *UBV*; 24 of them were also measured in *uvby*. Kron and Gordon are observing about 40 SMC clusters in 4 colors. Borgman, van Duinen, and Koornneef (**24**) have used the Astronomical Netherlands Satellite to study some associations around 30 Dor in the LMC in the far unltraviolet.

Walborn (09.131.168) studied the nature of the central object in 30 Dor.

Freeman and Munsuk (09.154.003) discussed the masses of old globular clusters in the LMC. Freeman and Craft are completing a study of the structure of 9 'blue globular clusters' in the LMC. Andrews and Evans (08.159.008) determined spectral types and velocities of 15 'blue globulars' in the LMC. Illingworth, Oemler, and Freeman are studying the 'red' globulars in the LMC spectrospically, to classify them and to determine their velocities within the Cloud. The distribution of clusters in the SMC was discussed by Hodge (12.153.004), and Hodge and Wright (12.153.003) catalogued 86 new clusters. An extensive study was carried out by M. Brück (**25**, **26**), on plates of the SMC taken with the U.K. 1.2–m Schmidt. Her survey more than doubles the number of clusters known in her $6 \times 6^{\circ}$ field; the types and the spatial distribution are discussed.

In M31 Sharov listed 25 new globular clusters (09.154.005), and he also published some finding charts for clusters (10.154.004). Sharov, Lutyj, and Esipov (**26a**) have prepared a summarizing photoelectric catalogue of the globular clusters of M31. Hartwick and Sargent (11.158.101) used the motions of globulars to estimate the mass of M31. In M87 Ables, Newell, and O'Neil (11.154.029) gave *B* and *V* magnitudes for a number of globular clusters, and Harris and Smith (**27**) studied the distribution of about 4000 globulars. Hodge (11.154.028) did *UBV* photometry of the 5 known globular clusters in NGC 185; he is also completing a study of clusters and associations in NGC 6822. Finally, Danziger's 11-color study (09.154.010) includes 3 globular clusters in the Fornax dwarf spheroidal galaxy.

8. ASTROMETRY

Astrometric research on clusters has been directed primarily towards the determination of membership in selected open clusters during the past few years. In the future there seem to be two areas that deserve attention; first, the confirmation of membership of more cepheid variables in open clusters to improve the zero point of the cepheid luminosity calibration; and second, extremely precise proper-motion studies of a few clusters for the purpose of investigating their internal kinematics. In the first case, great care must be taken to firmly establish the magnitude-dependent position errors, since the cepheid variable is usually by far the brightest star in the cluster.

Astrometric work on clusters in progress at the present time includes the following: New Mexico State University, Sanders has completed membership studies of M67, and is initiating similar studies of NGC 6494 (M23) and NGC 6709. He is also studying M11 in collaboration with MacNamara. University of South Florida, Fallon has derived new proper motions for members of the Orion Nebula Cluster for an investigation of the cluster's dynamics. Yale University Observatory, van Altena is initiating membership studies of NGC 188, NGC 2244 (The Rosette Nebula Cluster), NGC 2506 and Tr 37 (IC 1396), while Hanson is enlarging his

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previous study of the distance to the Hyades cluster based on new absolute proper motions with respect to the galaxies. Yerkes Observatory, Cudworth is determining membership for several globular clusters including M15, M92, M3, M5, and M13. The investigation of M15 is complete and that of M92 is just beginning. Stone has completed a membership study for NGC 654.

Astrometric research on clusters published, 1973–1974 (subsequent to the summary 09.112.008):

α Persei: 09.112.012. 11.112.014; Orion: 12.132.050; Pleiades: 09.112.002; NGC 129: 10.153.005; NGC 457: 09.112.010; NGC 663: 09.112.011; NGC 1039 (M34): 11.112.009; NGC 1664: 09.153.011; NGC 2682 (M67): 11.112.009; NGC 6611 (M16): 11.153.019; NGC 6633: 09.153.003, 11.112.010; NGC 6755: 11.112.011; NGC 6913 (M29): 09.153.004; NGC 7789: 12.153.018; IC 4756: 09.153.019.

9. DYNAMICS OF STAR CLUSTERS

Recent progress in the dynamics of star clusters has been conveniently summarized in review articles, *e.g.* those of Aarseth (10.151.030, 11.151.020, **28**), Aarseth and Lecar (**29**), Hénon (10.151.026), King (11.151.031, **30**), Spitzer (**31**), and Wielen (11.151.053, **32**). The proceedings of IAU Symposium **69** cover most of the important new results. A survey of the recent work of Soviet astronomers on cluster dynamics can be found in a conference report (10.012.034).

The theoretical predictions for the dynamical evolution of a star cluster by various methods are now in quite satisfying agreement (12.151.044, **32**): The *N*-body simulations give essentially the same results for the evolution of the spatial structure of an isolated, spherical star cluster as those methods which are based on the classical theory of relaxation by weak two-body encounters (Fokker-Planck equation). Hénon (**33**) has improved this agreement by considering also the non-dominant terms in the diffusion coefficients. There is, however, still disagreement on the mechanism of escape of stars from clusters (**28**, **31**, **32**). The importance of large energy changes for escape underlines the need for also considering discrete random processes for describing the effect of stellar encounters (*e.g.* 07.151.028, 09.151.015).

All the methods quoted above agree in predicting a 'singular event' at the center of a cluster after a finite time: In *N*-body simulations, a close binary is formed at the center. In the Monte-Carlo methods and in the fluid-dynamical approach, the central density becomes infinite. The thermodynamic explanation of this effect as a gravothermal catastrophe (*e.g.* 10.151.025) has been questioned (09.151.021, 12.151.033, 13.151.009). The central 'singularity' occurs after a few relaxation times for clusters with a realistic spectrum of stellar masses. Hence most of the open clusters and globular clusters should have reached this stage. Observational confirmation of some central abnormality in star clusters is highly desirable in order to confirm the theoretical predictions. For the theoretical studies, the central 'singularity' poses problems for a realistic continuation of the evolution after the collapse of the core (**33**, **34**), especially if the short lifetimes of the dominating massive stars are taken into account. Closely related to this problem is the question of how much the dynamical evolution of star clusters is affected by the presence of binaries. Shrinking close binaries could act as powerful energy sources for a cluster and could strongly affect the dissolution of clusters. Heggie (12.151.011, **35**) has studied the binary problem in great detail, and Hills (**36**) has attempted to show the effect of binaries on cluster cores.

Among other theoretical investigations of star cluster dynamics in general, the following papers are especially noteworthy: studies of the dynamical stability of spherical clusters (09.151.023, 09.151.047), comparison of simulations with theoretical predictions on the behaviour of the random force in gravitating systems (09.151.012, 13.151.017, **37**) and on dynamical friction (11.151.033), application of virial theorem in tensor form (07.151.001, **38**), correct simulation of field stars in numerical experiments (08.151.002), evolution of clusters under the effect of external gravitational shocks (10.151.004). The numerical methods of handling the *N*-body problem for clusters (surveyed in 11.012.005) have been drastically improved by Ahmad and Cohen's force separation (10.151.084) and by new regularization techniques (12.042.017–20). The consequence of the inherent instability of the N-body problem for cluster simulations (07.151.100) is still poorly understood. Interesting work has been done on the behaviour of relativistic star clusters (reviewed by Ipser, **39**), although there is as yet still no direct evidence for the existence of relativistic stellar systems. Saslaw (09.151.017) reviewed the properties of dense stellar systems.

