THE ASTROPHYSICAL JOURNAL, 255:382–391, 1982 April 15

SYSTEMATIC PROPERTIES OF COMPACT GROUPS OF GALAXIES

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Received 1981 March 12; accepted 1981 October 30

ABSTRACT

One hundred compact groups of galaxies have been identified by a systematic search of the Palomar Observatory Sky Survey red prints. Each group contains four or more galaxies within a 3 mag range, has an estimated mean surface brightness brighter than 26.0 mag arcsec^{-1}, and satisfies an isolation criterion. An analysis of estimated galaxy magnitudes, morphology, and group angular size indicates: (1) There is no correlation between group density and magnitude difference between the first and second-ranked galaxies, and no preferred morphological type for the first-ranked galaxies, many of which are spiral. (2) The groups contain fewer spirals than a comparable sample of field galaxies. The spiral fraction decreases from 60% in the least compact groups to 20% in the most compact. Groups which contain a bright spiral are typically a factor of 2 less compact than groups which do not. (3) There appears to be a deficiency of faint galaxies in comparison with rich cluster and field galaxies. This apparent deficiency is more severe in groups with elliptical first-ranked galaxies. Possible implications of these results for dynamical evolution are considered.

Subject headings: galaxies: clusters of — galaxies: structure — luminosity function

I. INTRODUCTION

Small associations of galaxies apparently in close proximity (groups) have been the subject of much study. Vorontsov-Vel'yaminov (1959) and Arp (1966) have cataloged groups of interacting galaxies. Shakhbazyan and co-workers (see Baier and Tierch 1979, and references therein) have published extensive lists of compact groups of compact galaxies. By a systematic search of galaxies listed in Zwicky's (1961–1968) catalog, Turner and Gott (1976) defined a sample of groups free from statistical bias. However, with the exception of Rose's (1977) study of groups selected on the basis of surface density enhancement, there has been no systematic search for a complete sample of very *compact* groups. Previous investigations of properties of compact groups (Hickson, Richstone, and Turner 1977; Heiligman and Turner 1980) have thus been based on groups selected largely on the basis of their peculiar appearance.

In view of the statistical biases that may be introduced by sample selection effects, a systematic search was made of the Palomar Sky Survey prints in order to identify a uniform sample of compact groups. For each group galaxy magnitudes and morphological types were estimated, and a group classification was made on the basis of galaxy content. One hundred groups were found with an estimated mean surface brightness $\bar{\mu}_G$ brighter than 26.0 mag arcsec^{-1}. Of these, the 69 groups with $\bar{\mu}_G \leq 24.0$ and total magnitude $m_G \leq 13.0$ form a sample that should be substantially complete.

This paper presents the catalog of compact groups and describes systematic properties and morphological trends that these groups exhibit. These properties are then considered in the light of current thinking on dynamical evolution. It is hoped that this catalog will stimulate further observational and theoretical studies of the interesting properties of compact groups.

II. THE CATALOG

a) *Selection Criteria*

A compact group is defined here by the following criteria:

$$N \geq 4 \quad \text{(population)}, \tag{1}$$

$$\theta_N \geq 3\theta_G \quad \text{(isolation)}, \tag{2}$$

$$\bar{\mu}_G < 26.0 \quad \text{(compactness)}, \tag{3}$$

where N is the total number of galaxies within 3 mag of the brightest, $\bar{\mu}_G$ is the total magnitude of these galaxies per arcsec^2 averaged over the smallest circle (angular diameter θ_G) that contains their geometric centers, and θ_N is the angular diameter of the largest concentric circle that contains no other (external) galaxies within this magnitude range or brighter.

Criteria (2) and (3) effectively exclude clusters since a sufficiently compact collection of cluster galaxies can rarely be isolated. The magnitudes were estimated from the red (E) sky survey print, since the red luminosity of a galaxy should be more indicative of galaxy mass than the blue (O) luminosity and thus should be more appropriate for studies of dynamical evolution in groups.

