centre is much underestimated when velocity data are used. He applied his method for a model of M 31 (04.158.066; 01.158.037; 02.158.062; 03.158.060; 03.158.074; 03.158.075 and elsewhere). L. Genkina (*AC* 650) using the luminosity and mass functions estimated the average density of the Metagalaxy as $2 \times 10^{-30}$ g/cm$^3$.

The following papers are theoretical but connected with observations. B. Komberg (04.158.098) proposed a scheme of evolution of galaxies mostly of the eruptive forms, and in a preprint considered that evolution runs thus: a QSO transforms into an N galaxy, then into a nucleus of an E radio-galaxy. Komberg and L. Ozernoy (04.158.058) discussed the excited states of different kinds of galaxies and searched for possible relations. Ozernoy (*AC* 661) considered that collapse of his 'magnetoid' (representing a QSO) apparently does not lead to a black hole according to observations and does not recur. S. Kaplan and V. Zitovich (*AZ*, **49**, 647) developed a theory of active nuclei as 'turbulent cauldrons' producing distributions of relativistic particles which radiate in the infrared, in the observed amounts. G. Bisnovatij-Kogan and R. Sunyaev (*AZ*, **48**, 881) proposed a disk formed of stars which become supernovae and produce neutron stars. Accretion at their surfaces gives rise to plasma radiation with a Langmuir frequency like that observed in the infrared. S. Vainstein and A. Rusmaikin (*AZ*, **48**, 902) visualize the creation of the magnetic field of a galaxy as follows. The poloidal component of the field due to differential rotation forms a toroidal component. B. Zeldovich and Sunyaev (03.162.027) discussed small scale fluctuations of the relic radiation. With Sunyaev, Zeldovich (preprint) developed a theory of fragmentation of clusters. I. Shklovsky (04.158.069) treated the conservation of momentum and problems of metagalactic astronomy. Yu. Gnedin and A. Dolginov discussed the origin of the X-rays in the metagalaxy (03.51.734). I. Pronik and K. Chuvaev (02.158.018; 02.158.073; *Izv. Crimean Aph. Obs.*, **38**, 83; **44**, 40; **45**, 162) investigated H II regions and colours in 9 galaxies and concluded that the two-colour diagram for spiral arms is the same as that of the central region. I. Karachentsev (01.160.001) determined the optical thickness of dust in clusters of galaxies, while a search for dust in pairs and groups by V. Lipovezkiy (*Vestnik Kiev Univ.*, No. 12, 116) led to $\tau < 0{\cdot}15$. L. Ozernoy (03.158.002) studied theoretically the interaction of intergalactic clouds with galaxies and (in 03.158.003) the accretion of this gas by QSOs. O. Prilutsky and I. Risenthal (04.161.009) developed a theory of the ionization and heating of intergalactic gas by ultraviolet radiation. V. Kurt and R. Sunyaev (03.161.008) considered that intergalactic gas and subcosmic rays produce the ultraviolet background. Sunyaev and A. Doroshkevich (01.161.001) studied also the thermodynamical conditions in the metagalaxy.

Finally, it must be noted for the first time since the appearance of Vol. **53** of the *Handbuch der Astrophysik* in 1958 a reasonably large book on galaxies appeared. It is Vorontsov-Velyaminov's *Extragalactic Astronomy* in Russian, labelled as a text book, but in fact of larger scope and summarizing also the author's investigations.

## WORKING GROUP ON THE MAGELLANIC CLOUDS

A. D. Thackeray

### 1. *General*

The Magellanic Clouds have received much attention in S. America, Australia and S. Africa, and further progress may be expected with the activation of new equipment in the near future. An excellent survey of Cloud problems was presented by Westerlund (1972) in Athens. The report presented here is to be regarded as a supplement to Westerlund's article where detailed references (by year) will be found. For further references see Section 159 of *Astron. Astrophys. Abstracts*.

The Santiago Symposium on the Clouds has been published (Ed. Muller 1971).

An important review article by de Vaucouleurs and Freeman (1969) deals specifically with structure and dynamics of barred spirals. Here the 'Magellanic Irregulars' are placed at the end of the spiral sequence and the main features of LMC and SMC, discussed in detail, are found to have much in common with such systems as NGC 4618, 4625 and 4027.

Hodge and Wright completed groundwork for the SMC Atlas similar to that previously published for the LMC identifying known variables, clusters etc.

## 2. *Extra-terrestrial observations*

In a pioneer venture the LMC was recorded in 1050–1600 and 1250–1600 Å bands, and spectra secured in the ranges 500–1600 Å. A 3-inch *f*/1 electronographic Schmidt designed by Page and Carruthers (1972, *Bull. Amer. astr. Soc.*, **4**, 331) was operated on the lunar surface during the Apollo 16 mission. The young population of Constellation III etc. is far more prominent in these wavelengths than the bar. Objective prism spectra of 10 OB star groups are recorded but interplanetary Ly $\alpha$ interferes.

