28. GALAXIES
(GALAXIES)

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The present report covers the period 1976- 1978. As with previous reports it has not been possible to write an all- inclusive account covering everything published, or even every field under investigation; the number of contributions to extragalactic research is increasing enormously fast. Summaries of the papers may be found in the Astronomy and Astrophysics Abstracts.

The report is divided into ten sections, including the four Working Groups, and they have been prepared by the Vice- President, by members of the Organizing Committee and by the Chairmen of the Working Groups.

Where possible, references are given by the numbers in the above- mentioned Abstracts; for papers published in 1978 commonly- used abbreviations for journals are used and volume numbers without year.

Numerous colloquia and symposia on extragalactic astronomy have been held during the past three years, and proceedings of some meetings held previously have appeared in print. Those referred to in the report of 1976 (18.158.115) will not be repeated here.

IAU Symposium No. 74, on "Radio Astronomy and Cosmology" (20.012.014),contains papers on galaxies and QSOs. IAU Colloquium No. 37, on "Redshifts and the Expansion of the Universe",together with CNRS colloque international No. 263, on"L'Évolution des galaxies et ses implications cosmologiques" (20.012.053),deal extensively with fundamental problems in extragalactic research: calibration problems, the Hubble diagram, the interpretation of redshifts - cosmological or non- cosmological.

IAU Symposium No. 79, on "The Large Scale Structure of the Universe",was held in Tallinn in September, 1977. It dealt with systems of galaxies of all scales from binary galaxies through groups, clusters, superclusters to the very largest structures in the observable Universe.

The Galaxy and the Local Group were dealt with in the Tercentenary Symposium at Herstmonceux Castle (19.012.018). The IAU Symposium No. 77, on "Structure and Properties of Nearby Galaxies", was held in Bad Münstereifel in August, 1977. The distribution of material in nearby galaxies was discussed with the emphasis on the interpretation of modern radio data, on spiral structure and on active nuclei. Active nuclei were also discussed at the Copenhagen Symposium in June, 1977; the complete title being "Quasars and Active Nuclei of Galaxies" (Phys. Scr. 17, No. 3).

A conference at Yale University in May, 1977, dealt with "The Evolution of Galaxies and Stellar Populations" (20.012.005). It centered on the fundamental problems of the unseen mass, the universal initial mass function and the relation between galaxies and their environment. Similar problems were dealt with in the NATO Advanced Study Institute, "Structure and Evolution of Galaxies"(18.012.002), and in the Sixth Advanced Course of the Swiss Society of Astronomy and Astrophysics, on "Galaxies" (18.012.043).

General extragalactic research was also discussed in a conference on "Astrono-

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mía Extragálactica" in Cordoba (Acad.Nac. Ciencias, Cordoba 1976). It was also extensively treated at the Fourth European Regional Meeting in Astronomy in August, 1978 (Abstracts in Uppsala Observatory Report No. 12).

Among important review papers to appear during the period under consideration are: Chemical evolution of galaxies (20.151.029); The BL Lacertae objects (20.158.505); The Line Spectra of Quasi-Stellar Objects (20.141.062); The Radio Continuum Morphology of Spiral Galaxies (20.158.071); Extended Extragalactic Radio Sources (20.141.063); Seyfert Galaxies (20.158.096); Recent Theories of Galaxy Formation (20.162.052); Theory of Spiral Structure (20.151.043); Clusters of Galaxies (20.160.053); Extragalactic X-Ray Sources (20.142.081) and, The Kinematics of Spiral and Irregular Galaxies (Annu.Rev.Astron.Astrophys. 16,103).

1. GALAXIES IN GENERAL
(B.E. Westerlund)

A. Survey work; Catalogues

The ESO/Uppsala "Quick Blue Survey" of the southern hemisphere has continued; lists nos. 3, 4, 5 and 6 are published (14.113.044; 19.002.002; 19.002.066, A.A. Suppl. 34,285). So far, 389 fields, south of - 27°.5 dec., covering 9191 square degrees have been investigated and 8356 galaxies and physically connected systems recorded, with total diameters $\geq$ 1.0 minutes of arc. Several hundred of these objects have been studied spectroscopically and photometrically (19.158.005; 20.002.041).

Vorontsov- Velyaminov has published Part II of his Atlas of interacting galaxies (19.002.004) with photographs of some 600 objects.

The second Reference Catalogue of Bright Galaxies appeared in 1976 (18.003.046). It gives some 200 000 information elements on 4 364 galaxies, mainly brighter than the 16th magnitude or larger than 0'.5 in diameter and having redshifts less than 15 000 km s^{-1}. This is almost double the information contained in the first Catalogue. It has also a more rigorous definition and a greater precision of the diameters, magnitudes, colours, and radial velocity data.

The ESO/Uppsala Survey has been used for a search for groups and clusters of galaxies (20.002.032). In the 97 fields searched, 770 groups and clusters were identified, forming a representative sample of nearby to distant systems in the southern sky.

UK 1.2 m Schmidt telescope plates have been searched for southern galaxies. Classifications, luminosity classes, inner and outer diameters have been given for 267 galaxies of types Scd and later south of - 22° in 101 fields (20.158.034). Among them are over 120 new, mostly low-surface-brightness dwarf objects. - From an inspection of about 36 000 galaxies on the UK Schmidt telescope plates the first third of a Catalogue of Southern Peculiar Galaxies and Associations has been prepared (19.158.161); it contains 2784 galaxies classified into 25 categories. - The same deep survey plates have been used for the identification of 474 clusters of galaxies in 99 fields (MNRAS 182, 241); these clusters have at least 10 members whose mean separation is typically a few times the mean galaxy diameter. The list should be valuable for the investigation of rich clusters and for the identification of extragalactic X-ray sources. - Also a search for compact galaxies has been carried out on the survey plates (MNRAS 184, 303). On the average high galactic- latitude plate 20-25 compact galaxies were found. Spectroscopic observations of 31 of the objects showed three to be galactic stars and the remainder galaxies of the same population as Zwicky's compact galaxies but at almost twice the distance.

Accurate optical positions of all galaxies brighter than 14.5 mag and north of dec. - 2°30' have been measured from Palomar Sky Survey prints; the rms errors are 4" in each coordinate (17.158.141).

A new reduction of the Lick catalogue of galaxies has been carried out (19.158.116) giving a catalogue with the original 10' x 10' resolution of the counts. The results are presented in two maps; details remain to be presented.

Hodge (BAAS 10,491) has presented a useful catalogue of 3003 galaxies and 15 clusters of galaxies in an 85 square degree area centered on the Small Magellanic Cloud.

The Curtis- Schmidt thin-prism survey for extragalactic emission-line objects by the University of Michigan has been presented in four lists up-to now (19.158.140; 20.158.109; 20.158.110; Ap.J. Suppl. 36,587), containing a total of 420 emission-line galaxies and QSO candidates to a continuum magnitude of about 18.5- 19. "Tololo" lists (17.141.097; 18.158.202) give another 125 objects of which nine are confirmed QSOs with redshift over 2.5. The initial description of the technique is found in (14.158.197). The nature of the emission- line galaxies found in these surveys, which were stimulated by the Markarian search for ultraviolet galaxies, has been investigated (Ap.J. 221,776). The emission lines from more than 80 per cent of the objects seem to be produced by hot stars. Virtually all Tololo galaxies would be discovered with the criteria of a Markarian-type survey (cf. 19.158.119), but only about one-third of the Markarian galaxies have sufficiently strong emission to be included in the Tololo listings. Of the "Tololo" galaxies about 2 per cent appear to be Seyfert class 1; less than 10 per cent belong to class 2 Seyferts. Similar conclusions are drawn in (19.158.149).

B. Classification

A new classification system for galaxies has been proposed (17.158.120). Normal spirals and lenticulars form parallel sequences within which "early" and "late" systems are distinguished by means of their disk-to bulge ratios. A sequence of "anemic spirals", occuring most frequently in rich clusters, is found between those of vigorous gas-rich normal spirals and gas-poor systems of type SO. The differences between normal spirals (Sa-Sb-Sc), anemic spirals (Aa-Ab-Ac) and lenticulars (SOa-SOb-SOc) are interpreted in terms of the influence of environment on the evolution of flattened galaxies.

A revised Shapley- Ames Catalog of Galaxies (Carnegie Inst., Washington) is in press; it includes most of the galaxies from the 1932 catalogue north of decl. -15°. A programme for direct photography for the southern section of the Shapley-Ames catalogue has begun; first results have appeared (PASP 90,5).

An interesting scheme has been presented (19.158.062) which unites quasars, radio galaxies, N galaxies and Seyfert galaxies into a single picture of activity in galaxies. It is a multiparameter fit to observational data but makes also predictions not implied by existing data.

From the classification of 35 radio galaxies scanned in the Lick spectrophotometric survey (Ap.J. 220,783) a high degree of association is found between the spectroscopic classification "broad line" and the morphological classification "N". Emission- line radio galaxies of types cD, DE, E form the "narrow-line" galaxies. This division of the radio galaxies parallels the division of Seyferts into class 1 and class 2.

C. Measurements in the Radio and X- Ray Regions

The investigations in the ultraviolet - infrared regions will be considered in

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Section 8. We deal here very briefly with contributions in the radio and X-ray regions; the reader is referred also to the Reports of Commissions 40 and 48.

A large number of surveys have been carried out on radio wavelengths: A survey at 8085 MHz of 0.181 sr of sky having $|b|>10^\circ$ and $|\delta| \leq 1\overset{\circ}{.}5$ (A.J. 83,157) revealed 64 sources, more than two-thirds of which could be optically identified, and two-thirds of these appear stellar. No anisotropy between the two galactic hemispheres was found. Observations at 5 GHz of the area between 35° and 70° decl. to a limit of 0.5 Jy led to the detection of 269 sources (A.J. 83,451) above this limit and another 215 below. The 5 GHz source counts differ from those at lower frequencies: there is less evidence for either a steepening of the counts at high flux densities or for their convergence at very low flux densities. A possible anisotropy related to the supergalactic system is indicated. A sample of these sources have also been observed at 9.5 mm (A.J. 83,475). - A 5 GHz survey of bright southern E and SO galaxies has been carried out (19.158.067). It is suggested that only about 40 per cent of the E/SO galaxies in the Reference Catalogue have S(5GHz)> 1 mJy.

A high- declination search at 8GHz for compact radio sources has been carried out with the Haystack- NRAO interferometer (A.J. 83,560) with an 845- km baseline. Seven sources with compact cores with diameters smaller than $0\overset{''}{.}005$ were found and their positions determined; the uncertainty in the coordinates range from $0\overset{''}{.}04$ to $0\overset{''}{.}6$.

At Arecibo (Ap.J.Suppl. 36,53) a 2380 MHz survey of 2095 bright galaxies has been made; 456 were detected above 15 mJy. Statistical and phenomenological tests of correlations between radio and optical characteristics of galaxies will be made; the optical information is from the Uppsala General Catalogue (10.158.072).

Continuum observations of 1194 optically bright galaxies at 1400 MHz have been made with the NRAO 300- foot transit telescope (19.158.117). Included were almost all the galaxies of types E, L, or I in the Reference Catalogue of Bright Galaxies, north of decl. -19°, but only less than one half of the spirals. 248 galaxies were detected.

In the Westerbork survey of clusters of galaxies the most recent study concerns the Halo Radio Source in the Coma cluster (A. 68,449). The Cambridge One-Mile telescope has been used to map six clusters of galaxies (MNRAS 184,387) down to limiting flux densities of about 200 mJy at 408 MHz and 20 mJy at 1407 MHz. Four of the clusters have been identified as sources of X-ray emission; the two others are used as reference clusters. In all 48 sources were detected.

The low- frequency characteristics of radio sources associated with 22 well identified extragalactic X-ray sources are discussed in (Ap.J. 222,761). It is confirmed that the probability of a cluster being an X-ray source is dependent on whether or not the cluster has a dominating galaxy. In addition, there is a correlation of the X-ray luminosity with the radio power at both 26 and 1400 MHz.

Among the many papers on extragalactic X-ray sources we mention:
The Ariel V(SSI) catalogue, 2A. It contains 105 X- ray sources with $|b|> 10^\circ$, detected in the 2 - 18 keV range down to 1.2 Ariel counts s^{-1} (3.2 Uhuru counts). A number of new identifications with groups or clusters of galaxies is proposed and many previously known identifications confirmed (MNRAS 182,489).

The Fourth Uhuru catalogue of X-ray sources (Center f. Aph. Preprint No. 763) gives positions and intensities for 339 X-ray sources: 10 may be Seyfert Type I galaxies; 45 are identified with clusters of galaxies; and some suggest that superclusters of galaxies may be a new class of X-ray emitting objects.

Of the 2A catalogue objects, 7 have been proposed as being identified with nearby galaxies, 33 with rich clusters of galaxies and 12 with catalogued Seyfert galaxies, BL Lac objects, and quasars. Additional identifications are found in (Ap.J. 223,788), where a new class of X-ray sources is also proposed, associated with galaxies whose emission lines are much narrower than is characteristic of type 1 Seyferts. - In a further analysis of the data in the two catalogues, a list of 14 clusters for which X-ray spectra exist, is presented (Ap.J. 224,1) and the properties of the 48 X-ray clusters (distance class 4 or less) are analyzed. In particular, the X-ray luminosity is found to be related to cluster richness. - The concentration of X-ray sources to superclusters is analyzed in (Ap.J. 220,L63): of the 48 X-ray clusters just referred to, at least 15 are probably clustered into 7 superclusters. - Further discussions of X-ray sources in clusters of galaxies are found in e.g. (MNRAS 184, 783 and Ap.J. 225,21). X-ray halos in clusters are considered in (Ap.J. 225,L1), and X-ray emission from superclusters of galaxies in (Ap.J. 219,L89). See also (MNRAS 183,51P; Ap.J. 221,745; A.A. 68,281 and Ap.J. 224,718) for further information on recent work on X-ray emission from clusters of galaxies.

D. The extragalactic distance scale

Here, only calibrations of distance indicators will be referred to, as the redshift and the Hubble constant are discussed in section 5.

Detailed reports on new calibrations of the 5 primary indicators: novae, cepheids, RR Lyr variables, supergiants of spectral types B and A, and eclipsing binaries; of the 5 secondary indicators: globular clusters, brightest nonvariable blue stars, brightest red variables, brightest blue variables, and largest HII regions; and of two tertiary indicators; isophotal diameters and total magnitudes of galaxies, have appeared in 1978 (Ap.J. 223,351; 223,730; 224,14; 224,710). Extensive comparisons of the distances of 458 spiral galaxies within 40 Mpc derived from luminosities, diameters and a composite luminosity index with independent indicators (metric diameters, supernovae, super-associations) verify the linearity of the new distance scale within a few per cent (Ap.J., Jan. 1979). - Wray and G. de Vaucouleurs (unpubl.) have investigated the properties of the brightest blue super-associations in spirals detected on UBV colour composite photographs. This new tertiary distance indicator appears promising; it has a potential range in excess of 100 Mpc. - G. de Vaucouleurs and Buta (unpubl.) have developed another type of metric indicator based on the diameters of inner ring structures of S(r) and S(rs) galaxies, which depend on luminosity index and strength of the bar. Distances of 175 galaxies were derived; the potential range is in excess of 100 Mpc. - Michard has developed a new type of distance indicator for elliptical and lenticular galaxies from a combination of effective(metric) diameter, total magnitude and colour index. Relative distances of about 200 galaxies and 50 groups were derived (A.A., in press). Distances of a dozen groups having a mixed population, derived from their E-L members and their S galaxies, are in good agreement.

