37. COMMISSION DES AMAS STELLAIRES ET DES ASSOCIATIONS

Report of Meetings

President: H. Haffner.

Secretary: G. Alter.

Business Meeting, 26 August 1964

In opening the session, the President referred to the Draft Report and asked the participants to communicate necessary changes, deletions, additions, misprints etc. to the Secretary.

The President then pointed out that time has come to rectify the terminology of open or galactic clusters. Since the term 'galactic' is nowadays of a purely topographical character referring to objects which are clearly members of the Galactic System (a great number of 'galactic clusters' have been detected in extragalactic objects), it appears advisable to designate those clusters by the term open instead of galactic clusters, so as to prevent designations like galactic galactic clusters or extragalactic galactic clusters. This recommendation was agreed to.

The President announced that a second edition of the *Catalogue of Star Clusters and Associations* by G. Alter, J. Ruprecht, and V. Vanýsek will be prepared. Some objections have been raised against the quality of the paper on which the first edition of the card catalogue was printed. Since a better quality can be assured only if the Publishing House of the Czechoslovak Academy of Sciences is granted financial support, it is proposed to ask the Finance Committee to aid the publication of that valuable astronomical tool by granting a sum of about \$3000—only for the purpose of better quality paper.* W. Becker objected to the designation GC which can be read either as galactic or globular cluster. The abbreviation should be single-valued. He further recommended a revision of abbreviations in the card catalogue, e.g. *Diam* instead of *D*, and *dist.* instead of *d*. Becker's question whether the Supplements could not be printed on one side only was answered by Alter negatively, since this would mean a great wastage of paper.

The President then introduced Alter's proposal of renumerating the Open Clusters in the second edition of the *Catalogue of Star Clusters and Associations* according to the natural system of galactic co-ordinates instead of the equatorial co-ordinates hitherto used.

Some discussion arose on the apparently different meaning of the term 'natural system' as seen either from an observer at the telescope or from an investigator of galactic structure. The proposal of G. Alter was finally agreed upon. An example of the new system of designation is given in the *Transactions IAU*, **12A** (Agenda and Draft Reports), 1964, page 579.

A. R. Hogg reported on the progress of an atlas covering Open Clusters south of $-45°$ declination. Reproductions of 99 blue plates taken with the Mt Stromlo 74-inch reflector have been prepared and will shortly become available with a set of remarks concerning each field. Some sample photographs were passed.

The President pointed to the desire to have something similar for the northern clusters. There is a suitable telescope at Merate-Milano ($f = 750$ cm, $ø = 50$ cm), but the question now is not only an instrumental one but concerns also staff.

*The Executive Committee, at its session on 1 September 1964, granted a contribution towards this project of \$1500.

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

G. Lyngå stressed the need of checking the reality of many of the clusters recently discovered. Stronger criteria should be used when accepting an object as a cluster, e.g. observations with two different instruments possibly of different scale or colour magnitude diagrams.

On the recommendation of S. van den Bergh it was agreed that authors of colour magnitude diagrams should use a standard scale 1:5 between colour index and magnitude in order to facilitate comparison of such diagrams.

M. F. Walker proposed the following resolution: Commission 37 requests that observers publish identification charts and photometric data for all stars observed in clusters.

The subsequent discussion (C. A. Murray, U. Steinlin, M. Walker) showed clearly both the urgent need of having full access to photometric cluster data and the many difficulties arising from the proposed procedure, as most journals refuse to publish longer lists of observations. Observers are requested to communicate, if necessary, with the President of Commission 37 who will determine what problems exist regarding the publication of such observations and will take steps to solve them. Some sort of IAU-publication of a relatively inexpensive form where all this material is collected and easily available may provide the desired solution.

The President then reviewed the recommendation of Commission 37 concerning the revision of the nomenclature of associations (see *Transactions IAU*, **11B**, p. 340) and introduced J. Ruprecht for presenting the new proposals.—*J. Ruprecht:* The reason for the disagreement of the designations was the fact that for the greater part of the associations defined in Burakan the lists of stars belonging to individual associations had not been published. Distances mentioned for individual associations by Markarian in 1952 were mostly underestimated, because the high luminosities of several stars have not been taken into account and the interstellar absorption has been over-estimated. When K. H. Schmidt in 1955 published a list of 62 groups of early stars, the coincidence between them and Markarian's associations was in several cases not correctly defined. During my visit at Burakan Observatory at the end of 1963, I had the opportunity of studying the star lists of individual associations. By studying Schmidt's material, i.e., Hiltner's catalogue of OB stars, the reality of all groups newly defined by Schmidt was checked. In each case the space density of individual groupings was compared with the average density of all stars in Hiltner's catalogue. The results of this investigation are contained in the tables distributed among the members of this Commission. Table I contains the suggested new designation; some of the groupings found by Schmidt or other authors were included in Table II as doubtful and Table III lists groupings rejected as real associations. In three cases no unambiguous proposal could be suggested. They are: Sgr VII, no. 2 of Table I (is this a separate association or should it be joined with association Sgr IV?); Car II, no. 47 of Table I (is it to be listed separately or included in Car I?); Sco IV, no. (11) of Table II (should this doubtful association be included among the undoubted objects of Table I?). I should like to suggest that the Working Group established at Berkeley turn its attention to a special consideration of these three cases.

The President expressed the high appreciation of the whole Commission 37 for the valuable and painstaking work of J. Ruprecht. During the subsequent discussion it became clear that at this advanced stage of a system of designations of associations it would be only a minor task to go one step further and to simplify the proposed system by replacing the hitherto used Roman numbers by Arabic numbers affixed to the letters OB and the respective constellation. These recommendations were agreed to. The President then proposed to publish Ruprecht's tables, changed according to these recommendations, in the *Transactions*. This proposal was adopted by the Commission. See page 347 in appendix to this report.

L. O. Lodén noted that there are a number of clusters of associations which do not appear on direct photographs but only on objective prism plates where they show a number of identical or nearly identical spectra of identical or nearly identical apparent magnitudes within a very small field of the sky ($5' - 30'$). Are they to be classified as real clusters, apparent clusters, associations or agglomerations? May be that 'spectroscopic cluster' would be the most adequate designation.

H. van Schewick pointed to the fact that in publications of proper motions of cluster stars frequently only the proper motions and the positions of the stars are given. It is suggested that in order to facilitate identification of the stars their numbers in one of the photometric or other catalogues be listed.

Scientific Meeting, 27 August 1964

R. M. Petrie reported on spectroscopic magnitudes of early-type stars in studies of Open Clusters: A revision of the relation between the total absorption at Hγ and absolute magnitude has recently been completed. This relation, and the associated spectral-type corrections, cover the spectral-type range O6 to A3. The shape of the curve was found by fitting together cluster sequences on an Hγ-apparent magnitude diagram. The clusters used in this work are the Pleiades, the Alpha Persei cluster, NGC 2244, and the associations I Orionis and h, χ Persei.

The zero point of the calibration is found from absolute magnitudes given by:

(*a*) stars of large trigonometric parallax,
(*b*) visual binaries with one component of solar type which can be fitted to the Hyades main sequence, and
(*c*) eclipsing binaries with well determined radii and effective temperatures.

The new calibration gives distance moduli of several star clusters and associations in close agreement with those of the photometric distance scale based upon colour-magnitude plots. A particularly interesting feature of the calibration is its freedom from the evolutionary effects which are so clearly revealed in colour-magnitude plots and which must be allowed for in obtaining distance moduli from such plots. The Hγ-absolute magnitude plot for a star cluster is, apparently, a single-valued relation, within the accuracy of the observations.

