28. GALAXIES

(GALAXIES)

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The present report covers the period 1979-1981. 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 faster every year. 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 President, the Vice- President, members of the Organizing Committee and the Chairmen of the Working Groups.

References are mostly given by commonly used abbreviations for journals with volume and page numbers but without the year of publication; in some sections references by the numbers in the above-mentioned Abstracts have been used.

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 1979 will not be repeated here.

IAU Symposium No. 92, on "Objects of High Redshifts", covered recent observations of objects of cosmologically significant redshifts. The investigations presented dealt with the whole spectral range, from X-rays to radio wavelengths. IAU Colloquium No. 54, on "Scientific Research with the Space Telescope", had papers dealing with the physical properties of galaxies and quasars. IAU Symposium No.94, on, "Origin of Cosmic Rays", included topics dealing with the nuclei of galaxies, compact and extended radio sources, and the distribution of non-thermal emission in galaxies. IAU Symposium No. 96, on "Infrared-Astronomy" had presentations of infrared studies of galaxy nuclei, Seyfert galaxies, quasars and cosmology.

IAU Symposium No. 97, on "Extragalactic Radio Sources", dealt with extended radio sources, various types of structures in sources, QSOs and compact radio sources, and the space distribution and evolution of these objects.

A conference was held in Austin, Texas, on "Photometry, kinematics and dynamics of galaxies", before the IAU General Assembly in Montreal.

The Highlights of Astronomy, vol. 5, contains the Joint Discussions in Montreal: "Nuclei of normal galaxies" and "Extragalactic high energy astrophysics".

The Fifth European Regional Meeting in Astronomy, in Liège 1980, dealt with "Variability in stars and galaxies".

https://doi.org/10.1017/S0251107X00004727 Published online by Cambridge University Press

A NORDITA Symposium in Copenhagen 1980, discussed "The universe at large redshifts" (Phys. Scr. 21, 599).

A discussion of "The origin and early evolution of the galaxies" was organized by McCrea and Rees in 1979 (Phil. Trans. Roy. Soc. London, Ser. A, 296,269).

Conferences and Workshops organized jointly by ESA and ESO dealt with "Optical jets in galaxies" (ESA SP-162), "Dwarf galaxies" (ESO Report), and Astronomical uses of the Space Telescope". An ESO Workshop on "Two Dimensional Photometry" has sections on extragalactic photometry.

Proceedings have appeared from the "Pittsburgh Conference on BL Lac objects" (Univ. of Pittsburgh), the NATO Advanced Study Institute on "Active galactic nuclei", and the Cospar Symposium on "X-ray astronomy".

Among important review papers to appear during the period under consideration are: Masses and mass-to-light ratios of galaxies (Ann.Rev.Astron.Astrophys. 17, 135); Globular clusters in galaxies (ibid.17, 241); Infrared emission of extragalactic sources (ibid.17,477); The structure of extended extragalactic radio sources (ibid.18,165); Optical and infrared polarization of active extragalactic objects (ibid.18, 321); Absorption lines in the spectra of quasistellar objects (ibid. 19, 41); Abundances in stellar population and the interstellar medium in galaxies (ibid. 19, 77); The extragalactic distance scale (ibid. 19, 357); Compact radio sources (ibid.19, 373); The emission lines of quasars and similar objects (Rev. Mod.Phys. 51, 715), and "The discovery and observed properties of QSOs at large redshifts- and update"(M.G.Smith, preprint, for publ. in "Investigating the Universe", ed. F.D. Kahn). A number of reviews have appeared in Comments on Astrophysics and in Science.

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

A. Survey work; Catalogues

The ESO/Uppsala "Quick Blue Survey" of the southern hemisphere is completed: lists nos. 7, 8 and 9 are published (AA Suppl 39, 173; 43, 307; 46, 311). In all, 606 fields south of decl.- 17°5 have been investigated and about 16 000 galaxies and physically connected systems recorded, with total diameter $\geq$ 1.0 arcmin. An updated, cross-checked version of the catalogue is being prepared and will become available in computer readable form at the end of 1981. It will also contain B mag, B-V colours and redshifts for about 2 000 galaxies.

The survey of southern galaxies ($\delta<-22^{\circ}$) on UK Schmidt plates has continued. De Vaucouleurs reports that during 1979 - 1981 a total of 278 fields were surveyed bringing the total to 537 and thus completing the survey. The second and third installments of the survey, restricted to late-type galaxies, have been published (AJ 83, 1566; 85, 1027). The fourth and final installment is expected to be published in 1982. About 6500 galaxies have been classified and measured in this survey. An extension of the survey, initially to $\delta = -17^{\circ}$ and eventually to the equator, has been started.

A survey on the Palomar Sky Survey of the northern galactic plane from $l = 33^{\circ}$ to $l = 213^{\circ}$, $b = \pm 2^{\circ}$, has led to the detection of 207 galaxies, 200 of them being new (AA Suppl 40, 123). There is a strong preponderance in number towards the galactic anticentre and the objects here tend to lie above the galactic equator.

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Fairall reports that a source catalogue for all galaxies south of $-17^{\circ}30'$ is being assembled at the Astronomy Dept, Univ of Cape Town; the galaxies listed have been observed spectroscopically.

A Catalogue of Galaxy Redshifts (CGR) has been compiled by H.J. Rood (See section 5).

An Extragalactic Data Center (CDE) has been created (Bull Inf CDS no. 20,79). It will set up two files: the Galactic Data Center (Centre de Donnêes Galactiques CDG) and the Clusters of Galaxies Data Center (Centre de Donnêes des Amas de Galaxies CEDAG), each holding untreated data and their coded references.

"A catalogue of galaxies within 10 Mpc" lists the 179 known galaxies (1979) within this distance (Astr Nachr 300, 181). The inclusion of a galaxy depends upon its redshift ($\leq$ 500 km s^{-1}) or, in the case of 7 dwarf galaxies, on the fact that the distances are known to be small. The catalogue contains also 50 bona fide Virgo cluster members and 2 members of the Leo group. It is believed to be complete for galaxies brighter than about - 18.5 mag, but it contains many considerably fainter galaxies.

"An optical catalog of radio galaxies" (ApJ Suppl 40, 583) contains basic optical information on all radio galaxies ($L_{radio} \geq 10^{41}$ ergs s^{-1}) which have been identified and for which redshifts have been measured.

"An update of the status of the Revised 3C Catalog of radio sources" (PASP 92, 553) contains optical positions, redshifts, magnitudes, and identifications as well as radio flux densities and spectral indices for a sample of 297 extragalactic 3C sources.

"A revised optical catalogue of quasi-stellar objects" (ApJ Suppl 43, 57) contains the basic information on all QSOs and BL Lac objects which have been certainly identified, a total of 1549 objects.

"A catalogue of polarization measurements and related data of extragalactic radio sources" (Acta Cosmol 9,7) gives mainly radio data but also some optical for a total of 510 extragalactic radio sources.

"A Catalogue of linear polarization of radio sources" contains all the data of linear polarization of radio sources published prior to December 1978 (AA Suppl 39, 379). Tabara and Inoue report that the catalogue contains 7225 data for 1510 radio sources. Optical data are source identification, optical magnitude, redshift.

"A master list of nonstellar optical astronomical objects" contains 185 000 listings from all known catalogues of nonstellar objects and gives 1950.0 position, angular diameter, magnitude and description (Dixon and Sonneborn, Ohio State Univ Press).

B. Classification

Revised galaxy types are estimated for 153 southern systems in "The las Campanas survey of bright southern galaxies"(AJ 84, 472). Estimates of luminosity class are included and effects of environment on galactic forms are looked for. A new class of amorphous galaxies is introduced, replacing the now abandoned Irr II type. The purpose of the survey was to reclassify the southern Shapley- Ames galaxies.

"A revised Shapley- Ames Catalog of bright galaxies" has now appeared (Sandage, Tammann, Carnegie Inst of Wash). It contains newly estimated types and luminosity classes for 1246 galaxies together with other information (See section 5)

"A catalogue of morphological types in 55 rich clusters of galaxies" (ApJ Suppl 42, 565) gives positions, morphological types, total magnitudes, bulge sizes, and ellipticities for about 6 000 galaxies, as determined from high-scale photographic plates.

De Vaucouleurs reports that a catalogue of "Diameters of nuclei, lenses, and inner and outer rings in 512 galaxies" has been published (AJ 85, 637). The measurements have been made on large-scale reflector plates for statistical studies of quantitative galaxy morphology as well as for other applications.

For the determination of the local value of the Hubble constant a luminosity classification on the DDO system for 670 Sb galaxies was carried out (AJ 85, 101).

C. Measurements in the Radio Region.

Many important catalogues of radio sources have been presented recently. The "Molonglo reference catalogue of radio sources" (MN 194, 693) lists 12 141 sources with 1950.0 positions, 408 MHz flux densities, source types and cross references.

The 14th part of the Parkes 2 700 MHz survey (Austr. JPh, Ap Suppl No 46,1) gives data for 278 sources and includes results of examination of the Palomar Sky Survey prints for indentification.

A catalogue has been presented (AA Suppl 40, 91) of sources belonging to either or both of two samples complete to 3.7 Jy at 178 MHz and 2.2 Jy at 408 MHz, respectively. The best available information on radio structure, radio spectrum, and optical identification is given. A statistical analysis has been carried out.

A confusion-limited 4.755 GHz survey covering 0.00956 sr between 7^h05^m and 18^h near decl + 35^o has been made with the NRAO 91-m telescope (AJ 85, 780) 237 sources were found down to 15 mJy. The material has been extensively analyzed.

A number of studies of bright galaxies has been carried out, often resulting in detailed radio maps. Thus, for exemple, 91 spiral galaxies from the UGCG have been observed at 408 MHz with the Bologna Northern Cross Radio Telescope (AA Suppl 41, 329); the sample is complete down to m_{pg} = 12 mag for the declination zone +20^o to + 60^o.

With the Effelsberg 100 m telescope 1616 galaxies from the RCBG and the UGCG were observed at 11 cm (MN 192, 635); 296 radio sources were detected within 2.5 arcmin of the centres of 323 galaxies. Individual detection limits are given for the 1293 undetected objects. - With the same telescope 141 optically bright galaxies were observed at 10.69 GHz; 68 were detected (AA Suppl 41, 151).

The radio continuum radiation at 1415 MHz was observed with the Westerbork Synthesis Radio Telescope of 450 galaxies (AA Suppl 41, 151); 190 objects were detected. The limit for point sources was 10 mJy and the resolution about 24 arcsec. - With the same telescope observations were made at 6 cm and 21 cm of a complete sample of sources from the NRAO - Bonn "S4" survey at 5 GHz that have flat high-frequency spectra and are identified with galaxies (AA 74, L11). Most of the brighter galaxies in the survey appear to be related to BL Lac objects.

High-resolution maps of all spirals with a radio-to-optical luminosity ratio R > 50 from the Arecibo 2380 MHz survey were made with the NRAO Very Large Array (VLA) at 4885 MHz (ApJ 242, 894). 7 of the 8 objects contained dominant central radio sources with no evidence for enhanced disk emission. 3 of the 7 have flat radio spectra; they are compact ($\leq$ 1 pc) synchrotron self-absorbed radio sources. All of the steep-spectrum sources were resolved with the VLA with typical sizes of $\sim$ 1 kpc.

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A continuum radio survey at 5 GHz with the NRAO 91 m telescope of all the isolated galaxies drawn from the Zwicky catalogue by Karachentseva and classified E or SO, and spirals between + 10^o and + 60^o declination, showed that both the ellipticals and the spirals are extremely deficient in radio sources (AJ 85,1010). A clear correlation is found between frequency of radio emission and local galaxy density, suggesting that gas falling in to a galaxy triggers radio emission.

A huge number of neutral hydrogen studies has been carried out for all types of galaxies. Thus an extensive mapping program with the Green Bank 91-m telescope gives the HI line radiation in and around 61 relatively nearby galaxies with diameters between 9 and 36 arcmin (AA Suppl 41, 189). Individual galaxies for which the HI observations have served to determine the internal motions,may be found in the table in section 9. References to neutral hydrogen studies are also found in sections 2, 3 and 5.

Evidence for warps in the gas layers of galaxies was found some years ago; a review appears in IAU Symp. No.84, 501. More recent studies of the HI distribution in galaxies has led to substantial warps being found in e.g. NGC 300 (ApJ 229, 509); NGC 3718 (MN 186,343); NGC 4565 (AA 89,95); and IC 10 (MN 187,839). It is noted that NGC 300 has massive HI companions, that NGC 3718 may have had a gravitational encounter with NGC 3729, and that IC 10 may have a chaotic distribution of HI clouds around it. The dynamics of warps in disks is being studied by J.W-K. Mark. He has found that the bending of galaxy disks is unstable in the presence of the more slowly rotating spheroidal subsystem. Analyses of the mechanism and related effects may be found in (AA 88,289; Nature 287,705; ibid 290,120).

The asymmetry of the HI distribution in a number of spiral galaxies is analyzed in (MN 193,313). It is proposed that the "lopsided" distribution may be associated with a pattern of elliptical orbits. As most of the galaxies analyzed are rather isolated on the sky the asymmetries are hardly transient phenomena.

Among new molecules detected in extragalactic systems we note NH_3, at 1,3 cm, in IC 342 and NGC 253 (AA 74, L7), and CH, at 3264 MHz, in the Large Magellanic Cloud, NGC 4945 and NGC 5128 (MN 190, 17P). Most of the search for molecules in extragalactic systems appears otherwise to have been for CO (AA 78, L1; 82, 381; ApJ 240, 60; 240,455) and H_2O (Nature 278,34; AA 91, 259).

For further investigations in the radio region the reader is referred to the Report of Commission 40.

D. Measurements in the X-ray region

Among the many publications on extragalactic X-ray sources we mention here the Proceedings from the AAS High Energy Astrophysics Division meeting on "X-ray astronomy with the Einstein satellite" and a review "The Einstein Observatory: New Perspectives in Astronomy" (Science 209, 865). X-ray observations are also referred to in several of the following sections of our report; they are frequently concerned with active galaxies. X-ray emission from elliptical galaxies has been observed; This may be considered as evidence for the accumulation of extensive gaseous envelopes (MN 192, 135). Normal galaxies may in fact contribute substantially to the diffuse background (Nature 281, 127).

For further investigations in the X-ray region the reader is also referred to the Reports of Commissions 44 and 48.

E. Deep galaxy samples and the luminosity function

A number of complete samples of galaxies to faint limiting magnitudes have been presented: Fields near the South Galactic Pole have been studied to B $\sim$ 22 mag

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(MN 186,69; 193, 1; Aph Space Sci 72, 315); more than 28 000 galaxies were counted in the field of 15 square degrees. In two high-latitude fields, each of 1080 arcmin^2, counts to below B = 24 mag have been carried out; about 20 000 galaxies were identified (ApJ Suppl 43, 305; Phys Scr. 21,652). Electronograms taken with the 6-m telescope have permitted counts to 25th apparent magnitude (Pis'ma AZh 6,3). In a high-latitude field (b=-65°) observed with the prime focus camera of the Anglo-Australian Telescope on IIIa-J plates a limiting magnitude of about 25 was reached (ApJ 233, L109). To J_o= 24 mag the integrated galaxy surface density was 17 800 deg^{-2}.

Tyson reports on a new technique for detecting and classifying images on astronomical plates (AJ 86, 476). Among the results derived are counts to J = 24 mag (IIIa-J plates) at the North Galactic Pole, giving 17 100 galaxies per deg^2 to this limit (ApJ 230, L153), and permitting a comparison with evolutionary models.

The conclusions drawn in most of the papers from the counts of the very faint galaxies are that no or only a very moderate amount of galaxy luminosity evolution is seen. The population becomes bluer with increasing faintness.

The luminosity function of nearby galaxies (within 10 Mpc) has been investigated by K.-H. Schmidt (AN 302,61). A large population of faint elliptical systems may exist and form an important constituent of the universe.

The luminosity function of field galaxies follows the Schechter function well (AJ 84,951); it does not differ significantly from the cluster galaxy luminosity function.

The luminosity function of radio galaxies has been studied (ApJ 229,25). No difference in it was found for $z < 0.1$ and $z > 0.1$; this is consistent with neither luminosity nor density evolution in the recent past.

The slope of the luminosity function of galaxies in Zwicky's catalogue has been scrutinized (Acta Astr 29,293). It was found to be unstable in the brighter part, to be approximately 0.6 in the intermediate magnitude interval and to be greater than 0.6 in the faintest interval studied (14.7 - m - 15.7).

F. Dwarf galaxies

The dwarf galaxies in the Local System as well as at greater distances have attracted much interest. The Draco dwarf galaxy has been carefully investigated by Stetson (AJ 84, 1149; 1167; 85, 387), who concluded (AJ 85, 398) that the galaxy may be considered as having one metallicity and an age younger than that of globular clusters. Zinn (AJ 85, 1468) confirmed his previous conclusions that Draco shows a significant dispersion in metallicity. The case for an abundance spread appears good and is upheld by Kinman et al.(AJ 85,414; Phys. Proc. Red Giants,p.71).