TABLE 1

COMPACT GROUPS

Number (1)	α(1950) (2)	δ(1950) (3)	Type (4)	N_S (5)	N (6)	θ_G (7)	m_G (8)	m_a (9)	$\bar{\mu}_G$ (10)	z (11)	Names (12)
1........	$00^h23^m23^s$	+25°26′29″	SIII	1	4	2.9	12.8	13.8	23.7	...	UGC 248
2........	00 28 55	+08 09 19	SII	3	4	7.1	12.1	12.9	25.0	...	UGC 312
3........	00 28 55	−07 52 07	SII	2	4	3.8	12.3	13.0	23.8	...	
4........	00 31 46	−21 43 20	SI	1	5	3.6	12.5	13.0	23.9	...	
5........	00 36 19	+06 47 20	SII	1	4	1.6	12.5	13.3	22.1	...	NGC 190, UGC 397
6........	00 36 38	−08 40 12	EIII	0	4	1.6	12.3	13.4	21.9	...	
7........	00 36 50	+00 36 13	SII	2	4	5.7	11.4	12.1	23.8	...	NGC 192, UGC 401
8........	00 46 57	+23 18 31	EII	0	4	1.2	12.3	13.2	21.3	...	
9........	00 51 51	−23 49 20	EI	1	4	2.1	13.1	13.6	23.3	...	
10........	01 23 17	+34 25 53	SIII	3	4	10.9	10.1	10.9	23.9	...	NGC 536, UGC 1013
11........	01 24 11	−23 29 26	SI	3	4	4.9	12.1	12.5	24.2	...	
12........	01 25 02	−04 55 46	EI	0	5	2.6	12.9	13.4	23.6	...	
13........	01 29 52	−08 08 16	EII	0	5	2.5	13.3	14.0	23.9	...	
14........	01 57 18	−07 16 14	SIII	3	4	6.7	12.3	12.1	24.9	...	
15........	02 05 04	+01 54 04	EIII	0	6	7.7	11.7	13.3	24.8	...	UGC 1624
16........	02 07 06	−10 23 56	SIII	4	4	6.4	10.2	11.4	22.9	...	Arp 318, NGC 835
17........	02 11 24	+13 04 49	EIII	0	5	1.0	13.7	15.0	22.3	...	
18........	02 36 19	+18 10 05	SII	4	4	2.0	12.7	13.4	22.8	...	Arp 258, VV 143, UGC 2140
19........	02 40 21	−12 37 26	EIII	3	4	3.1	12.1	13.0	23.2	...	
20........	02 41 20	+25 53 31	SIII	2	6	1.5	13.0	14.5	22.5	...	
21........	02 42 58	−17 49 46	SIII	2	5	10.8	10.1	11.0	23.9	...	NGC 1099
22........	03 01 11	−15 52 14	EI	2	5	10.5	11.1	12.5	22.6	...	NGC 1199
23........	03 04 41	−09 46 38	SIII	5	5	7.1	11.2	12.1	24.1	...	NGC 1214
24........	03 17 55	−11 02 40	EII	0	4	2.4	12.7	13.6	23.2	...	