The above-mentioned feature of the calibration suggests a relatively simple way of detecting non-members of a star cluster by plotting the spectroscopic absolute magnitude derived from Hγ against the apparent magnitude corrected for interstellar extinction. On such a plot the members of the cluster will lie along a straight line inclined at $45°$ to the axes while non-members will depart from this line and can often be eliminated. Some of the departures will be caused by stars which are binaries and their existence may be revealed in this way. The plot will, incidentally, supply the distance modulus of the cluster since the modulus is the value of V_0 on the straight line at $M = 0$.

A major obstacle to rapid progress in the study of star clusters is the large amount of time required to obtain spectroscopic observations to distinguish members from non-members. The method suggested here will be much faster since all the necessary observations can be obtained from photoelectric photometry. The Hγ intensities may be deduced from the β indices as measured by Strömgren, Crawford, and others, or from the Γ indices as measured by Bappu *et al.* and by Beer. The *UBV* photometry is readily obtained as the stars considered are usually the brightest members of the cluster.

The method outlined here is, of course, very like the use of colour-magnitude plots which also detect non-members and binaries, and yield distance moduli. The advantage of the $M - V_0$ plot appears to lie in the fact that it is not affected by evolutionary changes and corrections for age effects do not have to be applied before membership in the cluster can be tested. On the other hand groups of stars which are thought to be very young have had little weight in forming the Hγ calibration and it has not been positively demonstrated that the relation is valid for the youngest stars.

W. Becker: The Hγ luminosity classification method is one of the few which can be applied to a large extent to early-type stars and which gives reliable results. Therefore, I recommend to apply it really to a large extent to O, B0, B1, B2 stars. But not so much to early stars in general but to such stars which are responsible for H II regions because the H II regions show a much stronger concentration to spiral arms than early-type stars in general do. *Miss A. B. Underhill* commented: From the astrophysical view point one may expect W (Hγ) to correlate well with M_V because W (Hγ) is determined chiefly by the extended wings of the H lines and these depend strongly on electron pressure. The central intensities of the H lines are not so directly a function of electron pressure. Rather the measured value is determined by casual effects such as amount of rotation or turbulence and the temperature distribution in the outer layers of the atmosphere. These latter effects are not necessarily related uniquely to electron pressure or visual absolute magnitude. *A. A. Hoag* reported that Hγ observations of selected stars in 60 Open Clusters are to be published in the proceedings of an ONR Symposium on 'Basic Data Pertaining to the Hertzsprung-Russell Diagram' which was held at the U.S. Naval Observatory, Flagstaff, 20–24 June, 1964.

W. Buscombe spoke about stellar spectra in Open Cluster IC 2391: Slit spectrograms (90 Å/mm) of 38 stars in the region have been analysed and MK-classifications obtained. The mean radial velocity for 30 members is $+ 14 \pm 0{\cdot}7$ km s^{-1}. At least 12 stars show velocity variations which may indicate motion in binary orbits.

The cluster is of intermediate age and includes many A stars with enhanced lines of certain metals. An explanation is sought for the discrepancy between the spectroscopic distance modulus of $6{\cdot}6 \pm 0{\cdot}1$ mag (derived from Sinnerstad's calibration of central depth and equivalent width for the lines Hγ and Hδ), and the value 6·0 mag derived from *UBV* photometry.

D. Sher reported on Open Clusters near Eta Carinae: Of the nineteen clusters studied so far in the vicinity of Eta Carinae ($10^h20^m < \alpha < 11^h45^m$, $-65° < \delta < -57°$) eleven have been found to contain OB stars. Four clusters in the region seem to have an age of about 10^8 years and one, NGC 3496, is about 10^9 years old. Tr 15, in the direction of NGC 3372, the Eta Carinae nebula, could be young but only an estimate of its distance and the intervening absorption have been published to date. Possibly, Tr 17 is just an irregularity in the field and the results obtained so far for Mel 101, both published and unpublished, are a bit discordant.

All the OB clusters in the region, with the notable exception of IC 2602, which could be a member of the Scorpio-Centaurus association, are well over a kiloparsec away. The most distant clusters are Westerlund 1 (6 kpcs), NGC 3603 (3·5 kpcs), and NGC 3572 (2·8 – 3·3 kpcs), with corresponding absorption, A_V, respectively, of from about 1^m to $6^m\!.5$, 4^m and 1^m.

Westerlund 1, Tr 14, 15, and 16, NGC 3603, and IC 2944 all seem to be associated with Hα regions, but of these regions only those around Tr 14, 15, and 16—the Eta Carinae nebula—and IC 2944 are impressive optically. However, at about 1400 Mc/s, in the radio continuum, the nebulosity associated with the grouping of O stars in IC 2944 is relatively much less conspicuous than that associated with Westerlund 1 or NGC 3603 or, indeed, with the Eta Carinae nebula itself—in fact these last three objects were recently found to be amongst the strongest discrete sources of thermal radio noise in the southern Milky Way. Weak nebulosity is also seen in the same direction as NGC 3293—a cluster of early-type stars immediately preceding the Eta Carinae nebula and NGC 3572.

The group of stars near Theta Carinae is the Theta Carinae cluster IC 2602. It has been suggested this is part of the Scorpio-Centaurus association. The motions are uncertain, but A. Blaauw in a review which has not yet been published seems content to let it be part of the association. Several authors have named young clusters in Carina as this or that association and the result is rather confusing. IC 2602 remains a foreground object regardless.

L. Gratton commented: In discussing the distance of the OB-association connected with the Eta Carinae nebula (NGC 3372), I obtained on various ground in 1954 a distance modulus of $12\overset{m}{.}3$. Later, I got at Córdoba the spectra of several early-type stars from Morgan and Münch list. Among these, three are Wolf-Rayet stars, and two are A supergiants; the rest are main sequence stars from O9 to B2. From the strength of the interstellar Ca-lines I estimate that all these stars are more or less at the same distance, with the possible exception of a carbon Wolf-Rayet star and a probable foreground B2V star. The distance modulus of the remaining stars is $11{\cdot}4 \pm 0{\cdot}5$ (estimated p.e.). Adopting an absorption of $0\overset{m}{.}7$ we get a distance of 1·4 kpc.

This distance, however, seems to me too small because, due to selection effects, the absolute magnitude of the stars observed might be brighter than average. Besides, the adopted absolute magnitude of the 2 Wolf-Rayet stars might also be too faint. However, a distance modulus of 12^m is just the largest I feel disposed to accept.

A. Feinstein referred also to O and B stars in the Carina region: We had observed photoelectrically during the last summer at La Plata and at Cerro Tololo, a list of around 140 early-type stars (O and B) in a region of galactic longitude 283°–297°. All these stars between 6 and 9·5 magnitude have known spectral types and luminosities in the MK system. The observations were made in the *UBV* system.

With the observations we made two diagrams. The first is the galactic longitude against the distance modulus. This diagram shows that most of the stars are at a distance more than 1600 pcs ($m_0 - M = 11{\cdot}0$). In the second diagram, distance modulus against absolute magnitude, we can see more easily that for $m_0 - M < 11{\cdot}5$, all the stars have absolute magnitude $M > -3$. But, at a distance of $m_0 - M = 11{\cdot}5$ (around 2000 pcs) begin to appear some very high luminous stars, which are quite conspicuous. This is a very good agreement with the radio observations of the hydrogen line.