Tully and Fisher (19.158.045) have shown that there exists a good correlation between distance- independent observable, global galaxian HI profile widths and absolute magnitudes or diameters of galaxies. This offers a new extragalactic tool and may also be fundamental to our understanding of galactic structure.

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2. STRUCTURE AND EVOLUTION OF GALAXIES
(M. Peimbert)

I. Introduction

A considerable amount of work has been devoted to the study of the evolution of galaxies, several meetings were dedicated partially or totally to this topic (18.012.002; 18.012.043; 20.012.005; IAU Coll. 45; IAU Symp. 77). To reduce the overlaps of the reports to a minimum, galaxies will be considered as isolated systems (obviously this is not the case; cf. Saar and Einasto, IAU Coll. 45, 247); the interactions between galaxies and their environments as well as galaxy formation from the cosmological point of view will be discussed elsewhere. Fundamental questions raised by recent results on galaxies and stellar populations are stressed by King (20.158.042). In what follows we will review representative papers on: a) luminosities and masses, b) structure and contents, and c) dynamics and evolution.

II. Luminosities and Masses

Review papers on mass determinations are those by Burbidge and Burbidge (17.158.131), Roberts (17.158.135; 18.158.016), Burbidge (18.151.019), and Rubin (Comments on Ap. Vol. 8, No. 8). Rubin and coworkers (20.158.038; Ap. J. 224, 982; Ap. J.L. nov. 1978; Ap. J. dec. 1978) have obtained rotation curves for 15 very luminous spirals, some of their results are: a) the rotation curves are nearly flat up to the observed distances, b) secondary velocity undulations occur at positions of spiral features, c) there is a pronounced increase in the maximum rotational velocity with earlier Hubble type, d) the M/L_B ratio varies from about 2 to about 8 from the nucleus to the outer edge. From 21 cm observations Krumm and Salpeter (19.158.081) obtain rotation curves, mass distributions and total masses of 6 spiral galaxies, flat rotation curves were detected. Dickel and Rood (Ap. J. 223, 391) present integrated masses for 112 spirals and irregular galaxies from 21 cm observations. Pişmiş and Maupomé (Rev. Mex. A.A. 2, 319) discuss a compilation of masses for 230 galaxies, they find that the average mass from S0 to irregulars decreases, that barred spirals seem to have smaller mass than normal spirals of the corresponding Hubble type and that there are no spirals with masses smaller than 10^9 $M_\odot$.

Schweizer (Ap. J. 220, 98) finds a large increase in the M/L_V ratio from about 0.2 at 1 kpc to 9.1 at 15 kpc for NGC 4594. This result is apparently in contradiction with the high M/L values derived by Williams (19.158.113) and Morton and Thuan (09.158.056) for the nuclei of spiral galaxies. Rieke and Lebofsky from 10 micron observations of the nuclei of bright spiral galaxies find that $M/L\sim0.2$ (Ap. J. 220, L37). From velocity dispersions for 25 galaxies Faber and Jackson (17.158.036) find M/L_B values of about 7 for luminous ellipticals, which increase with luminosity; Smith and Tinsley (18.158.110) by means of evolutionary models find that this increase is not due to an increase of the metal content. Tully and Fisher (19.158.045) find that v_{max} is proportional to L, this result is not in agreement with the results by Rubin et al.. Young et al. (Ap. J. 222, 450) obtain M/L= 6 for the E5 galaxy NGC 4473, the M/L ratio increases slowly with radius. Monnet and Simien from a simple two component model of galaxies (19.151.019) find that the M/L ratio for the bulges of M31 and M81 is $\sim$5-7.

Gallagher and Hudson (18.158.070) did not detect a halo for the Scd galaxy IC 2233 to a level of $\sim$ one percent of the disk surface brightness. Hegyi and Gerber (20.158.078) detected an optical halo surrounding the spiral galaxy NGC 4565 with an intensity of 1/1000 of the night sky out to 34 kpc and suggest that it might correspond to a massive halo of cosmological significance; alternatively Kormendy and Bruzual, and Spinrad et al. (Ap. J. 223, L63; Ap. J. 225 in press) have also carried out observations of the outer regions of NGC 4565 and conclude that the measurements correspond to an extrapolation of the spheroid and not to a massive

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halo. Gunn (20.151.045) has studied the formation and evolution of massive halos and concludes that in the local group most of the mass is in halos but that in giant clusters only about 10 percent favoring a low density universe. The role of diffuse matter in galactic coronas has been studied by Chernin et al. (17.158.025). Knapp et al. (Ap. J. 222, 800) find that in NGC 4278 the HI gas lies in a rotating disk which extends well beyond the visible body of the galaxy; the HI curve is flat with M/L greater than 20 in the outer regions, this galaxy like many spirals is embedded in a massive low luminosity halo.

III. Structure and Contents

Sandage (17.158.129) reviewed the classification and the stellar content of galaxies obtained from direct photography, Freeman (18.158.196) the large scale structure, the masses and the content of galaxies and de Vaucouleurs (20.158.044) qualitative and quantitative classifications of galaxies. Van den Bergh (17.158.120) proposed a new classification of galaxies where spirals are divided in normal, anemic and lenticulars.

Hodge (private communication) has made a photometric survey of M31 with the KPNO 4m telescope from which 404 new open clusters have been found. Ford and Jacoby (Ap. J. 219, 437) have identified 315 planetary nebulae in M31 from this result they compute the stellar death rate and mass loss rate. A survey of suspected OB stars in M31 has been carried out by Richter (18.158.123). Matsumoto et al. (20.158.082) from near infrared photometry of M31 suggest the presence of a weak bar-like structure. Bajaja and Gergely (20.158.066) have determined the gas to dust ratio in M31. Several studies on the structure and content of IC 1613 NGC 6822 and Leo I have been carried out (18.158.168; 19.158.076; Ap. J. S. 37, 145; A.J. 83, 228). 2!3 synthesis observations of the neutral hydrogen in NGC 6822 have been made by Gottesman and Weliachew (20.158.086) they find that star formation is proportional to the 1.5 power of the gas density. From radio continuum observations of M33 at 4850 M Hz by Kap-herr et al. (A.A. 62, 51) the thermal and non thermal contribution is estimated. The interarm medium of M33 seems to be ionized by OB stars (18.158.243; 17.158.140).

Papers on physical conditions in extragalactic H II regions are reviewed in the report of Commission 34. Hodge and coworkers have continued their study on identification and distribution of H II regions in external galaxies (17.158.085; 18.158.012; 19.158.060) and have produced a high resolution Hα atlas of 72 galaxies (private communication). Radio observations of H II regions in external galaxies have been discussed by Israel (18.131.577). A review on H II regions in the nuclei of external galaxies has been presented by Ulrich (18.131.582), she has also studied the gas outflow from the nucleus of NGC 253 (Ap. J. 219, 424).

The large-scale radio continuum structure of spiral galaxies has been reviewed by van der Kruit (IAU Symp. 77, 33). From the radio continuum emission of M51 at three different frequencies van der Kruit (20.158.003) has been able to separate the thermal from the non-thermal component. From the brightness distribution of M51 Mizuno (20.151.074) finds that star formation is proportional to the second or third power of the gas density. Allen et al. (A.A. 62, 397) find that the radio continuum steepens at higher z and discuss several cosmic ray models fitting these observations. Shaver et al. (A.A. 64, 1) show that the recombination lines from M82 are mainly due to stimulated emission and suggest that a similar situation prevails in NGC 253.

Reviews on radio observations of molecules in external galaxies have been presented by Whiteoak, Rickard and Townes (IAU Symp. 77, 131; IAU Symp. 84, in press; 18.131.102); molecules detected include HCN, CS, CO, H_2O, OH, H_2CO (17.158.028; 19.158.053; 19.158.063; 19.158.111; 20.158.057; 20.158.089; 20.158.100; A.A. 64, L21; A.A. 67, L13, Ap. J. 223, 803). The CO observations may become very important for: a) estimating the H_2 content and b) comparing them with HI distri-

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butions to study the mechanism of molecular cloud formation. Such studies are still premature (see Emerson, A.A. 63, L29).

Sancisi (18.158.154; 20.158.069) and Emerson and Newton (IAU Symp. 77, 183) discussed the presence of warps from 21 cm observations. Byrd (Ap. J. 222, 815) suggests that warps are illusions created by: the orientation of galaxies, presence of spiral arms in the outer parts of their disks and the limited resolution of the radio observations. Binney (M.N. 183, 779) suggests that twisted and warped disks are consequences of heavy halos.

Van Woerden and Freeman (20.158.070; 20.131.082) discuss the gas content of early type galaxies. Detections and upper limits of the HI content in E and SO galaxies have been obtained by Knapp, Faber, Gallagher, Balick, Bottinelli, Gouguenheim, Huchtmeier and others (18.158.112; 19.158.033; 19.158.091; 19.158.104; 19.158.141; 20.158.013; 20.158.036; A.A. 64, 23; A.A. 67, L1; A.J. 83, 11; A.J. 83, 139, A.J. 83, 360; Ap. J. 222, 800). Koski and Osterbrock (17.158.014) and Warner (19.158.059) show that the emission line spectrum of the E galaxy NGC 1052 is consistent with shock wave models. Van den Bergh (18.158.186; 18.158.037) has studied the E galaxy NGC 5128 and the SO galaxy NGC 5102 and suggests that both objects have had recent bursts of star formation. Radio properties of the nuclei of E, SO and S galaxies and the large scale distribution of radio continuum in E and SO galaxies have been discussed by Ekers (IAU Symp. 77, 221 and 49).

Spinrad and Peimbert (17.158.130) and Faber (20.158.045) presented reviews on the integrated spectra of galaxies. Stellar population synthesis models of nuclei of spiral and elliptical galaxies based on optical and nearby infrared observations have been carried out by several groups (17.158.109; 18.158.006; 18.158.113; 18.158.157; 19.158.008; 20.158.123; Ap. J. 220, 75; Ap. J. 220, 442; Ap. J. 221, 788; Ap. J. 222, 14).

IV. Dynamics and Evolution

Cosmological aspects of galaxy formation are discussed in the report of Commission 47. Reviews on the formation and dynamics of galaxies have been presented by Field and Freeman (17.151.064; 17.151.065). Larson (18.151.044; IAU Coll. 45, 3) has presented reviews on the formation of galaxies as well as models for the formation of disk galaxies (18.151.004). Larson (20.131.081) and Talbot (IAU Coll. 45, 31) have written reviews on problems of star formation in galaxies relevant to galactic evolution. Strom and Strom (IAU Symp. 77, 69) presented a discussion on the evolution of disk galaxies. Icke (19.151.036) has discussed the origin of the Hubble sequence while Bertola and Capaccioli (Ap. J. 219, L95 and 404) based on angular momentum considerations argue that SO galaxies should be considered disk galaxies and not members of a transitional stage between ellipticals and spirals. Illingworth (20.158.088) finds that most elliptical galaxies, in a sample of 13, show a very small amount of rotation; Binney (M.N. 183, 501) finds that these observations are consistent with models of isotropic prolate spheroids and with anisotropic oblate spheroids.

Reviews on the density wave theory and on theories of spiral structure have been presented by Lin, Toomre and Roberts (18.151.020; 18.151.046; 20.151.053; 20.151.043; IAU Coll. 45, 11; 20.151.027). Lin, Mark and others have worked on density waves in galaxies, representative papers are (17.151.005; 17.151.035; 17.151.055; 18.158.182; 19.151.016; 20.151.006; M.N. 182, 457). Schweizer (18.158.017) and Strom et al. (17.158.095) have detected broad spiral patterns in the underlying disks of galaxies apparently associated with the old disk population. Gerola and Seiden (Ap. J. 223, 129) from a stochastic self-propagating star formation model obtain large-scale spiral features that are stable during the lifetime of a galaxy.

Contopoulos has been working on the study of stellar orbits in barred galaxies

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and the response density near the Inner Lindblad Resonance in general and that due to an imposed spiral field with particular attention to bars (20.151.041; A.A. 61, 477; IAU Coll. 45, 229; IAU Symp. 84 in press; A.A. in press). Vandervoort and coworkers have continued their study of resonant stellar orbits in spiral galaxies (Ap. J. S. 37, 519; Ap. J. 221, 87 and 539). Mennessier and Martinet (A.A. 65, 409) have studied orbits in a slowly growing spiral field near corotation and Frahm and Thielheim (Ap. J. 220, L43) have analyzed stellar orbits and the persistence of spiral structure. Numerical models to study the stability of disk like galaxies with massive halos have been carried out by Miller (Ap. J. 224, 32). Hohl (A.J. 83, 768) has made three dimensional galaxy simulations and finds the usual fast growing instability leading to bar formation. From simple mass models of disk-bulge systems Berman and Mark (A.A. in press) find that nuclear bulges suppress bar instabilities just as easily as massive halos and consequently that massive halos are not necessary to prevent rapid bar formation.

Reviews on chemical evolution of galaxies have been presented by Tinsley, Lynden-Bell, Audouze and Tinsley and Larson (18.158.197; 18.158.233; 20.151.029; 20.131.081). Recent papers on abundances and chemical evolution of galaxies include: (17.158.081; 18.131.103; 18.158.050; 18.158.114; 18.158.175; 19.158.031; Progr. Th. Phys. 58, 1972; IAU Coll. 45, 61; Ap. J. 221, 554; Ap. J. 223, 824).

3. GROUPS AND CLUSTERS OF GALAXIES
(K. C. Freeman)

This survey is not complete, it just attempts to identify some major areas of activity. *Abbreviations*: ApJ = Astrophys. J., AA = Astron. Astrophys., AJ = Astron. J., MN = Monthly Notices Roy. Astron. Soc., Nat = Nature. For reviews and conference proceeding relevant to this survey, see 17.003.010; 18.012.002.011; 19.012.018; 19.160.042, 20.003.010.012; 20.012.005.014.

A. X-Ray Observations of Clusters of Galaxies

The 7-keV line of Fe XXV, XXVI was discovered in the X-ray emission from clusters of galaxies (17.142.063; 19.160.011.028). The Fe abundance is close to solar (20.160.030, ApJ 219,795; 225,21).

Superclusters have been identified as high luminosity X-ray sources. The emission could result from hot tenuous gas pervading the whole supercluster (ApJ 219, L89; 220, L63).

Several clusters show extended X-ray emission (17.160.008; 18.160.037.038; 20.160.021; ApJ 221, L37; 222, L85; 224,718; MN 183, 39P; 185, 423). The typical core radius for this emission is about 8 Mpc. For a thermal bremsstrahlung model, the mass of hot gas within the core radius is about 10^{15} $M_{\odot}$. It was probably ejected from the component galaxies during their early evolution (ApJ 223,47).