For the application of dynamical theories to actual star clusters, it is necessary to know density distributions, velocity dispersions, total masses, etc., of these stellar systems. Our knowledge of relevant observational data for globular clusters has been dramatically improved by the velocity dispersions and total masses obtained by Illingworth and Freeman (11.154.011, **20**, **21**), by Griffin's individual radial velocities of cluster members (12.034.004), and by Peterson and King's cluster radii and structural parameters (13.154.016). For open clusters, new faint members of the Hyades (**40**) and internal radial velocities (13.153.027) represent a major observational progress for cluster dynamics.

A detailed dynamical model of the globular cluster M3 has been constructed by Da Costa and Freeman (preprint). They emphasize the importance of considering the whole spectrum of stellar masses and conclude that M3 is not deficient in low-mass stars. Much effort has been spent in investigating the relation between globular clusters and the surrounding gravitational field: Important studies have been carried out on the tidal effect of the galactic field (13.151.011, 13.154.006), on the effect of a compressive shock for a cluster when penetrating the galactic disk (10.151.004), and on the variation of the field star density due to the presence of a globular cluster (10.154.002, 12.151.029). Among the dynamical studies of open clusters, the discussion of the Hyades by Pels, Oort, and Pels-Kluyver (**40**) gave the interesting result that there exists a considerable number of probable members (perhaps escapers) outside the tidal radius and that there is no sign of the expected tidal compression of the cluster in the z-direction.

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Table 1. Associations

(*Note*: For abbreviations and lettered references, see end of table. For numbered references, see end of report.)

Name	Observer and data
η Car	Walborn (09.152.001) sp., *E*, *d* of indiv. st. in whole complex
Car OB2	Clariá (a) *UBVβ*
Cen OB2	Ardeberg (Lund), Maurice (Marseille) sp–ph
Cep OB2	Aslanov, Akhundova, Ivanova (b) sp–ph
Cep OB3	Garmany (09.152.004) p.m., r.v.
Cha T	Henize, Mendoza (09. 152.003) sp., em., var.
	Feast, Glass (10.152.005) R Mon object
	Grasdalen (13.152.002) *UBVHKLN*, sp-ph
CMa OB1	Clariá (12.155.043, 13.152.001) sp., *UBVβ*, *E*, *d*, relation to dust and cl.
CMa R1	Clariá (13.152.001) related to CMa OB1
CrA T	Knacke *et al.* (09.152.002) *BVHKLNQ*, sp.
	Glass, Penston (2) *JHKL* for *E*
	Marraco (La Plata, CTIO) *UBVRI*, polarimetry, sp.
Cyg OB2	Walborn (09.114.041) sp., *d*
	Voelcker, Elsasser (09.152.010, 10.113.085) i-r
	Voelcker (12.152.007, c) i-r, *E*
Cyg T1	Gieseking (11.152.003, 12.152.011) *UBV*, c-m, *d*, em. st., var. st.
Lac OB1	Peterson, Shipman (09.153.014) He abund.
	Adelman (10.152.010) sp., Ap st.
Nor OB1	Muzzio, Forte (La Plata, CTIO) *UBVβ*
	Vrba *et al.* (13.153.008) *JHKL*, 2μ map
Ori OB1	Strand (09.031.002) expansion of Ori OBld
	Isobe (10.152.008) distr. of st., dust, H II
	Steffey (10.152.009) motions in Ori OB1a
	Moreno (10.152.012) sp-ph
	Cannell, Ianna (12.132.050) p.m.
	Sharpless (12.152.008) rotations
	Hesser (CTIO), Warren (Indiana) *uvbyβ*, *d*, *E*, ages
	Sanders, MacNamara (N. Mex. State) r.v., sp-ph for masses
Ori T2	Zakirov (d) search for wide binaries
Per OB1	Dzervitis, Spulgis (Latvia) *BVR* of red super-G
Per OB2	Sancisi (12.131.075) H I, OH maps, expansion
Pup OB2	Havlen (12.152.005) *d* of st.
Sco OB1	Sivan (11.155.044) Hα survey, r.v.
	Walborn (e) sp., CNO abund.
	Laval, Sivan (Marseille) motions, st. form.
Sco OB2	Peterson, Shipman (09.153.014) He abund.
	Sancisi (12.152.009) expansion in H I
Tau T1	Uzbek cts.
Tau T2	Zakirov (d) search for wide binaries
Tau T3	Dragomiretskaya (12.114.069) sp., mags. of var.
	Zakirov (d) search for wide binaries
	Shevchenko, Slutskij (f) cts., mags., absorption
	Uzbek cts.
Vel OB1	Denoyelle (Uccle) r.v. of st., no expansion, doubtful ass'n
IC 274	Kolesnik (07.152.001) *d* of a ring
IS 58	Voroshilov, Kolesnik, Uranova (12.152.002) *BV*, sp., no real group

Abbreviations: *d* = distance, *E* = color excess or reddening, em. = emission, i-r = infrared, p.m. = proper motion, r.v. = radial velocity, sp. = spectrum, sp-ph = spectrophotometry, st. = stars, var. = variable.

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Table 2. Individual Open Clusters

(*Note*: For key to abbreviations and lettered references, see end of table. For numbered references, see end of report.)

NGC	Observer and data
129	Frolov (10.153.006) p.m., ceph.mem., *d*, age
	Clariá, Osborn (Mérida) DDO of RG
	Pulkovo p.m., color for mem.
188	Pagel (11.153.015) CN strength
	Maeder (11.153.017) compar. w. theory
	McClure (12.153.030) abund. range
	Danilov (12.153.034) mass, lifetime
	Osborn (Mérida) T_e, *g*, masses of RG
	Barry (S. Calif.), Schoolman (Lockheed) sp-ph
	van Altena (Yale) p.m. for mem.
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	Mano, Simoda (Tokyo) faint c-m
	Saio, Shibata, Simoda (Tokyo) age
225	Clariá, Osborn (Mérida) DDO of RG
457	Latypov (09.112.010) p.m.
	Lang (10.153.030) st. distr.
	Baldone Obs. (Latvia) Schmidt survey
559	Vasilevskij (a) sp. of RG, [Fe/H]
581	Steppe (11.153.008) *RGU*, *d*, *E*, age
	Clariá, Osborn (Mérida) DDO of RG
654	Samson (13.153.013) mass, interstellar mat.
659	Steppe (11.153.008) *RGU*, *d*, *E*, age
663	Latypov (09.112.011) p.m.
752	Chekanikhina (09.153.027) l.f.
	Maeder (11.153.017) compar. w. theory
	Clariá, Osborn (Mérida) DDO of RG
869	Cohen, Gaustad (10.113.116) i-r excess in M super-G
884	Cohen, Gaustad (10.113.116) i-r excess in M super-G
1027	Clariá, Osborn (Mérida) DDO of RG
1039 (M39)	Latypov (11.112.009) p.m.
	Ryadtchenko (12.153.029) *B* mags.
1245	Urals Obs. c-m, str., l.f.
1502	Clariá, Osborn (Mérida) DDO of RG
1545	Clariá, Osborn (Mérida) DDO of RG
1662	Vasilevskij (08.153.012) [Fe/H] for gK
	Clariá, Osborn (Mérida) DDO of RG
1664	Kerridge, Nelson, Mesrobian (09.153.011) p.m., mem.
	Alksnis, Alksne, Daube (10.113.016) C st.
	Clariá, Osborn (Mérida) DDO of RG
1778	Barbon, Hassan (09.153.015) *UBV*, *d*, *E*, age, sp.
	Joshi, Sagar, Pandey (13.153.028) *UBV*, *d*, *E*, age
1817	W. Harris, G. H. Harris (Yale) faint c-m
1893	Kholopov (07.003.154) var. st.
	Cuffey (09.153.035, 10.153.012) *UBV* c-m, *d*, var. *E*
1960	Vasilevskij (a) sp. of RG, [Fe/H]
2099	Vasilevskij (a) sp. of RG, [Fe/H]
	Baldone Obs. (Latvia) Schmidt survey
2129	Kuznetsov (08.114.067) sp. to 15^m
	Baldone Obs. (Latvia) Schmidt survey
	Abastumani *BV*, sp.
2158	Walker (Lick) spectracon *BV*
2168 (M35)	Vidal (09.153.040) *UBV* c-m, age, l.f.
	Salukvadze (Abastumani?) *UBV*, str.
	Clariá, Osborn (Mérida) DDO of RG
2169	Sagar (b) *UBV*, *d*, *E*, age, mem.
2175	Tovmassian, Shahbazian (11.153.004) amt. of H I
2186	Moffat, Vogt (13.153.016) *UBV*β, c-m, *d*, *E*, diam.
2204	Hawarden (c) *UBV* c-m, *d*, *E*, age 3×10^9 yr, $\lvert z \rvert = 1250$ pc
2232	Clariá (10.153.022) photometry
	Levato, Malaroda (12.153.006) MK, *d*
2243	Hawarden (13) *UBV* c-m, *d*, *E*, age 5×10^9 yr, $\lvert z \rvert = 1100$ pc
	van den Bergh (Toronto) old
2244	Ogura, Ishida (Japan) c-m, *d*
	van Altena (Yale) p.m. for mem.
2251	Vasilevskij (a) sp. of RG, [Fe/H]
2252	Vasilevskij (a) sp. of RG, [Fe/H]