The structure of the Sculptor dwarf galaxy has been examined by star counts (AJ 85,1587); a tidal radius of 75' is indicated. A tidal analysis of the 600 variable stars in the system has also been carried out (AJ 84,601). Here, a tidal radius of 47.'6 is derived. A number of the variables are extra-tidal. Conclusions of their distribution are drawn.

The Fornax dwarf galaxy has a wide giant branch (ApJ 232,84); the dispersion suggests the existence of a range of abundances among its stars. Also its globular clusters show a spread in metallicity with a least 3 clusters having lower metallicity than the field stars (AJ 86,357) and the most metal poor having lower metallicity than M15 (ApJ 247,849).

The luminous stars in the two irregular dwarf galaxies NGC 6822 and IC 1613 have been studied (ApJ 238, 65) as well as the history of their star formation

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(ApJ 241,125). Evidence for sporadic bursts of enhanced star formation is found. Kinman reports that 3 very compact HII regions have been found in NGC 6822 (PASP 91,749). The HI content of IC 1613 may be found in (AA Suppl 41.189).

A preliminary luminosity function for the recently found dwarf irregular galaxy in Sculptor (SDIG) has been presented (ESO Prepr. No. 155). It appears similar to those of IC 1613 and NGC 6822.

In several of the dwarf spheroidal galaxies carbon stars have been identified. They were suggested to exist in the Fornax system in (PASP 91,761); later on a number were found there and in the Sculptor system (Messenger 19,7; ApJ 240,804). They have also been found in the Draco dwarf galaxy (Steward Obs. Prepr. 341). In the recently detected Carina dwarf galaxies 2 carbon stars have been found (MN 196,IP), but Cannon reports that now 8 are known; they appear similar to those in Fornax (talk at RAS, England, in March 1981).

Of great interest is the detection of Wolf-Rayet stars in the dwarf galaxy Tololo 3 (AA 101,L5).

The new Local Group dwarf galaxy LGS 3, probably a satellite to M 33, was observed in HI (ApJ 232,L11). CCD camera observations led to a value of MV =-7.1 mag for LGS 3, provided it has an old population, only. If it is at the distance of M33, its M_V= -9.7, and it must contain a young population.

An investigation of the stellar content of dwarf spheroidal galaxies, based on the construction of models for extremely metal-poor horizontal branch stars, is found in (ApJ 241,111). Further theoretical studies of dwarf galaxies are presented in (ApJ 242, 517); here a stochastic self- propagating star formation model is applied.

Thuan reports on extensive studies of dwarf galaxies: 115 blue compact dwarf galaxies (BCDG) have been observed in HI. These data are combined with all available optical data for statistical studies (ApJ 247,823). In addition excellent spectra of 50 BCDG have been obtained as well as IUE observations of 7 BCDG. All UV spectra show strong NV, CIV and NIV stellar absorption features with P Cyg profiles on the latter lines in some cases, indicative of stellar winds in these galaxies.

Thuan is also continuing his HI study of the remaining Nilson (UGCG) low-surface brightness (LSB) dwarf galaxies, and he has begun a HI survey of all 1163 magellanic-type galaxies in the UGCG. These galaxies are intermediate in star-formation activity between the LSB galaxies and the BCDG. X-ray Einstein IPC observations have been obtained for two BCDG objects. X-ray emission is expected due to the large number of supernova remnants in these galaxies.

Kinman reports that spectroscopic observations have been obtained of 10 emission-line dwarf galaxies (ApJ 243,127) and the abundances of He and O determined. The underlying continua in these galaxies come predominantly from mixtures of O-type stars and moderately hot giants and supergiants. The ratio of HI mass to total mass is found to increase monotonically with decreasing total mass.

A morphological study of 15 blue dwarf galaxies showed 3, possibly 5, to be dwarf ellipticals. The others had bright knots and other morphological perculiarities as dominating features (AA Suppl 37, 541).

2. STRUCTURE AND EVOLUTION OF GALAXIES
(P.C. van der Kruit)

I. Introduction

In the period covered by this report two major meetings were devoted to the subject of the structure and evolution of galaxies: "Photometry, Kinematics and Dynamics of Galaxies" (Austin, Texas) in 1979 and the NATO Advanced Study Institute on "The Structure and Evolution of Normal Galaxies" (Cambridge, England) in 1980. The review papers in the published proceedings of these meetings provide a good summary of the recent progress in the field. Other reviews of interest appeared in IAU Symposia 84 and 94. Nuclei and active galaxies are not included in the report.

II. Masses and mass-to-light ratios

Mass determinations of spiral galaxies using the rotation curves in the disks have been reported by Bosma (Ph.D. Thesis, Univ. of Groningen) and he also compiled rotation curves obtained using the HI-line at 21 cm. Generally flat rotation curves out to distances beyond the Holmberg radius are found. A similar result has been reported by Rubin and co-workers (ApJ 238, 471) from optical spectra who discuss also the comparison of the curves among Sc's as a function of luminosity and size.

Much work has been devoted to the measurement of velocity dispersion in elliptical galaxies (AJ 85, 801; AA 91, 122; AJ 246, 666) with the general result that the luminosity L scales as $L \propto \sigma^4$, with σ the central velocity dispersion. The resulting integrated mass-to-light ratio is usually in the range 10-20 in reasonable agreement with results from double galaxies (Astroph. 15, 25; ApJ 232, 20; MN 195, 1037) where the last reference (White) reanalyses the Turner data and brings it into better agreement with other studies. Terlevitz et al. (MN 196, 381) have shown that there is good agreement in the velocity dispersion obtained by various groups of observers, but that it correlates with line strength (metallicity) in the sence that at a fixed absolute magnitude low dispersions occur in galaxies with low line strengths. The axis ratio may also play a role. The bulges of spiral galaxies too appear to follow a $L \propto \sigma^4$ correlation but with a lower proportionality constant (ApJ 234, 68).

Mass-to-light ratios have been reviewed by Faber and Gallagher (Ann. Rev. 17, 135). Bosma and van der Kruit (AA 79, 281) show that M/L increases dramatically with radius in spiral galaxies and van der Kruit (AA 99, 298) found from the thickness of the HI-layer in NGC 891 that this dark matter must be distributed outside the disk. Tinsley (MN 194, 63) finds that the integrated M/L of spirals is larger in blue galaxies, while Krumm and Salpeter (ApJ 84, 1138) show that it appears to be independent of type. Searches for extensive halos around spirals in the optical and infrared (AJ 85, 131; AJ 86, 178; ApJ 244, 476) remain unsuccessful.

Using X-ray observations Fabricant et al. (ApJ 241, 552) estimate the mass of M87 to be $4 \times 10^{13} M_\odot$. With present uncertainties of the dynamics of elliptical galaxies (see below) there is as yet no convincing evidence of radial increases of M/L in elliptical galaxies. This also accounts for the lack of agreement on whether the observations demand that there is a large condensed central mass in M87 (see also below).

III. Structure

Burstein (ApJ 234, 435/829) has studied So-galaxies and performed bulge-disk separations. He suggests that these system have a third component ("thick disks") that spiral galaxies lack. Boroson (ApJ Suppl 46, 177) studies bulges and disks in a large sample of spiral galaxies. Van der Kruit and Searle (AA 95, 105) study

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edge-on systems and propose a model for the three-dimensional distribution of light in spiral disks. This may also be the distribution of mass in these disks (AA 99, 298). The deformed outer spheroids in spiral galaxies may be similar to "thick disks" in So-galaxies.

The bulge of NGC 891 becomes bluer with increasing radius (AA 95, 116) presumably as a result of decreasing metal abundance. Wirth (AJ 86, 981) finds the same result for late type spirals, but finds no such trend among ellipticals. In M87 both the smooth light and that of the globular clusters becomes bluer with distance from the centre (Strom et al. ApJ 245, 416), but at each radius the clusters are bluer (presumably more metal poor). This is also true in three other Virgo ellipticals (ApJ 245, L9), while the density of clusters falls off less steeply than that of the light. It remains unclear whether non-giant ellipticals have in general abundance gradients.

Schweizer (ApJ 233, 23; AJ 86, 662) has studied the effect of seeing on determinations of core radii and finds the effects to be sincere. De Vaucouleurs and Cappacioli (ApJ Suppl 40, 699) published photometry of the elliptical NGC 3379 and propose it as a standard for surface photometry.

Talbot, Jensen and co-workers have performed a detailed study in various colours of the spiral M83 (ApJ 229, 91; 243, 716). Their work shows how the star formation has proceeded in the disk and how it relates to the spiral structure. No compelling evidence for the presence of density waves in M83 has emerged.

Radio continuum studies of spirals and the conclusions concerning the origin of cosmic rays are reviewed in IAU Symp. 94. Papers have been published on the presence of thermal radio emission (AA 94, 29) and on the magnetic field in M31 (Nature 283, 272). Hummel reported on a major radio continuum survey of galaxies (AA Suppl 41, 151; AA 89, L1; 93, 93).

HI-distributions in spiral disks have been published for many systems (e.g. Bosma thesis), notably in detail for M33 and IC343 by Newton (MN 190, 689; 191, 169; 615) and for M31 by Urwin (MN 190, 55; 192, 243). Sancisi et al. (AA 78, 217) studied the barred spiral NGC 5383. The thickness of the HI-layer of NGC 891 has been measured by Sancisi and Allen (AA 74, 73) and has been discussed also by van der Kruit (AA 99, 298). HI-maps of the So-galaxy NGC 1023 are published by Allsop (MN 187, 537) and of the elliptical galaxy NGC 4278 by Raimond et al.(ApJ 246,708).

IV. Dynamics and Evolution

Much effort has been devoted to the dynamics of elliptical galaxies, as also evident from the proceedings of the two conferences in Austin and Cambridge. Some references to various aspects are: numerical models (ApJ 232, 236; 235, 793; 243, 111; 121); rotation (MN 190, 421); anisotropic velocity dispersions (ApJ 227, 56; MN 189, 791; ApJ Suppl 41, 209; ApJ 244, 458) and reviews in Austin and Cambridge. Elliptical galaxies may be supported by anisotropic velocity distributions. This makes it difficult to rule out M/L gradients, because usually plausible anisotropics can be invoked to explain the observations. The observations of a possible dark, centrally condensed, massive object near the centre of M87 can be explained as well by invoking anisotropy in the velocity distribution (ApJ 237, L27). Bulges of spiral galaxies are rotationally supported (Illingworth in Austin and Cambridge and see also ApJ 235, 30).

Although still defended by van den Bergh (AJ Can. 73, 198), many authors now contend that sweeping cannot be the major cause for the occurrence of So-galaxies: Burstein (ApJ 234, 435) and Boroson (ApJ Suppl 46, 177) on the basis of disk-to-bulge ratios; Dressler (ApJ 236, 351) on the basis of occurrence of types as a function of environment, Larson et al. (ApJ 237, 692) on considerations of gas

https://doi.org/10.1017/S0251107X00004727 Published online by Cambridge University Press

consumption by star formation in spiral galaxies.

Density waves as the cause of spiral structure is supported by the existence of streaming motions in M81 (AA 58, 149; 159), but other interpretations are not ruled out. No streaming is found in M33 (MN 190, 689) and IC342 (MN 191, 615). Kormendy and Norman (ApJ 233, 539) find that there is observational evidence that spiral structure and density waves occur only in galaxies with oval distortions, bars or nearby companions. Stochastic star formation as the cause of spiral structure (or its absence in dwarfs) has been explored by Seiden, Gerola and co-workers (ApJ 232, 702; 233, 56; 242, 517).

Streaming motions in barred spirals have been studied by Sancisi et al. (AA 78, 217) and Rubin (ApJ 238, 808). Gas dynamical models have been published by Roberts et al. (ApJ 233, 67) and Sanders and Tubbs (ApJ 235, 803). The exitation and persistence of gaseous warps in the outer parts of spiral disks has been investigated by Tubbs and Sanders (ApJ 230, 736), Petrou (MN 191, 767) and Bertin and Mark (AA 88, 289). Baldwin et al. (MN 193, 313) studied the lobsided structure of gas disks.

The chemical evolution in galaxies has been reviewed by Pagel (Stars and Star Systems, p.17) and Tinsley (Fun. Cosm. Phys. 5, 287). Searle (Liège Conf.1978, p 437) discussed abundances in globular cluster systems. Work on galaxies in the Local Group and dwarf galaxies has been published by Lequeux and co-workers (AA 71 1; 80, 155).

V. Interacting and merging galaxies

Many investigators have emphasized the importance of merging between galaxies in clusters, for the cluster evolution. Model calculations (AA 76, 75) show that merging is most frequent in the early collapse phase of the evolution of the cluster; due to the increased velocity dispersion in the later stage the merging proceeds slower. The proportion of merged galaxies seems to be fairly insensitive to variations in the expansion rate of the universe (AA 95, 349).

The merging between gas-free axi-symmetrical systems should produce remnants with luminosity profiles similar to those of ellipticals and they should rotate slowly (ApJ 236, 43; MN 189,27;831).However, compared with observations of normal ellipticals the model galaxies appear to rotate too fast. The population mixing due to the merging appears to be weak; it may be masked by other effects such as induced star formation (ApJ 239, L9). It may thus be difficult to distinguish between normal ellipticals and mergers. Some statistical properties of ellipticals seem to invalidate the assertion that the bulk of these galaxies were formed by recent mergers (Comm. Astroph. 8. 177). However, if the merging occurred during the collapse phase these arguments may be weakened.

The importance of subclustering has been emphasized (ApJ 236, 43; MN 191 1p); the more compact a group the more frequent the merging. Observations appear to have confirmed this (ApJ 248, 439). Of the isolated compact groups of interacting galaxies observed today, about 5-15 percent may have originated from tight groups (AZh 56, 936). A correlation appears to exist between the dynamical timescale of a cluster and its Bautz-Morgan type, which could be understood as an effect of merging.

A number of individual galaxies have been suggested to be the result of a merging or to be in interaction with nearby objects.

A detailed morphology of NGC 1316 (Fornax A) shows irregularities that indicate that dynamical equilibrium is not yet achieved (ApJ 237, 303; 246, 722). It has a strongly inclined, rapidly rotating nuclear disk, which may have formed about

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10^9 years ago when a few gas-rich galaxies fell in. A similar case of a merging between a gas-rich and a gas-poor galaxy is IC 1182 (ApJ 247, 42).

Possible cases of merging between two gas-rich galaxies have been reported: NGC 3310 could be a merging between a spiral and an irregular galaxy (AA 96,271); NGC 6240 appears to be the result of the encounter between two galaxies of similar mass (MN 189, 79); and NGC 520, previously assumed to be a single exploding galaxy, consists most likely of two galaxies in close tidal interaction (AA 74, 110; ApJ 235, 37). Similar cases are discussed in (AA 97, 302; AA Suppl 35, 55). NGC 6052 (AA 78, L5) may be the result of the collision between two late spirals with a high rate of star formation induced in the central regions and the formation of supergiant HII regions in the outer parts. A quadruple system of galaxies, ESO 255-IG07, is reported by Bergvall et al. to be in the stage of merging (AA 95, 266).

A number of systems in different stages of interaction have been observed in the 21-cm line and analyzed in detail, in some cases in the combination with optical data: NGC 672/IC 1727 (AA 84, 85); NGC 1512/10 (AA 76, 230); NGC 4038/39 (AA 71, 131); NGC 4214(4190 (MN 188, 765); NGC 4490/85 (AA 82, 207); NGC 4725/47 (AJ 84, 1830); and Arp 205 (MN 187, 509).

A catalogue of interacting and merging galaxies south of decl. $-37^{\circ}.5$, $b \leq -30^{\circ}$, has been prepared by Bergvall (preprint). It contains 371 systems of interacting galaxies and 47 distorted single systems.

3. GROUPS AND CLUSTERS OF GALAXIES
(P.W. Hodge)

More than 250 significant papers on groups and clusters of galaxies can be found in the literature published since 1 January 1979. It is obviously not possible to report on every paper, and so the following cites only a few representative references to work in each of the categories. Several good reviews of the subject were written, e.g., by Bahcall (Highlights of Astr., 5, 699), Giacconi (X-ray and Gamma-ray Astr. in 80's, 33), Quintana (1st Latin-Am Reg. Astr. Mtg., 75); Huchtmeier and Materne (The Messenger, No.25, 8), and Rood (Repts. on Progr. in Phys., in press).

I. Morphology and Populations

Hickson (ApJ, in press) and Baier and Tiersch (Astrofiz. 15, 33) published new catalogues of compact groups, and Wakamatsu and Malkan (PAS Japan, 33, 57) reported the optical discovery of a cluster behind the Galactic center. Rudnicki et al. (in press) reported that Zwicky's ED-type clusters are probably mostly misidentified single low-surface brightness objects. Cluster types were the subject of certain revisions by Struble and Rood (AJ, in press), while Rood (ApJ 233, 21) studied the shapes of galaxy groups, finding that the average ellipticity is ~ 0.25.