The X-ray emission mechanism from clusters is not yet certain. Spectra favor thermal bremsstrahlung from hot gas (17.160.024; 17.161.005; 18.160.038.063, 19.160.011; AA 68,281; ApJ 219,795; 225,21). Many authors have discussed the relationships between the cluster X-ray luminosity and temperature, and other cluster properties like richness, central density, velocity dispersion and galaxy content (18.160.013; 20.142.031; 20.160.031.055; ApJ 224,1; MN 182,33P). They mostly support the thermal bremsstrahlung picture. It is not clear now how significant the luminosity velocity dispersion relation is (18.160.059). Cooling and accretion of hot cluster gas on galaxies in the cores of X-ray clusters can explain the enhanced soft X-ray

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emission at the cluster cores (20.160.004; ApJ 224,308). Lea and Holman (ApJ 222, 29) discuss the correlation of X-ray emission and the presence of steep spectrum radio sources in clusters. They show that heating of cluster gas by relativistic electrons is quite adequate.

B. Radio Observations of Clusters of Galaxies

There are many new observations of head-tail sources in clusters (eg 17.141.051; 17.160.008.014; 18.160.004.018; 20.141.069). The peculiar velocities of head tail sources in clusters are similar to those for other galaxies (ApJ 221,422; AA 70,303). There are also head-tail sources in poor clusters (AA 69,253) and in a group (ApJ 223, L9). Ram pressure models seem the most promising.

There is an apparent HI deficiency in Virgo cluster spirals (17.160.010) and in the spirals of the Coma and A1367 clusters (ApJ 225, 751). The halo radio source in the Coma cluster has a HP diameter of 33 arcmin.A 1367 and A2319 also have large radio halos (AA 68,449; 69,255; 19.142.110).

There are cold spots in the microwave background in the direction of clusters (18.160.033; 20.161.008; Nat 275,40; MN 185,245). They were interpreted as Compton scattering of the background by the hot intracluster plasma: see however ApJ 219,12. Tarter (ApJ 220,749) stressed the positive contribution from free-free emission by cooler gas. Observations by Rudnick (ApJ 223,37) put limits on the observed 2-cm brightness of several X-ray clusters, which are consistent with the expected effects. See 19.161.003 for theoretical predictions.

C. Individual Clusters: Optical Work

There are many new photometric and kinematic observations of galaxies in clusters, and number density distributions and luminosity functions for individual clusters. The inferred M/L ratios are usually of order 100. The Coma cluster has been particularly well studied (17.160.027.034; 19.160.024; 20.160.043; Astron. Nachr. 299,109). The Stroms have studied the environmental effect on galaxy structure in detail, through surface photometry in several clusters (20.158.046; AJ 83,732, 1293). See also ApJ Suppl. 37, No.4 for the Fornax cluster. Surface photometry of Coma shows that a significant fraction of the total luminosity comes from the diffuse light. This does little to help the "missing mass" problem (19.160.049; 20.160.059; 20.161.002).

Hartwick argued (18.160.011) that the tidal forces of the Virgo cluster on nearby groups are insufficient to disrupt them; this gives M/L<11 for Virgo, and the cluster is then unbound.

Tifft's new data on A1367 and Perseus (ApJ 222,421) shows bands in the redshift-magnitude diagram, similar to those in Coma.

New distances to Virgo, Fornax and Hydra have been derived from globular clusters in their early type galaxies (Nat 266,126).

Leir and van den Bergh classified 1889 rich clusters on the BM system (20.160.023). Rose (17.160.011) made a catalogue of 124 southern clusters; see also 20.002.032 and MN 182,241 for catalogues.

D. Superclusters

Although the debate continued about the reality of the local supercluster (17.160.005.006), the concept of superclusters (SC) is firmly established. Wesson (17.160.029) showed that the SCs and clusters themselves are defined at scales of

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about 15 and $2h^{-1}$ Mpc. Rood (18.160.001) showed how physical groups of clusters exist on scales < 25 Mpc. The Coma (or Coma/A1367) SC is detected out to 4° from the Coma cluster center (17.160.031). The two clusters have a common envelope which includes four groups and some isolated galaxies; see also 17.160.025. Almost every rich cluster is located in a SC (ApJ 222,784; MN 185,357: see also Nat 274,39). For the Virgo SC, the spatial density drops off roughly as r^{-3} (17.160.002).

E. Dynamics and Evolution of Clusters

Although the brightest cluster galaxies show little color evolution over $\Delta z \approx 0.46$ (ApJ 220, 376, this may not be so for the fainter members. Butcher and Oemler (ApJ 219,31) studied two clusters at z= 0.39, 0.46, which are Coma-like in morphology but have a large fraction of members with spiral-like colors. See also 20.160.035. They also showed (ApJ in press) that the galaxy content of nearby clusters correlates strongly with central concentration. This suggests conversion of spirals to S0s over this relatively short look-back time, which is surprising. The role of ram pressure in stripping spirals may be important for producing S0s. There is direct evidence for this stripping in the Hydra I cluster (ApJ 223 386). Galaxies can lose 80-90% of their interstellar matter in one crossing time (18.160. 062). In X-ray clusters, the ratio of spirals to S0s increases outwards, and the velocity dispersion correlates with the overall fraction of S0s among the disk galaxies. This also supports the stripping picture (19.160.045). Emission-line galaxies are much less common in dense clusters (MN 183,633); this probably results from stripping or evaporation.

The merging of normal cluster galaxies can produce the low surface brightness cD galaxies and the apparently nonstatistical properties of the bright end of the cluster luminosity functions (20.160.036; ApJ 224,320). Dynamical friction is important in its effect on the density profile of the massive objects, to form cD systems (17.151.001; 20.160.054). Collisions of galaxies in dense clusters can profoundly affect the evolution of the galaxies and the cluster (17.160.016; ApJ 225, L93).

The Coma cluster has a spherical core of early type galaxies and a more flattened distribution of later type systems (ApJ 220.809). Its flattening is apparently not caused by rotation (ApJ 220,798). There has been more work on the "pancake" picture for protocluster formation and the subsequent fragmentation (MN 184,643).

The absolute magnitude of the first-ranked cluster galaxy seems remarkably constant from cluster to cluster, depending very weakly on cluster richness (17.160. 017). Is this a statistical property of the cluster luminosity function, or is it due to some physical process. Dressler's study of cluster luminosity functions (ApJ 222,23) suggests a special process. Support for the statistical picture comes from 17.160.035, 18.160.036; see also 17.158.158. van den Bergh (Astron. Space Sci. 53,415) showed that extrapolation of the linear part of the integral luminosity function defines a magnitude with a dispersion of only 0.19 mag from cluster to cluster.

F. Groups and Hypergalaxies

Hypergalaxies are small aggregates of galaxies and intergalactic matter, with one concentration center. A first list is given in 20.160.132. The Galactic hypergalaxy has a radius of about 75 kpc, and its mass is about 12.10^{11} $M_\odot$. (18.155.027; 18.160.040).

Of 131 galaxies within 9.1 Mpc, 88 are in groups (20.160.063). These groups have M/L< 20. The remaining 33% are in the "field". This raises two contentious points: the M/L values and the existence of "field" galaxies. Turner and Gott's (18.160.064) catalogue of groups has 737 galaxies in 103 groups, while 350 are in the field. However, these "field" galaxies are themselves clustered (19.160.004). Perhaps no single galaxies were created outside groups and clusters (Nat 274,450). For the Turner-Gott groups, M/L is about 65 (19.160.022). Similar high M/L values are reported in ApJ 224,724 and 19.160.020. However Hartwick (ApJ 219,345) found M/L≈7 for 17 dense groups.

G. Binary and Interacting Galaxies

Elliptical galaxies may form through mergers of disklike systems; see 20.012.005 and Larson and Tinsley (ApJ in press). See also MN 184,185 and 19.151.012 for merger model calculations.

The ring structure of II HZ 4 was interpreted as the result of penetration of one galaxy by another (18.158.069). See also 18.158.035 and 19.158.058.

Several interacting galaxies have been studied in HI. From the HI bridges associated with IrII galaxies, it seems likely that these galaxies result from binary encounters in small groups (MN 184,259).

Larson and Tinsley (ApJ 219,46) showed how interacting galaxies have had bursts of star formation associated with the interaction. Close pairs have more frequent radio emission than wide ones (AJ 83,348).

There is disagreement in the M/L ratios derived from binary galaxies. For example, for spirals, Turner (18.151.010; 20.160.018) finds M/L≈50-100. Peterson's (Cornell thesis) value is about 50. Rood (17.158.079) derives a lower value (≈10), and van Albada and Freeman find M/L≈ 12 from Turner's sample. Karachentsev et al (18.158.047) also find a low value (≈16). The difference is probably in the method of analysis, rather than in the samples.

4. PECULIAR GALAXIES AND QUASARS

(J. Heidmann)

As it is not possible, in the limited space allowed, to write an allinclusive report and as in such a report it is desirable to avoid the reporter's personal views, the following lines deal with works which were specifically communicated to the writer by those members of Commission 28 who cared to answer our President's August 22, 1978, circular requesting brief accounts of their and/or their colleagues' activities.

The paper cD galaxies in poor clusters. II. (Albert, White and Morgan, Ap. J. 211, 309) contains several apparent clusterings which seem to contain a cD galaxy. The form of the latter is sharply discriminated from galaxies of other types; in addition, the cD galaxies are extremely rarely encountered in space. For these reasons, it seems exceedingly unlikely that such clusterings as AWM 3, 4 and 7 could be chance superpositions of random galaxies. For this reason, Morgan wishes to urge continued consideration of the reality of these clusterings - even if discordant redshifts are found for their members. In addition, the cD galaxies themselves should be investigated, by redshifts, for determination of luminosity and size.

Braccesi reports on the t variability of QSO's with Bonoli, Federici, Formiggini and Zitelli; almost all are radioquiet, with a smaller degree of variability than radioemitters; there is a suggestion of a 5-month characteristic time for the underlying phenomena. They also discuss the number-magnitude relation and obtain a very strong cosmological density evolution (to appear in A.A.).

Nieto re-examined the problem of quasar- galaxy association and found no significant tendency towards it (Nature 270,411, A.A. in press) and measured accurate positions of 50 radio-quiet quasars (A.J. in press).

Elvius found fairly strong polarization even outside the nucleus of NGC 1068 (A.A. 65,233), interpreted in terms of scattering in large dust clouds; other observations are analyzed in Ap. Sp.Sc. 55,49.

Markarian galaxies were investigated in the 21-cm line and spectroscopy by Bottinelli, Duflot, Gouguenheim and Heidmann and found to be overluminous for their types (3rd European Meeting, p. 222). The three first authors investigated also the peculiar galaxy NGC 3448 (A.A. 63,363).

Bergvall et al. made spectroscopic and morphological investigations of emission-line galaxies from the ESO/Uppsala Catalogues (A.A. Suppl. 31,427; 33, 243; in press). With few exceptions, there are no indications, for pairs, of instability of a dramatic kind; in the cases where there are large velocity differences, the data are rather poor or the physical companionship not secured.

In their morphological investigations of pairs containing Markarian galaxies, Casini and Heidmann singled out a class of clumpy irregular galaxies characterized by UV excess radiation, a morphology made up of half a dozen high surface brightness clumps loosely scattered in a common envelope, and luminosities, dimensions and internal velocities larger than those of classical irregulars (A.A. 47,371; A.A. Suppl. 24,473; 34,91). With Tarenghi they obtained indication that clumps may each be 50 times more massive than giant H II regions (A.A. in press). With Barbieri they made a first morphological and spectroscopic investigation of galaxies from Vorontsov-Vel'yaminov's Second Atlas of Interacting Galaxies (A.A. Suppl., submitted).

Osterbrock, Phillips et al. made spectroscopic investigations of Seyferts 1 and 2, broad- and narrow-emission line radiogalaxies, Arkelian galaxies and QSO's (Ap.J. 203,329; 206,898; 215,446,733,746; 220, 426,783; 223,56; PASP 89,251; Ap.J. Suppl., in press; Phys. Scripta 17,137). They investigated the physical state of emission line regions (Phys.Scripta 17,285) and give models of ionized gas in the nuclei (P.N.A.S. 75,540; Ap.J., in press). They suggested photoionization by the featureless continuum with, for Seyfert 1, rotational velocity of 5000 km s^{-1} and turbulent velocity 2000 km s^{-1} in a disk with dimension 0.1 pc for the dense gas.

Larson and Tinsley interpreted the U-B, B-V of peculiar galaxies by bursts of star formation as short as 10^7 yr involving 5 per cent of the total mass. N galaxies were interpreted as elliptical and spiral galaxies underlying their central miniquasar. Oemler obtained a new rotation curve of NGC 5128 (B.A.A.S. 10, 382).

Tinsley interpreted the strong thermal IR radiation from the nuclei of some galaxies with star formation rate 0.2 $L_{bol}/L_{\odot}$ Gyr^{-1}. With Larson she proposed that bursts are caused by gas compression during the collisions (Ap.J. 219,46).

Feldman and MacAlpine investigated the He I triplet in Seyfert 1 galaxies and interpreted it by gas clouds at 15 000 K and density 10^{10} cm^{-3}. Spectra of blue dwarf galaxies are interpreted by massive star formation rates.

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Caldwell obtained UBV photometry of galaxies similar to NGC 5128. He also found the most extreme early-type galaxy, NGC 5206, in which a burst possibly occurred 10^9 years ago.

Notni investigated the colour distribution in M82 (A.N.297,323) and the cut-off in quasar density with Oleak (A.N.297,71,147) and made identifications in 5C surveys (A.N. 297,265; 298,293; 299,1).

Börngen and Kalloghlian made morphological and colour investigations of Markarian galaxies (A.N. 297,279).

Richter investigated compact radiosources (A.N.297,5; in press) and pairs of spherical compact galaxies with Schnell (A.N. 297,275).

Afanasjev, Karachentsev and Lipovetsky made investigations of objects found by the Tautenburg Objective Prism Survey (A.N. 300, in press).

Oleak states that the search for quasars on low dispersion objective prism plates, detailed spectroscopic observations of peculiar objects and the multicolour photometry on Schmidt plates of the Tautenburg telescope will be continued in the future.

5. REDSHIFTS
(V. C. Rubin)

The acquisition of galaxy and QSO redshifts has accelerated; the pace is explosive, due to new detectors, larger telescopes, novel observing methods, increased wavelength coverage, and larger numbers of extragalactic observers. Velocities have been obtained for many types of objects: galaxies in X-ray clusters and velocity dispersions within clusters; Seyfert, Markarian, Arakelian, binary, and interacting galaxies; distant radio galaxies and QSOs. Objects for study come from the Curtis Schmidt (Tololo) objective prism study, the KPNO "grism", the ESO/Uppsala survey, the 3CR, 4C, Parkes, and NRAO surveys, and from the UGC. In Table 1 I have listed major publications of extragalactic redshifts since 1976. With the exception of The Revised Bright Galaxy Catalogue (RBGC), references are intended to refer only to new redshifts (i.e., objects which previously had no redshift). Although the distinction between new in this sense and new in the sense of an additional observation is not always clear, I have attempted to count only previously unobserved objects. Papers which report only a few redshifts are not included unless they are very unique. This restriction unfortunately eliminates, among others, the velocities observed by Boksenburg and colleagues (20.141.101), and the report of the detection at $z \sim 0.5$ of a 21-cm absorption line in AO 0235+164 (M.S. Roberts et al., 18.141.019). Table 1 contains references to almost 6000 radial velocities; 2502 from RBGC. The overlap between these papers and the RBGC is expected to be small.