25........	03 18 11	−01 13 53	SIII	3	7	6.4	11.8	12.9	24.5	...	
26........	03 19 33	−13 49 27	SII	1	4	1.9	12.7	13.3	22.7	...	
27........	04 17 00	−11 49 46	SIII	2	5	3.8	14.0	15.1	25.5	...	
28........	04 24 57	−10 25 39	SI	1	4	1.2	13.2	13.7	22.2	...	
29........	04 32 49	−30 38 58	SII	1	4	0.8	14.8	15.5	22.9	...	
30........	04 33 58	−02 55 59	SIII	4	4	4.5	11.6	12.4	23.5	...	
31........	04 59 08	−01 19 42	SII	3	4	0.9	13.5	14.3	21.9	...	
32........	04 59 27	−15 29 29	EI	1	4	3.0	12.7	13.3	23.7	...	
33........	05 07 53	+17 58 25	EIII	1	4	2.1	12.4	13.5	22.6	...	
34........	05 19 06	+06 37 45	EI	2	4	1.2	12.7	13.1	21.7	...	Arp 327, VV 169, NGC 1875
35........	08 41 56	+44 42 14	SIII	2	6	2.2	12.4	13.6	22.7	...	
36........	09 06 37	+15 59 57	SI	4	4	1.9	12.5	12.9	22.5	...	IC 528, UGC 4811
37........	09 10 36	+30 13 16	EII	1	5	3.2	11.5	12.1	22.7	...	NGC 2783, UGC 4859
38........	09 24 56	+12 29 56	SIII	4	4	2.9	12.5	13.8	23.4	...	Arp 237, UGC 5044
39........	09 26 56	−01 07 30	EII	0	4	1.0	13.9	15.1	22.5	...	UGC 5057
40........	09 36 24	−04 37 32	EII	2	6	1.7	11.4	12.5	21.2	...	Arp 321, VV 116
41........	09 54 31	+45 28 41	SI	3	4	4.1	11.9	12.4	23.6	...	UGC 5345
42........	09 58 00	−19 24 31	EI	1	4	6.0	10.6	10.9	23.1	...	NGC 3091
43........	10 08 40	+00 12 55	SII	3	5	3.5	12.4	13.3	23.7	...	
44........	10 15 15	+22 03 46	SII	3	4	16.4	9.3	10.0	24.0	0.004	Arp 316, VV 307, NGC 3190, UGC 5559
45........	10 15 49	+59 21 38	SI	2	4	3.4	13.5	14.0	24.8	...	UGC 5564
46........	10 19 19	+18 04 03	EIII	0	4	3.6	12.3	13.8	23.7	...	
47........	10 23 08	+13 59 10	SI	2	4	2.3	12.5	12.9	22.9	...	UGC 5644
48........	10 35 24	−26 49 13	EI	1	4	5.0	11.6	12.1	23.7	...	
49........	10 53 18	+67 26 47	EII	0	4	0.9	14.4	15.2	22.8	...	
50........	11 14 14	+55 11 30	EII	0	5	0.7	14.4	15.5	22.3	...	