Many studies of the Hubble types, brightnesses, and colors of galaxies in clusters were reported, including a massive survey by Dressler (ApJ Suppl 42, 565), giving data on 6000 galaxies in 55 rich clusters. Butcher et al.("Objs. of High Redshift", p. 49) examined colors of galaxies in several very remote clusters, concluding that they contain some galaxies with active star-formation and Gisler (AJ 85, 623) concluded that new statistics of morphological types in clusters argue that stripping of spirals does not explain SO galaxies in clusters. Hoessel et al. (ApJ 241, 486; 493) carried out surface photometry of brightest cluster galaxies in 116 Abell clusters, finding a correlation between absolute magnitudes and the structure of the galaxies with the properties of the host clusters. Paturel (AA 71, 106) analyzed the population of the Virgo cluster with a new taxonomic approach and Börngen (AN 301, 305) searched the Virgo cluster for faint blue members. Richter (AN 302, 31) carried out a search of clusters for red compact members. Thuan et al. (ApJ 248, 439) examined giant E's in poor clusters and Bahcall (ApJ 238, L117) classified types for galaxies in 23 poor clusters, finding a continuum of populations, smoothly blending into rich cluster morphologies. Worth and Gallagher (ApJ 242, 469), Carter (MN 190, 307), and Weekes (AJ 86, 1415) photometrically studied the galaxy content in a few individual clusters. Luminosity functions, studied for a wide range of types of clusters by Bahcall (ApJ 232, 689), were derived for several additional rich clusters (e.g., by Bucknell et al. MN 188, 579 and Thompson and Gregory, ApJ 242, 1). Takase (PAS Japan, 32, 605) showed that, compared to the field, cluster populations are deficient in UV-bright galaxies.

II. Structure and Dynamics

With the increased availability of fast spectrographs, a great deal of new material is available on velocities of members of clusters of galaxies. Analyses of the velocity dispersions and observed structure of clusters has provoked a number of increasingly realistic theoretical models of their dynamics. Comparisons of structure and velocity dispersions with models, including N-body simulations, were made by Gott et al. (ApJ 234, 13), Smith et al. (ApJ 234, L97), Dautcourt (AN 301, 155), Struble (AJ 84, 27, 40, 50, Ap. Sp. Sci. 64, 301) and others. Rose (ApJ 231, 10) showed that compact groups are often transient phenomena. The Coma cluster was compared to models by Quintana (AJ 84, 15) and by Sarazin (ApJ 236, 75) both concluding that some mass segregation has probably occurred. A new statistical test of clustering (Bonometto and Lucchin, ApJ 228, L5) and a new non-linear, thermodynamical approach (Saslaw, ApJ 235, 299) to cluster dynamics were developed. Cannibalism by central massive galaxies was further investigated by McClynn and Ostriker (ApJ 241, 915) and several astronomers pointed out the dynamical importance in many clusters of binary massive central objects (Ozernoy and Reinhardt, Ap. Sp. Sci. 60, 267; Valtonen and Byrd, ApJ 230, 655, Rood and Leir, ApJ 231, L3; Wesson, AA 90, 1; and Quintana and Lawrie (preprint). A discussion of the importance of primordial conditions and of galaxy formation was written by Fall (Phil. Trans. R. Soc. London, A 296, 339). Rudnicki et al. reported (Acta Cosm. Z. 9, 53) the detection of some sub-clustering tendencies in clusters. The missing mass continued to occupy the attention of several astronomers, with some of the papers mentioned above concluding that massive binary galaxies could alleviate the problem for some clusters; historical mass-loss (Ikeuchi, PAS Japan 31,169) mass-segregation (Saito and Tosa, PAS Japan, 31, 625), and modified gravitational theories were also investigated and were found to be able to eliminate or greatly reduce the mass discrepancy. Detailed structural studies of individual clusters were reported by MacGillivray and Dodd (0047-2946 cl, MN 186, 743); Baier (57 clusters, AN 300, 85, 133, 243; 301, 17, 165); Ziener (A1831, AN 300, 203); Quintana and Havlen (CA 0340-538, AA 79, 70); Chincarini et al.(N5416 cluster, AJ 84, 1500); Reakes (MN 187, 525 and Bosma et al. (AA 89, 345; both on the NGC 2805 group); Capelato et al. (Coma, ApJ 241, 521); Kirshner and Malumuth (Sh. 1 group; ApJ 236, 366); Danese et al. (43 clusters, AA 82, 322); Tully (N1023 group, ApJ 237,390); Jones and Jones (Fornax cluster, MN 191, 685), Thompson et al. (N5416 cluster, PASP 90, 644), and Dressler (A2829, ApJ 243, 26).

III. X-ray Clusters

Since the discovery of X-ray emission from clusters of galaxies, a large amount of work has gone into establishing the mechanism involved and the evolution of the characteristics of the X-ray-emitting gas. Only a brief summary follows, as this topic is also covered in the report of Commission 48. The radiation characteristics seem now to establish the mechanism as thermal bremstrahlung from a hot intracluster medium (e.g., Strimpel and Binney, MN 188, 883; Bahcall, ApJ 232, L83, and many others), with only a few cases of cooling reported for the cores of rich clusters (e.g. Mushotzky et al. ApJ 244, L47). A wide variety in the structure of X-ray sources seems to be related to the present and past structure of the clusters and galaxy formation therein (Jones et al., ApJ 234, L21; Ulmer et al., ApJ 235, 351; Perrenod and Henry, ApJ 247, L1, Schmidt, AN 301, 297; and many others). Many cD-dominated clusters were found to have their X-rays concentrated in the central galaxy, and sometimes its halo (Schwarz et al., ApJ, 231, L105, Kriss et al., ApJ 235, L61, Johnson et al., ApJ 236, 738), a situation that was studied theoretically by Takahara and Takahara (Prog. Theor. Phys. 62, 1253). Tenuous, diffuse haloes were searched for but only found in the Perseus and Virgo clusters (Nielsen et al., MN 189, 183, and Ulmer et al., ApJ 236, 58).

A promising tool for investigating cosmologically important data, especially the velocity of clusters with respect to the cosmic background radiation, was proposed by Sunyaev and Zeldovich (MN 190, 413), and Melchiorri et al. (AA 74, L20), and investigated by White and Silk (ApJ 241, 864), Lake and Partridge (ApJ 237, 378) and Boynton et al. (preprint).

IV. HI and Gas-Stripping

The old idea of tidal and/or collisional stripping of gas from cluster galaxies by close encounters was examined by comparison of 21-cm with optical and infrared data for cluster members. Livio et al. (ApJ 240, L83) examined the process of stripping of gas from galaxies by passing through a hot intracluster gas and several papers reported evidence that at least some cluster galaxies are anomalously gas-poor (Sullivan et al. AJ 86, 919, Schommer et al, AJ 86, 943, Giovanelli et al. ApJ 247, 383), although many clusters (particularly those less dense than Coma) show no good evidence for this process (Bothun, Ph.D. thesis, U. Washington). For several small groups, high-resolution HI studies demonstrated the probable influence of tidal interactions on the gas distribution in and around cluster members (Allsopp, MN 188, 371; Davies et al., MN 191, 253; Hart et al., MN 191, 269).

V. Radio Surveys

With increased use of interferometric arrays, radio continuum surveys of clusters became possible with increased resolving power, allowing beautifully - detailed maps to be made of interesting radio structures in clusters. For example, an extensive series of papers resulted from a Westerbork Survey of clusters of galaxies (e.g. Gavazzi and Perola, AA 84, 288, which is paper XII). Other radio surveys were published by Waldthause et al. (AA Suppl 36, 237), Gisler and Miley (AA 76, 109), Simon (MN 188, 637), Andernach et al. (AA Suppl 41, 339; 43, 155), Harris et al. (AA 90, 283; AA Suppl 42, 319), Johnson (ApJ Suppl in press) and Hanisch (AJ 85, 1565). The subject of the presence of diffuse radio emission and radio haloes was investigated, but though many clusters were searched, the only nearby clusters with confirmed detections were the Coma and Virgo clusters; e.g., see Hanisch et al., (AJ 84, 946), Jaffe and Rudnick (ApJ 233, 453), Birkinshaw (MN 190, 793), and Hanisch and Erickson (AJ 85, 183).

VI. Superclustering

Although most workers in the field seem to accept the existence of superclustering, some papers were presented that claim to make their existence either incorrect or unnecessary (MacGillivray et al., Ap. Space Sci. 67, 237; Fesenko, Astrof. 15, 599). The more common viewpoint pictures the arrangement of clusters either in somewhat hierarchical second-ordered clusterings or in a net-like framework, separated by immense voids. The local supercluster (de Vaucouleurs BAS India, 9, 1), that made up largely by Coma and A1367 (Williams and Kerr, AJ 86, 953; Chincarini and Rood, ApJ 230, 648), and the Hercules supercluster (Tarenghi et al., ApJ 234, 793; 235, 724) were studied in considerable detail. More general

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surveys of nearby superclustering were made by Einasto et al. (MN 193, 353, and Nature, 283, 47) and by Rood (ApJ 233, 431), while dynamical models of superclustering were proposed by Gerbal and Salvador-Solé (AA 87, 165) and by Miller (private communication).

4. COMPACT GALAXIES, QUASARS AND RELATED OBJECTS
(B.E. Westerlund)

Compact galaxies

Compact galaxies have been identified on Tautenburg Schmidt telescope plates, photometry has been carried out and the material has been statistically analyzed (AN 300, 281; 301, 301; 302, 29). Identifications are also found in (Astrofis. 15, 393; Astrofis 16, 25). A summary has been presented by N. Richter (Vistas in astr. 23, 143). A spectroscopic survey of 145 blue compact Zwicky galaxies gave 39 emission-line galaxies, 6 Seyferts. The remaining objects were galaxies with no emisson or galactic stars (AA Suppl 36, 259).

Kinman has obtained spectroscopic and photometric data for 23 faint compact uv-excess galaxy candidates. (PASP Aug 81). 18 were found to be emission-line galaxies with redshifts between 1 670 and 39 450 km s^{-1}.

The chemical composition and evolution of irregular and blue compact galaxies has been examined (AA 80, 155). The two types differ only in the present rate of star formation. The blue compact galaxy IZw 18 may be a galaxy in the process of formation by merging of primordial clouds (AA 91, 269).

The COSMOS measurements of UK Schmidt telescope plates for faint blue objects gave two distinct populations (ApJ 237, 371): diffuse images with a colour distribution consistent with high-redshift galaxies, and compact blue objects which appeared to be quasars.

The N galaxy Markarian Mk 421 is a composite system with a mini- BL Lac object and a considerably fainter giant elliptical. Its variations on X-ray and optical wavelengths have been discussed (ApJ 241, 74). Many Markarian galaxies may fall into the category compact galaxies; a particular class may be the clumpy irregular galaxies. Heidmann reports on spectroscopic and/or 21 cm investigations of some objects of this type (AA 73, 216; AA Suppl 37, 559; Nature 282, 272; MN, in press and ApJ, in press). The clumps are about 100 times more massive than the giant HII region 30 Dor in the Large Magellanic Cloud; each galaxy has about 5 to 10 bright clumps. It is likely that these galaxies are sites for star formation on an exceptional scale. (See also e.g. Publ. Astr. Soc. Japan, 31, 329; 31. 635).

Active galactic nuclei

Morphological and spectroscopic criteria place N galaxies, Seyfert galaxies, QSOs and BL Lac objects in this class. Much theoretical work as well as many spectrophotometric investigations deal with active nuclei more generally.

A review of the theories of the nuclei of active galaxies has been presented (Proc. R. Soc. London, Ser. A 366, 449). Extreme nonthermal radiation from this kind of nuclei has been discussied (ApJ 238, L63). The possibility that some active nuclei contain two massive black holes in orbit about each other has been considered (Nature 287, 307). The importance of a magnetic field in the accretion disk for the nonthermal activities has been studied by Takahara (Prog. Theor. Phys. 62, 629), who also investigated the Comptonized spectrum (Prog. Theor. Phys. 63, 1551; 65, 883). Takahara et al. (ApJ, in press) show that Comptonization of soft photons in

https://doi.org/10.1017/S0251107X00004727 Published online by Cambridge University Press

in a hot magnetized plasma can account for the observed features of X-ray emission of active galactic nuclei. Compton-heated winds from accretion disks in QSOs have been studied by Shields et al. (in prep.).

Emission-line spectra of active galactic nuclei have been reviewed by Osterbrock (Ann N.Y.Acad. Sci. 336, 22). He has discussed the ionized gas and the dust in them (AJ 84, 901), and presents with Shuder results from a spectrophotometric investigation (ApJ, in press). Infrared spectra of the nuclei of 3 active galaxies are described (MN 196, 101P) and dust-emission mechanisms considered.

Seyfert galaxies

X-ray observations of Seyfert galaxies with the Einstein Observatory added 17 Seyfert 1 and 4 Seyfert 2 galaxies to the 30 and 5, respectively, previously known to emit X-rays (ApJ 242, 492). The Seyfert 2 galaxies appear to be low-luminosity exemples of the same processes as occur in Seyfert 1's. The X-ray Seyfert 1 galaxy NGC 6814 has been found to show X-ray variability on timescales of less than 3 hours; this is in sharp contrast to a sample of over 30 active galactic nuclei (NASA Tech. Mem 82143). X-ray observations are also described in (ApJ 235, 355; 235, 377; 237, 414; 239, L5; MN 189, 37P; 192, 1P). A massive X-ray halo may exist around the Seyfert 1 galaxy Mk 541 (AA 72, L6). A variable iron emission feature has been found in the X-ray spectrum of NGC 5548 (MN 193, 15P).

IUE observations of Seyfert galaxies may be found in the proceedings of the symposia "The First Year of the IUE"; Second European IUE Conference". A.Elvius reports that in May 1981 more spectra of NGC 7469 were obtained with the IUE. The object was slightly fainter and the spectrum not as hard as in 1978. A study of the velocity field of this object has been presented (AA 89, L11). CIV 1550 Å line profiles have been measured for 4 Seyfert 1 galaxies (ApJ 247, 449). Possible line broadening mechanisms are considered. The CIV lines are at lower redshift than the Balmer lines. Osterbrock reports on the spectrum of the high-ionization Seyfert 1 galaxy III Zw77 (ApJ 246, 696; see also AA 76, 50), and on a new Seyfert 1 galaxy (PASP 92, 117). He has analyzed the spectra of 5 galaxies with line and continuum spectral properties intermediate between those of Seyfert 1 and 2: they are called Seyfert 1.8 and 1.9 galaxies(ApJ Oct 15, -81).M.P. Véron has shown that most of the narrow-emission line nuclei are either normal HII regions ionized by hot stars or Seyfert 2 galaxies (AA 100, 12); the separation can be done unambiguously on the basis of relative line intensities. In some cases the two types of emission nebulosities co-exist in the same nuclei (AA 97, 71).

Several authors have analyzed emission-line profiles, studied broadening mechanisms and/or the structure of the emission-line regions in Seyfert galaxies by spectrophotometric means (See e.g. ApJ 230, 360; 230, 681; 233, 809; 238, 45; 238, 502; 238, L1; 241, 903; 247, 403; AA 81, 172; 87, 245; AJ 84, 302; Astrofiz 16, 39; MN 191, 665 ; 195, 787; Proc. Southw. Reg.Conf. 5, 87).

Broad-band infrared observations have been presented for 16 Seyfert galaxies of which 7 are X-ray sources (ApJ 234, 471). The Seyfert 2's are dominated by a stellar continuum, the Seyfert 1's - and all the X-ray objects except one - have power-law spectra. Spectrophotometry from 2.1 to 4.0 μm of 3 Seyfert galaxies is described in (ApJ 245, 818). The 3.3 μm emission feature has been detected in the nuclei of IC 4329A, an extreme Seyfert 1 galaxy, and NGC 5506, a narrow-line X-ray galaxy, possibly with a Seyfert 1 nucleus (AA 100, L6). Multiaperture photometry of NGC 1068 has demonstrated that significant 20 μm emission originates at positions more than 3" from the nucleus (ApJ 241, L69). This supports arguments that most of the infrared flux is thermal emission from dust. The detection of millimeter-wave CO emission from two Seyfert galaxies has been reported (ApJ 247, 443). The width of the lines was smaller than those of the corresponding HI profiles. Radio maps of 10 Seyfert and Seyfert-like galaxies have been made with the VLA (ApJ 240, 429;

247, 419). A high sensitivity survey with the Westerbork telescope at 1415 MHz has been presented (AA Suppl 45, 99); it contains 36 Seyferts and 10 possibly Seyfert-related. Detection of H83α and H99α radio recombination lines in Mk 668 has been reported (ApJ 238, 818).

The variability of Seyfert galaxies has been investigated (see e.g. PASP 90, 661; 91, 624; AA Suppl 35, 387; MN 186, 297; Nature 284, 410). Morphological studies of Seyfert galaxies have been carried out (ApJ 237, 404). An extraordinary emission-line nebulosity has been found to be associated with Mk 335 (ApJ 247,32). An enormous HI envelope has been found around the Seyfert galaxy Mk 348 (ApJ 238, L7).