Numerous galaxy radial velocity programs currently underway are listed in Table 2; the numbers in Column 3 refer to velocities already obtained (but unpublished). Programs include study of nearby dwarfs, spirals in groups, clusters and superclusters, brightest ellipticals in clusters, and deep survey fields. Over 4000 radial velocites (not duplicated in Table 1) have already been gathered by these observers; this brings the total numbers included in Tables 1 and 2 to 10^4! The increase in known redshifts since Slipher's first one in 1914 is shown in Figure 1. In the past, known redshifts have increased by about a factor of 10 each 20 years. While it may be too optomistic to look forward to 10^5 by the year 2000, the current emphasis on constructing fast redshift machines may make even this possible. We will then be 10% toward Ambartsumian's goal of 10^6 redshifts.

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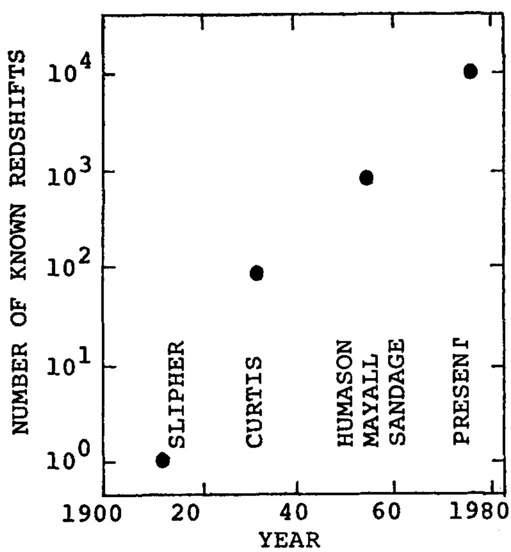
The program to determine redshifts for QSOs found on low dispersion objective prism plates of the 134/200/400 cm Tautenburg Schmidt is continuing. The program also identifies and obtains spectra of objects in 5C1 to 5C4 fields. Three papers by Afanasjev, Karachentsev, Lipovetsky, Lorenz, and Richter (AN, in press) describe the observations, and give radial velocities of 4 QSOs. A discussion of QSO redshift determination on low dispersion objective prism plates is in press (Lorenz, Lange, Richter and Stoll, Ap L).

Catalogues which contain velocities have been published for QSOs (G. Burbidge et al., Ap J Supl 33, 113; Smith-Haenni, 19.141.008), for the 3CR (H.E. Smith et al., 18.141.166), and for the Seyfert galaxies (Weedman, 20.003.012; MNRAS 184, 11P). An Index of Galaxy Spectra containing velocities for 2000 UGC galaxies will be published late 1978 by Gisler and Friel; a computer printout of best velocities for 4000 galaxies has been made by Huchra.

The motion of the Galaxy and the Local Group, and the sensitivity of the solution to the choice of included galaxies, is discussed by de Vaucouleurs et al. (19.160.009) and Yahil et al. (20.160.033). Debate continues over whether the elliptical and spiral galaxies in Virgo form a single cluster (Sandage and Tammann, 18.160.005; Sulentic, 19.160.010). Fairall (MNRAS 183, 59P) points to the possibly relevant observation that the ellipticals and the spirals in Centaurus form two distinct groups. From an examination of the peculiar velocity field in the Local Supercluster, Peebles (17.160.023) concludes that there is weak evidence

Figure 1. The increase in number of known redshifts from 1914 through 1978



of a systematic motion of contraction around Virgo. A motion for the Galaxy and the Local Group has been inferred by Rubin et al. (18.162.073) from the anisotropy of velocities of distant Sc I galaxies. The motion $V_{LG}=450\pm125$km s^{-1} toward $\ell=163°$, b=-11°, is almost perpendicular to the motion inferred from the anisotropy observed in the 3°K microwave background radiation (Corey and Wilkinson, 18.141.081; Smoot et al., Phys. Rev. Letts. 39, 898).

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Considerable research and controversy continues to surround the determination of the Hubble constant. Many papers presented at IAU Colloquium No. 37, Decalages vers le rouge et expansion of l'Univers (20.012.053) pertain directly to this problem and will not be mentioned here by title. Sandage and Tammann, from a series of steps and calibrations (18.162.060, 19.162.054, 20.162.121) find that the expansion is linear (nearby), isotropic, smooth, and that the Hubble constant is low, $H \sim 55 \pm 7$ km s^{-1} Mpc^{-1}. According to de Vaucouleurs (19.162.027, IAU Symp No. 79, 205), the expansion is neither linear nor isotropic within the Local Supercluster; outside of the Supercluster the Hubble constant is in the range $85 < H < 105$ km s^{-1} Mpc^{-1}. The higher value is supported by the 21-cm velocity width-luminosity relation of Tully and Fisher, as calibrated by them (19.158.045; Comments Ap 7, 85; Shostak, AA 68, 321), but not as calibrated by Sandage and Tammann (18.162.060). Additional difficulties in the application of this method are discussed by M.S. Roberts (AJ 83, 1026) and Rubin et al. (Ap J Lett Nov 1978). From an independent review of the relevant observations, Peebles (Comments Ap 7, 197) finds values in the range $50 < H < 85$ km s^{-1} Mpc^{-1}.

Novel attempts have been made to evaluate H, from superluminal radio sources ($H = 110 \pm 10$ km s^{-1} Mpc^{-1}; Lynden-Bell, 10.162.053), from supernovae (Branch and Bettis, AJ 83, 224) and from rotation curves (Noonan, 19.162.020). Hubble diagrams have been constructed from nuclear magnitudes of cluster galaxies (Weedman, 17.160.003), nuclear magnitudes with a Local Group motion (Rubin, 19.160.006), radio galaxies (H.E. Smith, 20.141.106), faint clusters and radio galaxies (Kristian et al., 17.160.074, Ap J 221, 383), QSOs (Bahcall and Turner, 20.141.107; Netzer et al., MNRAS 184, 21P; Setti and Zamorani, AA 66, 249). The Malmquist effect in QSO statistics was rediscovered and discussed, along with other problems in the determination of H (Oleak and K-H Schmidt, 19.162.001, Kruszewski and Semeniuk, 18.162.054; S.C. O'Dell and D.H. Roberts, 18.162.066; Jaakkola and Le Denmat, 18.162.005; Bottinelli and Gouguenheim, 18.162.023).

TABLE 1. PUBLISHED REDSHIFTS, 1976- October 1978

1st Author	Type of Object	New Velocities	Reference
G. de Vaucouleurs +	Bright Gal. Cat.	2502	18.003.046
Ulrich	Radio Sources	36	17.141.087
M. Smith +	CTIO QSO	9	17.141.097
West	Southern Strong Em.	7	17.158.019
Bottinelli +	21-cm	(156)	17.158.032
Doroshenko +	Arakelian	40	17.158.051
Rood +	Groups	14	17.158.078
A. de Vaucouleurs +	Bright	7	17.158.088
Martin	Southern	80	17.158.097
H. E. Smith +	N. Gal., Large z	3	17.158.107
Dickens +	A1367	31	17.160.001
Huchtmeier +	Virgo	5	17.160.010
Tifft +	Como	∿50	17.160.025
Sandage +	Clusters	37	17.162.037
B.A. Peterson +	Southern Radio	23	18.141.008
Savage +	Southern QSO	16	18.141.115
Turner	Double	101	18.158.027
Theys +	Ring	8	18.158.035
Karachentsev +	Double	52	18.158.047
Arkhipova +	Interacting	24	18.158.100
G. de Vaucouleurs +	Bright	30	18.158.104
West	Southern Strong Em.	14	18.158.201
Tarenghi +	A2255	9	18.160.003
Coleman +	A1314	18	18.160.004
Gudehus	A1367	16	18.160.009
Chincarini +	Peg I, II	35	18.160.035
Spinrad +	A2241	5	18.160.079
Rubin +	Sc I	(175)	18.162.072
A.E. Wright +	Southern Radio	27	19.141.020
Sargent	3CR + 3C	7	19.141.054
Osmer +	CTIO QSO	27	19.141.059
Browne +	Southern QSO	11	19.141.121
Osmer +	CTIO QSO	4	19.141.143
Hoag +	KPNO QSO	∿90	19.141.160
West	ESO/Uppsala	30	19.158.005
Cooke +	Obj. Prism	29	19.158.065
Penston +	CTIO QSO	33	19.158.149
Hintzen +	A401	14	19.160.016
Kirshner	6 Groups	46	19.160.020
Dawe +	Centaurus	61	19.160.026
Moss +	A262; Pisces	49	19.160.027
Faber +	11 Clusters	143	19.160.035
Chincarini +	A194	29	19.160.037
Spinrad	Cor Bor (A2065)	8	19.160.040
Scott +	A2634; Zw 2247 + 11	33	19.160.043
Schmidt	NRAO 5 GHz + 4C	37	20.141.034
Osmer	CTIO QSO	13	20.141.137
Denisyuk +	Markarian	64	20.158.026
Arakelian +	Arakelian	∿22	20.158.027
Dibai +	Arakelian	∿35	20.158.028
Osterbrock +	Arakelian	7	20.158.031
Borchkhadze +	Southern Interacting	16	20.158.055
Aguero	Southern	10	20.158.095
Vidal +	Centaurus	25	20.160.001
N.A. Bahcall +	A478	2	20.160.022
Tifft	Coma II	50	20.160.034

TABLE 1. CONTINUED

R. Kron	z = 0.947	1	20.160.035
Maccagni +	z Estimate	7	AA 62, 127
Karachentsev +	Cetus	6	AA 63, 411
Shostak	Late	(150)	AA 68, 321
West +	Southern	10	AA Supl. 31, 55
Westerlund +	Compact; Inter.	15	AA Supl. 31, 427
Bergwall +	ESO/Uppsala	∿130	AA Supl. 33, 243
Hintzen	A347, 779, Zw 1809 + 50	46	AJ 83, 478
Sandage	719 Bright	∿350	AJ 83, 904
Jauncey +	Parkes	27	Ap J 219, L 1
Havlen +	CA 0340-538	20	Ap J 220, 14
Chincarini +	Cl. K44	24	Ap J 221, 34
Kristian +	Brightest in Cl.	50	Ap J 221, 383
Ulrich	Clusters	76	Ap J 221, 422
Sramek +	QSO	91	Ap J 221, 468
Hartwick +	Local Group	3	Ap J 221, 512
Bohuski +	CTIO	68	Ap J 221, 776
Tifft	Perseus, A1367	88	Ap J 222, 54
Gregory +	A1367	44	Ap J 222, 784
Silverglate +	Ring	4	Ap J 224, L 99
D. Wills +	QSO	∿97	Ap J Supl. 31, 143
MacAlpine +	QSO ∿	∿25	Ap J Supl. 35, 197
MacAlpine +	QSO ∿	∿25	Ap J Supl. 35, 203
D. Wills	4C + Parkes	∿85	Ap J Supl. 36, 317
Longmore +	New Local Group	2	MNRAS 183, 97P
C.J. Peterson	Misc.	28	PASP 90, 10
Pedreros	Southern Peculiar	18	PASP 90, 14
Stauffer +	Cl. AWM-4	5	PASP 90, 20
Eastmond +	Virgo	135	PASP 90, 367
B.M. Peterson +	Radio	10	PASP 90, 386
		Σ ∿5600	

Exotic explanations of redshifts, i.e., observational evidence for discrete redshift states by Tifft (17.158.093, 19.160.005) or a chronometric non-linear theory by Segal and Nicoll (17.158.159, 17.162.090, 17.003.097, AA 68, 343; AA 68, 353; see Fairchild 19.162.030) left most observers unconvinced. Dautcourt (19.160.001) asked if the gravitational wave influence on light propagation could solve the redshift (virial mass) discrepancy for distant clusters, and concluded that it could not. The random/non-random nature of the distribution of QSO redshifts was actively investigated, with proponents and opponents about equally divided (Knight et al., 17.141.013; Wills and Ricklefs, 17.141.082; Green and Richstone 18.141.028; Barnothys, 18.141.079, 19.141.016; Karlsson, 19.141.104; Basu, 20.141.152; Owen, 20.141.154; Drew, AA 66, 343; Stephenson, 20.162.111; Varshni, 20.162.112). Penston (19.141.147) questioned whether the observed redshift is the redshift for Seyfert galaxies. Pence (17.158.004) published K-corrections for galaxies of different morphological types; the corrected energy distribution 1500-8000Å can be used to derive mean redshifts, assuming no evolution and no extinction. Studies of the dynamical stability of supermassive objects by Yabushita (17.066.001, 18.066.093) show that z_c = 1.41 is the maximum central redshift consistent with stability.

Efforts to determine q_o from observed redshifts and magnitudes are presently inconclusive, with uncertain evolutionary effects posing a severe problem. A valuable general reference is Tinsley (An NY Ac Sci 302, 423). Similarly, conclusive studies of a possible anisotropy in the Hubble expansion must await the finish of the large scale observing programs currently underway.

TABLE 2. GALAXY RADIAL VELOCITY PROGRAMS IN PROGRESS

Observers	Type of Objects	Number of New Velocities	Notes
Bergwall et al.	ESO/Uppsala	∿200	See AA Supl. 33, 243
Gaskell, Faber	E, SO; m > 12	10	
Gisler	UGC E; 13 < m < 15	140	
Huchra, Davis, Tonry, Shectman	Zw; $\|b\|\geq 40°$; $m \leq 14.5$	∿600	
Knapp, Sargent	Spirals in groups	∿100	
C.J. Peterson	Spirals; δ < − 45°	∿100	12 < m < 14
M.S. Roberts	Spirals	∿ 50	
Shecter, Oemler Kirshner	8 Survey Fields	∿140	
Spinrad, H.E. Smith, R. Kron, Stauffer	Faint Radio and Cluster	15	$0.4 < z \leq 1.378$ (3C427.1)
Thonnard, Rubin, Ford, Roberts	Sb, Sc	175	A.J. Dec. 1978
Thuan	Nilson Dwarfs	145	
Thuan, Gunn	Clusters	77	Abell, $R \geq 1, \theta \leq 4, \|b\| \geq 30°$
Thuan, Huchra, Knapp, Davis	Zwicky	∿500	$m \leq 14, \|b\| \geq 30°, \delta \geq 0$
Thuan, Thompson, Bania	Perseus Super Cl.	∿100	
Tifft	Virgo, Cancer, Per.	∿100	
Tifft	Abell Clusters	∿225	
Tifft	Karachentsev	∿350	
Tifft, Gregory	Perseus Super Cl.	∿300	
Tifft, Tarenghi, Rood, Chincarini	Hercules	∿100	
Tully, Fisher	V< 2000	} ∿800	Luminosity Criterion
Tully, Fisher	UGC, Sdm + Later		> 2', No Previous V
Tully, Fisher	UGC, Sd + Earlier		> 3', No Previous V
Tully, Fisher	Sb→Sd		With V
Tully, van Woerden, Goss, Mebold, Seigman, Chamerau, Fisher	Southern	∿100	From ESO Blue
G. de Vaucouleurs	Galaxy Meter	(200)	
B. Williams	Spirals, 14< m < 16	60	2000 < V < 9000 km s^{-1}
		Σ ∿4400	

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6. EXTRAGALACTIC RESEARCH IN THE U.S.S.R.