TABLE 1—*Continued*

Number (1)	α(1950) (2)	δ(1950) (3)	Type (4)	N_S (5)	N (6)	θ_G (7)	m_G (8)	m_a (9)	$\bar{\mu}_G$ (10)	z (11)	Names (12)
51	$11^h19^m42^s$	+24°34′03″	EII	1	6	4.5	11.5	12.6	23.4	...	NGC 3651, UGC 6388
52	11 23 41	+21 21 51	SI	4	4	3.2	12.8	13.4	24.0	...	
53	11 26 21	+21 03 07	SI	4	4	12.9	11.6	12.2	25.8	...	NGC 3697, UGC 6479
54	11 26 38	+20 51 15	EII	0	4	0.7	14.3	15.0	22.2	...	Rose 27, IC 700, UGC 6487
55	11 29 09	+71 05 17	EIII	2	5	0.9	13.4	14.9	21.8	0.052	Arp 329, VV 172, UGC 6514
56	11 29 47	+53 13 29	SIII	2	5	2.1	12.2	13.1	22.4	0.027	Arp 322, VV 150, UGC 6527
57	11 35 14	+22 15 43	SII	3	8	5.5	11.4	12.6	23.7	...	Arp 320, VV 282, UGC 6602
58	11 39 37	+10 35 40	SIII	4	5	8.8	12.5	13.5	25.9	...	NGC 3825, UGC 6668
59	11 45 51	+13 00 15	EIII	3	5	2.1	12.5	13.5	22.7	...	Rose 7
60	12 00 32	+51 58 17	EII	1	4	2.3	13.5	14.4	23.8	...	
61	12 09 52	+29 27 21	EIII	3	4	3.8	9.9	11.1	21.4	...	Rose 10, NGC 4169, UGC 7202
62	12 50 32	−08 57 10	EIII	1	4	3.7	11.6	12.4	23.1	...	
63	12 59 25	−32 29 58	SIII	4	4	2.9	13.1	13.9	24.0	...	
64	13 23 08	−03 35 53	SII	3	4	1.7	13.7	14.4	23.5	...	
65	13 27 06	−29 14 30	EI	0	5	1.7	12.7	13.6	22.5	...	
66	13 36 43	+57 33 28	EI	0	4	1.0	13.8	14.5	22.4	...	VV 135
67	13 46 26	−06 57 26	EIII	2	4	3.3	11.6	12.5	22.8	...	
68	13 51 34	+40 34 24	EII	2	5	9.2	9.5	10.5	22.9	0.008	NGC 5353
69	13 53 12	+25 18 26	SII	2	4	1.9	12.5	12.2	22.2	...	VV 281, UGC 8842
70	14 02 02	+33 34 01	SII	5	6	3.4	12.1	13.2	23.4	...	
71	14 08 48	+25 43 11	SI	3	4	5.0	12.8	13.3	24.9	...	IC 4381, UGC 9073
72	14 45 37	+19 16 02	EIII	0	5	1.8	11.9	13.2	21.8	...	Arp 328, VV 165, UGC 9532
73	15 00 27	+23 32 57	SI	4	5	4.8	12.5	13.0	24.5	...	Arp 42, VV 7, NGC 5839, UGC 9673
74	15 17 14	+21 04 27	EII	0	5	1.9	12.1	12.9	22.1	...	VV 139
75	15 19 20	+21 21 43	EIII	1	6	2.2	12.4	13.5	22.7	...	
76	15 29 15	+07 28 37	SIII	2	5	3.3	12.3	13.6	23.5	...	
77	15 47 06	+21 58 47	EIII	0	4	0.8	13.8	14.8	21.9	...	UGC 10049
78	15 48 15	+68 21 32	SIII	4	4	3.5	12.7	13.5	24.0	...	UGC 10057
79	15 57 01	+20 53 34	EIII	1	5	1.3	11.3	12.6	20.5	0.015	VV 115, NGC 6027, UGC 10116
80	15 58 44	+65 21 58	SII	4	4	1.7	12.6	13.3	22.4	...	
81	16 15 53	+12 54 54	EIII	0	4	0.9	13.3	14.5	21.7	...	UGC 10319
82	16 26 28	+32 55 59	EII	2	4	3.1	12.3	12.2	23.3	...	NGC 6162, UGC 10403
83	16 33 14	+06 22 17	EIII	0	4	1.9	13.8	14.8	23.8	...	
84	16 46 29	+77 55 31	EIII	3	6	2.4	13.5	14.7	24.0	...	
85	18 51 26	+73 17 19	EIII	0	4	1.3	12.8	13.6	22.0	...	
86	19 48 50	−30 57 18	EII	0	4	4.0	12.3	13.2	23.9	...	
87	20 45 20	−20 01 33	SI	2	4	1.5	12.4	12.9	21.9	...	
88	20 49 44	−05 56 49	SIII	4	4	5.2	11.3	12.2	23.5	0.020	NGC 6978
89	21 19 34	−04 07 17	SII	4	4	4.8	13.7	14.6	25.7	...	
90	21 59 11	−32 12 30	EIII	0	4	7.4	9.1	10.1	22.1	0.009	NGC 7172
91	22 06 22	−28 01 18	SI	3	4	5.2	11.7	12.3	23.9	...	
92	22 33 43	+33 42 23	SII	4	5	3.2	11.1	12.0	22.3	0.020[a]	Arp 319, VV 288, NGC 7320, UGC 12101
93	23 12 55	+18 42 37	EIII	2	5	9.0	10.9	12.0	24.3	...	Arp 99, NGC 7550, UGC 12456