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Table 2. (Continued)

NGC	Observer and data
2264	Peterson, Shipman (09.153.014) He abund.
	Tovmassian, Shahbazian (11.153.004) amt. of H I
	Koch, Perry (11.153.013) variables
	Badalyan, Erastova (09.122.130) mags.
	Mendoza (Mexico) *UBVRIα* + narrow-band
	Barry (S. Calif.), Schoolman (Lockheed) sp-ph, r.v.
	MacNamara (N. Mex. State) sp-ph, masses
2269	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
2281	Vasilevskij (08.153.012) [Fe/H] for gK
2287	Poppel, Vieira (10.153.023) H I study
	Eggan (11.153.009) *uvbyβ*, *UBV*, relation to Plei. grp.
	Clariá, Osborn (Mérida) DDO of RG
2301	Clariá, Osborn (Mérida) DDO of RG
2302	Moffat, Vogt (13.153.016) *UBVβ*, c-m,
2323	Clariá, Osborn (Mérida) DDO of RG
2335	Clariá (09.153.007, 13.152.001) *UBV*, *d*, *E*, age, not rel. to CMa OB1
2343	Clariá (13.152.001) not rel. to CMa OB1
2345	Moffat (11.153.021) *UBV* c-m, *d*, var. *E*
2353	Tovmassian, Shahbazian (11.153.004) amt. of H I
	Clariá (13.152.001) nucleus of CMa OB1
2360	Maeder (11.153.017) compar. w. theory
	Osborn (Mérida) T_e, *g*, masses of RG
2362	Tovmassian, Shahbazian (11.153.004) amt. of H I
	Clariá (Mérida) Hβ
2383	Clariá, Osborn (Mérida) DDO of RG
2414	Moffat, FitzGerald (Bochum) mags., sp. of OB st.
2420	McClure, Forrester, Gibson (11.153.023) *UBV*, DDO, age 3×10^9 y, [Fe/H] = −0.5
	Keenan, Innanen (11.155.024) galactic orbit
	Hawarden (13a) age, *d*
	Osborn (c) T_e, *g*, masses of RG
	Salukvadze (Abastumani?) *UBV*, str.
2421	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
2422	Dworetsky (13.153.005) MK, r.v., rotation, binaries
2439	White (13.153.007) *UBV* c-m, *d*, age, super-G
2451	W. Harris (Yale) *UBV* c-m, DDO
2453	Darsa, Hidajat (10.153.017) *d*, *E*
	Moffat. FitzGerald (12.153.007) *UBV* c-m, *d*, *E*
2467	Darsa, Hidajat (10.153.017) *d*, *E*
2477	Cannon (06.065.068) compar. of RG w. theory
	Lohmann (10.153.014) distr. of faint st.
	Hartwick, Hesser (12.153.010) *BV* c-m, *uvbyβ*, *g*, Am st., rotations
2482	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam., U Gem mem.?
2483	Darsa, Hidajat (10.153.017) *d*, *E*
	FitzGerald, Moffat (13.153.023) *UBV*, sp., not a real cl.
2506	van Altena (Yale) p.m. for mem.
2516	Feinstein, Marraco, Mirabel (09.153.006) *UBVRIβ*, *d*, *E*, age
	Eggen (11.153.009) *uvbyβ*, *UBV*, relation to Plei, grp.
	Snowden (12.153.035) *uvbyβ*, var. *E*, age, Ap st.
2527	Lindoff (09.153.005) *UBV*, *d*, *E*
2539	Naini Tal Obs. *UBV*
2548	Naini Tal Obs. *UBV*
2571	Clariá (Mérida) *UBVβ*, DDO of RG
2632 (Praesepe)	Maeder (11.153.017) compar. w. theory
	Moshkalev (d) *BV* for 8 new mem.
	Clariá, Osborn (Mérida) DDO of RG
2660	Hartwick, Hesser (10.153.003) *BV* c-m, *uvbyβ*, *d*, *E*, age, C st.
2669	Clariá, Osborn (Mérida) DDO of RG
2682 (M67)	Janes (09.153.017, 11.153.024) DDO, *d*, *E*, CN-abund.
	Latypov (11.112.009) p.m.
	Osborn (12.114.016) T_e, *g*, masses of RG
	Barry, Cromwell (11.153.001) sp., normal abund.
	Pagel (11.153.015) CN strength
	Maeder (11.153.017) compar. w. theory
	Barry (S. Calif.), Schoolman (Lockheed) sp-ph, *g*, *d*
	Sanders (N. Mex. State) p.m., 649 probable mem.
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	Pulkovo p.m.
2972	Clariá, Osborn (Mérida) DDO of RG
3053	Clariá, Osborn (Mérida) DDO of RG
3105	Moffat, FitzGerald (11.153.020) *UBV* c-m. *d*, *E*, possible ceph.
3114	Levato, Malaroda (e) MK, Ap st.
	W. Harris (Yale) *UBV* c-m, DDO
3255	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, diam., doubtful cl.
3293	Tovmassian, Shahbazian, Nersessian (11.153.005) amt. of H I
	W. Harris (Yale) *UBV* c-m, DDO
3324	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
	Clariá (Mérida) *UBVβ*

Table 2. (Continued)