A few of these very luminous stars are the brightest stars of some Open Clusters, accordingly situated at distances larger than 2000 pcs. But what happens with the stars which are very near to Eta Carinae? In 1962–63, we observed the stars which are in a radius of about two minutes of arc, that is the cluster Tr 16 (*Publ. astr. Soc. Pacif.*, Dec. 1963). We concluded from that work that all the stars belong to a cluster. If we include in the colour-magnitude diagram the stars that we observed now, around a circle of 5′ of radius, we see that all these stars fall in the main sequence of age zero. We had included now one star of spectral type O5 which would be the brightest of the group. This star is nearly on the main sequence.

There is a Wolf-Rayet star very near to Eta Carinae, but according to its magnitude and colour it does not seem to belong to the cluster.

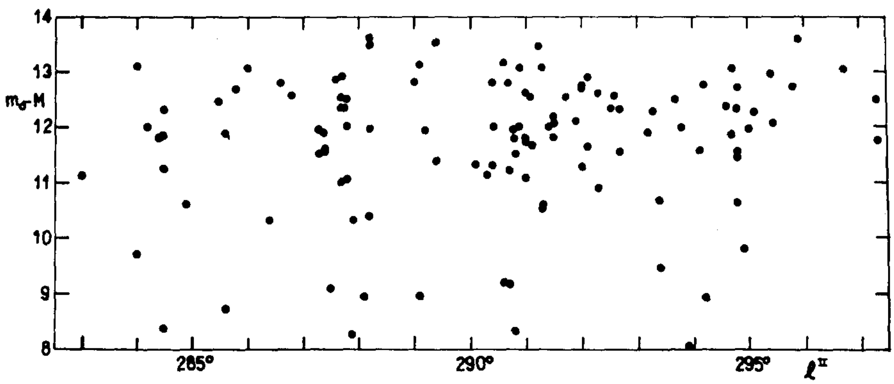

Fig. 1.

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

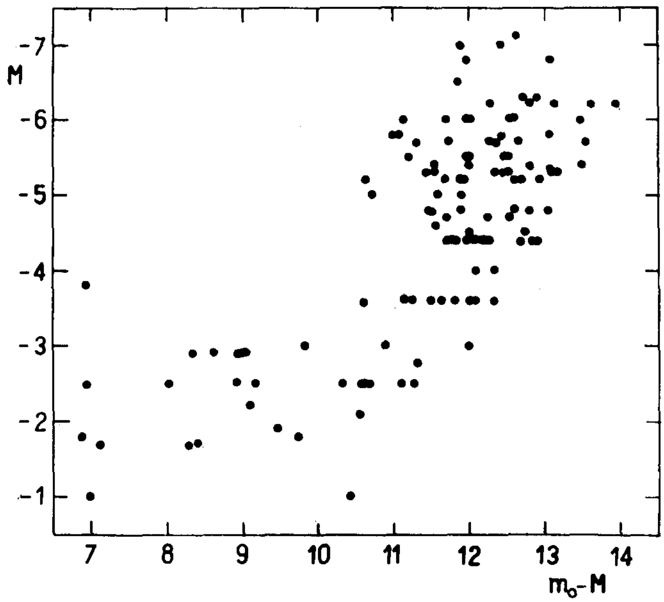

Fig. 2.

We made also observations of the star Eta Carinae during the last season to check if it is variable. The results show that the colours and the magnitude are completely stable, at least with $0^m.03$.

M. F. Walker discussed *UV* excess in globular clusters and, in a second contribution, in gravitationally contracting stars in the extremely young clusters NGC 2264 and the Orion Nebula.

I. *UV* Excess in Globular Clusters. In several globular clusters, the red giant branch is observed to be bifurcated. It has been suggested that the stars in the bluer of the two red giant sequences represent objects which have passed through the extreme red giant phase and are either (1) descending the red giant branch to transit the RR Lyrae gap or (2) stars which have moved quickly to the left in the $C - M$ diagram and are now again evolving to the right, up the giant branch, without mixing. It is also now supposed that during the extreme red giant phase, extreme convection occurs. Thus, if either (1) or (2), alone, are true, we might expect to detect a difference between the stars of the two red giant sequences in the sense that those having passed through the extreme red giant phase will show an increase in metal abundance due the material from the core, enriched by nuclear reaction processes, being carried into the outer layers of the atmosphere.

Examining those globular clusters for which adequate *UBV* photometry has been published (M3, M5, M92, Sandage and Walker, unpublished), one finds that indeed the stars on the 'blue' red-giant sequence in M3 and M92 have a smaller *UV* excess than those on the 'red' sequence. In M5 little or no difference exists. M3 and M92 are metal poor; M5 is relatively rich. Thus this difference in *UV* excess in M3 and M92 could arise either from an increase in metal abundance in the atmosphere or from differences in temperature and gravity between the stars on the two sequences. Theoretical $U - B$, $B - V$ colours for different temperatures and surface gravities have been computed for stars having no absorption lines, using the stellar models of de Jager and Wiven. Comparison with the observations suggests that the *UV* excess difference may really be due to a change in metal abundance. However, more detailed theoretical calculations for different metal abundances are required before the hypothesis can be considered proved.

II. *UV* Excess in gravitationally contracting stars in the extremely young clusters NGC 2264 and the Orion Nebula. About ten years ago, it was found by Haro and Herbig, and independently by Walker, that certain faint (T Tauri or RW Aur) stars in the Orion Nebula and in NGC 2264 have ultra-violet excesses. Since 1960, observations of these objects have been obtained with the 120-inch Lick reflector and (1) the Lallemand electronic camera attached to the 20-inch Schmidt camera of the coudé spectrograph and (2) the prime focus spectrograph and baked IIaO plates. The dispersions were: with (1) 49 Å/mm and with (2) 100 Å/mm. To date, 23 of these stars have been observed. The spectra consist of:

(*a*) emission lines of hydrogen, Ca II, and sometimes Fe I and He I;

(*b*) a blue continuum which is partly or completely obscured;

(*c*) an underlying late-type absorption spectrum.

Ten of the observed stars show, in addition, an 'inverse P Cygni' or 'YY Orionis' spectrum consisting of redward-displaced absorption lines of H and sometimes Ca II overlying the emission lines and blue continuum. These lines are displaced 150–300 km s^{-1} to the red. They sometimes disappear in a particular star, but when visible seem always to be shifted to the red. It is assumed that these absorptions result from infall of material. There is an absolute magnitude effect: The 'YY Ori' spectrum occurs more frequently among the brighter of the *UV* excess stars. This is consistent with the hypothesis of infalling material. Where large infall occurs, the redward-displaced lines become visible and the stronger interaction between the infalling material and the stellar atmosphere causes a greater brightening of the system than in objects of little or no infall.

The fact that about half of the observed *UV* excess stars show the YY Ori effect while hardly *any other* stars show such a spectrum indicates a causal relationship, presumably, as indicated above, the result of interaction of the infalling material with the stellar atmosphere. It is still not clear, however, what the nature of the *UV* excess is. Plates taken with the coudé spectrograph and Lallemand image tube have been used to derive the energy curve for several of the *UV* excess stars. The last observations obtained using the spectrograph slitless to avoid light loss at the slit and calibrated by comparison with a hot star of known energy distribution, indicate that the energy curve continues to rise below the Balmer limit to at least 3500 Å. This result shows that Balmer continuum emission cannot explain the excess. It appears possible that Balmer continuous emission plus 2-photon emission might explain the excess, provided that the excitation temperature is about 30 000°K. The energy to provide this temperature might result from collisional excitation by the infalling material.