TABLE 1—*Continued*

Number (1)	α(1950) (2)	δ(1950) (3)	Type (4)	N_S (5)	N (6)	θ_G (7)	m_G (8)	m_a (9)	$\bar{\mu}_G$ (10)	z (11)	Names (12)
94	$23^h14^m47^s$	+18°26′47″	EI	2	7	2.8	12.3	13.1	23.1	...	Arp 170, NGC 7578 UGC 12478
95	23 17 00	+09 13 05	EIII	3	4	1.5	11.9	13.1	21.4	...	Arp 150, VV 20, NGC 7609
96	23 25 26	+08 29 55	SII	1	4	2.3	11.5	12.0	21.9	...	Arp 182, VV 343, NGC 7674, UGC 12608
97	23 44 53	−02 34 60	EII	1	5	5.2	11.5	12.4	23.7	...	
98	23 51 39	+00 05 42	EII	0	4	2.4	11.5	12.2	22.0	...	Arp 323, VV 208, NGC 7783, UGC 12837
99	23 58 10	+28 06 38	SII	2	4	2.4	12.2	13.0	22.7	...	UGC 12896
100	23 58 47	+12 51 15	SI	4	4	3.6	11.5	12.1	22.9	...	NGC 7803, UGC 12906

[a] Redshift of galaxy b.

b) *Identification Procedure*

All Palomar Observatory Sky Survey red prints were systematically searched with a hand lens, and a list of candidate groups was prepared. These were then examined on both red and blue prints with a stereo microscope, and galaxies were compared with elliptical or spiral galaxies in the UGC (Nilson 1973) to determine estimated red (E) magnitudes. A $B-E$ of 1.9 for ellipticals and 1.5 for spirals was adopted in order to convert UGC B magnitudes to E. The average error in these estimated galaxy magnitudes is expected to be ~0.5 mag. Group angular sizes and coordinates and galaxy dimensions were measured on photographic enlargements. From the estimated magnitudes and angular sizes the mean surface brightness was computed for each group. Finally, the sample was restricted to those groups satisfying condition (3).

Each group galaxy was classified as elliptical, spiral, or other on the basis of morphological features, color, and sharpness of the edge of the image. Red lens-shaped galaxies and obvious S0s were classified as other. When spiral arms or H II regions were not distinguishable, spirals could often be recognized by the sharp edges of their images. These classifications agreed with those of Nilson (1973) for the 26 galaxies in common, with the single exception of UGC 12906 which we classified as spiral.

The estimated magnitudes for spiral galaxies were corrected for internal absorption by means of the inclination correction $A(i)=0.80\ \log\ (a/B)$ (de Vaucouleurs, de Vaucouleurs, and Corwin 1976), where a/b is the measured blue axial ratio.

Groups were given a type classification as follows:

S, if the brightest galaxy is a spiral;
E, if the brightest galaxy is not a spiral;
I, if $m_b - m_a \geq 1.0$;
II, if $0.5 \leq m_b - m_a < 1.0$;
III, if $m_b - m_a < 0.5$;

where m_a and m_b are E magnitudes of the brightest and second brightest galaxies, respectively. The number classification is intended to be similar to that of Bautz and Morgan (1970) for rich clusters.

c) *Completeness*

It is possible that some compact galaxies may have been mistaken for stars in the present catalog. It is very likely that some groups of compact galaxies have been overlooked, particularly in regions of high stellar density. The distributions of galaxy magnitudes, total magnitudes, and mean surface brightness suggests that the present sample is essentially complete to $\bar{\mu}_G \leq 24.0$ and $m_G \leq 13.0$. Sixty-nine groups satisfy both criteria. The statistical analyses that follow were done both for the full sample and the restricted sample of 69 groups. Since no significant differences were found between the two samples, the results presented here are those of the full sample of 100 groups.

No restrictions were placed on galactic latitude. Groups found near the galactic plane might thus be biased toward higher "intrinsic" surface brightness. However, excluding low latitude groups from the sample does not significantly change the results, and no corrections for extinction were made.

d) *The Compact Groups*

Data for 100 groups satisfying the selection criteria are presented in Table 1. Column headings are as follows:

Column (*1*).—Group number.

Columns (*2*)–(*3*).—Coordinates of the group: these are 1950 coordinates of the center of the circle enclosing the group.

Column (*4*).—Type: group classification as described in § II*b*.