(E.A. Dibay)

AA - Astronomy and Astrophysics;
AZ Lett-Letter to AZ;
Crim-Izvestia Crimean Observatory;
AZ - Astronomichesky Zhurnal USSR;
Af - Astrofisica Erevan;
PZ - Peremennye Zvezdy.

A. Catalogues and Lists of Galaxies

Markarian , Lypovetsky and Stepanian continued the publication of lists 8, 9, 10 and 11 of galaxies with intense UV-continuum in spectra (Af 12, 389, 657; 13, 225, 397). Seyfert type characteristics and QSO nature can be certainly predicted in a lot of the objects. Lists 12 and 13 are prepared for publication.

Vorontsov-Veljaminov published part II of Atlas of Interacting Galaxies (AA Suppl. 28, No. 1), which contains 700 images. On this basis some theoretical possibilities are considered. The interacting galaxies can be explained by tidal and collision mechanisms in several cases, the concept of lasting fragmentation of galaxies and of gemmation of satellites is more probable in general. The photographic investigation of interacting galaxies has begun in cooperation with Spezial Astrophysics Observatory, using the 6-meter telescope.

Karachentsev and Shcherbanovsky (AZ 55,449) presented a list containing 68 pairs and 24 triplets of galaxies. Borchkhadze and West (Af 13,605) investigated peculiar emission galaxies in the southern sky. Two galaxies may be classified as Seyfert 2. Einasto et al. (20.160.032) presented a new list of hypergalaxies.

B. Radial Velocities

Karachentsev, Pronyk and Chuvaev (18.158.047) have carried out the spectral observations of 92 galaxies in isolated pairs using the 2.6-m reflector of Crimea obs. Arkhipova, Esipov and Savelieva (18.158.010) have measured the redshift of interacting galaxies. Vorontsov-Veliaminov, Karachentsev and their colleagues have observed many interacting galaxies using the spectral equipment of the 6-m telescope (in press).

Kopylov, Lypovetsky, Pronyk and Chuvaev (18.158.193) have investigated the spectra of Markarian galaxies. Several Seyfert-type objects were found. Denisiuk and Lypovetsky (20.158.026) observed 75 galaxies from Markarian 4-7 lists. Broad emission lines were detected in spectra of a number of objects. The same authors (AZ Lett 3, 7) discovered 18 new Seyfert-type galaxies.

The galaxies with high surface brightness from the Arakelian list were observed by Arakelian, Dibay and Esipov (Af 11, 15; 12, 195; 12, 683) as well as by Doroshenko and Terebizh (Af 11, 631) and by Dibay, Doroshenko and Terebizh (Af 12, 689). Several hundred redshifts were measured, a dozen Seyfert-type objects were found.

The large radial velocity programme of galaxies with UV-excess in spectra has begun with the 6-m telescope (Markarian, Afanasiev and Lypovetsky).

C. Active Nuclei

Shklovsky (AZ 54, 713) considered the radiogalaxy M87 and concluded that the M87 jet is formed by clouds of magnetized plasma with masses about 1 solar mass outflowing from the nucleus with relativistic velocity. The synchrotron spectrum

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of the jet is discussed.

Ozernoy and his coworkers in many papers continued the development of a "magnetoid" model which may represent observed properties of active nuclei of galaxies. A critizism of the black hole model was given (Obs 96, 67, AA 56, 163, Proc IAU Symp 84 etc). Vilkovissky (AZ 55, 678) presented a new aspect of the massive body model. The stability of that body is provided by interaction with stars of the galaxy. According to Terebizh (18.158.308) the BL Lac objects can be considered as the last stage in the evolution of a massive black hole in the centre of a galaxy after the destruction of the surrounding stars.

Shakhovskoy and Efimov (Crim 56, 39) have studied linear optical polarisation of some BL Lac objects. A lack of correlation between polarisation and both radio and optical flux is a characteristic feature of the objects under consideration. The optical behavior of OJ 287 was observed photoelectrically by Lyuty (PZ 20,243). Polarisation and optical variations of a number of Seyfert and BL Lac objects, on the basis of long period of observations, were discussed by Hagen-Torn and his coworkers (AZ Lett 3,54; other results in press). Lyuty (20.158.121) presented the results of photoelectric UBV-observations of the nuclei of selected Seyfert galaxies. There are two components in the light curves: a fast and a slow one with time scales of several days and several years, respectively.

Dibay (AZ Lett 3,3) estimated the masses of active nuclei as about 10^8 - 10^9 solar masses. Bolometric luminosities correspond to the Eddington limit for such masses. A correlation exists between masses and the time-scale of optical variability (Dibay and Lyuty, 19.158.023). Dibay (AZ 55,456) has measured the physical parameters for 16 Seyfert galaxies (gas volume and mass, kinetic energy, luminosity etc).

Pronyk (20.158.049) pointed out that the as density calculated from the [OIII] lines is of the order of 10^5 -5 10^6 cm^{-3}. The gas distribution model in the active nuclei is considered, the gas density is suggested to change as r^{-2}. Spectral observations of the Seyfert galaxy NGC 1275 was made by Doroshenko, Terebizh and Chuvaev (20.158.015). A lot of rather weak lines have been detected which mainly belong to forbidden FeII. Permitted FeII lines are weaker than forbidden ones. The existence of the double structure of the [OIII] and Hβ lines, discovered by Esipov and Dibay, 1968, is confirmed. No variation was found in the emission line intensities.

Variability of some Seyfert galaxies was observed by I. Pronyk (19.158.071) and Saakian (19.158.057).

D. Statistics, Photometry, etc.

Vorontsov-Veliaminov (19.158.070) has detected and described 4200 compact galaxies from MGC. The red galaxies must consist of relatively cool stars, the blue galaxies may get their compactness from the luminosity of gases. There is no sharp boundary between compact and normal galaxies. Fesenko (18.158.008), based on the Lick counts of galaxies, has shown that among the galaxies brighter than a certain limit the fraction of single galaxies does not exceed ten per cent. Markarian and Stepanian (Af 13,627) established the existence of a correlation between the surface brightness and the morphology of galaxies. Börngen and Kalloglian (18.158.125) have investigated a number of Markarian galaxies morphologically; 55 per cent of the sample are spirals.

Multicolor photometry of selected Seyfert and Markarian galaxies was made by I. Pronyk and Metik (18.158.116;19.158.126) as well as by Borchkhadze (19.158.134), Artamonov *et al*. (18.158.068), Khachikian and Kazarian (Af 13,415). The morphological investigation of double systems was discussed by Pronyk and Metik (AZ 55,249). Artamonov (AZ 55,13) has constructed a map of the surface brightness of M82. The assymetry of colours in the southern and northern parts of M 82 is discovered. Zasov (AZ 55,465) has estimated the mean value of optical depth and internal extinction in spiral galaxies.

The photoelectric magnitudes of star clusters in the Andromeda nebula were measured by Sharov et al. (19.158.026). Smirnov and Komberg (AZ Lett 4,245) considered the large scale distribution of HII regions and OB associations in nearby galaxies. These aggregates are shown to form several ring-like structures. Einasto et al. investigated the kinematics of the Magellanic Stream. The virial mass of our Hypergalaxy was estimated. Einasto et al. (Symp 79 IAU) claimed a cell structure of the Universe. Galaxies and clusters of galaxies are concentrated to flattened aggregates of approximately 100 Mps in diameter.

Arakelian (Af 13,651) discussed the distribution of surface brightness of galaxies in the Coma cluster. The mean value of $\tilde{B}$ of galaxies in the central zone is significantly higher than the same value of a random sample of galaxies. Vorontsov-Veliaminov noted the broadcasting of M-51 type galaxies (AZ 52,692) and with his colleagues discussed the properties of interacting and ring galaxies (Symp 79 IAU). Results of a spectral and morphological investigation of double galaxies was presented by Karachentsev (AA 63,411, Soobshchenia SAO 18, 42, Symp 79 IAU).

7. WORKING GROUP ON THE MAGELLANIC CLOUDS
(B. E. Westerlund)

A. General

A large number of investigations ranging from the X-ray region to the radio frequencies have been carried out since 1976, and the available space does not permit a complete review. - Special topics regarding the Clouds have been presented at several symposia, e.g. at "The Galaxy and the Local Group" (19.012.018), at IAU Symp. No. 77, "Structure and Properties of Nearby Galaxies", and at IAU Symp. No.89, "The HR Diagram". The importance of the Clouds for the determination of the extragalactic distance scale was clear at the IAU and CNRS colloquia (20.012.053). The most recent determinations of the distance moduli of the Clouds are:

	de Vaucouleurs	Eggen	S.Gaposhkin	Canterna Schwartz	Martin et al.	Crampton
LMC	18.31	18.25	18.38	18.6	18.69	18.67
SMC	18.62	18.95	19.15			
Ref.:	Ap.J.223,730	(19.122.134)	(20.121.091)	(20.124.301)	preprint	Symp. 80

An identification atlas of the SMC has been published by Hodge and Wright (1977, Univ. of Washington Press), giving charts, tables and cross references.

B. New Observational Data

I. X-RAY OBSERVATIONS

Two new variable X-ray sources have been discovered in the SMC (20.142.118; BAAS 9,579); optical counterparts have been proposed (20.142.118; IAUC 3247). Their properties have been discussed by Clarke et al. (Ap.J. 221, L37) and by Crampton et al. (Ap.J. 223, L79). The previously known source SMC X-1 has been the subject for numerous investigations, e.g. (17.142.001; 17.142.092; 18.142,158; 19.142.085; 19.142.038). Orbital elements and masses of Sk160/SMC X-1 have been re-determined (20.142.026; 20.142.030; 19.142.039; 18.142.213). VBLUW photometry of Sk 160 has been carried out (20.113.016), indicating variations in the X-ray heating from the SMC X-1 of the massive star, and giving evidence for an accretion disk in SMC X-1 (20.142.043). Soft X-ray emission flaring from SMC X-1 has been observed (BAAS 10, 389).

Soft X-rays from the LMC have been observed (18.142.191) and previous observations have been analyzed (17.159.010). Longterm X-ray light curves for the X-ray sources in the LMC have been presented (20.142.001) together with the probable discovery of LMC X-6. LMC X-1 reveals a complex structure (20.159.008) but is also found to be a point source (Ap.J. 225,L59). The X-ray variability of LMC X-4 has been studied (20.142.012), and a possible optical counterpart for it has been proposed (19.142.124; 20.142.104).

II. SUPERNOVA REMNANTS

Clarke (17.125.002) has shown that few SNR:s remain to be discovered in the Magellanic Clouds. An abundance analysis of SNR:s indicates an underabundance of nitrogen in the LMC with a factor of 4 (18.125.057; 18.159.002). Line ratios for some elements are given by Dufour (17.133.025). Lasker (20.125.027) discusses the structure of N86, N186D and N206. Absolute photometry in the Walraven system is used by Greve and van Genderen (19.125.067) to discuss N 49 and N 63A. Abundances in N 49 are discussed in (18.125.019; 18.125.003). Particularly interesting are the high- velocity filaments in N 132D (19.125.053). N 132D may be very similar to Cas A (Ap.J. 223,109).

III. THE BRIGHTEST STARS

Photoelectric photometry has been carried out for stars in the SMC in the UBV system (A.A. Suppl. 33,193), and for stars in both Clouds in the Walraven system (20.159.007). BVI observations for 26 supergiants in the LMC have been presented (18.113.068) as well as ubvy photometry for 53 of the hottest stars in the LMC (19.159.014). Data for the known supergiants in the LMC have been collected by Rosseau et al.(A.A. 31, 243). Ardeberg and Maurice (20.159.010) have presented data for 91 supergiant stars in the SMC. Walborn (18.114.154; 19.159.015; Ap.J. 224,L133) has studied the brightest known O, OB + WN, and BO supergiants in the Clouds. Dubois et al. (20.159.001) have found that the spectra of SMC supergiants have He and some metallic lines weaker than those of galactic supergiants. Fehrenbach et al. (19.159.004) have investigated spectra of 9 A-type LMC supergiants and Feast (17.114.301) 4 B9- A0 supergiants in the SMC. Fehrenbach et al. (17.159.012) have presented a catalogue of 80 Wolf- Rayet stars in the LMC. Azzopardi and Breysacher (preprints) report the detection of 4 new WR stars in the SMC and 13 new in two fields near 30 Dor in the LMC.

Evans (MN 183, 305) has found 29 red variables in the SMC, whose red colours indicate that they are carbon stars. In NGC 419 and the surrounding field he has also found a number of probable carbon stars (MN 183,319). Westerlund et al. have published a catalogue of 302 carbon stars in the LMC (A.A. Suppl. 31,61). Ten of these stars have been studied spectroscopically (17.065.006; Ap.J. 219,452) and all the available spectroscopic and photometric data for the catalogued stars have been summarized and analysed (Ap.J. in press). - Sanduleak and Philip have also presented a catalogue of carbon stars in the LMC (Publ. Warner & Swasey Obs. 2, 103). They have also identified carbon stars in the SMC (18.159.021). Nine carbon stars may be members of clusters in the LMC (Ap.J. 221,586). - Blanco and McCarthy (Nature 271,638) have applied the "grism" technique to reach vary faint carbon and M stars in the Clouds and in the central region of the Galaxy. The ratio of carbon stars to late type M giants varies from 0.003 in the center of the Galaxy to 55 in the SMC.

Westerlund et al. (preprint) have prepared a catalogue of M stars in the LMC; it contains 532 M supergiants and 655 M giants. MK types have been determined for the brightest red stars in the LMC by Humphreys (preprint). Feast (preprint) has obtained spectrograms of 8 red supergiants in NGC 330 (SMC) and of 4 in NGC 2004(LMC). - Bappu et al. (Kodaikanal Obs. Bull. Ser. A 2, 85) have used ultra-low dispersion spectroscopy to find 298 red stars brighter than I = 13 in a field of 1.25 square degrees near 30 Doradus.

IV. VARIABLE STARS

(a). Butler has published B, V photometry for 72 Cepheids in the SMC (17.122.066) and for 98 in the LMC (A.A. Suppl. 32,83). He has discussed the amplitude as a parameter in their L-C relations (19.122.158).