Additional evidence that the *UV* excess is not entirely Balmer emission is provided by HS Ori. This star has almost the same spectrum as RW Aur: many emission lines, but no hydrogen emission shortward of about H8. However, HS Ori has a *strong UV* excess while RW Aur does not.

Regardless of the nature of the *UV* excess (and also of the blue continuum), the observations suggest the following model:

(1) lowest layer = photosphere, late type absorption spectrum;

(2) 2nd layer: origin of blue continuum and/or emission lines;

(3) 3rd layer: infalling material.

The model is thus essentially the same as that proposed by Herbig for normal T Tau stars, with the difference that in the *UV* excess stars, infall of material dominates, whereas in regular

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

T Tau stars the dominant phenomenon observed is the *ejection* of matter (normal P Cyg spectrum).

The *UV* excess stars so far observed are:

(*a*) Stars showing 'YY Ori' or 'inverse P Cyg' spectrum:
MO Mon, MM Mon, YY Ori, SY Ori, LX Mon, SU Ori, Brun 637, NS Ori, XX Ori, CE Ori.

(*b*) Stars not showing YY Ori spectrum:
BC Ori, LT Mon, Brun 134, AL Ori, NX Mon, LU Mon, YU Ori, HS Ori, VX Ori, VY Ori, KP Ori.

W. Becker: The D-M diagram for M3 has shown partly a separation of normal cluster stars and the *UV*-excess stars. Such a diagram for a globular cluster comprises only 5% to 10% of the total number of stars in a globular cluster. If one could measure 30% or 50% of the cluster stars it may be that the separation will turn over to a continuous segregation.

Scientific Meeting, 28 August 1964

In opening the meeting, the President read the recommendations of the first meeting, which were adopted by the Commission.

W. J. Luyten requested that all observers and authors who publish any kind of data for any cluster also give, at the beginning of their paper, the α and δ of the object, and not merely the NGC number or a number in some other catalogue.

The President then announced the proposed constitution of Commission 37.

President: M. F. Walker

Vice-President: G. Alter

Organizing Committee: O. J. Eggen, A. R. Hogg, P. N. Kholopov, W. Becker, L. Rosino, Miss H. H. Swope.

New members of Commission 37: B. Balázs, H. L. Johnson, Pik Sin The, J. Ruprecht, U. W. Steinlin.

S. Günther reported on slowly variable stars in the Pleiades. In the Pleiades several stars with $11^m < V < 13^m$ have been found to vary slowly but regularly in brightness. The 'periods' are 30 years and greater. The amplitudes scatter between $0^m < \Delta m \leqslant 0^m\!.35$ and may be correlated to the intensities of the bright H- and K-lines measured by O. C. Wilson (*Ap. J.*, **138**, 832, 1963). For these stars flares, as they are indicated for a few fainter stars, could not be ascertained. Most of the faintest stars $14^m < V < 16^m$ seem to be constant. Other results concerning the main sequence and stars below it are given in *Mitt. Astr. Gesellschaft*, 1963.
P. J. Treanor: I should like to mention here that in a recent infrared objective prism spectral survey of the Pleiades McCarthy and I have identified some 125 late K and M stars, about 20 of which appear to be M dwarf cluster members with photographic magnitudes fainter than 16, and lying on the main sequence. We have not been able to study this material for variable stars but positions and finding charts for these objects are being published in an article now in press in *Ricerche Astronomiche*. We hope that other observers may be interested in examining these stars for variations (see also report on Meetings of Commission 29).

T. D. Kinman described a photometric and spectroscopic study of the Open Cluster NGC 6791. A colour magnitude diagram ($12 < V < 20$) of this populous Open Cluster which was obtained with the 120-inch reflector showed it to be similar to the well evolved cluster NGC 188. An interstellar reddening (E_{B-V}) of 0·20 mag was deduced from *UBV* photometry of the bluer field stars and from 200 Å/mm spectra of cluster giants. Neglecting any correction of the colours for line-blanketing, the cluster modulus is 13·50 corresponding to a distance of

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

5 kpc and height above the galactic plane of 945 pc. The colour-magnitude diagram shows a sequence of stars between $M_V = +1$, $(B-V)_0 = +0{\cdot}4$ and $M_V = +3$, $(B-V)_0 = +0{\cdot}8$, which are too numerous to be a chance group of field stars and which show a similar distribution in the cluster as the red cluster giants. Spectra (200 Å/mm) of the red cluster giants show that the cluster radial velocity is about -70 km/sec, so that a separation of cluster stars from field stars (which have a radial velocity close to zero in this part of the sky) is possible. It is found from this radial velocity criterion that a broad quasi-horizontal branch exists in this cluster from $M_V = +0{\cdot}5$ at $(B-V)_0 = +1{\cdot}2$ to between $M_V = +1$ to $+2$ at $(B-V)_0 = +0{\cdot}4$, although no cluster stars were found in the colour range $0{\cdot}7 < (B-V)_0 < 0{\cdot}9$. The limiting radius of the cluster (14 pc) is reasonably compatible with the predicted tidal radius (19 pc, for a cluster mass of 3700 $M_{\odot}$) since a somewhat eccentric galactic orbit is not unlikely for this cluster. *I. King* commented: This is an excellent cluster to study; it may well be the richest of all Open Clusters. On the Palomar Sky Atlas it looks almost globular. It would be most important to blink this cluster. We have the problem of the high-metal-abundance RR Lyrae stars, which have never been placed in any HR diagram. Here is a hope of finding one or two.

W. Dieckvoss remarked on proper motions in the field around Alpha Persei: R. M. Petrie derived a convergent point for the Perseus Cluster from the proper motion material for 161 'members' published in 1953 at Bergedorf. This convergent is discordant with new radial velocities derived by Petrie, insofar as the angle distance of the convergent seems to be definitely less than 90° whereas the r.v. are clearly negative.

The final system of the Bergedorf 1953 p.m. depends on values taken from the G.C. Discussion of 'field-stars' showed systematic runs in p.m., depending on position in the field, up to about ″·05 on the edge in the form of a (probably spurious) contraction (see the end of the paper of Heckmann, Dieckvoss, Kox). When this effect was allowed for, the cluster stars showed a linear expansion. Subsequent photometric work of Heckmann and Lübeck left only 107 cluster members. These stars alone showed an expansion of exactly zero. It seems fair to state that the whole effect is a sign of systematic errors.

At Bergedorf in 1960 a thesis work was started in an enlarged field around Alpha Persei. The student turned out to become extremely lazy. Now we have taken matters in our own hand, and I think that in a few months we can furnish a clearer picture.

K. A. Strand reported on a proper motion programme on Open Clusters. The U.S. Naval Observatory is planning a proper motion programme with the 61-inch astrometric reflector located at the Flagstaff Station in Arizona. The programme is in some aspects an extension of the proper motion programme carried out with the 40-inch Yerkes refractor previously reported in *Transactions IAU*, **10**, 585, 1958.

For approximately two dozen clusters, plates are available with first epochs between 1903 and 1912 taken by Schlesinger and Parkhurst. Second epoch plates were taken in the late thirties by Ebbighausen closely matching the first epoch plates in magnitude.