Among the most studied Seyfert galaxies is NGC 4151. Gamma-rays at energies above 100 MeV have been observed from it (Pis´ma AZh 5, 317) as well as a low-energy gamma-ray spectrum (Non-solar gamma-rays, p. 67; Nature 282,484) and models have been proposed (AA 87, 192; 89, 370; ApJ 240, 636). X-ray spectral data have been obtained (ApJ 241, L13; 247, 458), and frequent flaring of its X-ray source, on a time scale of days, has been observed (MN 192, 83).

During the first 4 years of the IUE near 200 spectra have been taken of NGC 4151. Results from the first year are in press (MN 196), describing the continuum, 15 identified absorption features and many emission lines. A second paper, describing the variations of the continuum has been submitted to MN. Comparisons with X-ray and optical observations are presented. The large international group collaborating in this project reports that several papers will follow, possibly including an atlas of representative IUE spectra of NGC 4151.

The emission feature at 3.3 μm has also been detected in NGC 4151 (ApJ 241, L141), and infrared variability has been confirmed (ApJ 245, 818). Optical polarization studies of the emission lines and the continuum of NGC 4151 have been undertaken (ApJ 229, 909; 240, 759). The nuclear continuum of NGC 4151 has been investigated (Publ Astr Soc Japan 32, 185). It was found to have an essentially flat spectrum.

Quasars

111 QSOs were examined with the Einstein Observatory (Nature 288, 323) and 35 of them were detected as X-ray sources. More recently observations of 107 QSOs with the Einstein Observatory have been reported (ApJ 245, 357) with the detection of 79. In both cases a correlation between the 0.5-4.5 keV properties and the optical and radio continuum properties was found.

Optical spectra of 6 X-ray selected QSOs have been described (ApJ 239,L43), they are radio quiet, have relatively faint B mag (∿ 18)and low redshifts. The IUE satellite has been used for studying selected QSOs (see e.g. ApJ 239, 483; 245, 386; Nature 277, 457).

The ratios Lα/Hα and Lα/Hβ have been discussed for a number of objects (ApJ 227,L1; 228,8; MN 187,871), the intrinsic values are most likely appreciably larger than the observed ones. Corrections for reddening are necessary (ApJ 230,348). In the spectrum of 3C48 (ApJ 230,340) the forbidden lines are blue-shifted relative to the permitted lines; the Balmer lines can be decomposed into a narrow and a broad component. The MgII 2798 emission in QSOs and related objects is frequently composed of broad and narrow components (ApJ 232, 659). Gaskell (ApJ, submitted) has found that the high-ionization (emission) broad lines are blue-shifted with respect to the low-ionization broad lines in almost all quasars. The emission line profiles of CIV 1550 show similarities between species of differing ionization potentials; the lines may be formed in a number of clouds of different velocities (ApJ 240,1). The CIV line has been suggested to be useful as a standard cosmic candle (Nature 273, 431; MN 193, 537; BAAS 12, 537). The idea about (radiatively) accelerated emission-line clouds in QSOs has been analyzed (ApJ 233, 479; 241, L157) as well as the effects of dust within the broad-line emission regions (ApJ 235, L125). Absorption of X-rays within the broad-line emitting clouds has been investigated (ApJ 245, 406).

From a large sample of QSOs it has been found that the spectra are well approximated by power laws with spectral indices ranging from +0.3 to -2.5 (ApJ 235, 361). A broad wave is seen in residuals; it appears as a deficiency near 2 000 ; and 4 000 ; and an excess near 3 000 Å. It can be explained completely by Balmer line and continuum emission together with a large amount of FeII emission (Gaskell, thesis, Univ. of Calif). The same conclusions have been drawn by Shields and Oke (in prep.) who propose that the Balmer continuum can be produced in gas heated at large optical depths by gamma rays of energy $\geq$ 1 MeV. The importance of the blended FeII resonance lines has also been pointed out in (ApJ 237, 119; 242, L1).

High-resolution spectroscopic observations of quasars have led to the detection of multiple absorption-line systems in many objects (see e.g. ApJ 228,1;230, 49; 230,330; 234, 33; MN 188, 711; 189, 611). As a rule most lines longward of the Lα emission line have been successfully identified but only few lines shortward of it (ApJ 229, 891; MN 196, 715). The metal-line systems may arise in galactic halos whereas the Lα clouds must be an intergalactic population (ApJ Suppl 42, 41; see also ApJ 241, 889). An intrinsic model for the formation of narrow absorption-line systems in gas from the QSO has been presented (MN 191, 785; 195, 397). They may also form in thin shells of negligible densities (MN 186,1). The absorbing clouds may be only a few parsecs from the QSO (ApJ 227, L113) when they are optically thick; or the minimum distance may be as large as 750 kpc (ApJ 230, 330), and they are not ejected by the QSO.

CaII absorption lines have been detected in some objects and located to intervening galaxies (ApJ 242, L145; Anglo-Austr. Obs.Prepr. 128); this supports the idea that the narrow-lines heavy-element absorption systems in QSO spectra arise in extended galactic halos (see also ApJ 244, 768).

21-cm absorption lines have been detected in QSOs at redshifts corresponding to those of optical absorption (ApJ 230, L1; 232,49; AJ 84,699).Molecular hydrogen lines have been observed in the spectrum of OQ 172 (Ap Lett 20, 67) and in PHL 957 (Pis´ma AZh 5, 371), in the latter also absorption of CO is reported.

Infrared observations have been used in combination with other data to determine bolometric luminosities for some QSOs (MN 192, 37P). Observations at 2.2 μm at the positions of flat-spectrum radio sources led to the detection of a group of QSOs with much steeper infrared-to-optical spectra ($\alpha \sim -3$) than previously known (ApJ 232, L151). Their energy distributions are consistent with a BL Lac nature (ApJ247,780).

Radio structures of more than 150 QSOs have been examined with the NRAO interferometer (ApJ Suppl. 39, 291; AJ 84,707). The radio spectral properties of 74 QSOs have been studied (AA 73, 40). A sensitive search for radio recombination lines towards 24 galaxies and QSOs has been reported (AA 77, 316). A sample of 96 QSOs and other blue objects, chosen on the basis of optical variability, have been observed with the VLA (ApJ 242,486). Only 3 were detected; they are among the most variable in the sample. Other radio studies of optically selected QSOs indicate a detection rate of 35 to 50 percent at 5 GHz for the most luminous ones (MN 191, 871; Nature 283, 357), for the fainter ones it is about 10 percent. The radio-to-optical luminosity ratios may be correlated with optical properties and/or distance (AA 88, L12; ApJ 238, 445; 242, 486; 246, 624). An exceedingly large amplitude radio outburst was recorded for the QSO 1921-29 (Nature 283,747) making it the strongest QSO in the sky at 31 GHz. Evidence has been presented for a radio outburst occurring 2.2 yr after a preceding optical outburst in the QSO 0420-01 (ApJ 227, L9). Numerous VLBI observations of QSOs have been carried out. Exemples are the maps of the quasars 3C 119; 286; 345; 454.3 and CTA 102 with a resolution of 0".005 at 1.67 GHz (ApJ 236, 714); of 3C 147 and 3C 380 (ApJ 235, 11); and of the nucleus of 3C 390.3 (ApJ 240, L7).

Optical spectroscopy of a large number of radio sources has been carried out to confirm their QSO nature and/or to determine redshifts (see e.g. ApJ 229, 73; 232, 400; 236, 419; MN 189, 667; 192, 545; AN 300, 37; 117; 287). QSOs detected in the Tololo surveys have been studied in detail (cf. ApJ 227, 18; 233, 787; ApJ Suppl 42, 333; 523; MN 189, 363; ApJ 238,488) and the material has also been analyzed statistically (ApJ Suppl 42, 333; ApJ 239, 463; 247, 762).

The optical search for faint radio-quiet QSOs has continued (see e.g.AA 78, 125; AA Suppl 39, 129; AN 301, 51; 301, 305; ApJ 231, 653). The number-magnitude relation for optically selected QSOs has been discussed (AA 85, 80), a strong cosmological evolution is indicated (see also MN 195, 497; ApJ 245, 375; 246,365). The Hubble diagram and the luminosity function for radio-quiet QSOs are commented upon (AN 300, 197). Data on the X-ray emission from QSOs and on the X-ray background provide strong limitations on the number counts of QSOs (AA76, L1).

Some evidence for a real association between QSOs and galaxies has been presented (Nature 282, 451), in particular with clusters of galaxies (ApJ 236, L45; ApJ 240, 25; Nature 290, 480), and possibly also with superclusters (AA 95, 7). No definite evidence for associations are found in some cases (AA 96, 393; ApJ 246,L1) and statistical analyses appear to indicate random distribution effects (ApJ 237, 326; AA 76, 254; 81, 316; see also ApJ 244, L53). Peculiar configurations of quasars may indicate physical associations (Nature 282, 271). Their alignment with galaxies may contribute to a definite solution to this problem (ApJ 229, 496; 229, 489; 233, L97; 236, 63; 240, 415). The possible effects of gravitational focussing should, however, not be overlooked (see below).

The double quasar 0957+561A,B was presented at the IAU General Assembly in Montreal as a possible effect of a gravitational lens (see also Nature 279,374; 279, 381). Radio studies (Nature 280, 461) have revealed at least four components of which two coincide with the optical QSOs. The possibility of a gravitational lens is further discussed on the basis of spectroscopic observations with the multi-mirror telescope (ApJ 233, L43). Direct imaging led to the possible detection of an object between the two QSOs (Nature 282, 183).

VLBI observations at 1666 MHz showed two apparently unresolved ($\leq$ 20 marcs) sources with the same separation as the optical objects. Intervening neutral hydrogen was looked for in the direction of the objects (Nature 283, 175) and limits derived.

1.2 - 2.2 μm observations of the system supported the conclusion that the twin quasars are images of a single object (Nature 285, 91). The intervening galaxy is shown to be highly luminous. Further infrared observations confirmed that the lens galaxy is a giant elliptical (Nature 285, 385).

VLA observations at 6 cm confirmed the major features previously reported (Science 208, 495). The existence of radio jets associated with both QSOs was demonstrated. Further VLA observations confirm earlier maps and show additional features (Nature 286, 865).

UV observations of the objects have been obtained (Nature 285, 461). New spectrophotometric data (ApJ 238, 1) showed that the absorption line regions in each light path is very similar in redshift, in coloumn density of Fe^{+} and in velocity dispersion.

A 408 MHz map provided spectral information on all components of the radio source (Nature 288, 69) and showed a weak component coinciding with the lens galaxy. Dyer and Roeder have shown that when a spherical galaxy acts as a lens there must always be an odd number of images of the source (ApJ 238, L67). Further VLBI observations have revealed radio fine structure in the two image components A and B (Nature 289, 758).

Extremely deep CCD pictures of the region of the twin quasar show that they are behind a rich cluster of galaxies (ApJ 241, 507). The southern quasar image is seen through the brightest cluster galaxy. The cluster and the brightest cluster galaxy, together, act as a gravitational lens on the light from the more distant QSO. More direct imaging observations have led to the galaxy being located 1" north and 0".19 east of the southern QSO image (ApJ 242, L141). An expected 3rd QSO image may be nearly coincident with the galaxy.

It has been proposed that flux variations may be expected due to intervention by the stars in the outer parts of the gravitator (Nature 282, 561; ApJ 244, 756). The time delay between the two images A and B should fall in the range 0.03-1.7 yr (ApJ 241, L133). Recently, time delays of up to 5 yr have been proposed (ApJ 244, 736).

A phenomenon similar to 0957+561A, B has been found in the triple QSO PG1115+08 (Nature 285, 641; 287, 416). It may be a quintuple gravitational lens image (ApJ 244, 723), one of the three components has also been resolved into two components by speckle interferometry (ApJ 248, L1).

Brightness amplifications by undetected gravitational lenses could be responsible in part for the apparent evolution of quasars (ApJ 242, L135), particularly for those which appear to be of high luminosity. Even if lens events are rare, a large fraction of them will appear more luminous than the most luminous unlensed quasars. The effects of gravitational lensing on the relation between QSO and galaxy magnitude- number counts have been treated by Tyson (ApJ 248,L89). Canizares (Nature, in press) has shown that the enhanced surface density of quasars brighter than a given threshold near a galaxy may be due to gravitational focussing of light; there is no need to abandon the cosmological interpretation of the redshift in the cases where associations between QSOs and galaxies with discrepant redshifts appear.

The BL Lac objects

More than 60 objects are now known to belong to this class. About 40 have been studied at 6 and 2 cm (MN 190,269). They have as a rule flatter spectral indices in this range than a general sample of radio sources.

The peculiar outburst of BL Lac itself in 1975 has been described as an occultation phenomenon (AZh 57, 433) or as due to the structure of the emitting region (ApJ 227, L117). The presence of periodic components in its light variation has been discussed (Pisma AZh 5, 403). Outbursts have been observed in a number of objects in optical and/or infrared wavelengths. In some cases correlations with radio outbursts are indicated. Typical objects are OJ 287 (AJ 84, 1253; Aph Space Sci 73, 263); B2 1308+326 (ApJ 227, L11; 235, 717); AO 0235+164 (ApJ 234,466; 236, 84; 240, L3); and 0846+51W1 (ApJ 230,68). AO 0235+164 has recently been resolved into a very bright core and a jet-like component extending 5".4x10^{-3}; 98 per cent of the total flux is contained within a diameter 36"x10^{-3} (AA 96, 316). Similar VLBI observations of BL Lac showed a complex structure of several components.

In the middle of 1980 15 BL Lac objects were known to be soft X-ray sources

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(ApJ 243,42). High energy X-ray observations of several BL Lac objects gave, with the exception for Mk 421, only upper limits in the energy ranges 25-60 and 60-130 keV (Ap Lett 20,63). Mk 421 belongs to the soft X-ray sources (ApJ 227,L63). The X-ray spectrum of PKS 0548-322 has been described (ApJ 233, L47). This object consists of an elliptical galaxy and a point source (ApJ 233,504). It has a variable X-ray spectrum (ApJ 243,53). Far UV observations have been obtained of a number of BL Lac objects: exemples are Mk 501 (MN 189,873); PKS 2155-304 (Nature 285,555); and 9716+71 (AA 100,1).

The very weak emission lines seen in the spectra of several BL Lac objects show that, in general, these objects have rather low redshifts. However, some BL Lac objects have higher redshifts; MgII 2795, 2802 absorption lines are red-shifted into the visual spectrum (see Ap.Lett. 20, 119). A few BL Lac objects have multiple absorption-line systems: 1309-216 shows strong CIV absorption at z = 1.361, 1.489 and 1.491 (MN 191,61) and 0215+015 has 4 absorption system, z = 1.254; 1.345; 1.549 and 1.649 (Blades et al., MN in press; Gaskell, ApJ, in press).

5. REDSHIFTS
(V.C. Rubin)

The acquisition of galaxy and QSO redshifts continues at an accelerated pace as new detectors, larger telescopes, and novel observing techniques are employed. A comparison with the status only three years ago is interesting. Many more all-sky, large scale surveys are underway presently, in order to answer questions about the motion of the Galaxy, the dynamics of clusters and superclusters, and the three dimensional distribution of galaxies. Because it is not possible to mention most of the thousands of publications since 1978 which report new redshifts, the emphasis here will be on review which include extensive bibliographies, and some unpublished works.

GALAXIES: Redshifts for all 1246 galaxies in the Revised Shapley-Ames Catalog (Sandage and Tammann, Carnegie Inst. of Wash.) are available. NGC 3285, the only galaxy lacking a velocity in the catalogue, has now been observed. Over 500 references to individual observations are included. A Catalogue of Galaxy Redshifts (CGR) (paper copy from Rood, IAS, Princeton, N.J.;tape copy from J.M. Mead, NASA Goddard, Greenbelt, Md.) contains about 4000 redshifts for galaxies with V < 15,000 km/s, generally $\delta > -2^{o}30'$, blue magnitude brighter than 13, as well as hundreds of references. The CGR is based initially on Index of Galaxy Spectra (Gisler and Friel, Pachart Publ., Tucson, Az.), which lists redshifts published through Aug. 1978 and on the Huchra (unpublished) Bright Galaxy Redshift Catalog. A valuable analysis of the errors in the CGR (Rood, ApJ Suppl, 1982) shows optical velocities to have typical rms uncertainties of 100 km/s, but with accuracy for individual studies ranging from 8 km/s to 800 km/s. With care, optical velocities can be as accurate as 21-cm velocities. A comparison of very high signal to noise single dish profiles for 26 Sc and Sb spirals with high resolution long slit Hα velocities referred to the nightsky OH bands yields $\Delta(V_{opt} - V_{21}) = 0.23 \pm 7.5 (1\sigma)$ km/s (Thonnard et al., 1982).

Even as comprehensive catalogues are prepared, additional studies are completed. The following publications are tabulated to indicate the range of velocity programs:

Wright et al.	32	Southern Radio Sources	ApJ 229,73.
Karachentsev	301	Galaxy Pairs	ApJ Suppl 44, 137.
Smith and Spinrad	22	Revised 3C Galaxies	PASP 92, 553.
Arp	172	S. Galaxies, companions	ApJ Suppl 46,75.
Balkowski et al.	25	Galaxies with Supernovae	AA Suppl 43, 121.
Bottinelli et al.	457	HI galaxies	AA Suppl 44, 217.
Fairall	70	S. Compact Galaxies	MNRAS 196, 417.