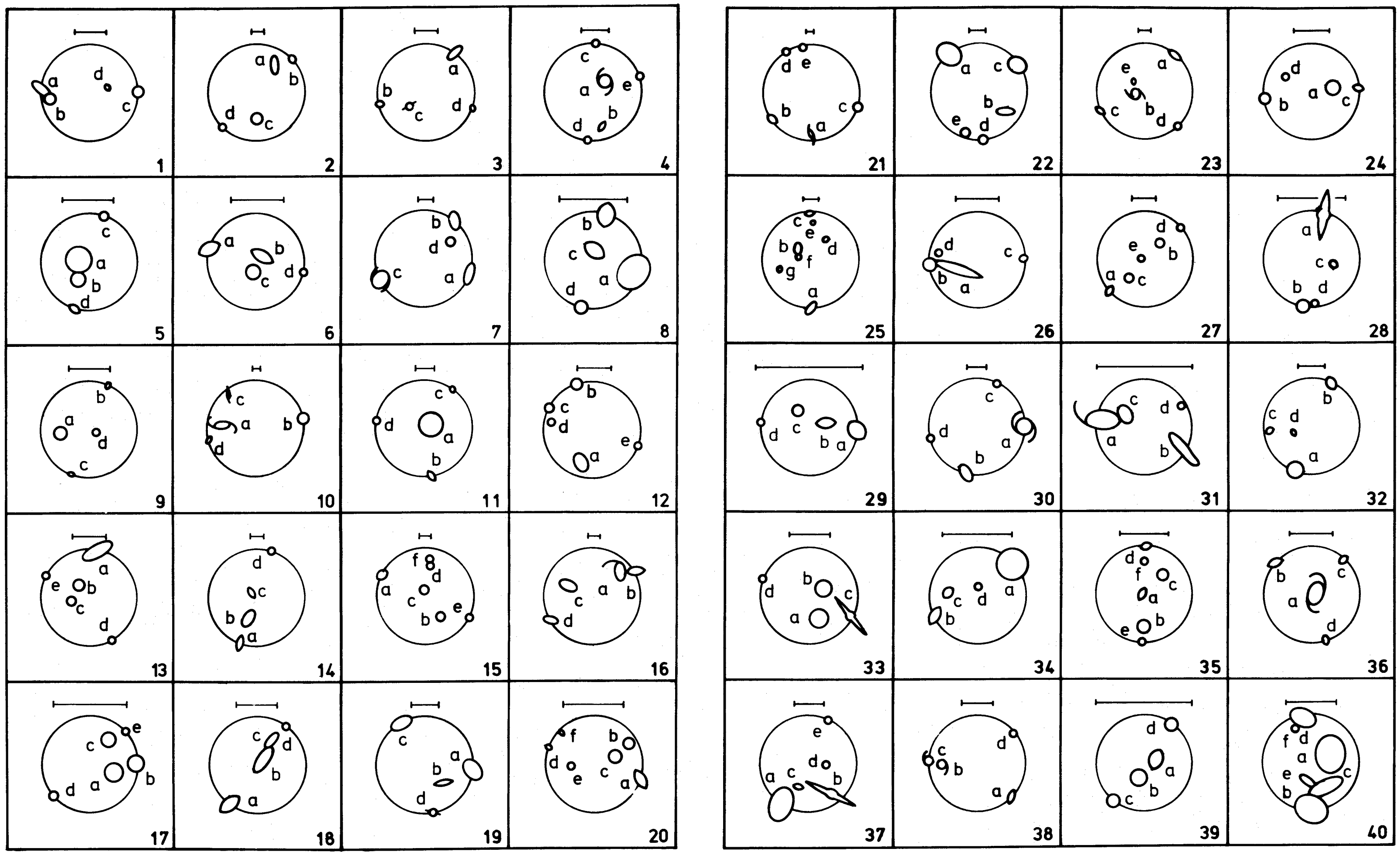

FIG. 1.—Galaxy identifications for compact groups. Groups are scaled to the same angular size; 1′ is indicated by a bar. North is up, and east is to the left.