NGC	Observer and data
3572	Moffat, Vogt (13.153.017) $UBV\beta$, c-m, d, E, diam.
	Clariá (f) nucleus of Car OB2
3590	Moffat, Vogt (13.153.017) $UBV\beta$, c-m, d, E, diam. Clariá (f) UBV
3603	Walborn (09.131.168) central trapezium, WR st.
	Moffat (12.131.525) UBV, d, E
3680	Maeder (11.153.017) compar. w. theory
	Hawarden (13a) $E, \delta(U\text{-}B)$
	Osborn (Mérida) T_e, g, masses of RG
3766	Winnenburg (09.153.009) UBV c-m, d, E, age, diam.
4337	Moffat, Vogt (09.153.031) faint, diam.
4439	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
4463	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
4755	W. Harris (Yale) UBV c-m, DDO
4815	Moffat Vogt (09.153.031) $UBV\beta$, probably no cl.
5168	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
5281	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
5460	Clariá (09.153.022) UBV
5606	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
5617	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
	Lohmann (g) l.f., str.
5662	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
5822	Bozkurt (13.153.004) UBV, c-m, d, E, diam.
6005	Moffat, Vogt (13.153.018) $UBV\beta$, doubtful cl.
6031	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
6067	Dzigashvili (08.151.052) orbit
	W. Harris (Yale) UBV c-m, DDO
6167	Tovmassian, Shahbazian, Nersessian (11.153.005) amt. of H I
	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
6169	Moffat, Vogt (09.153.031) $UBV\beta$, no cl.
6178	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
6192	Handschel (11.153.032) UBV
6193	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
	Tovmassian, Shahbazian, Nersessian (11.153.005) amt. of H I
	Herbst (12.153.013) UBV, sp., c-m, d, E
6200	Tovmassian, Shahbazian, Nersessian (11.153.005) amt. of H I
6204	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
	Tovmassian, Shahbazian, Nersessian (11.153.005) amt. of H I
6231	Tovmassian, Nersessian, Shahbazian (11.153.006) amt. of H I
	Walborn (h) sp. N-deficient
	Laval (Marseille) nucleus of Sco OB1, r.v.
6242	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
6249	Moffat, Vogt (09.153.031) $UBV\beta$, c-m, d, E, diam.
6250	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
6259	Hawarden (12.153.028), 13.153.901) UBV, c-m, d, E, age
6281	Feinstein, Forte (11.153.053) UBV, c-m, d, E, age, X-ray source
6322	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
6383	Tovmassian, Nersessian, Shahbazian (11.153.006) amt. of H I
6396	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
6405 (M6)	Vleeming (12.153.001) UBV, c-m, d, E, age
	G. H. Harris (Yale) MK, r.v., mem., irr. var. BM Sco
6475 (M7)	Conti, Hensberge, van den Heuvel, Stickland (12.153.008) blue stragglers
	Abt (13.153.030) sp., Ap, Am, binaries
6494 (M23)	Sanders (N. Mex. State) p.m. for mem.
6514 (M20)	Tovmassian, Nersessian, Shahbazian (11.153.006) amt. of H I
	Ogura, Ishida (Japan) UBV, c-m, d, E, age
6523 (M8)	Naini Tal Obs. UBV
6530	Parsatharathy (13.153.029) sp.
6531	Tovmassian, Nersessian, Shahbazian (11.153.006) amt. of H I
6604	Tovmassian, Nersessian (11.153.007) amt. of H I
	Moffat, Vogt (13.153.018) $UBV\beta$, c-m, d, E, diam.
6611 (M16)	Tovmassian, Nersessian (11.153.007) amt. of H I
	Kamp (11.153.019) p.m. for mem., $B\text{-}V$, E, d, age
6618 (M17)	Ogura, Ishida (Japan) UBV, c-m
6633	Vasilevskij (08.153.012) [Fe/H] for gK
	Sanders (09.153.003) p.m. for mem.
	Latypov (11.112.010) p.m.
6649	Talbert (13.153.021) UBV, minimum d, ceph. V367 Sct
	van den Bergh, Madore (Toronto) ceph. V367 Sct
6705 (M11)	W. Harris, G. H. Harris (Yale) UBV, $uvby\beta$, DDO, sp., faint c-m

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Table 2. (Continued)

NGC	Observer and data
	Sanders, MacNamara (N. Mex. State) p.m., mem., vel. disp.
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
6709	Clariá, Osborn (Mérida) DDO of RG
	Sanders (N. Mex. State) p.m., mem.
6755	Latypov (11.112.011) p.m.
6811	Vasilevskij (a) sp. of RG, [Fe/H]
	Urals Obs. c-m, str., l.f.
6819	Auner (11.153.002) *UBV*, c-m, *d*, *E*, MS gap, cts.
6823	Tovmassian, Nersessian (11.153.007) amt. of H I
6834	Voroshilov, Kalandadze, Kuznetsov (08.131.123) *BV*, *E*, st. distr.
	Abastumani *BV*, sp.
6866	Koroleva (08.153.008) str. of corona
	Pulkova p.m., color for mem.
6871	Bogdanovic, Straizis (08.113.049) *UPXYZVS*
	Crawford, Barnes, Warren (11.153.002) *uvbyβ*, *d*, *E*, Cyg X-1 more distant
	Alksnis, Bogdanovic (12.113.015, 016) multicolor, sp.
6883	Alksnis, Alksne, Daube (10.113.016) C st.
6913 (M29)	Raznik (07.113.013, 13.153.012) time changes of *E*, pecularities of st.
	Sanders (09.153.004) p.m. for mem.
	Bakos (09.153.029) light var. of st.
	Abastumani *BV*, sp.
6940	Clariá, Osborn (Mérida) DDO of RG
7031	Hassan, Barbon (10.153.004) *UBV*, *d*, *E*, age, mem.
7039	Hassan (09.153.008) *UBV*, *d*, age, mem.
7062	Hassan (09.153.008) *UBV*, *d*, age, mem.
7067	Hassan (09.153.008) *UBV*, *d*, age, mem.
7082	Hassan (09.153.008) *UBV*, *d*, age, mem.
7092 (M39)	Abt, Sanders (10.153.019) sp., r.v., rotations, binaries
7127	Uranova, Tsarevskij (13.152.003) *UBV*
7128	Alksnis (10.123.003) var. st.
7142	Pendl (09.153.037)
7160	Vasilevskij (a) sp. of RG, [Fe/H]
7209	Clariá, Osborn (Mérida) DDO of RG
7243	Hill, Fisher, Allison (11.153.012) Hγ EW, *d*
	Pulkovo p.m.
7419	Daube (06.114.128) new C vars.
	Alsknis, Alksne, Daube (10.113.016) C st.
	Handschel (11.153.032) *UBV*
	Fawley, Cohen (12.153.026) sp., r.v., sp-ph, far i-r of M st.
7654	Voroshilov, Kalandadze, Kuznetsov (08.131.124) *E*, st. distr.
	Abastumani *BV*, sp.
	Clariá, Osborn (Mérida) DDO of RG
7762	Zacharova (08.153.030) *UBV*, l.f.
	Urals Obs. c-m, l.f., str.
7788	Pulkovo p.m., colors for mem.
7789	Alksnis, Alksne, Daube (10.113.016) C st.
	Koroleva (12.153.018) corona, blue stragglers, p.m.
	Artyukhina, Kholopov (13.153.025) st. distr.
	Pendl (13.153.031) blue stragglers
	Pulkovo p.m., colors for mem.
7790	Pulkovo p.m., colors for mem.
IC 348	Strom, Strom, Carrasco (12.153.033) *UBVHKL*, *E*, age, st. form.
IC 1369	Hassan (08.153.008) *UBV*, *d*, age, mem.
IC 1396	Vasilevskij (a) sp. of RG, [Fe/H]
	van Altena (Yale) p.m.
IC 1795	Ogura, Ishida (Japan) *UBV* c-m
IC 2157	Grubissisch (10.153.001) *RGU* c-m, *d*
IC 2581	Turner (10.153.007) var. *E*
	Moffat (11.153.011) *E*
IC 2602	Levato (13.153.002) rotations
IC 4651	Hawarden (**13a**) *E*, δ(*U-B*)
IC 4665	Ferrer, Jaschek (09.153.028) inclinations of binaries
IC 4756	Vasilevskij (08.153.012) [Fe/H] for gK
	Herzog, Sanders, Seggewiss (13.153.006) p.m. for mem., *UBV*, *d*, *E*, blue stragglers, super-G
IC 4996	Clariá, Osborn (Mérida) DDO of RG
IC 5146	Samson (13.153.014) gas, dust
Coma	Sedyakina (06.122.149) new flare st.
	Barry (S. Calif.), Schoolman (Lockheed) sp-ph
Hyades	Sedyakina (06.122.149) new flare st.
	Golay (10.153.009) $UBVB_1B_2V_1G$,*d*
	Upgren, Kerridge, Mesrobian (10.153.010) *d* from px.
	van Altena (11.153.014) review of *d*
	Robinson, Kraft (11.153.030) var. of dK, dM
	Clube (11.153.034) convergent
	Conti, Hensberge, van den Heuvel, Stickland (12.153.008) blue stragglers
	Upgren (12.153.025) *d* from *R-I*
	Hanson (13.153.019) p.m., mem., *d*
	Corbin, Smith, Carpenter (13.153.020) *d*
	Barry (S. Calif.), Schoolman (Lockheed) sp-ph
	MacNamara (N. Mex. State), Klemola, Harlan, Wirtanen (Lick) px.
	Hanson (Yale) new p.m.
	Moscow p.m., color for men
α Per	Sedyakina (06.122.149) flare st.
	Artyukhina (07.153.015) str.
	Dieckvoss (09.112.012) p.m.