Third epoch plates of some of these clusters have been taken in recent years by the writer and others, thus providing a baseline of nearly sixty years on which to determine the proper motions. With a sixty year time interval the yearly proper motions are determined with an accuracy of $\pm 0''{\cdot}0016$ (m.e.) in each coordinate from one pair of plates. The limiting magnitudes of the plates are between 14^m and $14^m{\cdot}5$ (visual).

It is intended to take additional plates of these clusters over the next several years with the Yerkes refractor and at the same time take first epoch plates with the 61-inch astrometric reflector, closely matching the Yerkes plates in limiting magnitude. In this manner it is hoped that with the information obtainable from the plates taken at the same epochs with the two telescopes, direct translation between coordinates obtained from plates taken with either telescope will be feasible. This will then preserve the value of the early plates taken with the Yerkes telescope should this telescope, now nearly 70 years old, become inoperable. The Yerkes telescope has a focal length of 19 m while that of the 61-inch is 15 m. This gives nearly the same scale for plates taken with either telescope ($10''\cdot65$/mm and $13''\cdot5$/mm, respectively). It is also planned to take long exposure plates with the new telescope with measurable images to a limiting magnitude of 19^m (visual). This will require exposure times of the order of 90 minutes. Plates with intermediate limiting magnitudes between $14^m_\cdot5$ and 19^m will also be taken.

Preliminary investigations of plates taken with the new reflector show an attainable accuracy of $\pm\ 0''\cdot040$ (m.e.) in x and y for a single exposure on a plate which means that with a 10 year time interval proper motions can be obtained with an accuracy of $\pm\ 0''\cdot006$ in each coordinate from a single pair of plates. *I. King* asked whether the list includes any clusters for which there is any hope of determining internal velocity dispersion. These would be most valuable for dynamical studies.

K. Aa. Strand: Besides the Orion Nebula Cluster in which the internal proper motions have been determined, I believe there would only be the h and χ Persei clusters, where the r.m.s. proper motions are of the order of $\pm\ 0''\cdot001$/year. *C. A. Murray* remarked: I would like to emphasize the urgent need for taking first epoch plates for the determination of proper motions of globular clusters. On account of their great distances it is necessary to have large numbers of reference stars if the transverse velocities are to be determined with reasonable precision, say $\pm$ 10 km s^{-1}. The limiting factor is the intrinsic dispersion among the proper motions of the foreground field stars, and in order to get enough stars it is necessary to go to faint magnitudes, say 19 mag, depending on the galactic latitude and the size of the measurable field.

S. Vasilevskis referred to his paper in *Astronomical Journal* where a critical review is given on the status of work on proper motions of clusters, and he emphasizes the following:

(1) As W. Dieckvoss has shown in the previous report, extreme care has to be exercised in measurement, reduction, and discussion and that sometimes effects attributed to clusters are actually caused by plate errors not taken into account. For instance, recent measurements at Lick of Pleiades on plates taken with the Yerkes 40-inch refractor in 1905–06 and 1963–64 would show an appreciable expansion of the cluster if it were assumed that the scale coefficient of the plates has not changed during the period between both epochs.

(2) In many cases colour-magnitude diagram and star counts are used in addition to proper motions for segregation of membership of a cluster. In such cases results are useless for discovery of peculiar members not fitting on the normal curve and for establishing the spacial extent of the cluster. In astrometric work the astrophysical criteria can be used only as indicators of the reliability of the proper motion and not as a means of discarding possible interesting members.

(3) Most of the astrometric work on clusters is of accidental character, and not many systematic investigations have been carried out. It is particularly regrettable that many observatories with collections of old cluster plates are not active in using them for proper motion determination. Such observatories should be urged to consider possibilities of activity in the field. *W. J. Luyten* suggested that for the determination of proper motions of clusters the usefulness of Schmidt plates not be overlooked. Using several pairs of plates of Praesepe with an interval of 13 years we find we can get motions with a mean error of $\pm\ 0''\cdot004$. *W. Dieckvoss* mentions Praesepe which is definitely not expanding. *K. Aa. Strand* points out that no expansion was found on plates of M 39 and NGC 2099.

C. A. Murray reported on an investigation at Herstmonceux of M 67 and Omega Centauri.

The material for the study of M 67 were van Maanen's plates taken with the 60-inch reflector at Mount Wilson and second epoch plates obtained by Sir Richard Woolley and myself during a visit to Mount Wilson as guest investigators three years ago. In addition, we have an old plate taken with the 26-inch refractor at Greenwich which was matched with a new plate. I would like to support the remarks of S. Vasilevskis on the need for selection of cluster members on purely astrometric grounds, without appeal to a subjective view of where cluster members ought to be found on the $C - M$ diagram. We were very fortunate in having the three-colour photometry by Johnson and Sandage made available to us, and we are very grateful to A. Sandage for it. His photometric results will in fact be published together with our astrometric measures in a forthcoming *R. O. Bulletin.*

The first slide shows the $C - M$ diagram for all stars in the field and the second slide only the stars selected as probable cluster members on the basis of their proper motion. The bright blue stars and some bright stars of intermediate colour are members.

In order to check our results we studied the distribution of non-members over the plate. They are very evenly distributed.

We further studied the colour-magnitude diagrams for various annular regions centred on the cluster. The concentration of the bright stars towards the centre is very striking. Also, the evolving stars at the turn-off point appear to be very centrally concentrated, and there is an almost abrupt upper limit to the main sequence, some $0^m.5$ below the turn-off point, in the outer regions.

The last slide shows the area covered by the 26-inch plates and also the much smaller area included in the present study. Proper motion measures have now been completed over the rest of the plates, and the *RGU* photometry is being very kindly supplied by Dr Tammann who is working at Mount Wilson. Since the plate is centred well away from the cluster, we have a good opportunity to study the outer regions and perhaps locate the cluster boundary.

The material for the Omega Centauri investigation was a pair of plates taken with the Cape 24-inch refractor. On these Mr Candy measured almost 5000 stars. Another team at Herstmonceux determined the B and V magnitudes of most of these stars. Our proper motion discussion was broken down into separate studies of stars in different regions of the $C - M$ diagram. A typical plot of relative proper motion in a particular colour and magnitude range is shown in the next slide. Our problem was to represent the observed distribution as the combination of an elliptical distribution for the field star component and a circular distribution for the cluster members (corresponding to errors of measurement only). This we achieved for fifteen independent colour magnitude groups. Their proper motions relative to different groups of field stars were plotted against mean parallaxes. The latter were derived from the observed dispersions in the proper motions of the field stars. The individual results taken separately are of little value, but the combination leads to a transverse velocity with a certainty of about $\pm$ 15 km s^{-1} in each coordinate.

The proper motion was combined with the radial velocity also measured at Herstmonceux to give the space motion, and an orbit has been computed using Schmidt's field. The cluster never gets much further than 6 kpc from the galactic centre and is in fact seen at present near its apogalacticon. The motion is retrograde.

We have plans for similar studies of 47 Tucanae for which we have Cape plates, and also the nearest globular NGC 6397 with plates taken with the Yale-Columbia telescope by courtesy of Dr Woltjer who lent us old plates taken in 1948, and Mr Abraham from Mount Stromlo who has taken a recent plate.

Finally *I. King* reported briefly on IAU Symposium no. 25 and referred to the report by L. Perek in Commission 33.