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Gordon, Gottesman	72 Blue Compact Galaxies	AJ 86,161.
Kinman and Hintzen	18 Faint Haro Galaxies	PASP 93, 405.
Wilkinson et al.	37 4C Galaxies	MNRAS 196, 669.
West et al.	275 Uppsala Galaxies	AA, in press.

A few of the major studies currently underway include the following:

Bottinelli et al.	150 Galaxies with outer rings	HI observations,10% new
Chincarini, Haynes	324 Isolated Galaxies	HI,observations compl.
Giovanelli	150 edge-on Sc	
Green and Schmidt	100 Palomar Bright QSO Survey	75 new
Osterbrock	50 Suspected Seyferts	14.5<B<16.5; 25 new
Spinrad	3C Radio Galaxies	z=1.08,3C356;z=132, 3C368
Thuan	418 Dwarf Galaxies	HI
Tifft	370 Karachentsev doubles	
West	500 Peculiar S. Galaxies	90% new objects

Harrison and Noonan (ApJ 232, 18) warn of the erroneous and confusing form in which redshifts are often presented, a warning which observers would do well to heed. Finally, several books contain papers which are related to the subject of this report, notably Extragalactic High Energy Astrophysics (9th Advanced Course, Swiss Soc. Astr. and Ap., Geneva Obs.), Objects of High Redshift, IAU Symposium 92, and The Universe at Large Redshifts (Physica Scripta, 21). CLUSTERS: The determination of redshifts of galaxies in clusters remains an active field of observation. A tabulation of 439 clusters of galaxies with published redshift (Noonan, ApJ Suppl 45, 613) lists galaxy data and about 200 references. A comprehensive review, Cluster of Galaxies (Rood, Rep. on Progr. in Phys. 44, No. 10) discusses most aspects of galaxy clustering, has an extensive bibliography, as well as velocity diagrams for the Local Supercluster, Coma, A1367, Hercules, and Perseus. This is one of the most valuable publications on clusters to appear in the last few years. Velocity dispersion profiles for 13 clusters (with more than 30 galaxy velocities each) are tabulated by Struble (AJ 84, 27). A representative selection of publications concerning velocities of galaxies in clusters follows:

Fairall	S. Cluster 0122-688	MNASSA 38,18.
Hoessel et al.	116 Abell Clusters	ApJ 241, 486.
Chincarini et al.	32 Gal. in CA 0340-538	AA 96,106.
Cooke et al.	Objective prism velocities	MNRAS 196, 397.
Dressler	31 more velocities;A2029	ApJ 243,26.
Haynes	Neutral H streams in Groups	AJ 86,1126.
Schommer et al.	67 Gal. in Cancer, Herc, Peg I	AJ 86, 943.
Sullivan et al.	82 Spirals in A1367,Coma,Z74-23	AJ 86,919.
West and Frandsen	32 Galaxies in 28 Clusters	AA Suppl 44,329.

Using an especially innovative spectrograph with fiber optics to bring images of many galaxies simultaneously to the slit, Hill et al. (ApJ 242,L69) obtained velocities of 26 cluster galaxies in A1904. Redshifts, of the order of 20,000 km/s, were measured with a precision of about 100 km/s, with a factor of six reduction in telescope time. Velocities of galaxies in cluster are an especially attractive use for such instrumentation.

VELOCITIES WITHIN THE LOCAL SUPERCLUSTER: It is now 30 years since de Vaucouleurs described the Local Supercluster; its reality is amply established. de Vaucouleurs (Bull Astr Soc India, 9,1) traces ideas of its kinematics and dynamics, with references to over 100 early papers. Additional velocities are still being obtained (Gastmond and Abell, PASP 90, 367; Sulentic, ApJ 241, 67). More recently, Tully (ApJ, in press) details its three dimensional structure, based largely on velocities (Fisher and Tully, ApJ Suppl Dec.) of 1171 late-type gas rich nearby galaxies.

Galaxies are distributed in a thin disk of axial ratio 6 to 1 (60%), and in the halo (40%); halo galaxies make up a small number of clouds separated by significant voids. The thinness of the disk implies that random motions are small (less than 100 km/s), thereby favoring models in which galaxies form out of larger scale structures (Zeldovich, IAU Symposium 79, 409). The three dimensional distribution of galaxies in the Revised Shapley-Ames catalogue is studied by Yahill et al.(ApJ 242, 448).

An infall of the Local Group toward the mass concentration represented by the center of the supercluster may be expected on theoretical grounds (Silk, ApJ 193, 525; Peebles, ApJ 205, 318). Searches for such an infall are currently underway (Aaronson et al., ApJ 237,655; 239,12; Davis et al. ApJ 238, L113; Hoffman et al. ApJ 242,861; Schechter, AJ 85, 801; Tonry and Davis, ApJ 246,680; Yahill et al., Les Houches Summer School, 1980). Generally, infall velocities in the range 150 to 500 km/s result. The infall motion does not completely explain the anisotropy in the 3° microwave background radiation (Cheng et al., ApJ 232, L139; Smoot et al. Phys.Rev.Lett. 39, 898); these imply a velocity vector about 50° from Virgo.

Other studies examine the more general motion of the Local Group with respect to an extragalactic frame assumed to be at rest (Rubin et al., AJ 81,719; de Vaucouleurs et al., ApJ 248, 408; de Vaucouleurs and Bollinger, ApJ 233,433; de Vaucouleurs and Peters, ApJ 248, 395) or with respect to the microwave background (Smoot and Lubin, ApJ 234,L83; Boughn et al., ApJ 243, L113). These somewhat contradictory results are compiled and discussed in Aaronson et al.(ApJ 1982); differences with the background radiation remain.

Most optical studies still suffer from imcomplete sky coverage and complex systematic effects. Yet the size of the discrepancy with the background radiation is surprising, if symmetry of the background radiation is assumed (Wilson and Silk, ApJ 243,14). From an examination of the velocity fluctuations which can be introduced by observed density fluctuations, Clutton-Brock and Peebles (AJ 86,1115) conclude that only a dense universe can produce velocity fluctuation of hundreds of km/s.

SUPERCLUSTERS: Most rich clusters are contained within superclusters, aggregates with scales up to 100 Mpc. These in turn are separated by large voids. Most recent velocities for well studied superclusters are contained in the following papers:

Perseus	Einasto et al., Nature 283,47.
	Gregory et al., ApJ 243, 411.
	Giovanelli et al., HI observations of 1200 members in progress
Pegasus, Cetus	Einasto et al., Nature 283, 47.
Coma/A1367	Gregory and Thompson, ApJ 222, 784.
	Williams and Kerr, AJ 86,953.
	Giovanelli et al., HI observations of 500 members in progress
Hercules	Tarenghi et al., ApJ 234, 793;235,724.
	Chincarini et al., BAAS 12, 809.
Horologium	Chincarini et al., Optical observations of 350 members in progress.

The distinguishing characteristic of superclusters is their distribution in elongated structures surrounded by large voids. A cellular structure for galaxy distribution had been proposed by Joeveer et al. (Estonian Ac.Sci. preprint A-1) from an analysis of the galaxies in the Second Reference Catalogue of Bright Galaxies (de Vaucouleurs et al. Univ of Texas). Similar aggregates are also seen in the distributions of radio galaxies (Burns and Owen, AJ 84, 1478), in an all sky sample of double galaxies (Tifft, ApJ 239, 445) and an all sky high luminosity Sc sample (Chincarini and Rood, ApJ 230, 648). Clumpiness is even more dramatically apparent in the samples of Kirschner et al. (AJ 83, 1549; ApJ 248,L57). For a maximum distribution near V=15,000 km/s, these authors observe only 1 galaxy in a 6000 km/s interval centered at 15,000 km/s. They infer that a region of 10^6 Mpc^3 *is essentially devoid of galaxies. This is impressive evidence for large voids in* the distribution of galaxies.

Motions of clusters within superclusters can be used to map the gravitational field of the supercluster. Such studies are underway. Ford et al. (ApJ 245,L53) use the dynamics of superclusters to derive mass densities on large scales, and conclude that a closed universe is strongly excluded. Hartwick (ApJ 248,423) chooses the tidal radii of small groups as a measure of the mass of the Coma cluster ; the derived mass, 10^{16} $M_\odot$, is an order of magnitude greater than the virial mass. But Bahcall and Tremaine (ApJ 244, 805)have shown that the projected mass method produces mass estimates which are probably more accurate and generally larger than virial masses. Using this method, they find the mass of M31 (R < 100 kpc) to be 10^{12} $M_\odot$, an order of magnitude greater than that given by the virial theorem. Their work is important for all astronomers who make use of virial masses.

In what may well be an epochal paper, Oort (AA, in press) points out that the spacial separation between major superclusters at z = 2.5 is of the same order as the separation between strongest Lyman absorption systems in six QSO's, 2.2 < z < 3.3, observed by Sargent et al. (ApJ Suppl 42,41). Oort suggests that the absorption originates in superclusters along the line-of-sight. Additionally, Oort, Arp, and de Ruiter (AA 95,7) show that neighboring QSO's with equal redshifts can originate in superclusters. Two QSO pairs at z = 2.84 and at z = 3.15 indicate that superclusters exist at z $\sim$ 3. Oort believes that the data are consistent with the assumption that all QSO's reside in superclusters. This view is questioned by Osmer (ApJ 247,762) from an analysis of QSO in the Tololo surveys. The question is one for future work.

NON-VELOCITY REDSHIFTS: Accurate velocity data have contributed to the progress in understanding the large scale structure of the universe, and at the same time have weakened the case for non-velocity redshifts. Quasars occur in groups and clusters (Stockton, in Objects of High Redshift ,89; Wyckoff et al., ApJ 240,25) and the cluster galaxies have the same redshift as the quasar. Moreover, a few QSO's have been shown to be imbedded in normal galaxy components (Wyckoff et al., ApJ 242 L59). Band structure in redshift-magnitude diagrams is not compelling. although claims of its existence still are made (Tifft, ApJ 233,799; Nanni et al., AA 95, 188). Periodicity in histograms of binary galaxies (Tifft, ApJ 236,70) has disappeared with CGR redshifts (Rood, ApJ Suppl 1982). Arp and Burbidge continue to argue for the association of high redshift objects near low velocity galaxies (Arp, ApJ 240, 415; Burbidge, Nature 282, 451), and Segal for a non-linear Hubble law (MNRAS 192,755, but see Sandage et al., ApJ 232,352). A catalogue of Untrivial Redshifts (Reboul, AA Suppl, 45,129) lists references to 772 velocity measurements which the author chooses to consider anomalous; most are remarkably normal. This is a good starting point for anyone who wishes to delve into the question of anomalous redshifts.

DETERMINATION OF THE HUBBLE CONSTANT: Observers participating in programs to determine the value of H now recognize the complexity of the problem, due to the combination of a variety of factors. The motion of our Galaxy, the biases inherent in picking the sample, the evolutionary effects with distance, all combine to thwart efforts to determine H with high accuracy. A few of the recent determinations (since 1978) for H follow.

Visvanathan, ApJ 228,81.	m,v for E and SO gal	50.8 km $s^{-1}Mpc^{-1}$
Birkinshaw;MNRAS 187,847.	X-ray fluxes,microwave bg	$5 \lesssim H \lesssim 50$
de Vaucouleurs et al., ApJ 233,433	various	100 ± 10
Hanes,MNRAS 188,901.	Glob Cluster lum.fnct.	80 ± 11
Kennicutt,ApJ 228,696.	HII regions diameters	65
Kennicutt, ApJ 228,704.	HII region fluxes,gal.diam.	60(+15,-10)

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Aaronson et al., ApJ 239,12.	HI profile widths,distant	95±4
Mould et al., ApJ 238,458.	Virgo HI profile widths	65±4
Stenning and Hartwick, AJ 85, 101.	Sb luminosity class	75±15
Birkinshaw et al., ApJ Letts., Dec.15,1981.	Microwave bg toward 0016+16	>10

Wagoner (Comm. Aph. 8,121) has discussed the evaluation of H and q_0 from supernova atmospheres, and van den Bergh (ApJ 225,1) has argued that HII region diameters put only weak constraints on the determination of H. Comparison of two approaches to the Hubble constant (de Vaucouleurs, 10th Texas Symp. of Relat. Astroph.) gives valuable details and references. A recent review of the situation by Hodge (Ann. Rev. Ast.Ap.19,357) draws no convincing conclusion; the choice for H remains up to the consumer.

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

(E.A.Dibay)

Af-Astrofisika Erevan
AZ-Astron. Zhurnal
AZ Lett.-Letters to AZ (Pisma)
AC-Astron.Circular
Abast.-Bull.Abastumany Observatory
Crim-Izvestija Crimean Obs.
DAN-Doklady Acad.Nauk Armenia
SAO-Communication of Special Astrophysical Observatory
LGU-Trudy Astron.Observatory Leningrad University

Catalogues and lists of galaxies

Markarian, Lipovetsky and Stepanian continued the publication of lists (XII, XIII, and XIV) of galaxies with intense UV continuum in their spectra (Af 15,201; 15,363; 15, 549; 16,5; 16,193; 16,609). All the UV galaxies were investigated with the 6-meter telescope, 20% being Seyfert objects and quasars (AZ Let 5,271; 5,505; AC 1039,1; 1125,4; 1134,6). Using the same equipment Kazarian presented the UV-galaxy lists (Af 15,5; 15,193; 16,17). Iscudarian detected on Palomar Sky Survey prints more than 500 Irr II type galaxies (DAN 67,93; 68,94).

Borchkhadze and West investigated the morphological and spectroscopic data of southern galaxies with emission lines (Af 16,397). Spectral and photometrical observations are presented for total of about 275 galaxies, selected from ESO/UPPSALA lists (ESO Preprint N142). Blue objects and 5C radiosources were reobserved with 6-m telescope after a spectral survey with the 2-m Tautenburg Schmidt telescope (Notni et al. AN 300, 31; 300,37; 300,121). A list of 84 triplets of galaxies was presented by Karachentseva et al. (SAO 11,3).

Active nuclei

Radio, optical, and polarisation variability of several QSOs was observed at the Crimean Observatory by Efanov et al (Crim 64,1). A connection between radio flux and optical polarisation was found. Shakhovskoy et al., (AZ Let 7) measured the optical polarisation of objects with "pure" continuous spectrum. Variability of BL Lac objects and Seyfert galaxies was observed by Hagen-Torn and others (A.AP. 73,279; LGU 34; 46; 35,52; 36, 20; 36, 26; Ap Sp Sci 73, 263) and Ljuty (AZ 56,918). Ljuty has detected the correlation between optical and X-ray variability of NGC 4151 (AZ Let 4, 496). The possible periodicity of compact objects was analysed by Hagen-Torn (LGU 36,20).

Spectroscopical investigations of some Seyfert galaxies was carried out by

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Khachikian et al (Af 16, 207; 16,39; 14,603), Pronik et al. (Af 15, 37; 16,405;17), Chuvaev (AZ Let 6, 323) Afanasiev et al. (Af 15, 4; 17), Dibay et al.(AZ 55,937; AZ Let 5, 379). Khachikian et al. (Af 14,69; 15,209; 15,373; 16,589; 16,621; 16, 631; AZ Let 6, 262; AC 1096) claimed blue galaxies with double and multiple nuclei. The distances between their nuclei (1-3 kps) and the absolute magnitudes (-18) are estimated. For Mkn 266 with double nucleus the radial velocity difference is equal to 280 km/s. The emission lines are typical for double nuclei.

Dibay and Tsvetanov have collected the data about Seyfert 1 and 2 types of galaxies. The difference between types 1 and 2 can be explained on the base of dimensionless ratio of luminosity to corresponding Eddington luminosity (AZ 57, 677; 57, 1143, AZ Let 7). The models of continuous spectra of QSOs, and especially 3C 273, were presented by Charugin and Tsvetanov (Ap Sp Sci 67, 309) and Synyaev and Titarchuk (AA 86, 121). Grinin and Fabrika (AZ 57, 480) have calculated emission line profiles in active nuclei moving gas clouds. According to Dibay et al. (AZ Let 7) the space configuration of clouds is probably more or less spherical. Ginzburg and Ozernoy (Ap Sp Sci 48, 401) discussed several models of active nuclei (SN, magnetoid, black hole) from an observational point of view. The space density of Seyfert galaxies was estimated by Terebizh (Af 16,45) and Dibay and Romanov (AZ 57, 476).

Arakelian et al. have detected the correlation between radio-luminosities of Seyfert galaxies and their surface brightness (Af 16,657; IAU Symp 79,274).Radio fluxes of high brightness galaxies was determined by Arakelian and Kojoian (Bull AAS 12, 822).