Four X-ray sources in the LMC and one in the SMC are now known; for Uhuru positions see Westerlund (1972). Chance projection is unlikely and the total X-ray emission from the Clouds is of order 10% that from the Galaxy. No optical identifications have been made, but SMC-X1 in the Wing undergoes apparent eclipses in period 3·89 days with subsidiary fluctuations in matters of hours and possibly minutes.

## 3. *Supernova remnants*

Mathewson and Clarke (1972, *Astrophys. J.*, in press) have discovered 9 more SN remnants in the LMC from Molonglo radio data and narrow-band image-tube photometry which measured [S II]/H $\alpha$ as a criterion to distinguish from H II regions. They suggest that the radio source 0525-66.0 has been ejected from N 49 to a distance at least 13 times the radius of the N 49 shell.

## 4. *Brightest stars*

The Fehrenbach-Duflot Catalogue (1970) serves as the basis for further ESO investigations with slit spectrographs and *UBV* photometry. In a very rich compilation Ardeberg *et al.* (1972) publish photometry of 409 LMC members with velocities and spectral types for 162; supplementary data have been given by Bigay *et al.* (1972) and Brunet *et al.* (1972). The results agree satisfactorily for stars in the smaller Radcliffe list.

Brunet and Prévot (1971, Trieste) compare statistics in the $M_b - \log T_c$ diagram with theoretical evolutionary time-scales and find an excess of yellow super-supergiants in the LMC. Variability of LMC supergiants in days to weeks (rather than in hours) has been observed by Rosendahl and Snowden (1971) for later types and by Appenzeller (1972) for OB stars.

In the SMC Florsch (1972, *Publ. Obs. Strasbourg*, **2**, f. 1) uses objective-prism velocities to segregate all the brightest members; most members of type B to F with $M < -6$ have probably been detected in the outskirts. The most luminous stars agree in position and velocity with hydrogen data; in particular, within the bar the optical members also show a double-peaked velocity distribution.

Przybylski (1971, 1972) has followed up his analysis of HD 33579 with similar studies of HD 32034 (LMC) and HD 7583 (SMC). The latter star is found to be metal-deficient by a factor 10, although Wolf (1972b) finds it to be similar to the Sun within a factor 2, apparently due to adopting a different temperature. Wolf (1972a) agrees with Przybylski in deriving a near-solar composition for HD 33579. He finds asymmetry in all absorption lines with Ca II K displaced by $-21$ km/s relative to the mean velocity. This may be the same phenomenon as observed in galactic supergiants.

Osmer (1972, in press) presents *uvby* photometry of 169 SMC supergiants and concludes that the stars are probably in the later stages of He-burning. The colours suggest a smaller value for the SMC distance than do the cepheids.

## 5. *Variable stars*

(a) *Cepheids.* Sandage and Tammann (1971), Sandage (1972), in a further discussion of the *P-L*-colour relation for classical cepheids, derive a somewhat smaller distance to the LMC than

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Gascoigne while leaving the SMC distance unchanged. Westerlund (1972) in a general discussion derives 50 kpc (LMC) and 69 kpc (SMC). Gascoigne, Ford and Robinson have light-curves of 13 cepheids associated with LMC clusters NGC 2010, 2031, 2136, 2157, 2214 and some near NGC 2164.

In an extensive study of the topography of 1830 LMC variables S. Gaposhkin (1970) presents individual light-curves. 16 W Vir variables are found to define a *P–L* relation which runs parallel to that for classical cepheids but displaced to fainter magnitudes by 2·4 (pg).

(b) *RR Lyrae Variables*. Graham (1972, *I.A.U. Coll.* **21**) has discovered RR Lyr variables in the LMC globular NGC 1835; periods of 9 of type RR ab establish the cluster as of Oosterhoff Type I like the others with known variables NGC 121, 1466, Wesselink (05.159.003), 2257. He has also studied field variables near clusters in both Clouds. They have remarkably small dispersion in magnitude; $\langle B \rangle = 19{\cdot}56$ for 50 variables in the field near NGC 1835. The best available distance moduli suggest that the mean $M_v = +0{\cdot}5 \pm 0{\cdot}2$ for RR Lyr stars in both Clouds, from which little spread in metal-abundance may be inferred.

(c) *Novae*. Graham has also been successful in discovering four novae (1970.7 to 1972.8) all in the LMC which has now produced 11 known novae as compared with 4 in SMC. (Early statistics were probably affected by Harvard concentration on SMC cepheids). Nova Dor 1971 a, a fast nova, reached $V = 11{\cdot}84$. (See Graham and Araya, 1971). Spectra were obtained.