APPENDIX

TABLES OF ASSOCIATIONS

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

APPENDIX. TABLES OF ASSOCIATIONS

Table I. Revised List of OB Associations

No.	Designation in Cluster Cat. [16]	page	of Markarian [13] No		of Morgan [11] No		of Schmidt [10] No		Other References	New
1	Sgr I	1257	14	Sgr I	3 4	I Sgr II Sgr	53 54	I Sgr II Sgr		Sgr OB 1
2	Sgr VI	1255·1					55	VII Sgr		Sgr OB 7(?)
3	Sgr IV	1261			5	III Sgr	56	III Sgr		Sgr OB 4
4	(Sgr II)	(1267)			6	IV Sgr	57	IV Sgr		Sgr OB 6
5	Sgr II Ser I	1267 1259	15	Sgr II	7	I Ser	60	I Ser		Ser OB 1
6	(Sgr II)	(1267)					59	I Sct		Sct OB 3
7	Ser II Sgr III Ser-Sct II	1265 1263 1269·1	(4)	Sgr III	8	II Ser	61 58	II Ser III Ser	Ser-Sct II [1]	Ser OB 2
8	(Sct I)	(1269)					62	II Sct		Sct OB 2
9	(Vul I)	(1271)					2	II Vul		Vul OB 4
10	Vul I	1271			9	I Vul	1	I Vul		Vul OB 1
11	Cyg III	1273	16	Cyg	10	I Cyg	5	I Cyg		Cyg OB 3
12	Cyg I	1275			11 12	II Cyg III Cyg	6	II Cyg	II Cyg	Cyg OB 1
13	(Cyg I)	(1275)					7	VIII Cyg		Cyg OB 8
14	(Cyg II)	(1277)					8	IX Cyg		Cyg OB 9
15	Cyg II	1277					9	VI Cyg		Cyg OB 2
16	Cyg IV	1279			13	IV Cyg	10	IV Cyg		Cyg OB 4
17	Cyg VI	1277·1					12	XI Cyg		Cyg OB 7
18	Lac I	1285			14	I Lac	13	I Lac		Lac OB 1
19	Cep II	1281	17	Cep II	15	I Cep	14	I Cep		Cep OB 2
20	Cep I	1287	(6)	Cep I	16	II Cep	15	II Cep		Cep OB 1
21	(Cep I)	(1287)					16	IV Cep		Cep OB 5
22	Cep III	1289			17	III Cep	17	III Cep		Cep OB 3

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

Table I. Revised List of OB Associations

No.	l^{II} from	l^{II} to	b^{II} from	b^{II} to	Some members of the association	Other associated feature	Distance pc	References	Note
1	4°	14°	−2·6°	+1·4°	HD 164794, 164816, 164906, 164402, 164514, 164637, 164833	NGC 6530, 6523	1560	[9]	(1)
2	10·5	10·8	−1·7	−1·3	HD 167263, 167264; BD −20°5043, −20°5060		1860	[10]	(2)
3	11·2	12·7	−1·4	−0·5	HD 166628, 166965, 167224, 167287, 167336, 167659, 167771, 168021	Burakan 5	2130	[10]	
4	13·4		+1·0		HD 166286, 166287, 166304, 166540	NGC 6561	2000	[10]	
5	14	19	−1·5	+1·5	HD 168075, 168076, 168137, 168504	NGC 6611	1700	[9]	
6	16·7	18·0	−1·6	−0·1	HD 169034, 169727; BD −14°5029, −14°5062		1600	[10]	
7	18·0	19·1	+1·1	+2·3	BD −12°4970, −11°4586, −12°4982; HD 167971, 168112	NGC 6604	2000	[11]	
8	20	26	−2·8	+1·5	HD 172252, 172488, 173219; BD −09°4742, −11°4667, −09°4713		730	[10]	
9	59	62	−3	+4	HD 183561, 187983; BD +25°3941, +24°3893, +21°3959		1020	[10]	
10	59·1	61·5	−1·2	+1·5	HD 186841, 186745–6; BD +23°3745, +23°3759, +22°3782, +23°3761	NGC 6823	2050	[10]	
11	71·3	73·8	+1·2	+3·4	HD 190429(br.), 190429(ft), 190864, 190918, 190919, 227634, 190967, 227696, 227704	NGC 6871	2300	[11]	
12	74	77	−0·6	+2·8	HD 192422, 192639, 193237 (P Cyg), 228841, 193443, 193514, 229059, 229221, 229227, 229234, 229238, 229239	NGC 6913	1700		
13	76·3	79·2	+2·1	+5·4	HD 190991, 191423, 191978, 192660, 228712, 193117, 228882, 228928, 194092; BD +40°4061, +41°3670		2190	[10]	
14	77	79	+0·8	+2·2	HD 229159, 194205, 229196, 194279, 194649, 195213; BD +38°4054; +39°4168, +40°4185; Hiltner's Cat.: nos. 960, 970		1170	[10]	
15	80·1		+0·9				1500	[12]	
16	81	84	−8·3	−6·3	HD 201795, 201819, 201349; σ Cyg		1000	[10]	
17	84	96	−4·9	+9·0	HD 198512, 198895, 198931, 199216, 203938, 204722; BD +42°3914, +43°3913; Hiltner's Cat. no. 1042		740	[10]	
18	96	98	−15·6	−18·7	8 Lac, 10 Lac, 12 Lac		600	[9]	
19	97	108	−0·9	+12·3	HD 202214, 204827, 206773, 207538, 208905		700	[11]	
20	98	108	−0·7	−3·0	HD 235673, 209678, 209900, 210809, 235781, 235783, 211853, 235813, 212455, 235825, 213470–1, 214419, 215835, 216927; BD +53°2827, +53°2833, +54°2726, +53°2843, +54°2764, +55°2840	NGC 7380	3600	[11]	
21	108·3	108·6	−3·2	−2·3	HD 240168, 240171; BD +56°2930		2090	[10]	
22	109·4	112·9	2·3	+5·2	HD 216532, 216658, 216711, 217035, 217061, 217086		960	[11]	

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

Table I—continued

No.	Designation in Cluster Cat. [16]	page	of Markarian [13] No		of Morgan [11] No		of Schmidt [10] No		Other References		New
23	Cas II	1291	18	Cas II			19	V Cas			Cas OB 2
24	Cas V	1293	19	Cas V	18	I Cas	20	I Cas			Cas OB 5
25	Cep IV	1293·1								[2]	Cep OB 4
26	Cas IV	1203			19	II Cas	21	II Cas			Cas OB 4
27	(Cas IV)	(1203)					22	VI Cas			Cas OB 14
28	Cas VII	1205			20	III Cas	23	III Cas			Cas OB 7
29	Cas I	1207	1	Cas I			24	VII Cas			Cas OB 1
30	Cas VIII	1209					25	VIII Cas			Cas OB 8
31	Per I	1211	2	Per I	21	I Per	27	I Per			Per OB 1
32	Cas VI Cas XI Cas XII Cas XIII	1213 1211·2 1213·1 1211·1	3	Cas VI			28 30	X Cas XII Cas	Cas V	[1]	Cas OB 6
33	Cam I (Cam II)	1215 (1219)			22	I Cam	31 29	I Cam XI Cas	Cas V NGC 1502	[1] [3]	Cam OB 1
34	Per III	1213·2					32	III Per	I Per (α Per)	[4]	Per OB 3
35	Cam III	1217·1					33	II Cam			Cam OB 3
36	Per II	1217	4	Per II	23	II Per	34	II Per			Per OB 2
37	Aur I	1223	5	Aur	24	I Aur	35	I Aur			Aur OB 1
38	Aur II	1223·1					36	II Aur			Aur OB 2
39	Gem I	1229	7	Gem	25	I Gem	38	I Gem			Gem OB 1
40	Mon I	1233	(1)	Mon I			39	II Mon			Mon OB 1