Martin and Warren (SAAO Circ.) have carried out BVI observations of LMC cepheids. The results have been analysed (Martin et al., preprint); Eggen (19.122.134; 135) has carried out UBVRI observations of 21 cepheids in the LMC and SMC with periods greater than 35 days. Madore (18.122.017) has derived colour excesses for 36 long-period cepheids in the LMC and the SMC (19.122.157). He confirms Feast's (12.122.043) reddening interpretation of the colour/spectral type anomaly for the longperiod cepheids. Cogan (17.065.064) has discussed the mass-luminosity relationship for cepheids in the SMC. Efremov (18.122.035) has derived a relation between cepheid periods and their ages. De Yoreo et al. (BAAS 9, 642) suggest that the SMC cepheids are bluer than their galactic counterparts because of blue background stars in the fields during observations. The blueness of the SMC cepheids is also commented on by van Genderen (19.122.043) who, however, finds that they fit well into the instability gap of the SMC clusters NGC 330 and NGC 458, whereas the galactic cepheids do not.

(b). Graham has published the results for 68 RR Lyr stars in a 1 x 1.3 field in the LMC (20.122.091). Kinman et al. (18.122.039) have observed 15 RR Lyr stars in the field of NGC 1841.

(c). Three new novae have been discovered in the LMC, all by Graham (19.124.023; IAUC 3045, 3049; IAUC 3204). LMC nova 1977b has been observed by many astronomers, e.g. (19.124.023; 20.124.301).

(d). Light curves of 108 eclipsing variables in the Clouds are tabulated by S. Gaposhkin (20.121.091), giving their behaviour over more than 75 years.

V. CLUSTERS AND ASSOCIATIONS

From the lunar surface spectra in the 900- 1600 Å wavelength range were obtained of OB associations in the LMC during the Apollo 16 mission. The spectral distributions appear consistent with radiation from reddened OB stars (19.159.002). This result was confirmed by Henry et al. (18.159.012) from low-dispersion ultraviolet spectra taken during the Apollo 17 mission.

Hodge has been working on intermediate age clusters in both the LMC and the SMC, obtaining colour- magnitude diagrams to V $\sim$ 21 and fainter. He and Flower are deriving ages, age spreads and heavy element abundances for the clusters. It appears that previous surveys are only about 30 per cent complete.

Kron has observed 38 clusters in the SMC in VBGR (Stebbins-Whitford's six-colour system). Some of the SMC clusters may be heavily reddened. The blue LMC cluster NGC 1854 has been discussed by Connolly and Tifft (20.154.001). The frequently studied SMC cluster, NGC 330, has been observed in the UBV and in the DDO system by Janes and Carney (19.159.023). NGC 2209 has been studied by Gascoigne et al. (18.154.017) who found that the cluster has an age of $\sim 8\times10^8$ years and a metal abundance [Fe/H] $\sim$ - 1.2. A reanalysis of the data by Gustafsson et al. (20.154.009) gave a value of [Fe/H] $\sim$ - 0.5.

VI. PLANETARY NEBULAE AND HII REGIONS

Jacoby has searched for faint planetary nebulae(PN) in the Clouds (BAAS 10, 397). A list of stellar-like and compact nebular objects in the Clouds with very low-excitation spectra is given by Sanduleak and Philip (PASP 89,792). Webster has discussed (17.133.002; 19.135.031; preprint Anglo-Austr.Obs.) various properties of the PN in the Clouds. A normal He abundance is found. The O abundance in the LMC is about half the Orion value; it may be even lower in the SMC. The LMC PN have higher excitation than those in the SMC; the galactic bulge sample resembles a sum of the two Cloud distributions. Also Osmer (17.133.004; 19.135.030) and Dufour (19.135.002) have discussed the abundances of various elements in the PN in the Clouds.

Recently, Pagel et al. have analysed their own and previous results for HII regions in the Clouds to derive electron temperatures and densities and abundances of O,N,Ne,S,Cl and Ar (MN 184,569 with references).

The detection of CO emission in N 159 in the LMC by Huggins et al. (14.131.148) has now led to the detection of H_2CO absorption (17.159.001) and OH absorption (18.159.003).

30 Doradus

Schmidt-Kaler and Feitzinger (17.159.014) have reactivated the idea that 30 Dor is the nucleus of the LMC. The structure of its nebular complex has been investigated by Elliott et al. (19.159.009). The ANS observations of the 30 Dor region in the ultraviolet light have been catalogued (19.159.016). They have been used for studying the extinction laws in the LMC (13.131.131), and, in combination with uvbyR photometry (20.159.005) for further investigations of the reddening law and the deficiency of the 2200 Å feature (19.131.027; 19.159.022; A.A. 64,179; A.A. 69,245). Additional uvbyR observations (A.A.Suppl. 30,199) have been combined with the previous data for an analysis of the stellar population in the area (A.A. 69,309).

Hyland et al. (A.J. 83,20) have made a 2 μ survey of 30 Dor and found a significant population of M supergiants. Werner et al. (MN 184, 365) found in their far-infrared survey of 30 Dor that the strongest radiation comes from a region of increased dust density just outside the region of highest density of ionized gas.

In a 3.4 cm wavelength survey of regions in the LMC, McGee et al.(MN 183,794) present contour maps of the 30 Dor nebula. Mills et al.(MN 185,263) have mapped 30 Dor at 1415 MHz. Their results show with published maps at 408 MHz and 5 GHz that the emission from 30 Dor is entirely thermal.

C. The Structure of the Magellanic Clouds

Page and Carruthers (NRL Rep.8206) have presented a far-ultraviolet atlas of the LMC. Charts give the ultraviolet brightness versus position over the LMC. The Molonglo Radio Source Catalogue 4: the Magellanic Cloud region, is presented by Clarke et al. (18.141.075).

Schmidt (17.159.011) concludes from his studies of the polarization in the Magellanic Cloud region that within both Clouds no polarimetric evidence of a spiral structure or a symmetry around the rotation axes could be found.

Gull has used a wide-field camera and narrow bandpass filters to study the Clouds (20.159.013). Davies et al. (17.159.006) have photographed the ionized hydrogen complexes in both Clouds with the 48" SRC Schmidt telescope.

Feitzinger et al. (19.159.013) have studied the space orientation and translational motion of the LMC. -- Martin et al. have continued their studies of the stellar content of the LMC (18.159.006). Hardy has studied the old population of the LMC background (18.159.011; 19.159.001, Ap.J. 223, 98). The underlying disk in the LMC has an exponential brightness distribution; the bar has essentially the same colours as the disk (PASP 90,132).

Butcher (20.159.002) has determined a main-sequence luminosity function between $M_V = 0$ and + 4 mag for a field in the LMC: The bulk of star formation began 3-5 x 10^9 years ago in the LMC (10 x 10^9 years ago in the Galaxy).

Olson and Pena (17.065.061) describe a simple model for galactic nucleosynthesis. Their conclusions for the Magellanic Clouds are: a.- the average stellar birthrate has been nearly constant; b.- the initial mass function for star formation in the Clouds must be different from that in the Galaxy; c.- the stellar birthrate is not a monotonically decreasing function of time but is interrupted by periods with higher than average star formation.

Nandy et al. (MN 184,631) have made absolute surface brightness measurements of the SMC at 1550, 2350 and 2740 Å. There is a small reddening in the Wing, and the ultraviolet extinction law is similar to the galactic one.

Azzopardi and Vigneau (19.159.011) have studied the structure of the SMC as revealed by the supergiants. Ardeberg and Maurice (preprint) discuss their spectrographic and photometric data of stars in the SMC. The depth of the SMC appears to be about 40 per cent larger than that of the LMC. The complex structure of the SMC may be explained by the gravitational interaction between the Galaxy and the Clouds (C.R.Acad.Sci. Paris 286, Ser. B., 375).

McGee et al. (18.159.015) have surveyed the SMC in the continuum at 6 cm. The stronger sources have also been observed at 3.4 cm.

The stellar content of the SMC Wing and halo regions is discussed by Brück (A.A. 68,181). The population of the Wing may not be as young as galactic population I (A.A. 68,193).

D. The Magellanic Stream

New 21- cm observations of the Magellanic Stream and adjacent high-velocity clouds have been presented by Cohen (19.159.020). Optical studies have been carried out by Philip (18.159.010;020).

Mathewson et al. (18.159.004; 19.159.017) consider it unlikely that the Stream has a tidal origin as proposed e.g. by Davies (19.159.018) and Davies and Wright (19.159.021). With new observations they show (20.159.003) that the Stream is composed of 6 discrete gas clouds; these clouds are now sinking toward the galactic center. -- Kunkel and Demers (19.159.019) interpret a group of globular clusters and dwarf spheroidical galaxies as relics of tidal interaction between the Clouds and the Galaxy. Lynden-Bell (17.159.002; 19.161.008) has drawn similar conclusions.

Fujimoto and Sofue have made numerical calculations on the triple system of the Galaxy and the Clouds (17.151.021; 20.159.006). Einasto et al. have investigated the kinematics of the Magellanic Stream and of other high-velocity clouds (17.159.013; 18.160.040). The individual clouds in the Stream move around the Galaxy along elliptical orbits. Kunkel (preprint) has used computer similation to generate a family of models for the formation of the Magellanic Stream.

Tremaine (17.159.003), taking into account the effects of dynamical friction, tries to explain the present proximity of the LMC and the SMC by assuming that they earlier formed a bound system, which was disrupted by tidal forces only at its last, closest perigalacticon. - The gravitational interaction between the Milky Way and the LMC has frequently been considered as responsible for the warping of the disk of the Milky Way. Recently Spight and Grayzeck (19.155.018) have carried out calculations showing that substantial warping can be caused by a retrograde encounter at a perigalactic distance of 20 kpc.

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8. WORKING GROUP ON GALAXY PHOTOMETRY AND SPECTROPHOTOMETRY
(M. Capaccioli)

This triennium started with a major coming-out, the publication of the "Second Reference Catalogue of Bright Galaxies" (18.003.046). In this monumental work G. and A. de Vaucouleurs and Corwin provide information on 4364 galaxies with references to published papers up to 1975.

Reviews on the subject of galaxy photometry were given by Holmberg (17.158.132), de Vaucouleurs (20.003.043; 20.158.044). In the series of "Contributions to galaxy photometry" de Vaucouleurs and collaborators (Bollinger, Corwin, Head and Pence) published standard total magnitudes for 228 bright galaxies (20.158.073) in the B_T system defined by 115 primary standards (19.158.083) and other relevant catalogues (19.158.084/85/86/87; Ap.J. Suppl.36, 439, 1978). Systematic corrections to magnitudes of galaxies in the Zwicky and Shapley-Ames catalogues are reported by Kron and Shane (17.158.041). Huchra (18.158.234) provided a comparison of the Zwicky catalogue magnitudes with other sources. Total magnitudes and other photometric data for Virgo galaxies from Byurakan surface photometry were given by Head et al. (18.160.078). de Vaucouleurs, Corwin and Pence inform that they have in preparation a catalogue of magnitudes for Virgo galaxies ($B_T < 15$) and a catalogue of corrected B_T galaxy magnitudes for the six volumes of the Zwicky catalogue.

Very many papers dealing with detailed surface photometry have been published. de Vaucouleurs and Capaccioli completed the detailed study of NGC 3379 (Ap.J. Suppl., in press), thus fulfilling the recommendation by the Working Group. Schweizer studied six SbI and ScI galaxies (NGC 3031, 4254, 4321, 5194, 5364, 5457) showing the separation of light into disk and arm components (18.158.017). Oemler investigated the structure of elliptical and cD galaxies up to very faint light levels (18.158,111). Kormendy (19.158.109; 20.158.087) debated the observations of the brightness distribution in red compact and normal galaxies. Fraser published the detailed surface photometry of 48 Virgo galaxies (20.160.005). Photometry of the interesting edge-on spiral NGC 4565 was given by Frankston and Schild (18.158.102), by Hegyi and Gerber (20.158.078) and by Kormendy and Bruzual (Ap.J. 223, L63, 1978). In a provocative paper King (Ap.J. 222, 1, 1978) analyzed the light distribution in 16 ellipticals and one SO galaxy. An observational and speculative paper was given by van den Bergh (18.158.037) on the puzzling galaxy NGC 5128 (=Centaurus A), which was also studied by Dufour et al. (preprint). Hodge reported detailed photographic and photoelectric studies of NGC (17.158.022, in coll. with Steidl), NGC 147 (17.158.023), NGC 6822 (19.158.076) and IC 1613 (Ap.J. Suppl. 37, 145, 1978). Okamura and collaborators (Kanazawa, Kodaira and Takase) investigated the barred spirals NGC 2859, 3992, 5921, 7479, 7743, (17.158.123; Publ. Astron.Soc. Japan 30, 91, 1978), M51, M101 and NGC 5195 (17.158.150), NGC 3379 (19.158.194) and the ScIII NGC 2403 (20.158.081). Strom et al. (19.158.043; Ap.J. 220, 62, 1978) gave detailed photographic and photoelectric photometry of NGC 2768 and NGC 3115. B and V surface photometry of the Virgo spirals NGC 4321, 4548, 4596 and 4608 was reported by Benedict (17.160.019; 18.158.188) who also informs that he undertook a photometric program on DDO dwarfs by means of a Digital Area photometer. The Asiago group (Barbon, Benacchio, Benvenuti, Bertola, Capaccioli and D'Odorico) studied NGC 4096 (17.158.087), NGC 3389 (18.158.041), NGC 660 (18.158.153), NGC 128 (19.158.011), NGC 3898 and NGC 4036 (Astron.Astrophys.65,165, 1978). They have in preparation detailed surface photometry of NGC 1600, 2685, 2775, 3079, 4125, 4261 and several bright galaxies in Virgo. Gallagher and Hudson studied the Scd edge-on galaxy IC 2233 (18.158.070) and the SO NGC (19.158.013), Freeman et al. (19.158.056) a new galaxy in Circinus, Ables and Ables (19.158.188)

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the WLM galaxy, Netzer and Formiggini (20.158.074) NGC 1265, 4151 and IC 310, Pastoriza and Agüero (17.158.026) NGC 4575, Sersic (17.158.042) a southern triplet of galaxies, Martins and Chincarini (18.160.023) the Seyfert Sextet, Matsumoto et al. (20.158.082) the central region of M31, Thompson and Theys (Ap.J.224, 796, 1978) the ring galaxy VIIZw446, Talbot et al. (Ap.J., in press) M83, Bendinelli et al. (Mem.SAIt. 48, 713, 1978) M32. Börngen et al. gave photographic photometry of Markarian 11, 12 and 13 (17.158.050) and of three dwarf galaxies in M81 group (17.158.105). Artanamov et al. studied NGC 3077 (17.158.068) and the color distribution in M82 (18.158.133). Borchkhadze (19.158.134/135) provided UBV surface photometry of NGC 3593, 3623, 3627 and 3628. Ables and Ables inform that they have in preparation the B and V photometry of the galaxy A0956. de Vaucouleurs, Angione, Buta, Corso, Davoust, Meston and Pence are preparing detailed surface photometry of the following galaxies: NGC 55, 253, 2537, 4027, 4631, 7793 and DDO155. In her thesis Tsikoudi (Univ.Texas Publ. in Astr.No.10, 1977) provided a very careful photographic study of three edge-on lenticulars, NGC 3115, 4111 and 4762. Other dissertations rich of data on surface photometry of galaxies are from Blackman (NGC 157, 1084 and 7331); two papers in press in M.N.R.A.S.), Gamalaldin (NGC 2784, 2855, 3640 and 3957; Univ. Cairo, 1977) and Burstein (16 SO's and NGC 3379; Univ. California at Santa Cruz, 1978).