(d) *Red Variables*. Lloyd Evans (05.122.107) has established spectroscopic SMC membership of two large-amplitude variables among bright red supergiants whose galactic counterparts (e.g. S Per?) are difficult to find. He has continued work on Mira-type and other red variables in both Clouds. Feast (1972, *I.A.U. Coll.* **21**) reports that the 140-day variable in NGC 121 (SMC) has a spectrum like an SRd variable.

(e) *R CB variables*. Feast (1972, *M.N.R.A.S.*, **158**, 11P) records $C_2$ in spectra of three of the four RCB variables in the LMC listed by Payne-Gaposchkin (1971).

## 6. *Clusters and associations*

M. Walker (1970), (1971), (1972) continues electronographic studies of *c-m* arrays of globulars to very faint limits ($V > 22$). Kron 3 and NGC 419 (SMC) and NGC 2209, 2257 (LMC) show differences which make them uncertain distance indicators. A Hyades-like branch at the faint limit of NGC 2209 is puzzling if it represents true cluster-members.

Robertson (Mt. Stromlo) has obtained *c-m* arrays for NGC 330 (SMC), 1818, 2004, 2100 (LMC) containing stars in the mass-range 10–20 $M_\odot$ and for NGC 1850, 1854, 2136, 2164, 2214 with stars up to $8 M_\odot$. Freeman and Gascoigne find that the surface brightness distributions of NGC 1866, 1835 can be closely fitted to King's modified isothermal models. A low mass ($\sim 5 \times 10^4 M_\odot$) and $M/L \sim 0{\cdot}2$ is inferred. Similar results are obtained by Freeman and Chun for other clusters, including red clusters like NGC 419.

Andrews and Lloyd Evans (1972) publish (photographic) radial velocities of 15 blue globulars in LMC which follow the same rotation curve as that for young stars, with perhaps slightly larger velocity dispersion. H. C. Ford (06.159.036) has also studied image-tube spectra of 36 LMC and 3 SMC globulars.

Hodge and Lucke (1970) find the mean diameter of the 122 LMC associations in their Catalogue to be 78 pc ($m - M = 18{\cdot}9$), similar to the associations near the Sun. 79% of them contain H II regions. 15 super-associations have mean diameter of 255 pc similar to the associations identified in M 31. The 'miniclusters' studied by Gaposhkin (1970) are presumably related to familiar galactic clusters and require more attention with high resolving power.

The centroid of the Hodge-Lucke associations is at $5^h 24^m - 68°39'$. This is displaced to the north of the bar like the centre of rotation. (See p. 183 of the Vaucouleurs and Freeman (1969).)

In extensive photometry of 3 regions at the end of the LMC bar Tifft and Shell (1970) find evidence of a rich giant red population below $V = 16$, and at $V = 16$ some very red stars ($B - V = 2{\cdot}2$ to $2{\cdot}8$). In the latter class one star in Kron 3 (SMC) has been proved by Feast to be a carbon star.

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Feast (1972) continued spectroscopy of bright members of the SMC cluster NGC 330 and found ten of Arp's bright main-sequence stars to be Be stars in the range $M_v$−3·6 to −4·2; this resembles the situation in the nucleus of $\chi$ Per.

## 7. H II *Regions*

Interference spectra of Hα in 120 LMC H II regions and of Hα and [O III] 5007 in 71 regions are used to obtain radial velocities by Cheriguene and Monet (07.159.001) and Smith and Weedman (1971) respectively. The rotation curves are similar to those previously derived. The latter authors find a dispersion of only 7·9 km $s^{-1}$ about the mean rotation curve except for the violently disturbed region near 30 Dor. H II and 21cm H I velocities of individual regions show an average difference of only 4·6 km $s^{-1}$.

In the SMC Feast (1970) measured velocities for 15 H II regions. 9 regions in the core have a low velocity dispersion 7 km $s^{-1}$, much smaller than that of the 21 cm profiles, but the detailed agreement with the peak 21 cm velocities is good, as if the H II regions correlate with regions of maximum H I density.

Sanduleak *et al.* (07.159.027) report that spectra of SMC planetaries show [N II] stronger than the LMC planetaries.

## 8. *Dust*

H. M. Johnson (1972, *I.A.U. Symp.* **52**) used a filter-pair designed to measure continuum/line-emission ratios in 85 Henize nebulae (LMC). Continuum is strong for Orion-class and point nebulae but weak for larger H II regions.

At the Radcliffe Observatory the problem of dust in the core of the SMC has been tackled by selecting stars in the Bok-Basinski-Bok 2-colour plot which might be heavily reddened. The only certain member found is a Be star.

## 9. *Polarisation*

Mathewson and Ford have measured polarisations of 180 LMC and 80 SMC stars. They conclude that the Clouds are enveloped in a large-scale regular magnetic field with lines of force parallel to the line joining the Clouds. Irregularities occur especially near 30 Dor.