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

Table I—continued

No.	l^{II} from	to	b^{II} from	to	Some members of the association	Other associated feature	Distance pc	References	Note
23	110·1°	114·0°	−1·3°	+1·8°	HD 219287; BD +58°2549, +61°2408, +60°2525, +59°2735, +60°2584; Hiltner's Cat. nos. 1202, 1207, 1208		2680	[10]	
24	114·9	118·0	−2·4	−1·3	HD 108, 224424, 225094, 240464; BD +59°2829, +61°2509, +60°2615, +62°2296, +62°2299, +61°2529 +61°2550, +61°2559; Hiltner's Cat. nos. 3,1226, 1251		2450	[10]	
25	117·4	118·6	+3·9	+6·5	BD +66°1673, +67°1585, +66°1580, +66°1661, +67°1598, +65°1973, +66°1669a, +66°1669b, +66°1674, +66°1675		?		
26	119·0	121·6	−2·1	+2·0	HD 1544; BD +60°39, +62°68, +63°41, +61°74, +61°77, +62°79, +61°105; Hiltner's Cat. no. 33		2650	[10]	(3)
27	119·7	121·1	−1·3	+2·5	HD 2619, 2905, 3191; BD +63°33, +63°48, +61°122; Hiltner's Cat. nos. 31, 37		1180	[10]	
28	121·7	125·2	−0·9	+2·6	HD 3940, 4694, 4717, 4841, 5551, 5689		2340	[10]	(3)
29	122·3	125·8	−2·3	−0·4	HD 4768, 6182, 236633, 7103; BD +61°220		2630		(4)
30	129·2	129·7	−1·5	−0·2	BD +60°311, +60°331, +60°333, +60°339, +60°345; Hiltner's Cat. no. 164	NGC 663	2940	[10]	
31	132	136	−2·5	−5	HD 12953, 13267, 13476, 13744, 13745, 13841, 13854, 13866, 14134, 14143, 14302, 14322, 14433, 14489, 14535, 14542, 14818, 14956, 15316, 15497, 15571	NGC 869, 884	2300	[9]	
32	133·8	138·0	−0·3	+3·0	HD 15629, 237007, 17520; BD +60°470, +61°411, +59°447, +60°493, +62°411, +60°497, +60°498, +60°507, +62°419, +60°586, +60°594	IC 1805	2420	[9]	(5)
33	134	151	−3	+7	HD 15558, 19820, 20959, 21291, 21389, 22253, 23675, 23800, 24431, 24432; BD +60°503		900	[11]	(6)
34	142	152	+2	+4	HD 20365, 20391, 20809, 21091, 21375, 21479, 21551, 21699, 22192, 18537, 20315, 25940	α Per cl.	170	[9]	
35	146·3	147·7	+2·0	+3·9	HD 237211, 237213, 25914; BD +56°864, +56°866		3500	[10]	(7)
36	156·4	162·1	−13·0	−21·3	HD 21856, 24131, 24534; 40 Per, *o* Per, *ζ* Per, *ξ* Per		400	[9]	
37	168·1	178·1	−7·4	+4·2	HD 34656, 34921, 35345, 35600, 35633, 35653, 35921; *χ* Aur	NGC 1912, 1960	1340	[9]	
38	172	174	−1·8	+2·0	HD 242908, 242926, 35619, 36280; BD +34°1059, +34°1058, +35°1141; Hiltner's Cat. no. 446	NGC 1893, IC 410	3600	[9]	
39	187·4	190·8	−2·1	+4·2	HD 42088, 42379, 42400, 43753, 43818; *χ* Ori, 3 Gem, 9 Gem		1500	[11]	
40	196	210	−2·5	+2·5	HD 44637, 45910, 46484	NGC 2264	715	[9]	

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

Table I—continued

No.	in Cluster Cat. [16]	page	of Markarian [13] No		of Morgan [11] No		of Schmidt [10] No		Other References	New
			Designation							
41	Ori I	1225	6	Ori	26	I Ori	40	I Ori		Ori OB 1
42	Mon II	1231	8	Mon II	27	I Mon	41	I Mon		Mon OB 2
43	CMa I	1235	9	CMa			42	I CMa		CMa OB 1
44	Pup I	1237	10	Pup			44	II Pup		Pup OB 1
45	Vela I	1239	(2)	Vela			45	I Vel		Vela OB 1
46	Car I	1241	11	Car			46	I Car		Car OB 1
47	Car II	1243							Unnamed [5]	Car OB 2 (
48	Cen I	1247	12	Cen			47	I Cru		Cen OB 1
49	IC 2944	1245							[6]	Cen OB 2
50	Ara-Nor	1251	(3)	Ara-Nor			48	I Ara		Ara OB 1
51	Sco I	1253	13	Sco	1	I Sco	49	I Sco		Sco OB 1
52	Sco II	1249			2	II Sco	50	II Sco		Sco OB 2
53	Sgr V	1255					51	V Sgr		Sgr OB 5

Table I—continued

No.	l^{II} from	l^{II} to	b^{II} from	b^{II} to	Some members of the association	Other associated feature	Distance pc	References	Note
41	198°	214°	−13°	−25°	ϵ Ori	NGC 1976	500	[11]	
42	205	209	−2·7	+0·8	HD 46056, 46106, 46149, 46150, 46202, 46223, 46485, 46573, 46711, 46847, 46966, 47129, 47240	NGC 2244	1400	[11]	
43	222	226	−3·4	+0·7	HD 53667, 54439	NGC 2353	1315	[9]	
44	242	246	−1	+2	HD 64315; CD −27°4264, −27°4269, −28°4707, −27°4404, −25°5122, −25°5215, −29°5106, −27°4813, −28°5227	NGC 2467	2500	[13]	
45	262	268	−2·7	+1·4	CD −46°4447, −45°4487, −44°4784, −46°4558, −48°4096, −45°4573, −46°4694, −48°4287, −47°4562, −45°4875	NGC 2650	1450	[13]	
46	283	292	−2	+2	HD 91943, 91969, 91983, 92007, 92044	NGC 3293	2600	[5]	(8)
47	289·9	290·2	+0·3	+0·4	HD 96248, 96446, 96662, 96638, 96670		1900	[5]	(8)
48	301	308	−2·5	+4	HD 110984, 111193, 113163, 113511, 113754, 114011, 114122, 114341, 114478, 114800, 115704, 117460, 117856		1500		
49	294·3		−1·0		HD 101084, 101131, 101191, 101205		2100	[5]	
50	335	341	−3	+3	HD 148937, 330950, 149065, 149277, 149298, 331044, 149452, 331003, 149589, 149658, 149834, 149855, 150135, 150168, 328686, 328678, 150423, 328869, 150675, 150958, 329032, 151213; CD −48°11078	NGC 6193	1300	[14]	
51	343·3		+1·2		HD 151804, 152003, 152076, 152147, 152218, 152233, 152234, 152235, 152247, 152248, 152249, 152314, 152408, 152424	NGC 6231	1400	[11]	
52	347·1	353·0	+12·3	+23·3	π Sco, δ Sco, β Sco, ω Sco, σ Sco, τ Sco		160	[9]	(9)
53	358·8	1·5	−3·9	+1·4	HD 161291, 316332, 316326, 316274, 316325, 316406, 316587, 316589, 316569, 164032; Hiltner's Cat. nos. 652, 655		2600	[10]	

