OUR GALAXY AS A MEMBER OF THE LOCAL GROUP*

Sidney van den Bergh
Dominion Astrophysical Observatory
Herzberg Institute of Astrophysics
National Research Council Canada
Victoria, B.C.

1. INTRODUCTION

Galaxies are like people. When you get to know one well it always turns out to be peculiar in some way or other. In many cases such peculiarities appear to be inherent whereas in others they seem to result from the environment in which a galaxy has evolved. Very few galaxies live in total isolation; most are members of cluster families. The purpose of the the present paper is to introduce the known members of the Local Group to you in the hope that a closer acquaintance with our closest relatives in space will ultimately lead to a deeper understanding of the structure and evolution of our own Milky Way system.

By definition the Local Group is a dynamical unit (Yahil, Tammann and Sandage 1977) which does not expand with the Hubble flow. The diameter of the Local Group is ~ 3 Mpc. An up to date census of Local Group members is given in Table 1. References to new or probable new members of the Local Group, which have been added since my review ten years ago (van den Bergh 1968), are given below:

IC 10: de Vaucouleurs and Ables (1965), Shostak (1974)
Leo A: Fisher and Tully (1975), Yahil *et al.* (1977)
Wolf-Lundmark-Melotte: Ables and Ables (1977)
IC 5152: Baade (1963)
Pegasus: Yahil *et al.* 1977
DDO 210: Fisher and Tully (1975), Yahil *et al.* (1977)
And I, And II, and And III: van den Bergh (1972ab, 1974)
Sagittarius: Cesarsky *et al.* (1977), Hawarden *et al.* (1977)
Carina: Canon, Hawarden and Tritton (1977)

The status of the Phoenix dwarf galaxy (Schuster and West 1976, Canterna and Flower 1977, Laustsen *et al.* 1977) is not yet clear. It

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W. B. Burton (ed.), The Large-Scale Characteristics of the Galaxy, 577–582.

TABLE 1

DATA ON PROBABLE LOCAL GROUP MEMBERS

Name	α 1950	δ	Type	M_V
M31=NGC 224	00 40.0	+41 00	SbI-II	-21.1
Galaxy	17 42.5	-28 59	Sbc	-20.5:
M33=NGC 598	01 31.1	+30 24	ScII-III	-18.9
LMC	05 24	-69 50	IrIII-IV	-18.5
IC 10	00 17.6	+59 02	IrIV?	-17.6
SMC	00 51	-73 10	IrIV/IV-V	-16.8
M32=NGC 221	00 40.0	+40 36	E2	-16.4
NGC 205	00 37.6	+41 25	E6p	-16.4
NGC 6822	19 42.1	-14 53	IrIV-V	-15.7
NGC 185	00 36.1	+48 04	dE0	-15.2
NGC 147	00 30.4	+48 14	dE4	-14.9
IC 1613	01 02.3	+01 51	IrV	-14.8
WLM=DDO 221	23 59.4	-15 44	IrIV-V	-14.7
Fornax	02 37.5	-34 44	D Sph	-13.6
Leo A=DDO 69	09 56.5	+30 59	IrV	-13.6
IC 5152	21 59.6	-51 32	IrIV/IV-V	-13.5:
Pegasus=DDO 216	23 26.1	+14 28	IrV	-13.4
Sculptor	00 57.5	-33 58	D Sph	-11.7
And I	00 42.8	+37 46	D Sph	-11:
And II	01 13.6	+33 11	D Sph	-11:
And III	00 32.7	+36 14	D Sph	-11:
DDO 210	20 44.1	-13 02	Ir	-11:
Leo I=DDO 74	10 05.8	+12 33	D Sph	-11.0
Sagittarius	19 27.1	-17 47	Ir	-10:
Leo II=DDO 93	11 10.8	+22 26	D Sph	-9.4
Ursa Minor=DDO 199	15 08.2	+67 18	D Sph	-8.8
Draco=DDO 208	17 19.4	+57 58	D Sph	-8.6:
Carina	06 40.4	-50 55	D Sph	...

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has therefore not been included in the present listing of probable numbers of the Local Group.

The total number of probable Local Group galaxies listed in Table 1 is 28, i.e. ~ 2 galaxies per Mpc^3. It should be emphasized that the present census of Local Group members is probably quite incomplete below M_V ~ −10. Furthermore some Local Group members might be hidden at low galactic latitudes.

Table 1 shows that the three brightest Local Group galaxies are all spirals. Of the remaining objects 11 are irregulars and 14 are dwarf elliptical/spheroidal galaxies. The luminosity function of known Local Group members, which is shown in Fig. 1, gives no sign of a turndown at the low-luminosity end.