Double and interacting galaxies, systems and clusters

Using the 6-m telescope Karachentsev determined the radial velocities of 300 double galaxies (ApJ Suppl 44, 137, AZ Let 7). The mass-luminosity ratio of 470 double galaxies was determined (Af 15,25), statistical problems are considered (Af 17, in press, AZ Let 7,3). The UBV catalogue of about 100 double galaxies was published by Tomov et al. (AZ 58, N5).

The radial velocities and UBV magnitudes of more than 100 interacting galaxies was observed (Vorontsov-Veljyaminov et al. 25,158, 242; AA 91,302). The internal motions and physical parameters are investigated, star formation problems are discussed (AZ 58; AZ Let 6, 394; 26.158.115; 25.158.240; 25.158.153; 25.158.129; 27.158.186; 27.132.050; 26.158.125; 25.151.081; 25.151.017; 26.158.114).

The 65 triple galaxies (masses, luminosities etc) were observed with 6-m telescope (Af 17,5; 17). The radial velocities of galaxies in multiple clusters were measured by Kopylov et al. (AZ 58). The space structure of the Coma and Virgo clusters was investigated (MN 192, 109; SAO 31,23). Photometry of compact galaxies in clusters was carried out by Kalloglian (Af 14, 467; 14 613; 15,393; 16, 25; 16, 599). A summary of redshifts and other cluster-of-galaxies parameters was presented by Fetisova (AZ 58, N5). Compact galaxies were investigated by Shakhbazian (Af 14, 273; 14, 455).

The members of some hypergalaxies have been observed (25.160.041; 27.160.012). The space configuration of superclusters was discussed using new data (27.160.005). Clusters of galaxies are concentrated to flattened aggregates with empty space between them ("cell structure"). Epoch of cell structure formation is estimated as z = 2-10 (Einasto et al. 27.160.077).

Dynamics, Statistics, etc

New models are constructed of M31 (25.158.195), of M81 (27.158.315) and of M87 (27.158.054). The model of M31 was presented also in (AZ 57,28). SB-galaxy dynamics was considered in (AZ 57, 926), and the general family of dynamical models has been investigated (Abast 52, 93).

Distribution of morphological types of 30000 galaxies in MGC was considered by Dostal (25.158.130). The properties and distribution of compact galaxies was discussed by Kogoshvily (Af 16, 645; Abast 53, 113; Af 17). Sculptor type galaxies photometry was made by Börngen et al. (AN, in press). Ring-type and some peculiar galaxies was observed by Kostiuk (SAO 26, 33; 13, 45; AZ Let 7, N5), and Zasov (AZ Let 5, 237). Star formation problems was discussed by Pronik (Highlights of astron 5, 223). The value of the Hubble constant and its distance dependance was considered by Einasto (27.162.011). Spectra of 130 isolated galaxies were investigated by Karachentseva (Af 15, 589; AZ Let 7). According to Arakelian and Magtesian (AF 17, 53) surface brightness in double spiral galaxies is higher in comparison with single spiral galaxies.

7. WORKING GROUP ON THE MAGELLANIC CLOUDS
(M.W. Feast)

Complete references to work on the MC are given in a special section of A and A abstracts. The following short report tries simply to indicate the lines of current research with a few of the more striking results. The papers cited will frequently be found to contain additional references. A recent review is Westerlund ESA/ESO Workshop 1979 p 193.

30 Doradus, H II Regions, Interstellar Extinction

Perhaps the most intriguing recent observation has been the suggestion that the nucleus of 30 Dor (R136) is a supermassive object ($\sim$ 2500 solar masses)rather than a dense cluster of normal massive stars (Cassinelli et al. Science 212,1497 following Feitzinger et al. AA 84, 50 etc). Models of 30 Dor are discussed by Icke et al. (ApJ 236,808), Mills (MN 185, 263). The law of reddening may be abnormal and vary with distance from the central source (Koornneef, Mather ApJ 245,49) which contributes significantly to the excitation of the whole nebula (Israel, Koornneef ApJ 230, 390). Reddenings were determined from $H\alpha/H\beta$ ratios (Strauss et al AA 74,280). Other work includes the extent of faint filaments (Meaburn AA 75, 127) and the under-abundances of heavy elements (Boeshaar et al. Ast Sp Sci 68, 335). Contrary to earlier work both carbon and nitrogen sequence WR stars are present in 30 Dor (Phillips, AAO preprint).

Lasker (PASP 91, 153) carried out a survey of shell nebulae. Meaburn and Goudis studies the optical structure of H II regions (MN 190, 403; AA 68, 189; 70, 635, see also Geyer Ast Sp Sci 69, 495). The ring nebula N70 is expanding at 70 km/sec (Rosado et al. AA 97, 342). Ring nebulae round LMC WR stars are ten times larger than is typical of our Galaxy (Chu, Lasker, PASP 92, 730).

Nandy et al., (MN 196,955) find an abnormal reddening law (especially at 2200 A) in the LMC (see also MN 186, 421; 188, 131; Nature 283, 725). The gas/dust ratio is higher in the LMC than in the Galaxy but the infrared absorption law is normal (Koornneef, preprint). Isserstedt (AA 83, 322) uses the distribution functions of interstellar reddening to infer $Av/E_{B-V} \sim 2$ for the SMC. The ratio of 4430 A band intensity to E_{B-V} is normal in the LMC (Houziaux et al. AA 84,377; Blades, Madore AA 71, 359). Rocca-Volmerange et al. (AA 99, L5) find the uv extinction curve in the SMC is higher than in the LMC and the Galaxy and does not show the 2200 A hump.

https://doi.org/10.1017/S0251107X00004727 Published online by Cambridge University Press

Supernova Remnants, XR Sources and Planetary Nebulae

Observations of MC SNRs strongly support a cloudlet shock model (Dopita ApJ Suppl 40, 455; Dopita, Mathewson ApJ 231, L147). Mathewson et al. (ApJ 242, L73) report a new oxygen rich LMC SNR. Van den Bergh, Dufour (PASP 92, 32) suggest N63A must have a mass $\geq$ 30 $M_\odot$ from its presence in an association. Lasker (ApJ 237, 765) continued work on the velocity structure of N132D. The optical counterpart of 30 Dor B was detected (Danziger et al. MN 195, 33p). Radio observations show the LMC SNRs to be only marginally different from galactic ones (Milne et al. MN 191, 469). N49 has been suggested as an X-ray transient source (Mazets et al. Nature 282, 587; Helfand, Long Nature 282, 589; Terrell et al. Nature 285, 383; Ramaty et al. Nature 287, 122; IAU Circular 3356; ApJ 237, L1, L7). The XR emission from LMC SNRs was compared with theory (Long, Helfand ApJ 234, L77).

Individual XR sources in MC have continued to be studied intensively primarily because of their well defined absolute magnitudes (see Commission 42 report etc). Amongst XR surveys of MC are an Einstein survey of SMC (Seward, Mitchell ApJ 243, 736) including the detection of several new probable SNRs (Clark et al. ApJ 227, 54). There is no 1 keV diffuse XR absorption by the SMC (Bunner et al. ApJ 228, L29).

Aller et al. (MN 194,613) determined abundances in 7 SMC planetaries, A. Walker (priv. comm.) has obtained spectra of 84 MC planetaries. He has measured radial velocities and is deriving abundances. Jacoby (ApJ 226, 540) published a list of faint SMC planetaries.

Cepheids, Supergiant Variables, Novae

A coefficient of 2.7 for the colour term in the P-L-C relation for LMC Cepheids was confirmed by Balona, Feast (MN 192,439). Additonal BVI photometry of MC Cepheids has been published (Martin SAAO Circ 5, 172; 6,96) and more has been obtained (Coulson, Caldwell priv. comm.). Martin et al. (SAAO Circ 6,31) have given BV light curves for 394 MC Cepheids. Pel (2nd Asian-Pacific Regional Meeting, in press) reviews abundance effects in MC Cepheids (including work by Lub, Pel, Harris). The SMC Cepheids show definite indications of metal deficiency. An alternative binary model to explain the anomalies of SMC Cepheids was investigated by De Yoreo, Karp (ApJ 232,205). Connelly (PASP 92, 165) discusses sinusoidal variables in the LMC as overtone pulsators. At ESO CORAVEL has been used to derive velocity curves for some of the brighter Cepheids. Some 8-day Cepheids have been observed for velocities at SAAO.

Van Genderen (AA Suppl 38, 381) discussed the variability of supergiants. A number of reports on LMC novae have been published (AA Suppl 36, 365; Inf Bull Var Stars 1488; IAU Circ 3206; 3308; 3641). Graham (IAU Colloq 46) summarizes available data on the frequency and distribution of MC novae.

Red Stars (including variables)

There has been a great deal of recent activity in this field. Glass, Lloyd Evans (Nature 291, 303) have shown, using infrared observations, that LMC Mira variables define a very narrow Period-Luminosity relation. Glass, Feast (MN in press) combine data on Galactic and LMC Miras to show that these stars are low mass stars pulsating in an overtone. Infrared observations of MC red supergiant variables have been made (Feast et al. MN 193, 77; Catchpole & Feast MN, in press, Wood et al. preprint, Elias et al. ApJ 242, L13). Evidence for period-luminosity relations exists (cf Summary Feast ESO Workshop 1981, in press). M supergiants, many of which are variable were observed spectroscopically and photometrically by Humphreys (ApJ 231, 384; ApJ Suppl 39, 389) and Glass (MN 186,317).

The ratio of C type to M type stars and its variation from galaxy to galaxy as well as apparent discrepancies between observed and predicted limits to the luminosities of C stars has led to much work (observational and theoretical). Much of this is summarized in "Physical Processes in Red Giants" (ed. Iben, Renzini; see also Blanco et al. ApJ 242, 938; Richer ApJ 243, 744; Iben ApJ 246, 278; Lloyd Evans MN 193, 333; Becker Orange Aid Preprint 628). The detection of the first SC and S stars in the Magellanic Clouds have been reported (Richer, Frogel ApJ 242, L9; Blanco et al. PASP 93, 532; Lloyd Evans priv. comm.).

Clusters

The study of clusters in MC has been continued, especially with the purpose of investigating similarities and differences to clusters of similar age in our own Galaxy (cf. Hesser et al. ApJ Suppl 32, 283; Kontizas AA Suppl 40, 151; Geyer AA 77, 61; Walker MN 186, 767; 188, 735; Hodge ApJ 235, 769; 247, 894; Indian AA 2, 161; Alcaino AA Suppl 34, 43; Martin et al. AA Suppl 41, 219). The marked ellipticity of MC globulars has been measured quantitatively (Geisler, Hodge ApJ 242, 66). Limits on the binary content and velocity dispersion of NGC 330 were obtained by Feast, Black (MN 191, 285). Arp, Madore (ApJ 227, L103) listed new faint SMC clusters. Graham, Nemec are searching MC globulars for variables. NGC 2210 in which 15 RR Lyraes have been found is of Oosterhoff type II.

The study of C type and M type stars in clusters is being vigorously continued both spectroscopically and photometrically (infrared) (Cf. related field work above) (Frogel et al. ApJ 239, 495 and preprint; Mould, Aaronson ApJ 232, 421; 240, 464; Blanco et al. PASP 91, 659; Lloyd Evans MN 193, 87; 97; Bessel et al. preprint; Danks preprint (Lindsay 102).

Stellar Content (General)

Sanduleak (AA 35, 347) published a deep objective prism survey of two regions of the LMS. Westerlund et al. (AA Suppl 43, 267) published a catalogue of over 1000 LMC M giants and supergiants. Wamsteker (AA 43, 127) gave Walraven photometry for 500 stars in and between the MC. UBV data for MC stars were given by Isserstedt (AA Suppl 33, 193; 38, 239) and Ardeberg (AA Suppl 42, 1). Azzopardi (AA 35, 353) lists new SMC members. Feitzinger (AA Suppl 37, 575) Compiled a catalogue of known LMC radial velocities. The kinematics of the SMC were discussed by Ardeberg, Maurice (AA 77, 277). They also compare different photometric and radial velocity systems (AA 77, 269; see also Kontizas AA Suppl 45, 121). Buscombe (priv. comm.) has catalogued known MC UBV and spectral type data. Azzopardi and collaborators are carrying out a search for faint Hα emission stars in the SMC as well as BVRI and spectroscopy of faint SMC stars. Martin et al. are obtaining BVR photometry for about 1000 LMC late type supergiants.

In an important study Smith (AJ 85, 848) derived calcium abundances from F type supergiants ($|Ca/H|$ = -0.6 (SMC) and -0.2 (LMC)). The intrinsic colours of early type high luminosity stars is discussed by Dubois (AA 79, 143) whilst Feast (IAU Colloq 47) discusses problems of spectral classification in MC.

Several workers discuss WR stars in MC (AA Suppl 39, 19; 43, 203; AA 75, 243, 120; 90, 207; MN 193, 43p; Prevot-Burnichon AA, in press; Breysacher, Azzopardi IAU Symp 83). Walborn (in press) has made a detailed study of Of WN9 circumstellar shells. Amongst peculiar stars studied are: The UV Cephei systems (PASP 90, 636); A Carbon Symbiotic (Ast Let 20, 131); R81 (AA 99, 351); S22 (AA 85, 233); S Dor (AA 88, 15); S18 (AA 95, 191); N55 (Walker, in press). UV fluxes were derived for LMC OB stars (MN 192, 905).

Distance, Structure, Magellanic Stream

De Vaucouleurs (PASP 92, 579) summarizes some of the evidence on the distance to the LMC. He notes that his derived modulus (18.3) may be too small due to the adoption of too high an interstellar absorption correction. Such a high absorption is inconsistent with Cepheid and other data (cf. Martin et al. MN 188, 139; Feltz, McNamara PASP 92, 609; see also Feast 2nd Asian-Pacific Meeting, in press). In these circumstances the best true modulus would seem to be 18.7.

UV interstellar lines give evidence of a hot gaseous corona for both the Galaxy and the LMC (Savage, de Boer ApJ 230, L77; de Boer, Koornneef, Savage ApJ 236,769). In the case of R136 observations the conclusions depend on whether particular features are associated with 30 Dor or the LMC generally (cf. Gondhalekar et al. MN 193, 875; Blades, Meaburn MN 190, 59p; see Blades MN 190, 33; Walborn ApJ 235, L101 for interstellar lines in 30 Dor and Songaila and York ApJ 242, 976 for other MC stars). The suggestion of a hot corona for the SMC (de Boer, Savage ApJ 238, 86) has been disputed (Prévot et al. AA 90, L13).

Following an early estimate of the tilt of the LMC from photographic photometry of Cepheids (cf. de Vaucouleurs PASP 92, 576 for a historical summary) Gascoigne, Shobbrook (Proc Ast Soc Aust 3, 285; see also MN 188, 139) have provided a definitive result from photoelectric observations of Cepheids. The view that the SMC is very deep in the line of sight has been advocated (Florsch et al. AA 96, 158).

Lequeux et al. (AA 71, 1; 86, 299; 90, 73 and preprint) conclude that the rate of massive star formation in MC is consistent with a gradual evolution (not a short burst of star formation). The upper stellar luminosity function in the LMC is similar to the galactic one (AA 85, 305). The Hess diagram of the LMC was studied by Humphreys, Davidson (ApJ 232, 409) and further interpreted in terms of mass loss during evolution by Maeder (AA 92, 101).

The dependence of the C star/M star ratio on abundance was mentioned above (see also Scalo, Miller ApJ 248, L65). From galactic and MC work Maeder et al. (AA 90, L17) suggest that the WR star/red supergiant ratio is also a strong function of abundance. From the ratio of blue to red supergiants Cowley et al. (PASP 91, 628) suggest that there is an abundance gradient across the LMC. Brück (AA 87, 92) discussed the distribution of old and young disk stars in the SMC. Similar work has been carried out for the LMC (in preparation). Hawkins, Brück (MN in press) discuss a faint C-M diagram of the outskirts of the SMC.

Observations of small scale structure in the Magellanic Stream have been published (Mirabel et al. MN 186, 433; Erkes et al. ApJ 238, 546). Bregman (ApJ 229, 514) has investigated a tidal wake model for the stream.

8. WORKING GROUP ON INTERNAL MOTIONS IN GALAXIES
(S.T. Gottesman)

Following the presentation of material on redshifts (1979 report) and galaxy photometry and spectrophotometry (1976 report) we summarize the substantial amount of work done in the field of internal motions in galaxies in the following table. The material is listed by NGC number and a distinction is made between radio (Ra) and optical (Op) spectroscopy. Discussion of galaxy dynamics have been noted as well (Th). The table ends with several surveys, which may be of interest for dynamical studies but are only indirectly observations of internal motions in galaxies. Numerical references are in the format of "Astronomy and Astrophysics Abstracts".