Table 2. (Continued)

Name	Observer and data
	Zakharova, Svechnikov (09.153.042) st. formation, age
	Artyukhina, Kalinina (11.112.014) p.m., mem.
	Crawford, Barnes (11.153.029) *uvbyβ*, var. *E*, *d*
Pleiades	Ambartsumyan *et al.* (06.122.094, 08.122.142, 09.122.136, 10.122.030, 11.122.020) flare st.
	Mirzoyan, Mnatsakyan (06.122.130) distr. of flare st.
	Kholopov (11.122.006) distr. of flare st.
	B. F. Jones (09.112.002) p.m., mem.
	Erastova (09.122.131) flare st.
	van Altena, B. F. Jones (09.153.018) absolute p.m.
	Vykhrestyuk, Karetnikov (10.153.020) sp-ph
	Robinson, Kraft (11.153.030) var of dK, dM
	Conti, Hensberge, van den Heuvel, Stickland (12.153.008) blue stragglers
	Artyukhina, Kholopov (13.153.024) distr.
	Coyne (i) polarization
UMa	Wielen (Heidelberg) dynamics
Ba 10	Moffat, Vogt (09.153.039) *UBV*, c-m, *d*, *E*, diam., super-G?
Ba 12	Hassan (13.153.022) *UBV*, c-m, *d*, *E*
Ba 13	Hassan (13.153.022) *UBV*, c-m, *d*, *E*
Ba 14	Hassan (13.153.022) *UBV*, c-m, *d*, *E*
Ba 15	Hassan (13.153.022) *UBV*, c-m, *d*, *E*
Be 4	Sanduleak (11.153.010) has OB st.
Be 7	Sanduleak (11.153.010) has OB st.
Be 59	Sanduleak (11.153.010) has OB st.
Be 62	Sanduleak (11.153.010) has OB st.
Be 65	Moffat, Vogt (09.153.039) *UBV*, c-m, *d*, *E*, diam.
	Sanduleak (11.153.010) has OB st.
Be 86	Sanduleak (11.153.010) has OB st.
Be 87	Sanduleak (11.153.010) has OB st.
Be 90	Sanduleak (11.153.010) has OB st.
Be 94	Sanduleak (11.153.010) has OB st.
Be 96	Sanduleak (11.153.010) has OB st.
Be 97	Sanduleak (11.153.010) has OB st.
Biur 10	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; faint
Bo 1	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 2	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 3	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 4	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 5	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 6	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 7	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.; new cl., WR st.
Bo 8	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 9	Moffat, Vogt (13.153.017) suspected new cl., but no cl.
Bo 10	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 11	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 12	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 13	Moffat, Vogt (13.153.018) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 14	Moffat, Vogt (13.153.018) *UBVβ*, c-m, *d*, *E*, diam.; new cl.
Bo 15	FitzGerald, Hurkens, Moffat (l) *UBV*, c-m, sp., *d*, *E*, OB st.
Cr 96	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Cr 107	Isserstedt, Schmidt-Kaler (09.153.033) *UBV*, sp., part of ring
Cr 121	Clariá, Osborn (Mérida) DDO of RG
Cr 132	Clariá (Mérida) *UBVβ*, p.m.
Cr 135	Clariá (Mérida) *UBVβ*, p.m.
Cr 140	Clariá, Osborn (Mérida) *UBV*, *uvbyβ*, DDO, p.m.
Cr 228	Walborn (09.152.001) sp., *d*
	Feinstein, Marraco, Forte (j) *UBV*
	Clariá (Mérida) *UBV*
	Moffat (Bochum) *UBV*
	Thé (Amsterdam) 5-color
Cr 240	Clariá (g) *UBVβ*, OB ass'n related to Car OB2?
Cr 258	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Cr 268	Moffat, Vogt (13.153.018) *UBVβ*, c-m, *d*, *E*, diam.
Cr 271	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Cr 307	Moffat, Vogt (13.153.018) no cl.
Cr 347	Moffat, Vogt (13.153.018) *UBVβ*, c-m, *d*, *E*, diam.
Cr 367	Clariá (Mérida) *UBV*
Cr 399	Clariá, Osborn (Mérida) DDO of RG
Cz 8	Moffat, Vogt (09.153.039) *UBV*, c-m, *d*, *E*, diam.
Cz 9	Moffat, Vogt (09.153.039) no cl.
Cz 10	Moffat, Vogt (09.153.039) no cl.
Cz 11	Moffat, Vogt (09.153.039) no cl., ≡ galaxy Maffei 1
Cz 13	Moffat, Vogt (09.153.039) no cl.?
Dol 25	Moffat, Vogt (13.153.016) *UVBβ*, c-m, *d*, *E*, diam.
Dol 28	Moffat (Bochum) *UBV*, WR st.

Table 2. (Continued)