Extensive surface photometry of galaxies in clusters other than Virgo has been given by Melnick et al. (19.160.049), Godwin and Peach (20.160.043), Thuan and Kormendy (20.160.059), Strom and Strom (20.158.046; A.J. 83, 73, 1978) for Coma, by Carter (19.158.002) for four giant galaxies in Abell 2197 and 2199, by Massey (19.160.033) for the compact cluster of compact galaixes Shakhbazian I. by Börngen and Kalloglyan (20.160.011/029) for Abell 193 and Zw Cl 1710.4+6401.

Surface photometry of compact galaxies was reported by Babadzahnyants et al. (17.141.085), Richter and Schnell (18.158.124) and Richter and Högner (20.158.052; Astron.Nachr.299, 121, 1978). Richter and Richter (Mitt.Karl Schwarzschild Obs. No.80, 1977) provided a catalogue and finding charts for 745 compact galaxies. Barbon et al. inform on the progress of the photometric study of the group of compacts IVZw32. A review on compact galaxies by Richter will appear in Vistas in Astronomy.

The study of geometrical parameters in galaxies gained importance due to the discovery of HI distribution warps in spirals and to the reconsideration of the structure of ellipticals forced by the recent dynamical findings. Peterson et al. (19.158.088) provided the orientation profile in the nuclear region of M31. Ellipticity profiles for large samples of galaxies were given by King (Ap.J.222, 1, 1978), di Tullio (Astron. Astrophys. 62, L17, 1978), Bertola et al. (M.N.R.A.S., in press). Twisting of isophotes in elliptical galaxies was studied by King (Ap.J. 222, 1, 1978), Bertola et al. (M.N.R.A.S., in press), Guthrie (M.N.R.A.S. 184, 611, 1978) and Barbon et al. (18.158.041; paper II in preparation). Correlation between flattening and twisting of isophotes was discussed by Galletta (Astron. Astrophys., in press). Bertola and Galletta (Ap. J. Letters, in press) proposed a new class of galaxies with prolate structure. Other papers dealing with the structure of galaxies were published by van den Bergh (17.158.120), Kormendy (20.158.040), Bertola and Capaccioli (Ap.J. 219, L95, 1978), Peterson et al., Strom and Strom and Kormendy (preprints).

Technical papers on galaxy photometry were given by Owaki et al. (Bull. Tokyo Gakugei Univ. 28, 237, 1976), Barbon et al. (Mem. SAIt. 47, 263, 1976), Arp and Lorre (18.158.158), Young (18.158.189), Bendinelli and Lorenzutta (Mem.SAIt. 48, 55, 1977), Okamura (19.158.193/194), Fritze et al.(19.034.085), Lorre (Ap.J. 222, L99, 1978), de Vaucouleurs and Capaccioli (in preparation.)

We isolated the contributions to photometry and spectrophotometry of the most relevant galaxies. NGC 1068: Tolesco et al. (17.158.055), Angel et al. (17.158.094), Kleinmann et al. (18.158.030), Glaspey et al. (18.158.156), Daltabuit et al.

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(18.158.244), Hildebrand et al. (20.158.023), Lebofsky et al.(Ap.J.222, 95,1978), Thompson et al.(Ap.J.222, L49, 1978), Elvius (Astron.Astrophys. 65, 233, 1978), M31: Iijima et al. (17.158.047), Morton and Andereck (17.158.080), Thuan and Oke (17.158.081), Alloin et al. (18.158.005/079), Deharveng et al. (18.158.039/90), Matsumoto et al. (20.158.082), Jameson and Hough (M.N.R.A.S. 182, 179, 1978). NGC 4151: Netzer and Penston (17.158.001), Glaspey et al.(17.158.013), Osterbrock and Koski (18.158.011), Boksenberg and Penston (18.158.181) Netzer and Formiggini (20.158.074), Arp (20.158.075), Ulmer (20.158.077), Romano and Minello (20.158.117), Oknyanskij (20.158.118), Wu and Weedman (Ap.J.223, 798, 1978). M87: O'Connell (17.158.008), Shkovskij (20.158.006), de Vaucouleurs and Nieto (Ap.J.220, 449,1978), Young et al.(Ap.J.221, 721, 1978), Carter and Dixon (A.J.83, 574, 1978), Bertola and Capaccioli, Perola et al. and de Vaucouleurs and Nieto (in preparation).

Contributions to photoelectric photometry of galaxies come from Glass (17.158.027), Strom et al.(17.158.037), Bucknell and Peach (17.158.075), Alcaino (18.158.122), Graham (18.158.167), Thompson (18.160.080), can den Bergh (18.158.186/187: 19.160.019/047), Zasov and Lyutyi (19.158.024), Hoffman and Crane (19.160.044), Ardeberg and Bergvall (20.158.085), Kinman et al.(20.158.092), Godwin et al.(20.158.094), Butcher and Oemler (Ap.J.219, 18, 1978, O'Dell et al.(Ap.J. 219, 818, 1978), Wilkinson and Oke (Ap.J.220, 376, 1978), Kristian et al.(Ap.J.221, 383, 1978), van den Bergh (P.A.S.P.89, 746, 1978), Keel and Weedman (A.J.83, 1, 1978), Green and Dixon (Observatory 98, 166, 1978), Godwin et al. (Observatory 97, 238, 1978), de Vaucouleurs and Corwin (A.J., in press). de Vaucouleurs, Corwin, Nieto and Pence inform that they have in preparation the UBV photometry of about 200 galaxies including 40 DDO dwarfs.

Variability has been studied by Barbieri et al.(17.158.030), Barbieri and Romano (19.158.128), Magnitskaya and Saakyan (20.158.016), Green et al. (20.158.032), Romano and Minello (20.158.117), Lyutyj (20.158.121) and Barbieri et al. (Astron. Astrophys. Suppl. 31, 401, 1978).

Theoretical papers pertaining light distribution in galaxies were given by Tinsley and Gunn (17.158.005), Tinsley (17.158.006; 18.158.045; 20.158.030) and Kaufman and Thuan (19.158.123).

Contributions to photometry and spectrophotometry of Markarian and Seyfert galaxies were published by Osterbrock (17.158.012/20.158.004), Glaspey et al. (17.158.013), Fricke and Kaufmann (17.158.045), Börngen and Kalloglyan (17.158.050:, 18.158.085/125/208), Neugebauer et al. (17.158.056), Stein and Weedman (17.158.057), Börngen et al. (18.158.002), Osterbrock and Koski (18.158.011), Oke and Shields (18.158.019), Weedman (18.158.028; 20.158.096), Phillips (18.158.029; 20.158.005), Pronik and Metik (18.158.088/116/128), Glaspey et al. (18.158.156), Rieke (18.158.159), Tohline and Osterbrock (18.158.173/240), Joyce and Simon (19.158.014), Boksenberg et al. (19.158.020), Biermann and Fricke (19.158.028), Boksemberg and Netzer (19.158.036), Saakyan (19.158.057), Markarian (19.158.119), Metik and Pronik (19.158.126), McCrea (19.158.148),Shields (19.158.151), Doroshenko (20.158.015), Osterbrock and Phillips (20.158.031), Huchra (20.158.60/108), Ptak and Stoner (20.158.031), Huchra (20.158.60/108), Ptak and Stoner (20.158.061), McGimsey and Miller (Ap.J. 219, 387, 1978), Koski (Ap.J. 223, 56, 1978), Abell et al. Ap.J.221, L1, 1978), Adams et al. (Ap.J. 223, 758, 1978), Borngen et al. (Astrofizika 13, 223, 1977).

Infrared broad band photometry and spectrophotometry of early type galaxies was reported by O'Connell (17.158.008), Sherwood (20.158.119) and Frogel et al. (Ap.J. 220, 75, 1978). Other infrared observations were published by Allen (18.158.014), Grasdalen and Joyce (18.158.033), Rieke and Lebofsky (Ap.J. 220, L37, 1978) and Aaronson (P.A.S.P. 90, 28, 1978). Kleinmann (19.158.074) reviewed infrared observations of extragalactic sources.

A good deal of work was done in the field of spectrophotmetry of galaxies in the optical region. Osterbrock et al. (17.141.094) published optical spectra of broadline radio galaxies. The emission line spectrum of NGC 1052 was studied by

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Koski and Osterbrock (17.158.014). Observations of Hα amount in disks of 53 spirals were published by Cohen (17.158.015). van den Bergh (17.158.016) investigated the nucleus of M33. Williams (18.158.113) obtained high resolution spectra for the nuclear regions of 10 nearby galaxies. Pritchet (20.158.123) observed the nuclear bulges of M31, M32, M51, M81, M86, M87, M94, NGC 3115 and NGC 5195. Multichannel scans of energy distribution inside and outside the dust lane in NGC 5128 were published by Rodgers (Ap.J. 219, L7, 1978). A report on spectrophotometry and line intensities in several radio galaxies was given by Grandi and Osterbrock (Ap.J.220, 783, 1978) and Penston and Fosbury (M.N.R.A.S. 183, 479, 1978). Integrated spectral energy distribution was obtained by Wells (Univ.texas Publ. in Astr.No.13, 1978) for a dozen of galaxies. Burstein (Univ. California at Santa Cruz, thesis) derived data for five lenticular and two elliptical galaxies. Other papers were by Smith et al.(17.158.107), Andrillat and Collin-Suffrin (17.158.111), Danzinger et al. (19.158.069), Barbieri et al. (19.158.107), West et al.(18.158.201; Astron. Astrophys. Suppl. 31, 55, 1978). Solinger et al. (19.158.012) organized all available spectral data on M82 from radio to X rays.

Van der Kruit and de Bruyn (17.158.071) reported ultraviolet observations of NGC 3310 made with ANS. Two photographs of the nuclear part of M31 in far and near UV were obtained by Deharveng et al. (18.158.039/90). Boksenberg et al.(Nature 275, 404, 1978) published a preliminary study of the UV spectra of NGC 1068, NGC 4151, M81, M87, B2 1101+38, obtained with the International Ultraviolet Explorer. Several extra-galactic targets have been already observed successfully with this telescope. Elvius obtained spectra of two Seyfert galaxies, NGC 3516 and NGC 7469. Bertola and Capaccioli observed the nucleus of M87 in the short wavelength range. Perola et al. the jet.

Whitford (17.158.133) gave a review of the integrated energy distribution in galaxies. The problem of population synthesis in galaxies was considered by O'Connell (17.158.109), Williams (18.158.113) and Turnrose (18.158.157). Pence (17.158.004) computed the K-corrections for all different morphological types.

Optical maps of polarization in M82 were published by Bingham et al. (17.158.029) and by Schmidt et al. (17.158.121). Polarization in NGC 1068 was investigated by Elvius (Astron. Astrophys.65, 233, 1978) in the optical region and by Dyck and Jones (18.158.229) in the infrared. Elvius (Astrophys. Space Sci. 55, 49, 1978) published a study of the optical polarization of NGC 2685, 3718 and 4216. Angel et al.(17.158.065) investigated four Seyfert galaxies. Near infrared polarization of the nucleus of M31 was reported by Jameson and Hough (M.N.R.A.S. 182, 179, 1978). Martin et al. (18.158.046) searched for variations of the optical polarization of the Seyfert nucleus of NGC 1275.

From the above list of references it is apparent that the field of galaxy photometry and spectrophotometry is alive and well throughout the world. The present state-of-the art sketched here will be debated in a meeting that this Working Group and the Working Group on internal motions in galaxies have organized for the Summer of 1979 at the University of Texas in Austin (U.S.A.)

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9. WORKING GROUP ON INTERNAL MOTIONS IN GALAXIES
(P. Pişmiş)

A. Introduction

Research on the internal motions in galaxies has been actively continued, in the triannium covered by this report, using optical and radio data; particularly noteworthy is the advent of the study of velocity fields from molecular lines. Better spatial and velocity resolution together with improved sensitivity have contributed to more detailed information on the kinematics of galaxies including their central regions. Flat rotation curves are found to be common phenomena; non-circular motions also have been frequently detected in particular in the nuclear regions and along bars of galaxies. Of interest is the detection, by H I, of rotation in ellipticals as well as in irregular galaxies. Masses and mass to light ratios are obtained in almost all studies of velocity fields. A comprehensive review of the kinematics of spiral and irregular galaxies by van der Kruit and Allen has appeared in Annual Review of Astr. and Astrophysics Vol. 16, 1978. A thorough discussion of the global 21 cm line profile in galaxies as a measure of the internal motions and the parameters derivable from it, is given by Roberts (submitted to A.J.).

B. Spirals

In a series of papers Rubin and collaborators discuss the properties of high luminosity galaxies. Two such galaxies NGC 4378 (Paper II, Rubin et al. preprint) and NGC 7217, the "anemic" Sa galaxy (Paper III, Peterson et al. preprint) show flat rotation curves, in NGC 3672 (Paper I, Rubin et al., 20.158.038) a large velocity gradient is observed in the nuclear gas along the minor axis. One interpretation is that the rotation axes of the nucleus and of the outer disk do not coincide. A comprehensive review on the topic by Rubin will appear in the Proceedings of IAU Symposium 84 where the rotation curves of 11 galaxies and pertinent references are given. In several of these rotation curves the existence of undulations are pointed out and suggested to be confirmation of the density wave theory. However this interpretation is not unique (Pişmiş 1978 AAS Dynamical Astronomy Division Meeting). Detailed H I observations of the edge-on galaxy NGC 891 yield a flat rotation curve to the edge of the bright optical disk (Sancisi and Allen, preprint). A flat maximum at 270 km s^{-1} is shown by the S0 galaxy NGC 128 (Bertola and Capaccioli, 19.158.011). Flat rotation curves are obtained from H I observations by Krumm and Salpeter (19.158.081) for the edge-on spirals: NGC 672, 925, 4559, 4565, 4631 and 4656.

The extensive program of de Vaucouleurs and collaborators principally by Fabry-Pérot interferometry has yielded detailed velocity fields with 10^3-10^4 velocity points each, of 10 large galaxies: NGC 55, 253, 1156, 1560, 1569, 2366, 2537, 4449, 4631 and 7793 (in preparation). Under study by G. and A. de Vaucouleurs are 25 late-type spirals and Magellanic irregulars based on a total of 140 image tube interferograms. Rotation curves using 2 to 6 spectrograms per galaxy are obtained by Carozzi for the following spirals: NGC 6015 (17.158.118), NGC 6207 (17.158.119), NGC 3079 (19.158.052), NGC 4088 (1978, A and A, 63, 415), NGC 2742 and 5907 (A and A Suppl. in press). It is suggested that in NGC 3079 the N and S arms do not lie in the same plane. In NGC 4088 the dynamical and optical centers do not coincide-possibly caused by ejection from a nuclear hot spot. In preparation is the determination of the rotation and mass of NGC 2776. Comte et al. (1978, A and A in press) have given a detailed velocity field for M101 from F.P. interferometry and spectroscopy. A rotation curve for NGC 4096 is determined by Metlov (14.158.178) and by Barbon and Capaccioli (17.158.087).