OBJECT	FIRST AUTHOR	TYPE	REFERENCES
NGC 157	Blackman	Op	25.158.039
NGC 221	Whitmore	Op	28.158.217
NGC 224	Simien	Th	25.151.007
	Henderson	Th	25.158.164
	Richstone	Op	27.158.001
	Unwin	Ra	27.158.046
	Einasto	Th	27.158.054
	Cram	Ra	27.158.076
	Unwin	Ra	27.158.284
	Whitmore	Op	28.158.217
	Boulanger	Ra	AA 93, L1
NGC 253	Martin	Ra	25.158.103
	Pence	Op	28.158.033
	Rickard	Ra	ApJ 243, 765
NGC 300	Rogstad	Ra	25.158.133
NGC 488	Peterson	Op	27.158.074
	Kormendy	Op	In Progress
NGC 520	Stockton	Op	27.158.002
NGC 598	Wright	Ra	26.158.068
NGC 598	Newton	Ra	27.158.045
NGC 598	Colin	Th	AA 97, 63
NGC 612	Goss	Op	27.158.048
NGC 613	Blackman	Op	MN 195, 451
	Peterson	Op	In Progress
NGC 628	Briggs	Ra	27.158.321
NGC 672/IC 1727	Combes	Ra	27.158.075
NGC 681	Kyazumov	Op	27.158.252
NGC 741	Jenkins	Op	28.158.005
NGC 891	Sancisi	Ra	25.158.104
NGC 925	Gottesman	Ra	28.158.003
NGC 986	Peterson	Op	In Progress
NGC 1023	Allsopp	Ra	25.158.059
NGC 1052	Bottinelli	Ra	28.158.026
NGC 1055	Kyazumov	Op	27.158.252
NGC 1079	Meabern	Op	MN 195, 39
NGC 1084/87/90	Blackman	Op	25.158.040
NGC 1097	Blackman	Op	MN 195, 451
NGC 1291	Mebold	Op	25.158.106
NGC 1300	Peterson	Op/Th	28.158.322
NGC 1313	Marcelin	Op	26.158.094
	Blackman	Op	MN 195, 451
NGC 1316	Jenkins	Op	28.158.005
NGC 1326	Mebold	Op	25.258.106
NGC 1365	Blackman	Op	MN 195, 451
	Peterson	Op	In Progress
NGC 1433	Peterson	Op	In Progress
NGC 1510/12	Van Woerden	Op/Ra	25.158.192
NGC 1512	Lindblad	Op	28.158.188
NGC 1530	Peterson	Op	In Progress
NGC 1566	Peterson	Op	In Progress
NGC 1569	Reakes	Ra	27.158.285
NGC 1672	Peterson	Op	In Progress
NGC 1800	Gallagher	Op/Ra	AJ 86, 344
NGC 1961	Rubin	Op/Ra	25.158.141
NGC 2442	Peterson	Op	In Progress
NGC 2685	Shane	Ra	27.158.059
NGC 2776	Carozzi-Meyssonnier	Op	26.158.036

https://doi.org/10.1017/S0251107X00004727 Published online by Cambridge University Press

OBJECT	FIRST AUTHOR	TYPE	REFERENCES
NGC 2805/15/20	Bosma	Op/Ra	AA 89, 345
NGC 2974	Bottinelli	Ra	25.158.117
NGC 2976	Carozi-Meysonnier	Op	28.158.209
NGC 2997	Milliard	Op	AA 95, 59
NGC 3067	Rubin	Op/Ra	In Press
NGC 3031/group	van der Hulst	Ra	25.161.012
	Einasto	Th	27.158.054
	Appleton	Ra	MN 195, 327
NGC 3115	Rubin	Op	28.158.032
NGC 3359	Gottesman	Ra	In Progress
NGC 3448	Reakes	Ra	25.158.058
NGC 3623/group	Haynes	Ra	25.161.010
NGC 3686 Quartet	Blackman	Op	27.158.052
NGC 3718	Allsopp	Ra	25.158.020
NGC 3962	Bottinelli	Ra	25.158.191
NGC 3992	Gottesman	Ra/Th	In Progress
NGC 4038/39	van der Hulst	Ra	25.158.008
NGC 4105	Bottinelli	Ra	25.158.117
NGC 4214	Allsopp	Ra	26.158.004
NGC 4258	van Albada	Ra	28.158.110
NGC 4278	Raimond	Op	ApJ 246, 708
NGC 4469	Kormendy	Op	In Progress
NGC 4486	Duncan	Th	27.158.191
	Jenkins	Op	28.158.007
	Dressler	Op	28.158.081
NGC 4490/85	Viallefond	Ra	27.158.057
NGC 4594	Kyazumov	Op	27.158.252
NGC 4565	Huchtmeier	Ra	28.158.090
NGC 4725/4747	Haynes	Ra	26.158.210
NGC 4965	Peterson	Op	28.158.181
NGC 5128	Graham	Op	26.158.021
	Gosachinskii		Sov Astr 24,647
	Möllenhoff	Op	AA 93, 248;99, 341
NGC 5194	Goad	Op	25.158.134
NGC 5236	Huchtmeier	Ra	AA 100. 72
	de Vaucouleurs	Op	In Press
	Peterson	Op	In Progress
NGC 5291	Hawarden	Op	25.158.183
NGC 5363	Haynes	Op	ApJ 246, L105
NGC 5383	Sancisi	Ra	26.158.066
NGC 5457	Comte	Op	25.158.014
	Allen	Ra	25.158.050
	van der Hulst	Ra	26.158.062
	Bosma	Ra	AA 93. 106
NGC 5728	Rubin	Op	27.158.326
NGC 5838	Kormendy	Op	In Progress
NGC 5846	Bottinelli	Ra	25.158.117
NGC 5921	Peterson	Op	In Progress
NGC 6502	Alloin	Op	26.158.060
NGC 6503	Shostak	Ra	AA 96, 400
	de Vaucouleurs	Op	In Press
NGC 6744	Peterson	Op	In Progress
NGC 6902	Gallagher	Op/Ra	26.158.058
NGC 7331	Blackman	Op	25.158.040
NGC 7332	Kormendy	Op	In Progress
NGC 7339	Kyazumov	Op	28.158.156
NGC 7469	Westin	Op	28.158.104

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OBJECT	FIRST AUTHOR	TYPE	REFERENCES
NGC 7479	Peterson	Op	In Progress
NGC 7537	Kyazumov	Op	28.158.156
NGC 7541	Kyazumov	Op	28.158.03
NGC 7626	Jenkins	Op	28.158.005
NGC 7793	Davoust	Op	28.158.216
IC 10	Cohen	Ra	25.158.137
	Huchtmeier	Ra	25.158.156
IC 239	Allsopp	Ra	25.158.059
IC 342	Martin	Ra	25.158.103
	Newton	Ra	27.158.053
	Newton	Ra	27.158.083
IC 342 comp.	Rots	Ra	26.158.188
IC 5063	Danziger	Op/Ra	MN 196, 845
LGS 3	Thuan	Ra	26.158.024
MK 108	Bosma	Op/Ra	AA 89, 345
MK 296	Casini	Ra	25.158.065
MK 348	Morris	Ra	27.158.241
VV8	Metlov	Op	25.158.152
VV 5-32-63/64	Hintzen	Op	26.158.078
I Zw 18	Lequeux	Ra	28.158.172
3C 129	Icke	Th	ApJ 286, L65
3C 293	Baan	Op	ApJ 243, L143
Orion object	Giovanelli	Ra	25.158.100
Ring galaxy	Dennefeld	Op	25.158.115
		SURVEY	
Hercules Supercluster	Giovanelli	Ra	ApJ 247, 383
Early type galaxies	Balkowski	Ra	26.158.064
	Krumm	Ra	25.158.097
	Krumm	Ra	25.158.108
Spiral galaxies	Bottinelli	Ra	In Press
	Krumm	Ra	26.158.048
	Krumm	Ra	28.158.119
	Huchtmeier	Ra	28.158.175
Large galaxies	Rots	Ra	17.158.278
	Shostak	Ra	27.158.024
Small galaxies	Allen	Ra	25.158.007
40 Sa galaxies	Bottinelli	Ra	27.158.177
	Bottinelli	Ra	28.158.023
Galaxy masses	Castertano	Ra	27.158.029
Blue Compact	Gordon	Ra	ApJ 86, 161
galaxies	Thuan	Ra	ApJ 247, 823
Dwarf galaxies	Thuan	Ra	25.158.204
	Thuan	Ra	26.158.016
Seyfert galaxies	Bieging	Ra	ApJ 247, 443
Rotation data:			
Spiral galaxies	Rubin	Op	25.158.051
	Karachentseva	Op	26.158.208
21 Sc galaxies	Rubin	Op	27.158.318
S(r) galaxies	Buta	Op	In Progress
Disk galaxies	Kormendy	Op	In Press
Barred spirals	Kormendy	Op	In Press
Multiple galaxies:	Peterson	Ra	26.158.042
	Dickel	Ra	28.158.010
	Zasov	Op	27.158.248

OBJECT	FIRST AUTHOR	TYPE	REFERENCES
	Afanasiev	Op	28.158.173
Mass, M/L of galaxies	Faber	Op/Ra	26.158.090
	Bosma	Op/Ra	26.158.118
	Basu	Th	27.158.245
	Burstein	Th	In Press
	Gunn	Th	27.158.309
Velocity Dispersions and shapes of early type galaxies:	Whitmore	Op	26.158.135
	Binney	Th	27.158.050
	Binney	Th	27.158.310
	Terlevich	Th	MN 196, 381
	Bailey	Th	MN 194, 195
	Davies	Op	MN 194, 879

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

Several conferences and meetings took place in this triennium whose proceedings are rich of information. While most of them should be mentioned having something to do with the matter of this Working Group, for pure reasons of space we limit to recall (1) the "Conference on Photometry, Kinematics and Dynamics of Galaxies" (ed. D.S. Evans, Univ. of Texas Press) held in Austin in 1979, organized with the collaboration of this Working Group, two ESO meetings, (2) "Two-dimensional Photometry" (ed. P. Crane and K.Kjar, ESO publ.) held in Noordwijkerhout in 1979 and (3) "Dwarf Galaxies" (ed. M. Tarenghi and K. Kjar, ESO publ.) held in Geneva in 1980, which summarize the state-of-the-art in many fields of galaxy photometry, and two technical meetings, (4) the "International Conference on Image Processing in Astronomy" (ed. G. Sedmak, M. Capaccioli and R.J.Allen, Trieste Obs. publ.) held in Trieste in 1979 and (5) the "Conference on Applications of Digital Image Processing to Astronomy" (ed. D.A. Elliott, SPIE vol. 264) held in Pasadena in 1980. With three exceptions only, papers appeared in the proceedings of these and other meetings are not included in the following compilation.

The output of papers in the field of detailed surface photometry remained conspicuous in this triennium. As a partial accomplishment of the Working Group recommendation (IAU Trans., XIB, 304) de Vaucouleurs and Capaccioli (ApJ 40, 699) produced the E-W mean luminosity profile of the E galaxy NGC 3379, intended to provide a standard for galaxy surface photometry work. Strom and Strom continued their monumental work on multicolor surface photometry of E, SO and cD's(AJ 83,73; 83, 732; 83, 1293; 84, 1091). They also studied the color-color distribution in NGC 2768 and 3115 (ApJ 220, 62) in view of its use as metallicity index and, in collaboration with Forte (ApJ 245, L9), the surface brightness and color differences between the radial distribution of stars and globular clusters in three ellipticals. Hodge(ApJ Suppl. 37, 429) presented a study of 13 galaxies in the Fornax cluster. Searching for black holes, Young et al. (ApJ 234, 76) published the CCD photometry of three supergiant galaxies. Gallagher et al. (ApJ 235, 743) provided B-V profiles at faint light levels for NGC 4472, 5846 and 6168. An extensive study of NGC 1316 (Fornax A) was presented by Schweizer (ApJ 237, 303; 246, 722). Williams (ApJ 244, 458) studied the puzzling elliptical NGC 596. Watanabe et al. (ApJ in press) mapped 20 galaxies in Virgo. The effects of seeing convolution on nuclei of galaxies were examined by Schweizer (ApJ 233, 23) for the King's (1978) sample of Virgo ellipticals and by Capaccioli and Rampazzo (Mem.SAIt. 51, 497) for the general case of the $r^{1/4}$ law. Lenticulars were extensively investigated by Burstein (ApJ Suppl. 41, 435) who studied 18 SO's and NGC 3379, by Tsikoudi

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(ApJ 234, 842; ApJ Suppl. 43, 3) who mapped NGC 3115, 4111, 4762, by Hamabe et al. (PAS Japan 31, 431; 33, in press) who inspected NGC 4762 and 5866, by Rampazzo (Univ. of Padova Thesis) who mapped NGC 404 and 524. The central bright region of M87, already discovered by Young et al. (ApJ 221, 721), the jet and the corona, discussed also by Carter and Dixon (MN 83, 574), were carefully studied by de Vaucouleurs and Nieto (ApJ 220, 449; 230, 679; 231, 364). Carter (MN 186, 897) investigated 19 E and SO's. In his dissertation (Univ. of Arizona) Boronson studied 26 spirals. A conspicuous number of these galaxies (NGC 157, 972, 1084, 1087, 1090, 3521, 3675, 4826, 5005, 6503, 7331, M82 and the NGC 3686 quartet) was also mapped by Blackman in a series of papers (MN 186, 701 and 717); 188, 93; 189, 751; 190, 459; 191, 123). Hossel (ApJ 241, 493) produced CCD and SIT photometry of 108 first ranked cluster galaxies. de Vaucoleurs and Davoust (ApJ 239, 783) mapped the southern Sd NGC 7793, Pence (ApJ 239, 54) the late spiral NGC 253. The first results of the Palomar-Westerbork project, which include the 3-colour photometry of NGC 891, were publised by van der Kruit and Searle (AA Suppl. 38, 15; AA 95, 105 and 116). Davies et al. (AJ 85, 131) used the new technique of grid photography to map NGC 4565. Spinrad et al. (ApJ 225, 56) studied NGC 253, 4594 and 4565; van der Kruit and Bosma(AA 70, 63) NGC 5383; Burkhead (ApJ Suppl. 38, 147) the M51 system; Talbot et al. (ApJ 229, 91) M83; Hoessel and Melnick (AA 84, 317) M31; Benedict (AJ 85, 513; AJ in press) NGC 4314 and 7479; Hamabe et al. (PAS Japan 32, 197) the edge-on spiral NGC 4565; Bronkalla et al.(AN 301, 217) M82; Burkhead and Hutter (AJ 86, 523) the Leo II triplet, Davenhall (Univ. of St. Andrews Thesis) NGC 4258, Schweizer (ApJ in press) NGC 7252. An interesting result concerning the bulge of the spiral NGC 4565 was presented by Kormendy and Bruzual (ApJ 233, L63). Peculiar galaxies were studied by Thompson and Theys (VII Zw 466; ApJ 224, 807), Weistrop et al. (PKS 0548-322; ApJ 233, 504), Pastoriza (IC 4329A; ApJ 234, 837), Kaneko (NGC 4151; PAS Japan 32, 185), Williams et al. (Mrk 10; AJ 86, 178). There have been several review papers on the subject of galaxy photometry. We limit to mention Freeman (IAU Symp 84, 9), de Vaucouleurs (Austin Conference, 1) and Kormendy(Two-Dimensional Photometry, 191).

A renewed effort as well as the use of modern techniques blew-up the amount of information about broad band photometry (magnitudes and colours) of galaxies both in the visual and infrared, for bright galaxies and very distant objects (the latter group is not discussed here). UBV photometry is given by Keel and Weedman (400 bright galactic nuclei; AJ 83, 1), de Vaucouleurs et al. (300 galaxies; AJ 83, 1331), Penfold (MN 186, 297), Ginsey and Miller (ApJ 219, 391), Wegner (262 southern galaxies; Ap Sp Sci 60,15), Dottori (AA Suppl 37, 519; Ap Sp Sci 67, 417; 73, 327, in coll. with Bevilaqua), Corwin (MN 191, 1), Notni (AN 301, 51), Griersmith (AJ 85, 789), Stone (in press), Graham (in prep.). Infrared magnitudes and colours are given by Frogel et al. (51 E and SO's; ApJ 220, 75), Martin (MN 184, 15P), Persson et al. (137 E and SO's; ApJ Suppl 39, 61), Glass (MN 186, 29P), Mc Alary et al. (ApJ 234, 471), Tolesco and Harper (ApJ 235, 392), Gatley et al. (ApJ 236, 411), Aaronson et al. (ApJ 237, 655), Thompson et al. (ApJ 238, 24), Balzano and Weedman (107 nuclei; ApJ 243, 756), Hohlfeld and Krumm (ApJ 244, 476), van Genderen and Meurs (AA 96, 78), Guidoni et al. (AA 96, 215), Persson et al. (ApJ 240, 779), Phillipps et al. (J-R colours of 20,000 galaxies with COSMOS; MN 194, 49), Mould (PASP 93, 25). Other papers are by Aaronson (ApJ 221, L103), Green and Dixon (Obs 98, 166), Kirshner et al. (magnitudes and colours of 807 galaxies; AJ 83, 1549), Schild and Davis (AJ 84, 311), Griersmith and Visvanathan (AA 79, 329), Kodaira et al. (PAS Japan 31, 647), Bucknell et al.(MN 188, 579), Smyth and Stobie (MN 190, 631), Bigay and Paturel (B total magnitudes for 61 objects; AA 89, L1), Aaronson and Mould (PASP 93, 20), Harris and Smith (AJ 86,90), Peterson and Baumgart (200 southern galaxies; in prep.). de Vaucouleurs and collaborators (ApJ Suppl 36, 439; 39, 49) gave new estimates of the total magnitudes of Virgo galaxies Sandage and Visvanathan (ApJ 223, 707; 225, 742) and Michard (AA 74, 206; 79, 337) investigated the colour vr. absolute magnitude relation for early type galaxies.