Name	Observer and data
Haf 8	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Haf 16	Darsa, Hidajat (10.153.017) *d*, *E*
Haf 18	FitzGerald, Moffat (12.153.005) *UBV*, r.v., c-m, *d* for Haf 18 ab; 18c no cl.
Haf 19	FitzGerald, Moffat (12.153.005) *UBV*, r.v., c-m, *d*
Haf 20	FitzGerald, Moffat (12.153.016) *UBV*, c-m, *d*, *E*
Haf 21	FitzGerald, Moffat (12.153.016) *UBV*, c-m, *d*, *E*
Hogg 9	Moffat, Vogt (13.153.017) no cl.
Hogg 10	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
	Clariá (f) *UBVβ*
Hogg 11	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
Hogg 12	Moffat, Vogt (13.153.017) no cl.
Hogg 14	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Hogg 15	Moffat (12.113.002) WR st. possible mem.
	Muzzio, Feinstein, Orsatti (LaPlata, CTIO) *UBVβ*
Hogg 16	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Hogg 22	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
King 4	Moffat, Vogt (09.153.039) *UBV*, c-m, *d*, *E*, diam.
King 22	Burkhead, Kalinowski (Indiana) *UBV*, c-m
	King (Berkeley) cts., str., mass > 4000$m_\odot$
Lyngå 4	Moffat, Vogt (13.153.018) no cl.
Lyngå 6	Madore (13.153.009) ceph. TW Nor mem.
	Moffat, Vogt (13.153.018) no cl.
	van den Bergh (Toronto), G. H. Harris (Yale) ceph. TW Nor. mem.
Lyngå 14	Moffat, Vogt (13.153.018) *UBVβ*, c-m, *d*, *E*, diam.
Mark 6	Moffat, Vogt (09.153.039) *UBV*, c-m, *d*, *E*, diam.
Mark 38	Moffat, Vogt (m) *UBV*, c-m, sp., *d*, *E*
Mel 66	Hawarden (k) c-m, old, rich, blue stragglers
Pis 1	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Pis 4	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Pis 11	Moffat, FitzGerald (Bochum) *UBV*
Pis 12	Moffat, Vogt (13.153.016) no cl.
Pis 17	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
Pis 18	Moffat, Vogt (09.153.031) too faint
Pis 20	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Pis 21	Moffat, FitzGerald (Bochum) *UBV*
Pis 24	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Rup 18	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam., ceph. mem.?
Rup 32	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Rup 34	Moffat, Vogt (13.153.016) no cl.
Rup 44	Moffat, FitzGerald (12.155.011) *UBV*, sp., c-m, *d*
Rup 55	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Rup 67	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam.
Rup 79	Moffat, Vogt (13.153.016) *UBVβ*, c-m, *d*, *E*, diam., ceph. mem.?
	van den Bergh (Toronto), G. H. Harris (Yale) ceph. mem.
Rup 97	Moffat, Vogt (13.153.017) *UBVβ* c-m, *d* *E*, diam., ceph. mem.
	van den Bergh (Toronto), G. H. Harris (Yale) ceph. mem.
Rup 98	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
	Clariá, Osborn (Mérida) DDO of RG
Rup 107	Moffat, Vogt (13.153.018) *UBVβ* c-m, *d*, *E*, diam.
Rup 108	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Rup 118	Moffat, Vogt (09.153.031) *UBVβ*, c-m, *d*, *E*, diam.
Rup 119	Moffat, Vogt (09.153.031) no. cl.
Rup 127	Moffat, Vogt (13.153.018) *UBVβ*, c-m, *d*, *E*, diam.
Rup 166	Moffat, Vogt (09.153.031) probably no. cl.
S289(H II)	Moffat, FitzGerald (Bochum) *UBV*, sp., OB cl.
Sher 1	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
Stock 2	Clariá, Osborn (Mérida) DDO of RG
Stock 13	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
Stock 14	Moffat, Vogt (13.153.017) *UBVβ*, c-m, *d*, *E*, diam.
Tom 4	Moffat, Vogt (09.153.039) not found
Tr 1	Steppe (11.153.008) *RGU*, c-m, *d*, *E*, age
	Naini Tal Obs. *UBV*
Tr 2	Clariá, Osborn (Mérida) DDO of RG
	Naini Tal Obs. *UBV*
Tr 5	Kalinowski, Burkhead, Honeycutt (12.153.024) C st. mem.?
	Kalinowski, Burkhead (Indiana) *UBV* c-m

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Table 2. (Continued)

Name	Observer and data
Tr 9	Darsa, Hidajat (10.153.017) *d*, *E*
	Clariá, Osborn (Mérida) DDO of RG
Tr 10	Levato, Malaroda (13.153.010) MK types, *d*
Tr 14	Walborn (09.152.001) sp., *d*, beyond Tr 16
	Feinstein, Marraco, Muzzio (10.153.013) *UBVRI*, Hαβγ
	Forte (La Plata, CTIO) *UBV*
	Thé (Amsterdam) 5-color
Tr 15	Walborn (09.152.001) 1 sp., *d*, beyond Tr 16
	Feinstein, Forte (La Plata, CTIO) *UBV*
	Thé (Amsterdam) 5-color
Tr 16	Walborn (09.152.001) sp., *d*, assoc. with η Car
	Feinstein, Marraco, Muzzio (10.153.013) *UBVRI*, Hαβγ
	Forte (La Plate, CTIO) *UBV*
	Thé (Amsterdam) 5-color
Tr 18	Moffat, Vogt (13.153.017) *UBV*β, c-m, *d*, *E*, diam.
Tr 21	Moffat, Vogt (09.153.031) *UBV*β, c-m, *d*, *E*, diam.
Tr 27	Moffat, FitzGerald (Bochum) *UBV*, MK, var. *E*, WR st.
	Thé (Amsterdam) 5-color
Tr 37	Garrison, Kormendy (12.153.012) *UBV*, MK, *d*, nucleus of Cep OB2
vdB 130	Racine (12.153.014) *UBV*, *E*
West 2	Moffat, Vogt (13.153.017) *UBV*β, c-m, *d*, *E*, diam.
LMC fgd	Philip (09.153.013) *uvby*β, c-m, *d*
Anon	Moffat (Bochum) pec. st. found by Klare, Neckel (11.121.075) is in a cl.

Abbreviations: amt. = amount, c-m = color-magnitude array, cts. = star counts, *d* = distance, *E* = color excess or reddening, *EW* = equivalent width, fgd = foreground, *g* = surface gravity, grp. = group, i-r = infrared, l.f. = luminosity function, mem. = membership, p.m. = proper motion, px. = parallax, RG = red giants, r.v. = radial velocity, sp-ph = spectrophotometry, st. = stars, str. = structure, super-G = supergiants, T_e = effective temperature, var. = variable.

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Table 3. Individual Globular Clusters

(*Note*: See also major data lists referred to in the text. Papers dealing solely with variable stars have been omitted. For key to abbreviations and lettered references, see end of table. For numbered references, see end of report.)

NGC	Observer and data
104 (47 Tuc)	Eggen (07.113.007) *UBVRI* of RG
	Glass, Feast (10.113.030) *JHKL* of RG
	Menzies (10.113.031) *UBV* c-m
	D.H.P. Jones (10.122.055) i-b of RR Lyr
	McClure, Osborn (11.114.102) DDO
	Evans (11.154.013) *VI*, *I* < 13, sp.
	Cannon (11.154.017) *UBV*
	Cathey (12.154.019) *UBVR* of RG, AGB, sub-G
	Hartwick, Hesser (12.154.023) *UBV* c-m
	Crawford, Snowden (**a**) foreground reddening
	Bell, Dickens (**b**) indiv. sp., enhanced N
	Illingworth (**20**,**21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M*/*L*
	Lee (Stromlo) *BV* c-m, l.f.
	Cannon (Edinburgh) faint photometry
	Hartwick (Victoria), Hesser (CTIO) DDO of RG, l.f.
	Osborn (Mérida) T_e, *g*, [Fe/H]

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Table 3. (Continued)