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High resolution observations of M31 from H I emission by Emerson (18.158.009) show close agreement between H I and H II velocities. In the central region of this galaxy stellar velocities are axisymmetric but the gas velocities are not (Pellet, 18.158.040). Peterson et al. (19.158.088) detect a tilting of the major axis of the nucleus of M31. Complex nuclear kinematics are observed in M81 (Goad, 18.158.160).

Rotation curves (spectroscopic) and orientation parameters are analysed by van der Kruit and Bosma (preprint) of NGC 2715, 5033 and 5055, to be used later in combination with Westerbork H I observations. No large scale non-circular motions are detected in the inner parts. Rood and Dickel (17.158.078) obtain 21 cm line profiles of 50 galaxies. In NGC 4258 van Albada and Shane (14.158.101) find disturbance in H I density and velocity in the neighborhood of the anomalous arm; otherwise the galaxy behaves normally. From H I, a velocity curve is obtained for NGC 253 by Combes et al. (1977, A and A 59, 181). A very detailed analysis of the velocity field of this "transition" barred galaxy by Pence (in preparation) based on 9842 F.P. velocities, exhibits a flat rotation curve for 3'<r<10'; outflow of gas, detected earlier by optical and radio data, is found to be along the bar. Blackman has discussed the rotation curves and the radial variation of M/L in the galaxies NGC 157, 1084 and 7331 (MN in press). The results are interpreted in terms of the density wave theory.

C. Barred Spirals

In NGC 7723, SB, (Chevalier and Furenlid, 1978 Ap.J. in press) the bar has rigid body rotation while the spiral region shows constant velocity. Published reports of the extensive program of Duval-Cheriguene are emerging; it is suggested (Proceedings of the Third European Astron. Meeting Tbilisi July 1975) that a nucleus of greater or lesser importance is related to a more or less rapid rotation gradient in the bar. The velocity field of the SB galaxy NGC 5383 is given by Duval (20.158.115). Peterson et al. (1978, Ap.J. 219, 31) detect radial as well as rotational motions in NGC 5283. Moreover they suggest that the nuclear gas is rotating and contracting. A similar phenomenon is observed earlier in NGC 3351. However NGC 5383 is more luminous and bluer with higher H content and higher angular momentum than NGC 3351. Lindblad, from spectroscopic data, confirms the existence of rapidly rotating nuclear disk in NGC 1365 (1978, Astronomical Papers Dedicated to B. Stromgren).

D. Seyfert Galaxies

Simkin (14.158.054) optically and Bosma et al., from H I (1977, A and A 57, 97) have studied the velocity field in NGC 4151; the resolution of the H I data is not sufficiently high for a detailed comparison of H I with the optical data. Identified as Seyferts are the galaxies NGC 6764 barred (Rubin et al., 14.158.005) and NGC 5506, an X-ray source (1978, Rubin, preprint). Rubin et al. (1978 Ap.J. Supplement) present velocities of the filamentary system of NGC 1275 for which galaxy Oort (18.158.236) gives an interpretation of the radio and optical data. It is interesting to report that A. Elvius in collaboration with J. Lind and L. Lindegren has obtained spectra in the region λ1150-3200 A of the Seyfert galaxies NGC 3516 and NGC 7469 with the IUE satellite in June 1978. The same group has taken part in the international (ESA+UK) collaboration on IUE spectroscopy of NGC 4151 and 3C 273.

E. Irregulars

They are treated in a number of papers; Tully et al. (1978, A and A 63, 37) find, at 21 cm, well-ordered solid body rotation and comparable random motions, in DDO 125 and H_oI. H_oII, synthesized in H I, shows regular rotational velocity, out to 7 kpc (Cottrell, 18.158.120). The optical as well as 21 cm velocity fields suggest a past explosive event in NGC 2915 (Sersic et al. 1977, A and A 59, 19). A high angular resolution study of M82 is made by Gottesman and Weliachew

(19.158.003); large scale non-circular motions are detected. Gottesmann and Weliachew have discussed the large scale distribution and kinematics from the 21 cm line of the optical core of NGC 6822 (20.158.086). They find that non-circular motions are important in the structure of the system.

F. Peculiar Galaxies

Van der Kruit (17.158.071) finds radial gas streaming in NGC 3310 while in NGC 3256 Feast and Robertson (W.G. circular 20) suggest the presence of non-circular motions. Strikingly enough, the central region of the hot spot nucleus of NGC 2782 resembling a type-II Seyfert, shows no evidence of non-circular motions. Optical and 21 cm line studies in NGC 3448 exhibit its very peculiar kinematics suggestive of two different systems in the nucleus of this galaxy (Bottinelli et al., 1978, A and A 63, 363); joint studies of the kind are desirable. Cottrell from H I detects a deviation of the projected centroid from the optical center in NGC 3077 (17.158.003). The very interesting galaxy NGC 2685 (Ulrich 14.158.234) shows a velocity gradient of gas along its apparent minor axis.

G. Dispersion of Velocities

Morton and co-workers have continued their research on the dispersion of velocities; equivalent widths of H and K absorption lines in M31 are found to be 120 km s^{-1} in the nucleus and 110 km s^{-1} in the bulge. In the bulge of M31 Simien et al. (1978, preprint) find the slightly larger value of 140 km s^{-1}. In the dwarf elliptical M32 the estimated dispersion near the nucleus is 60 km s^{-1} (1978, Simien and Pellet, preprint). For 13 galaxies Sargent et al. (19.158.042) have determined the velocity dispersions. Their values are systematically smaller by 22% compared to Faber and Jackson's.

H. Ellipticals

Improved sensitivity has allowed the detection of H I in several ellipticals revealing as a result rotation in these galaxies. H I velocity profiles obtained for NGC 3904 and 4636 by Bottinelli and Gouguenheim are around 480 km s^{-1} and 750 km s^{-1} respectively (20.158.013). Huchtmeier et al. have obtained H I profiles in NGC 4105 and 5846 (19.158.104). Rotational properties of 13 elliptical galaxies are discussed by Illingworth (20.158.088) based on spectroscopically obtained velocities, for 10 galaxies by him, and 3 determined previously by others. It is concluded that the peak rotational velocity is about one third that predicted by the models of Gott, Larson and Wilson. We note that none of the galaxies mentioned above, observed in the H I line, is contained in the list.

I. Double Galaxies

Rotation curves in the NGC 935 and I 1801 pair are determined by Blackman (19.158.001) and in NGC 4485-4490 by Duval (preprint). The velocity field from H I data of the pair NGC 4631-4656 is derived by Weliachew et al. (1978, A and A 65, 37).

It is gratifying to witness the onset of contributions to the kinematics of galaxies from molecular, particularly CO lines. The NRAO group has mapped the radial velocity field of several galaxies: M82, NGC 253 and Å51, by Rickard et al. (19.158.063) and Maffei 2 by Rickard et al. (20.158.089). Line widths of CO are given for M31, 51 and 81 by Combes et al. (19.158.053). Further contribution to the kinematics of galaxies is anticipated from this fastly developing novel field of research.

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10. WORKING GROUP FOR EXTRAGALACTIC SURVEYS FROM SPACE
(R. Barbon)

This Working Group has been formed during the Grenoble IAU General Assembly to fulfil the intentions of those astronomers who first realized the growing need of a wide field, fast focal ratio telescope operating from space. Following the trend of the long and profitable cooperation shown on Earth between the ground based Schmidt telescopes and the large reflectors, this instrument would support the research done by the Space Telescope and would detect the faint extended sources which are beyond the capabilities of the presently planned, slow focal ratio, space telescopes. The Working Group has been set up within Commission 28 since extragalactic research, which has been almost neglected in past space astronomy, would be greatly helped by observations carried out with such instrument, but it is recognized that galactic, stellar and solar system research would also benefit from the new type of data.

A recommendation has been addressed to the space agencies of the IAU member nations to give high priority to survey telescopes for space astronomy. In support of this, the Working Group was expected, (quoting from the official statement): "to promote discussions of the scientific objectives of such telescopes and of their impact on telescope design, and to aid in the coordination of the study efforts of various groups of astronomers interested in such telescopes and the data produced by them."

The success of this initiative and the world wide interest of the astronomical community to survey type observations from space are testified by the large number of scientists, from twelve nations, who joined the Group. During the past two years, besides bringing to the attention of space agencies the developments of survey telescopes studies, the Working Group has mainly acted as information network among interested astronomers. The present report will therefore deal mainly with the initiatives and study efforts carried out recently by groups in the United States and in Europe who are particularly involved in survey telescopes projects.

A proposal to NASA of a Deep Ultraviolet Optical Survey (DUOS) has been submitted by K. Henize in November 1976 for the Spacelab 2 mission. Surveys of large sky areas, both in a very wide band including the middle UV and the optical region from 2200 Å to 5500 Å and in a narrower band in the far UV from 1300 Å to 1800 Å, are proposed to be conducted with an all reflecting Baker-Schmidt telescope with a field diameter of 6°. The instrument has an aperture of 52.2 cm and an effective focal ratio f/3. The resolution is about 4" to 8" from axis to field edge. The proposed detectors are IIIa-J photographic emulsion and the far UV electrographic camera developed by G. Carruthers at Naval Research Laboratory. Primary targets for such survey include tidal extensions in gravitationally interacting galaxies, faint star bridges and dwarf systems, intergalactic matter in clusters of galaxies, detection of hot stars in the Milky Way as well as in numerous external galaxies.

The Baker-Schmidt optical design, which provides a flat focal plane, has been chosen after a study made by D. Schroeder (Optical Study of the Deepsky Ultraviolet Survey Telescope, Report to NASA, LBJ Space Flight Center, 1976) who carefully compared the capabilities of the Baker-Schmidt telescope (BST) and the all reflecting Schmidt (ARS). Schroeder showed that the ARS has the advantage of providing the best image quality for a given telescope focal ratio. Its main disadvantage is the curved focal surface. The main advantage of the BST is that the system parameters can be chosen to give a flat focal surface but it has a poorer image quality than ARS along with a lower light gathering power because of vignetting by the secondary mirror.

Although DUOS was a very good proposal, as it was recognized by NASA, budget

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constraints prevented it to be selected for Spacelab 2, but it made that agency aware of the possibilities offered by a survey space telescope. High priority has been in fact given to the DUVS project, already proposed by K. Henize some years ago, consisting of a deep ultraviolet survey to be carried out by a one meter class, wide-angle telescope. A new feasibility study has started early in 1978 at NASA, Goddard Space Flight Center, to investigate on the scientific objectives and preliminary design of a Shuttle orbiting telescope. This study is conducted under the supervision of T. Gull, T. Stecher and L. Wilson. The new acronym SWAT (Spacelab Wide Angle Telescope) has been proposed for the instrument which should probably be of the all reflecting Schmidt type class, 75-100 cm aperture, f/3 focal ratio, capable of imaging a 5^0 diameter field with an angular resolution of 1"-1".5. It is expected that modern technology should be able to provide photocathodes of the needed size and matching the curved focal surface. A detailed technical report, indicating the final choice of the optical design, is due in June 1979.

The science that can be done by SWAT has been investigated by an ad hoc working group, with K. Henize as chairman, who convened twice in 1978. A document with the results of these discussions will be published soon. The main fields of interest for SWAT, which should be capable to observe from far UV to near IR, have been identified as follows: 1- detection of hot hidden objects, 2- UV morphology of galaxies, 3- presence of dust in the Milky Way and external galaxies, 4- detection and study of faint extended objects, 5- detection and study of emission line objects. The instrument will be in fact also designed as an adaptive telescope of accepting pre-dispersing elements as gratings or prisms for specific spectroscopic studies. A decision by NASA on this project will be taken in mid-1979.

Space survey studies are well underway also in Europe as testified by the experiments proposed by Courtès and by Schmidt-Kaler for Spacelab and the Deep Photographic Survey, also a proposal for Spacelab by Barbon and collaborators.

The very wide field camera developed at the Laboratoire d'Astronomie Spatiale, Marseille, has been recently selected as part of the Spacelab 1 payload. It will provide a wide sky coverage in the 1300-3300 Å wavelength region with a 3' resolution, allowing studies of gas and star clouds and mapping of faint extended sources. Our knowledge of the interstellar medium will especially benefit from the data provided by this experiment which may be considered as a first step to higher resolution sky surveys.

Barbon et al. (ESA Colloquium on Long Term Planning, Trieste, May 1977; "New Instrumentation for Space Astronomy", p.3, K. van der Hucht and G. Vaiana ed.,Pergamon Press 1978) submitted to ESA a proposal for a deep photographic sky survey to be carried out from Spacelab. Preliminary optical design and mechanical structure are given for a 50 cm aperture, f/3 focal ratio, all reflecting Schmidt telescope imaging a 5^0 diameter field at about 1" resolution. The use of the far UV region, the visual and the near IR as observing bands is indicated. It is stressed that "the huge amount of information stored in the wide field photographs will support the work of many users with a variety of interests, qualifying the survey as a low-cost-per-unit-of information experiment.

Progress in the theory and design of wide field telescopes for space astronomy, besides the already mentioned work of Schroeder, has been made by Lemaitre (18.031.052) who analysed a two-surface all reflecting Schmidt, proposing a dioptric elasticity method, which could be used also for a large aperture telescope, to aspherize the primary mirror.

Bertola et al. ("A folded all reflecting Schmidt telescope for space astronomy", ESA Colloquium on Space Astrometry, Padova, 1978) describing the figuring and the optical tests of a 20 cm, f/3 all reflecting Schmidt. A resolution of 1".2 is achieved over a 5^0 field.

Although the wide angle space telescope is still in the engineer's drawer, some highlights of what it can do for modern astronomy may be anticipated from the results

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of recent space experiments which made use of UV wide angle cameras for imaging and objective prism spectroscopy. We refer mainly to the S 201 experiment performed on the Moon during the Apollo 16 mission, the S 019 and S 183 experiments from Skylab and the recent results obtained during sounding rocket flights.

Far UV spectra and imagery in the Large Magellanic Clouds have been reported by Carruthers and Page (19.159.002; COSPAR Science Research, 17, p.749, 1978) together with imagery in the Cygnus region (17.132.017).

The S 019 objective prism experiment from Skylab described by O'Callaghan et al. (19.032.557) has already yield a number of new discoveries as reported by Parsons et al. (17.126.016; 17.114.005) and Laget et al. (Astrophys. J. 219, p.165, 1978).

With the S 183 experiments from Skylab (Laget et al.: 19.032.556) observations have been made of the Magellanic Clouds, the nucleus of the Andromeda galaxy and of galactic nebulae in the Milky Way.

Sounding rocket flights have been used by Carruthers and Opal to observe the Orion nebula (20.134.015), the Barnard Loop nebula (19.134.004) and the Andromeda galaxy (Astrophys. J. 225, p.346, 1978). UV observations of the nucleus of M 31 have been also reported by Deharveng et al. (18.158.039).

In closing this report it is worth mentioning also the importance of the wide angle observations to study temporary events like the appearance of comets as shown in the case of comet Kohoutek (see full references in 18.103.123).

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