N

Table II—List of Doubtful OB-Associations

No.	in Cluster Cat. [16]	page	Designation of Markarian [13] No		of Morgan [11] No	of Schmidt [10] No		Other References	New
(1)	Aql I	1269·2						Aql I [1]	Aql OB 1
(2)	Cyg V	1271·3				4	VII Cyg	Vul II [1]	Cyg OB 5
	Vul III	1271·1							
(3)	Vul II	1271·2				3	III Vul		Vul OB 2
(4)	Cyg VI	1277·1				11	X Cyg		Cyg OB 6
(5)	Cep-Lac	1283	(5)	Cep-Lac					Cep-Lac OB 1
(6)	Cas IX	1291·1				18	IV Cas		Cas OB 9
(7)	Cas X	1209·1				26	IX Cas		Cas OB 10
(8)	Ori II	1227·1				37	II Ori		Ori OB 2
(9)	Pup II	1235·1				43	I Pup		Pup OB 2
(10)	Cru I	1245·1						Cru [1]	Cru OB 1
(11)	Sco IV	1253·1						[7]	Sco OB 4
(12)	Cas-Tau	1293·2						Cas-Tau [8]	Cas-Tau OB 1

Table III. No OB-Associations

No.	in Cluster Cat. [16]	page	Designation of Markarian [13] No.	of Morgan [11] No.	of Schmidt [10] No.		Other References
1/	(Sgr I)	(1257)			52	VI Sgr	
2/	(Ser-Sct I)	1255·2					Ser-Sct I [1]
3/	Sct I	1269					
4/	Cas III	1201					
5/	Sco III	1251·1					

https://doi.org/10.1017/S0251107X00019180 Published online by Cambridge University Press

Table II—List of Doubtful OB-Associations

No.	l^{II} from	l^{II} to	b^{II} from	b^{II} to	Some members of the association	Other associated feature	Distance pc	References	Note
(1)	37·3°		−0·6°				2750	[1]	
(2)	64·2	70·0	−2·7	+6·9	HD 186980, 187459, 225985, 189779; BD +28°3438, +28°3485, +29°3814, +29°3842, +28°3598, +25°4083, +30°3980		1610	[10]	
(3)	63·9	65·5	+0·4	+3·1	BD +28°3434, +27°3512, +29°3774, +27°3550		4130	[10]	
(4)	83	89	−3	+5	HD 198479, 199478, 200776; BD +46°2948, +45°3230, +45°3260, +45°3341, +44°3655, +47°3302, +44°3731; Hiltner's Cat. No. 1035		1700	[10]	
(5)	99	103	−4	0			1700	[13]	
(6)	109	118	−5	0	HD 220116, 223924, 224151; BD +60°2581		800	[10]	
(7)	129·8	131·8	−6·7	−6·0	HD 10063, 232522; BD +55°393, +54°395, +54°404		3800	[10]	
(8)	186·8	189·4	−3·8	+0·9	HD 248587, 248893, 248894, 251204; Hiltner's Cat. nos. 498, 510		3240	[10]	
(9)	242·1	245·2	−4·7	+1·2	HD 60284, 63005, 63290, 64315		4200	[10]	
(10)	295	299	−1				2700	[1]	
(11)	352·8		+3·2		HD 154500, 154768, 155015, 155272, 155349, 155448, 155550, 155754, 155851, 155890, 156066, 156213, 156323, 157003				
(12)					HD 221253, 224559, 829, 1976, 17 Cas, 1 Per, 61 Ari, 35 Eri, 94 Tau, 105 Tau, 15 Cam, 121 Tau, 67 Ori, 85 UMa		1400	[7]	(10)

NOTES TO TABLES I, II AND III

Designations and pages in Cluster Catalogue [**16**] noted here in brackets show that the objects have to be placed on another card after approval of this index.

(1) The stars belonging in the Morgan index to the *two* aggregates I and II Sgr occur in Markarian's index in a *single* association Sgr I. Since the distances of both the aggregates are approximately the same, both the aggregates are included into a single association in our index.

(2) The association Sgr OB 7 is rather concentrated and the dispersion of the distance moduli of stars is relatively small. Nevertheless, some uncertainty arises whether this group of early stars (O6 – B0) should not be joined to the association Sgr OB 4.

(3) The associations Cas OB 4 and Cas OB 7 are close together at approximately the same distance. We have considered them as two separate objects taking into account their considerable linear dimensions. The spectral classes of both associations are a little different. (On the average, there are earlier stars in Cas OB 4 than in Cas OB 7.)

(4) The reality of this association is not quite evident.

(5) Schmidt's XI Cas has been defined as coinciding with Markarian's Cas VI (see note (6)). Comparing Markarian's unpublished index of stars in Cas VI we can see that it coincides with Schmidt's group X and XII Cas. Having compared Kopylov's (**15**) index of stars the object hitherto designated as Cas XIII (p. 1211·1) has also been joined to association Cas OB 6.

(6) Schmidt's group XI Cas occurs in the vicinity of association Cas I. For this reason the stars belonging to it (HD 15558, 20959, 21291; BD +60°503) have been joined to association Cas OB 1 (see note (5)).

(7) The space concentration is not very high. Nevertheless, the reality of the association seems to be confirmed; (1) the space concentration is affected by a large distance; (2) in view of the high galactic latitude the grouping does not appear to be accidental; (3) the dispersion of distance moduli is small (0·21).

(8) The relation of the star associations Car OB 1 and Car OB 2 is not quite clear. If the two groups have to be separated, it seems that the group of hot stars about Eta Car should be defined as a separate association as well.

(9) Scorpio-Centaurus moving cluster.

(10) It is possible that this object should be included into Table I.

REFERENCES

1. Kopylov, I. M. *Astr. Zu.*, **35**, 390, 1958.
2. Blanco, V. M., Williams, A. D. *Astrophys. J.*, **130**, 482, 1959.
3. Blaauw, A. *Astr. J.*, **59**, 317, 1954.
4. Harris, D. L., III *Astrophys. J.*, **123**, 371, 1956.
5. Hoffleit, D. *Astrophys. J.*, **124**, 61, 1956.
6. Thackeray, A. D. *Mon. Not. astr. Soc. S. Afr.*, **15**, 20, 1956.
7. Pik-Sin The *Contr. Bosscha Obs.*, no. 12, 1961.
8. Blaauw, A. *Astrophys. J.*, **124**, 408, 1956.
9. Becker, W. *Z. Astrophys.*, **57**, 117, 1953.
10. Schmidt, K. H. *Astr. Nachr.*, **284**, 76, 1958.
11. Morgan, W. W. *Astrophys. J.*, **118**, 318, 1953.
12. Schulte, D. H. *Astrophys. J.*, **128**, 41, 1958.
13. Markarian, B. E. *Dokl. Akad. Nauk Armjanskoj SSR*, **15**, 11, 1952.
14. Whiteoak, J. B. *Mon. Not. R. astr. Soc.*, **125**, 75, 1962.
15. Kopylov, I. M. *Izv. Krym. astrofiz. Obs.*, **20**, 156, 1958.
16. Alter, G., Ruprecht, J., Vanýsek, V. Catalogue of Star Clusters and Associations, Prague, 1958, and Supplements 1–6, Appendices to the *Bull. astr. Inst. Csl.*, **10–15**, 1959–1964.