NGC	Observer and data
	Hesser (CTIO) *uvbyβ* of blue st., reddening
288	Cannon (11.154.017) *UBV*
	Alcaíno (c) *BV* c-m
362	Eggen (07.113.007) *UBVRI* of RG
	McClure, Norris (12.154.013) DDO of RG
	Illingworth (**20**, **21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M*/*L*
	W. Harris (Yale) *UBV* c-m
	Alcaíno (ESO) *BV* c-m
	Philip (Albany) *uvby* of BHB
1851	Clark, Markert, Li (**15**) X-ray source
	Vidal, Freeman (**16**) blue st. as possible X-ray source
	M. Liller (d) RR Lyr's normal
	Illingworth (**20**, **21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M*/*L*
	Alcaíno (ESO) *BV* c-m
	Cannon (Edinburgh), Stobie (Stromlo) *BV* c-m
1904 (M79)	W. Harris, Stetson (Yale) *BV* c-m
	Alcaíno (ESO) *BV* c-m
2298	Alcaíno (11.154.001) *UBV* c-m
2419	Racine, W. Harris (13.154.004) *BV* c-m, *d*, *E*, orbit
	Kinman (KPNO) faint seq. for c-m, cts.
2808	W. Harris (12.154.012, e) *BV* c-m; more current *BV*
	Illingworth (**20**, **21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M*/*L*
	White (Steward) l.f.
3201	Philip (08.154.003) *uvby* of HB
	White (13.154.012) DDO of RG; more current DDO of RG, AGB, DDO seq., *BV* c-m, l.f.
	White, Mosley, Furenlid, White (f) mem. from obj. prism sp.
	Lee (Stromlo) *BV* c-m, l.f.
	Alcaíno (ESO) *BV* c-m
4147	Zinn (12.122.069) sp., T_e of uv-bright st.
4572	Hartwick, Hesser (10.154.023) *UBV* c-m
	Alcaíno (11.154.002) *UBV* c-m
4590 (M68)	W. Harris (e) *UBV* c-m
	Alcaíno (ESO) *BV* c-m
	Terzan, Rutilly (Lyon) *R* seq. to 16.5
5024 (M53)	Philip (07.154.007) *ubvy* of HB
	Zinn (12.122.069) sp., T_e of uv-br. st.
	Faber (09.158.027) integr. 10-color
	Butler (g) *E* (*B-V*)
	Pulkovo *BV*, p.m.
5053	Walker (Lick) spectracon *BV* c-m, $V < 21$
5139 (ω Cen)	Eggen (07.113.007) *UBVRI* of RG
	Rodgers (07.114.016) T_e, g, He-abund. of BHB
	Dickens (08.114.045) C^{12}/C^{13} from CH st.
	Dickens, Feast, Evans (08.122.044) red vars.
	Bell, Dickens (09.114.070) C^{12}/C^{13} from CH st.
	Cannon, Stobie (09.154.015) *UBV*
	Glass, Feast (10.113.030) *JHKL* of RG
	D.H.P. Jones (10.122.055) i-b of RR Lyr
	Naumova, Ogorodnikov (10.154.002) extremely high mass
	Bell, Dickens (11.064.005) CNO-abund of CH st.
	Schmidt, van den Bergh (11.154.006) spread in [Fe/H]
	Cannon, Kontizas (11.154.014) *BV* c-m
	Norris (12.154.017) [Fe/H], T_e, g of uv-bright st.
	Poveda, Allen (13.154.006) mass, tidal radius
	Sturch (h) *E*, [Fe/H] from RR Lyr
	Lee (Stromlo) *BV* c-m, l.f.
	Butler (Maryland) [Fe/H] from RR Lyr sp.
	Hartwick (Victoria), Hesser (CTIO) DDO of RG
	Bessell, Norris (Stromlo) abundance variations
	Freeman, Rodgers (Stromlo) Ca-abund from RR Lyr sp.
5272 (M3)	Philip (07.154.007, 13.154.013) *uvby* of HB
	Osborn (07.154.030, 10.154.018) DDO of RG
	Kuzmin *et al.* (09.154.008, 10.154.021) surf. br.
	Faber (09.158.027) integr. 10-color
	Zinn (12.122.069) T_e of uv-bright st.
	Butler (g) *E* (*B-V*)
	White (Steward) DDO of RG, AGB, BHB
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	Cudworth (Yerkes) p.m.
	Wilson (Yale), King (Berkeley) l.f.
	Simoda, Fukuoka (Tokyo) l.f.
	Toyama, Nishimura, Kaneko (Tokyo) l.f., color, distr.
	Pulkovo *BV*, p.m.
	Da Costa, Freeman (Stromlo) dynam. model, mass f'n

Table 3. (Continued)

NGC	Observer and data
5286	Alcaíno (12.154.003) *UBV* c-m
	W. Harris (e) *UBV* c-m
5466	Zinn (12.122.069) T_e of uv-bright st.
5694	W. Harris (e), *BV* c-m, more current *UBV*
5824	W. Harris (e) *UBV* c-m
5897	Eggen (07.113.007) *UBVRI* of RG
5904 (M5)	Eggen (07.113.007) *UBVRI* of RG
	Simoda, Tanikawa (07.154.027) l.f.
	Osborn (07.154.030, 10.154.018) DDO of RG
	Kuzmin *et al.* (09.154.008, 10.154.021) surf. br.
	Faber (09.158.027) integr. 10-color
	Rusev (11.113.007) i-r of RG
	Philip (13.154.013) *uvby* of HB
	Butler (**g**) *E* (*B-V*)
	Cudworth (Yerkes) p.m.
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	Toyama, Nishimura, Kaneko (Tokyo) l.f., color, distr.
5927	Menzies (12.154.015) *UBV* c-m
	Alcaíno (ESO) *BV* c-m
	White (Steward) *UBV* c-m, l.f., DDO of RG
5986	Harris (e) *UBV* c-m
	Alcaíno (ESO) *BV* c-m
	White (Steward) *BV* c-m, l.f.
6093 (M80)	W. Harris, Racine (11.154.015) *BV* c-m
	Grasdalen (12.154.011) integr. *JHK*
	Illingworth (**20**, **21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M*/*L*
6101	Alcaíno (12.154.003) *UBV* c-m
	White (Steward) *UBV* c-m, l.f., DDO of RG
6121 (M4)	Eggen (07.113.007) *UBVRI* of RG
	Philip (07.154.007, 09.154.014, 13.154.013) *uvby* of HB
	Moshkalev (11.154.008) *BV* c-m
	Alcaíno (ESO) *BV* c-m
6205 (M13)	Simoda, Tanikawa (07.154.002) l.f.
	Philip (07.154.007, 12.154.005, 13.154.013) *uvby* of HB
	Osborn (07.154.030, 10.154.018) DDO of RG
	Kuzmin *et al.* (09.154.008, 10.154.021) surf. br.
	Faber (09.158.027) integr. 10-color
	Rusev (11.113.007, **i**) i-r of RG, sp. search for TiO
	Auer, Norris (12.114.109) He abund.
	Zinn (12.122.069) T_e of uv-bright st.
	Cathey (12.154.019) *UBVR* of RG, AGB, sub-G
	Butler (**g**) *E* (*B-V*)
	Cudworth (Yerkes) p.m.
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	Toyama, Nishimura, Kaneko (Tokyo) l.f., color, distr.
	Wilson (Yale), King (Berkeley) l.f.
6229	Grasdalen (12.154.011) integr. *JHK*
6254 (M10)	Osborn (07.154.030, 10.154.018) DDO of RG
	Faber (09.158.027) integr. 10-color
	Zinn (12.122.069) T_e of uv-bright st.
	W. Harris (e) *UBV* c-m
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
6256	Terzan, Lelièvre (10.153.024) new globular?
	Bernard (Lyon) *UBV* seq.
6266	Illingworth (**20**, **21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M*/*L*
	W. Harris (e) *UBV* c-m
	Alcaíno (ESO) *BV* c-m
	White (Steward) *UBV* c-m, l.f.
6273	W. Harris (e) *UBV* c-m
6284	Grasdalen (12.154.011) integr. *JHK*
6304	Hesser, Hartwick (**j**) *BV* c-m, *d*, *E*, also current *uvbyβ*, DDO
	Bernard (Lyon) *UBV* seq.
6325	W. Harris (e) *UBV* c-m
6341 (M92)	Eggen (07.113.007) *UBVRI* of RG
	Philip (07.154.007) *uvby* of HB
	Faulkner (07.154.019) He abund.
	Osborn (07.154.030, 10.154.018) DDO of RG
	Hogner *et al.* (08.154.007) equidensity curves
	Zinn (09.114.148) G-band of RG
	Kuzmin *et al.* (09.154.008, 10.154.021) surf. br.
	Faber (09.158.027) integr. 10-color
	Böhm-Vitense (10.154.003) T_e, *g*
	Rusev (11.113.007) i-r of RG
	Zinn (12.122.069) T_e of uv-bright st.
	Kadla (12.154.018) *UBV*, uv-excess
	Cathey (12.154.019) *UBVR* of RG, AGB, sub-G
	Butler (**g**, **k**) *E* (*B-V*), C and N abund. in sub-G, AGB
	van den Bergh (**l**) l.f. to $V = 23.2$
	Cudworth (Yerkes) p.m.
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	Illingworth (Berkeley) vel. disp., l.f. and distr. for 25,000 st., $B < 23.3$
	Fukuoka, Simoda (Tokyo) l.f.
	Toyama, Nishimura, Kaneko (Tokyo) l.f., color, distr.
	Takikawa, Simoda (Tokyo) c-m