Due to their importance in the problem of understanding the spatial structure of early type galaxies, geometrical properties of isophotes such as ellipticity and twisting of major axis were the subject of many papers. Carter (MN 182, 797) studied 19 E and S0's in two clusters. Williams and Schwarzschild (ApJ 227, 56; ApJ Suppl 41, 209) investigated the twisting in NGC 584, 1052, 4697, 5102 and IC 1459. Di Tullio (AA Suppl 37, 591) produced the ellipticity profile for 75 galaxies. Bertola and Galletta (AA 77, 363) and Barbon et al. (SPIE 264, 250) presented ellipticity and twisting profiles for several early type galaxies. Fiebelman (AJ 84, 497) studied the twisting in M31 and M51. Galletta (AA 81, 179) found a correlation between maximum flattening and amount of twisting in ellipticals. Discussion of the true shape of E's is presented by Marchant and Olson (ApJ 230, L157), Richstone (ApJ 234, 825) and Binggeli (AJ 82, 289). The apparent flattening of galaxies was re-examined by Efstathiou and Ellis (MN 185, 555), Noerdlinger (ApJ 234, 802) and Binney and de Vaucouleurs (MN 194, 679). Kormendy (ApJ 227, 56) and Burstein (ApJ 234, 435 and 829) discussed morphological aspects concerning galaxian subsystems. de Vaucouleurs and Buta (AJ 85, 637) measured diameters of nuclei, lenses and inner-outer rings in 532 galaxies.

Enhancement techniques were discussed and applied by Lorre (NGC 1097; ApJ 222, L99), by Dufour et al.(NGC 5128; AJ 84, 284), by Malin and Carter (Nature 285, 643). Filtering techniques were examinated by Frandsen and Thomsen (AA 72, 111) and Brian and Skilling (MN 191, 69). Fritze et al. (1978, A.Nach. 299, 61) and Ziener (AN 300, 127 and 203) discussed a number of techniques concerning geometrical and photometric measurements. Photometry of faint galaxies was also analyzed by Tyson and Jarvis (ApJ 230, L153) and Kron (ApJ Suppl 43, 305). de Vaucouleurs and Corwin (AJ 83, 1356) investigated the systematic and accidental errors in galaxy classification and Capaccioli and de Vaucouleurs (in prep.) those of galaxy photometry.

Pension and Fosbury (MN 183, 479) presented the optical spectrophotometry of 3C 33, 3C 327 and PKS 1934-63, Fosbury et al (MN 183, 549) studied NGC 1052, Rodgers (ApJ 219, L7) NGC 5128, Phillips (ApJ 227, L121) NGC 6221 and 7213, Hawley and Phillips (ApJ 235, 783) NGC 1566, Sparke (ApJ 235, 755) VII Zw 421 and II Zw 67. The absolute spectrophotometry of 68 Seyfert nuclei was given by de Bruyn and Sargent (AJ 83, 1257), while Cohen and Osterbrock (ApJ 243, 81) investigated narrow-line radio galaxies. Koski (ApJ 233, 56) provided the optical spectrophotometry of Seyfert 2 and narrow-line radio galaxies.

Near infrared spectrophotometry of M31 was produced by Taylor (AJ 83, 1377). NGC 253 was investigated at 2μ by Wynn-Williams et al. (MN 189, 163). Optical and IR broad band photometry of NGC 1365 and 1386 was presented by Phillips and Frogel (ApJ 235, 761). O'Dell et al.(ApJ 219, 818) studied 3C 382 in the range 0.36-3.5μ, Ledden et al. (ApJ 243,47) a Bl Lac candidate and Cutri et al. (ApJ 245, 818), three Seyfert galaxies.

Due to the coming into operation of the international Ultraviolet Explorer UV spectrophotometry gained more and more space in the literature. Technical and scientific presentations can be found in the proceedings of the meetings organized in USA and Europe by NASA and ESA-SRC and in the conference held in Vienna in 1980. The first results produced by IUE for galaxies are accounted by Boksenberg et al. (Nature 275, 404). Papers on ellipticals so far published concern M31 and M32 (Johnson; ApJ 230, L137), M87 (Bertola et al.; ApJ 237, L65) and its jet (Perola and Tarenghi; ApJ 240, 477), NGC 3379 and 4472 (Oke et al.; ApJ 243, 453; Norgaard-Nilsen and Kjaergaard; AA 93, 290), NGC 4649 (Bertola et al.; ApJ in press). Together with the pioneering work of OAO II (Code and Welch; ApJ 228, 95), these results brought to the discovery of an hot stellar population in E galaxies. Consequences of that are evaluated by Coleman et al. (ApJ Suppl 43, 393) and by Bruzual (Univ. of Calif. Thesis). Welsh (ApJ 228, 419) investigated NGC 5128 with OAO, Wu et al.(ApJ 237, 290) the UV continua of M31 and M81 with ANS.Benvenuti et al. (MN 192, 769) studied NGC 7582, Benacchio and Galletta (ApJ 243, L65) NGC 3077,

https://doi.org/10.1017/S0251107X00004727 Published online by Cambridge University Press

Bergeron et al. (AA 97,94) NGC 4507 and 5506, and Peimbert and Peimbert-Torres (ApJ 245, 845) M81. NGC 4151 has been investigated with ANS by Weedman (ApJ 223, 798) and, with IUE, by Penston et al. (MN 196 in press) and Perola et al. (MN in press). Other peculiar galaxies were studied by Oke and Zimmerman (ApJ 231, L13), Benvenuti et al. (Nature 282, 272), Snijders et al. (MN 189, 873), Maraschi et al. (Nature 285, 555) and Oke and Goodrich (ApJ 243, 445). Deharveng et al. (AA 88,52) produced and UV image of M31.

Variability was studied by Miller and Gimsey (BL Lac; ApJ 220, 19) Belokon' Babadzanjianz (AA Suppl 31, 383), Vogt et al. (ApJ 227, L59), Miller (Seyferts; PASP 90, 661; AA Suppl 35, 387; PASP 91, 624), Rieke and Lebofsky (ApJ 227, 710; Nature 284, 410), Geller et al. (NGC 1275; ApJ 230, L141), Usher (AJ 84, 1253), Kingham and O'Connell(NGC 1275; AJ 84, 1537), Moore et al. (ApJ 235, 717), Pica et al.(ApJ 236, 84), Baumert (PASP 92, 156) Barr et al. (MN 193, 549), Lawrence et al. (NGC 4151; MN 195, 149), Puschell (AJ 86, 16) Oke et al. (3C 120; PASP 92, 758).

Optical polarization of NGC 4151 was investigated by Kruszewski (Acta Astr 27, 319), Thompson et al. (JRAS Canada 72, 287; ApJ 229, 909). Polarization of NGC 1068 was studied by Lebofsky (ApJ 222, 95) and Elvius (AA 65, 233). Jameson and Hough (MN 182, 179) investigated the nucleus of M31 in the Ir, Maza et al. (ApJ 244, 368) and Thompson et al. (MN 192, 53) the optical polarization of 4 Markarian galaxies and NGC 3227, 3516. BL Lac objects were studied by Angel et al. (Pittsburgh Conf., 117), Puschell et al. (ApJ 227, L11) and Puschell and Stein (ApJ 237, 331). Polarization of ellipticals is discussed by Jura (ApJ 223, 421).

Once more the activity in the fields of galaxy photometry and spectrophotometry has been vivid and conspicuous in this triennium which, at its expiration, witnesses the publication of another main stone along the way of cataloguing galaxies, the Revised Shapley-Ames Catalogue (Sandage and Tammann; Carnegie Instit. Washington) and the coming into operation of another powerful tool, the microdensitometric system known as Kibblewhite machine, at the Institute of Astronomy in Cambridge.

10. WORKING GROUP FOR SPACESCHMIDT SURVEYS
(K. Henize)

The Working Group was formed at the 1976 Grenoble IAU General Assembly to coordinate the interests and efforts of those astronomers who realized the growing need for a wide-field, fast-focal-ratio space telescope. The basic objectives of such a telescope are to conduct a Palomar-quality sky survey in the far UV and to detect and study very faint extended sources which, because of field diameter and focal ratio constraints, are very difficult to study with presently planned space telescopes. Although originally named the "Working Group for Extra-Galactic Surveys from Space" the present name was adopted at the 1979 Montreal meeting in recognition of the fact that such a telescope has extensive galactic as well as extragalactic applications.

Dr. Barbon in his 1979 Working Group Report gave an excellent summary of the history of the Space Schmidt concept. One event which should be included in this summary is the result of a May 1978 NASA peer review of potential "facility-type instruments" in which the Space Schmidt was included under the name "DUVS" for Deep UV Survey. This group gave a strong endorsement to a whole-sky UV survey as an aid to efficient Space Telescope operation. However, in view of its limited aim and its relatively low cost it was recommended that it be funded as a "Principal Investigator (PI)-type" instrument rather than as a "facility-type" instrument. Unfortunately, since October 1978 NASA has had no funds available for developing new PI-type Spacelab instruments.

The initial concepts of the international group of astronomers which constituted the NASA Working Group for Spacelab Wide-Angle Telescope (SWAT)have already been included in the 1979 Report. This group held two meetings in 1979 during which it reviewed the results of a study contract by Perkin-Elmer Corporation, reviewed the status of potential image tube and electrographic detectors and made final revisions to the Working Group Report. This report was issued in late June 1979 and is available through T.R.Gull at Goddard Space Flight Center.

Several European members of the SWAT Working Group (F.Bertola, R.D. Cannon, G. Courtes and R.M. West) submitted a proposal to ESA for a Space Schmidt on Spacelab in March 1979. This telescope incorporated the basic qualifications defined by the SWAT Working Group, i.e., it was an f/3 folded all-reflecting Schmidt with an aperture between 0.7 and 1.0 meters, and with a 5° circular field image yielding image diameters of $\sim$ 1 arcsec at field center and $\sim$ 2 arcsec at the edge. It could use a variety of detectors to image the wavelength region from 1100A to 11000A but would concentrate initially on work in the 1100-1800A region. The assessment study of this proposal was completed in October 1979 and the report may be obtained from H. Olthof of the Scientific Programme Directorate of ESA. It reached a favorable conclusion that "the proposed systems concept will lead to a feasible design that would meet the scientific requirements." Nevertheless the Astronomical Working Group, in November did not approve the proposal for further study.

In the meantime, under the leadership of H.J. Smith and J.D.Wray at the University of Texas, progress has been made towark a multi-national PI proposal for a Space Schmidt telescope similar to that recommended by the SWAT Working Group. The Centers involved include an Italian group headed by the Asiago Astrophysical Observatory at Padova, a French group headed jointly by the Space Research Laboratory in Marseille and the Observatoire de Marseille, Uppsala Observatory in Sweden,the Photographic Reproduction Group of ESO and the U.S. Naval Research Laboratory as well as the University of Texas. It had been hoped to submit joint cooperative proposals to the respective national space agencies in 1980 or 1981 but this plan has been frustrated by first a postponement and finally a cancellation of the NASA opportunity to propose for new Spacelab projects. However, further Space Schmidt studies continue at several of these centers and it is hoped that funding will become available in the not-too-distant future. These studies include a detailed study by Aeritalia (under contract to the Asiago Astrophysical Observatory) to provide a design and cost analysis of the basic optical bar and telescope structure for the Space Schmidt, continuing studies on optimizing the optical configuration of all-reflecting Schmidt telescope by G. Lemaitre at the Marseille Observatory and studies of UV electrograph detectors at the Naval Research Laboratory (see below).

A Space Schmidt project status meeting was convened in Garching bei München, FRG, in June 1981 under the leadership of R.M. West and F. Bertola. This group reaffirmed their conviction that a Space Schmidt telescope is a vital and fundamental instrument in a well-rounded space observatory program. A reassessment of detectors led to the conclusion that the UV electrographic camera is still the best available detector in the immediate future but that if it were possible to improve the resolution of large microchannel arrays in the near future, these might then become the preferred detector. The space vehicle from which a Space Schmidt might be operated was also discussed. As long as electrographic detectors are required it is clear that a Space Schmidt must be operated on Shuttle/Spacelab missions or on the projected Space Platform which will be visited at regular intervals by the Space Shuttle.

Studies of high-resolution UV electrographs with photocathode diameters up to 175 mm continue at the U.S. Naval Research Laboratory under the direction of G. Carruthers. One of the most promising developments has been the successful manufacture (by Perkin-Elmer Corporation under contract to NRL) of two CaF_2 plates 1 mm in thickness and 178 mm in diameter curved to a spherical radius of 2000 mm. Such a plate is required as the photocathode substrate for a far-UV electrograph - the curvature is required to match the curved field of the Schmidt telescope and the thinness is required to avoid image deterioration due to chromatic aberration within the plate.

Earlier laboratory studies at NRL as well as a recent study by Raytheon Company demonstrate the ability of permanent magnet focusing assembly to provide a 200 gauss field uniform to ± 4% over a 170 mm field diameter. These data plus previous laboratory optical tests at NRL lead to the conclusion that image diameters of 10 micrometers or less can be achieved over the entire 170 mm field.

Both the final report of the SWAT Working Group (June 1979) and the proposal to ESA for a Space Schmidt on Spacelab (March 1979) include detailed evaluations of the capabilities of a Space Schmidt telescope and of the scientific potential of such an instrument. For example, it is noted that the SWAT could achieve a signal-to-noise ratio of 5 in the far UV passband (1250-1800A) for an unreddened B0 star with V = 26.0 in a 30-minute exposure. Assuming that sixteen 30-minute exposures may be obtained each 24 hours, then a 20-day Spacelab mission could cover 4400 square degrees of sky. This would for example, permit coverage of 150 degrees of the galactic equator between $\pm 5^{\circ}$ galactic latitude, of a 40-degree diameter circle at one galactic pole and of an additional 70 fields centered on special interest objects.

The specific scientific objectives described in both reports include: ultraviolet studies of the morphology of galaxies; observations of very faint extension, halos, jets and filaments in galaxies; detection of hidden hot objects; studies of the dust component of the Milky Way and of external galaxies; objective-prism spectroscopy of UV emission-line objects and solar system observations.

The potential for new insights into the role played by hot, young stars in the structure, dynamics and evolution of galaxies is well illustrated by the difference seen in the structure of the Large Magellanic Cloud when earth-based photos are compared with the UV photos obtained by the S-201 experiment on Apollo 16. T. Page and G.R. Carruthers (ApJ 248,906) summarize findings concerning the distribution of hot stars relative to clouds of interstellar hydrogen by noting a characteristic dimension of about 100 pc for the HI clouds and that at least 25 associations of O and B stars appear not to be associated with HI clouds.

Ground-based observations show a few intriguing examples of very low surface brightness phenomena (halos, jets etc.) in galaxies which may be discovered in greater abundance and studied in greater detail by a fast-focal-ratio space-based telescope operating above the earth's sky background. An interesting example of such phenomena is the recent discovery of very faint UV spiral features in the outer regions of the galaxy M101 by Donas et al. (AA in press) using a balloon-borne telescope operating at 2000A at an effective focal ratio of 2.2.

Potential hidden hot objects include: hot stars and non-thermal sources in galactic nuclei and elliptical galaxies, ultraviolet sources in globular star clusters and hot secondary companions in multiple star systems. An interesting example of the last is the discovery (via UV objective-prism spectra obtained with Skylab experiment S-019) of the hottest white dwarf star yet known (Wray et al. ApJ 234, L187). This star, which is the sixth brightest white dwarf yet discovered, had been hidden from ground-based observations by a K0 V primary companion.

Studies of galactic and extra-galactic dust potentially include both studies of dust extinction and also of dust scattering of starlight. This potential is based mainly on the expectation that observations in the region of the 2200 A peak in the interstellar extinction curve will give much greater leverage in the detection of interstellar dust phenomena than is available through ground-based observations.

Objective spectroscopy of UV emission-line objects would be aimed primarily at the discovery and study of galaxies with moderately red shifted Lα emission and at the detection and study of very faint peculiar emission-line stars.

Solar system studies would include studies of comets as well as of large scale gas cloud phenomena about the outer planets and their satellites.

However, by far the greatest contribution of a Space Schmidt will be the wide-ranging benefits of a UV survey covering a large fraction of, if not the entire sky. Such a survey will not only greatly increase the efficiency of Space Telescope usage, but will also provide basic astronomical data of tremendous value in their own right. These data will be made available to all astronomers in the form of an atlas and will undoubtedly be used to support as wide a range of research as do the Palomar Observatory Sky Survey and the ESO/ SRC Southern Sky Survey.

B.E. WESTERLUND
President of the Commission