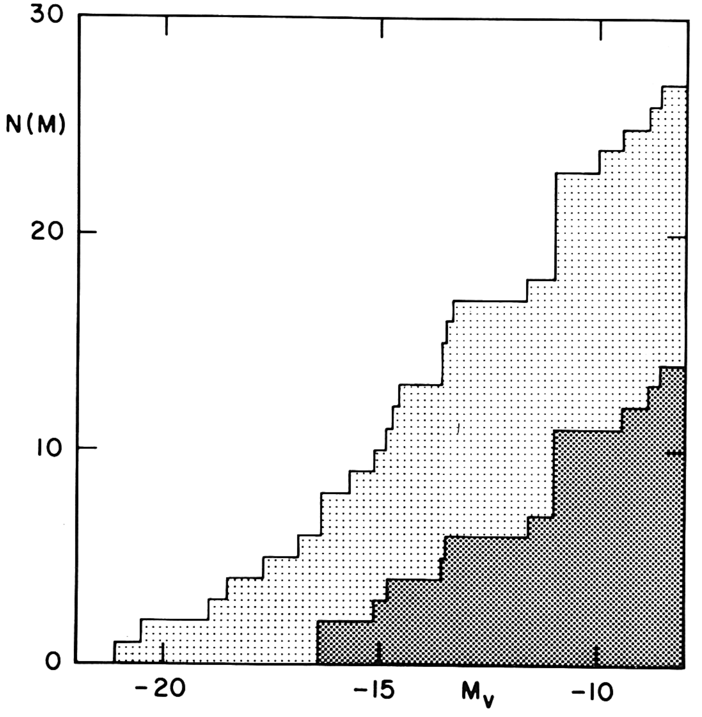

Figure 1. Integral luminosity function of Local Group galaxies. The upper histogram shows the total luminosity function for all types of galaxies. The lower histogram refers to elliptical and dwarf spheroidal galaxies only.

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Table 2 shows that there is a hierarchy of subclustering within the Local Group. Two major subgroups are centered on M31 and on the Galaxy. It is interesting to note that the majority of early-type (dE + D sph) galaxies are located in subgroups, whereas 9 out of 11 of the irregulars occur outside them. This may indicate that irregular galaxies form preferentially in a low-density environment. Due to their low mean density dwarf spheroidal galaxies are extremely fragile and are easily disrupted by tidal forces. As a result the present number of dwarf spheroidals is probably much smaller than it was originally.

TABLE 2

SUBCLUSTERING WITHIN THE LOCAL GROUP

Galaxy		Galactic Subgroup
LMC	Magellanic Double	
SMC		
Ursa Minor		
Sculptor		
Draco		
M31	M31 Satellites	M31 Subgroup
M32		
NGC205		
And I		
And II*		
And III		
N147	Dwarf E double	
N185		
M33		
NGC6822	Dwarf Ir pair	
Sagittarius		

*And II is actually located closer to M33 than it is to M31

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The Local Group may be regarded as a gigantic laboratory in which the effects of differing initial conditions and environmental factors on chemical evolution and morphology may be studied. Probably the most striking conclusion that can be drawn from presently available chemical abundance studies is that heavy element abundance is strongly correlated with galactic mass. In first approximation $Z/Z_\odot \propto \mathcal{M}^{\frac{1}{2}}$. Within the rather low accuracy of presently available data Elliptical, Spiral and Irregular galaxies of comparable mass have similar metallicity. Within the Local Group the only obvious exception to this conclusion is M32 which has a metallicity (cf Faber 1973ab) which is appropriate to its mass before it was stripped by tidal encounters with M31.

Within individual galaxies mean metallicity appears to correlate with density in the sense that the high density cores of galaxies have above-average metallicity whereas low density halos are generally metal-poor. The mean metallicity of globular cluster families is found to correlate with the masses of their parent galaxies (van den Bergh 1975).

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DISCUSSION

Peimbert: I would like to make two comments with respect to the carbon-

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to M-stars ratio: 1. The distribution of WC9 stars goes in the opposite direction, i.e., most of the WC9 stars in the Galaxy are located closer to the galactic center than the Sun. 2. It is possible that carbon stars in the direction of the galactic center are embedded in dust clouds that prevent their detection; there are some infrared observations by Grasdalen and Joyce that seem to indicate that this is the case.

van den Bergh: 1. The abundances observed in WR stars might well be due to stellar evolution. 2. Many of the globular clusters in the Magellanic Clouds contain carbon stars with B-V > 2.0. Not a single star has been observed in any galactic globular cluster. It seems rather artificial to assume that all the carbon stars in galactic globules are hiding in dust clouds!

Mezger: You mentioned the very interesting result that z α (mass of galaxies)$^{1/2}$. What is known about the He-abundances in the local galaxies?

van den Bergh: Peimbert's results seem to indicate that the helium abundance ranges from $\sim$0.07 (by number) in the SMC to $\sim$ 0.10 in the Galaxy.

Lequeux: I have recently studied (Astron. Astrophys., in press) the rate of star formation in several galaxies of the Local Group, using a direct comparison between the populations of identical portions of the upper HR diagrams in these galaxies and in the solar neighborhood. The main result is that the rate of star formation per unit mass of gas is largest in the solar neighborhood, three times smaller in the LMC, and eight times smaller in the SMC. Thus the often-quoted vague statement that "the rate of star formation is extremely large in the MC's" has no basis. There is no evidence from my data for important bursts of star formation in the studied galaxies, and these data are consistent with a similar age for all these galaxies. There is also no evidence for strong variations in the Initial Mass Function.

Felten: You remarked that the luminosity function of the Local Group is roughly flat at the faint end. The statistical significance of this is low (with only 28 objects). Nevertheless, the Local Group is one of the few handles we have on the luminosity function for galaxies of low luminosity. This prompts me to ask whether you could say a few words about the accuracy of distance determinations in the Local Group, particularly for the smaller members.

van den Bergh: For dwarf spheroidals the distances are pretty good, because most of the dwarf spheroidals are evidently companions of larger galaxies. For dwarf irregulars, the distances are much more uncertain.

Tinsley: Of course you are right that the Coma cluster is very different from small nearby groups. However, Coma is relevant because I expect that if galaxy formation were inefficient in the Coma cluster, it must have been even less efficient in sparse groups.

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