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Table 3. (Continued)

NGC	Observer and data
	Pulkovo *BV*, p.m.
	Wilson (Yale), King (Berkeley) l.f.
6342	Grasdalen (12.154.011) integr. *JHK*
6352	Hesser (CTIO), Hartwick (Victoria) DDO of RG
	Hesser (CTIO) *uvbyβ*, *BV* c-m to MS
6356	Faber (09.158.027) integr. 10-color
	Walker (Lick) spectracon *BV* c-m, $V < 21$
6366	Walker (Lick) spectracon *BV* c-m, $V < 21$
6388	Illingworth, Freeman (11.154.011) mass
	Scott, Rose (13.154.005) H II detectable?
	Illingworth (**20, 21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M/L*
	White (Steward) *UBV* c-m, l.f., DDO of RG
6397	Cannon (11.154.017) *UBV*
	Mallia (13.154.003, 13.154.018) AGB, mem. from r.v.
	van den Bergh (Toronto) J-plate seq. to 24^m
	Alcaíno (ESO) *BV* c-m
	Stock, Clariá (Mérida) r.v. pec. st.
6402 (M14)	Mironov (10.154.017) c-m
	Smith Kogon, Wehlau, Demers (11.154.012) *BV* c-m, *d*, *E*
6440	Grasdalen (12.154.011) integr. *JHK*
	Markert *et al.* (in press) X-ray source
6441	Giacconi *et al.* (11.142.035) X-ray source
	Clark, Markert, Li (**15**) X-ray source
	Hesser, Hartwick (**m**) *BV* c-m, *d*, *E*
	Illingworth (**20, 21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M/L*
	Hesser (CTIO), Hartwick (Victoria) *uvbyβ*, DDO
6517	W. Harris (**e**) *UBV* c-m
6522	Grasdalen (12.154.011) integr. *JHK*
6528	Grasdalen (12.154.011) integr. *JHK*
6553	Hartwick (13.154.008) *BV* c-m
6624	Canizares, Neighbours (**16**), variable X-ray source
	M. Liller, W. Liller (Harvard) *BV* c-m
	N. Bahcall (Princeton) central light distr.
6638	Bernard (Lyon) *UBV* seq.
6652	Grasdalen (12.154.011) integr. *JHK*
6656 (M22)	Eggen (07.113.007) *UBVRI* of RG
	Butler *et al.* (09.122.008) [Fe/H] from RR Lyr
	Evans (13.154.015) *BVI* of RG, AGB
	Butler (**g**) *E* (*B-V*)
	Lee (Stromlo) *BV* c-m, l.f.
	Alcaíno (ESO) *BV* c-m

NGC	Observer and data
	Griffin (Cambridge), Gunn (Hale) r.v. of indiv. st.
	White (Steward) DDO of RG, AGB, BHB, sp. of RG
	Hesser (CTIO) and Hartwick (Victoria) *uvbyβ*, DDO
	Philip (Albany) *uvby* of BHB
6681	Grasdalen (12.154.011) integr. *JHK*
	W. Harris (**e**) *UBV* c-m
6712	Butler (**g**) *E* (*B-V*)
6715	Grasdalen (12.154.011) integr. *JHK*
	Illingworth (**20, 21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M/L*
	W. Harris (**e**) *UBV* c-m
6723	Menzies (12.113.001) *UBV* c-m
6752	Eggen (07.113.007, 08.154.014) *UBVRI* of RG, AGB, sub-G
	Cannon, Stobie (09.154,016) *UBV*
	Wesselink (12.154.001) *BV* c-m
	Cannon (Edinburgh), Lee (Stromlo) *BV* c-m, l.f.
6779(M56)	Faber (09.158.027) integr. 10-color
6809 (M55)	Philip (13.154.013) *uvby* of BHB
	W. Harris (**e**) *UBV* c-m
	Lee (Stromlo) *BV* c-m, l.f.
	Alcaíno (ESO) *BV* c-m
	Trimble (Irvine) search for W UMa st.
6838 (M71)	Cuffey (09.153.035) *UBV* standards
	Rusev (11.113.007) i-r of RG
	Butler (**g**) *E* (*B-V*)
	Walker (Lick) spectracon *BV* c-m
	Philip (Albany) *uvby*, *by* c-m
6864 (M75)	Grasdalen (12.154.011) integr. *JHK*
	W. Harris (**e**) *UBV* c-m
	Illingworth (**20, 21**) surf. br., cts., *d*, *E*, diam., vel. disp., *M/L*
6934	Racine, Harris (09.154.009) *BV* c-m
	Mironov (11.154.030) c-m
	Grasdalen (12.154.011) integr. *JHK*
	Terzan, Rutily (Lyon) *R* seq.
7006	Hartwick, McClure (08.154.002) DDO, N abund.
	Grasdalen (12.154.011) integr. *K*
7078 (M15)	Demarque, Mengel, Sweigert (07.154.013) explanation of gaps in c-m
	Faber (09.158.027) integr. 10-color
	Böhm-Vitense (10.154.003) T_e, *g*
	MacGregor, Phillips, Selby (10.154.007) tentative 10μ detection
	Zinn (12.122.069) T_e of uv-bright st.
	Caloi, Panaggia (12.154.016) nature of possible 10μ source
	Castellani, Martini, Petitti (13.154.011) i-r for mem.
	Giacconi *et al.* (11.142.035) X-ray source

Table 3. (Continued)

NGC	Observer and data	NGC	Observer and data
	Clark, Markert, Li (15) X-ray source		W. Harris (e) *UBV* c-m
	Butler (g) *E* (*B-V*)	7099 (M30)	Castellani, De Amicis, Smriglio (11.154.020) i-r for mem.
	Newell, Norris (Stromlo, Yale) high-res *UBV* surf. br. at center	(M30)	Butler (g) *E* (*B-V*)
	White (Steward) DDO of RG, AGB, BHB, sp. of RG. AGB		Alcaíno (ESO) *BV* c-m
	Philip (Albany) *uvby*, *by* c-m	IC 4499	Fourcade, Laborde, Arias (12.154.002) *BV* c-m
	Illingworth (Berkeley) vel. disp.		Cannon (Edinburgh), Lloyd (RGO) *BV* c-m
	Cudworth (Yerkes) p.m., vel. disp.		
7089 (M2)	Eggen (07.113.007) *UBVRI* of RG	Pal 12	W. Harris (Yale), Canterna (Washington) *UBV* c-m
	Faber (09.158.027) integr. 10-color		
	Kuzmin *et al.* (09.154.008, 10.154.021) surf. br.	Pal 15	Kinman (KPNO) faint seq.
	Butler (g) *E* (*B-V*)	Ret	Demers, Kunkel (n) new globular, *BV* c-m; from MW or LMC?

Abbreviations: AGB = asymptotic giant branch, BHB = blue horizontal branch, c-m = color-magnitude array, cts. = star counts, *d* = distance, *E* = color excess or reddening, *g* = surface gravity, i-b = intermediate band, l.f. = luminosity function, mem. = membership, p.m. = proper motion, RG = red giants, r.v. = radial velocity, sp. = spectra, st. = stars, sub-G = subgiants, T_e = effective temperature.

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