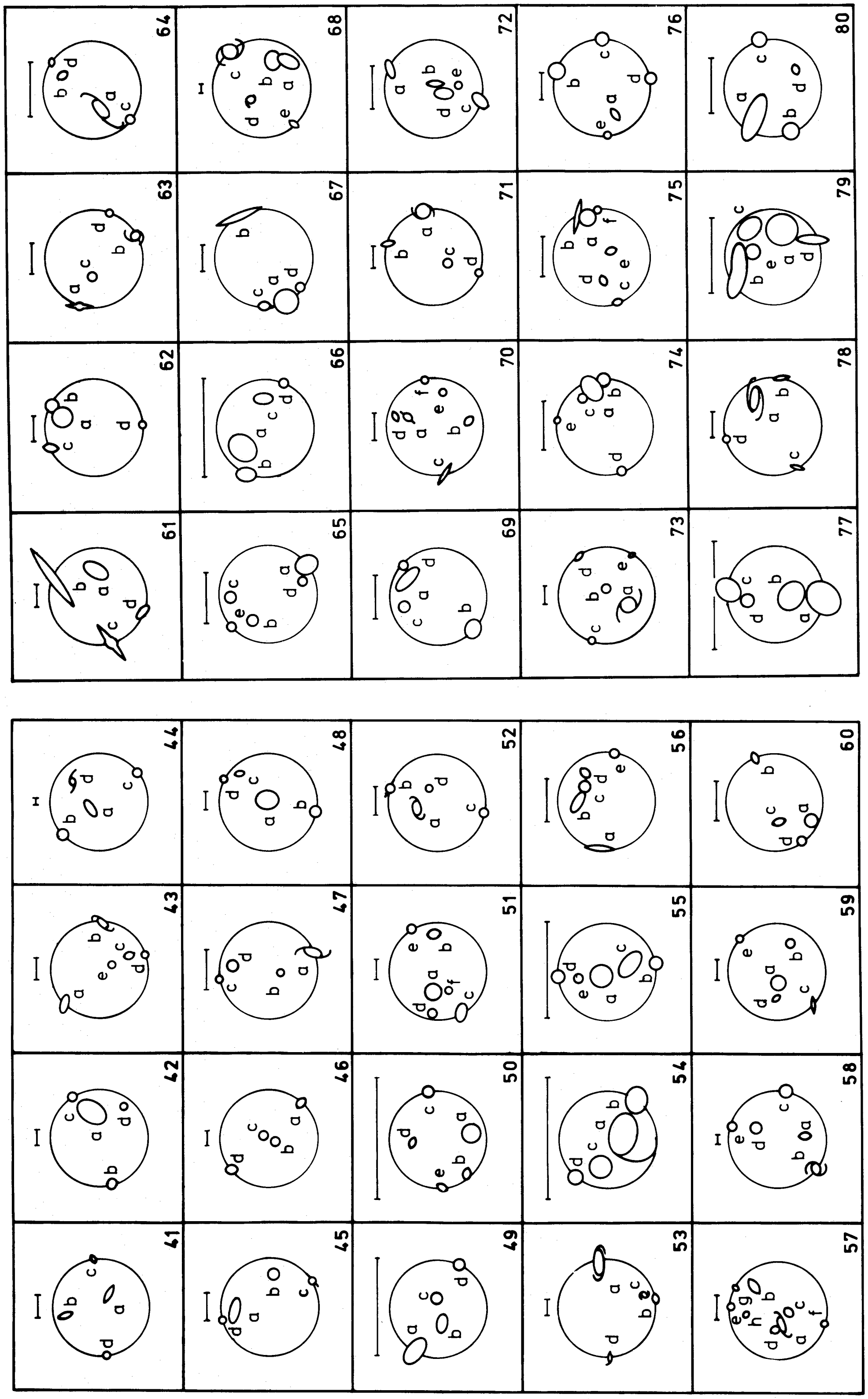

FIG. 1.—*Continued*

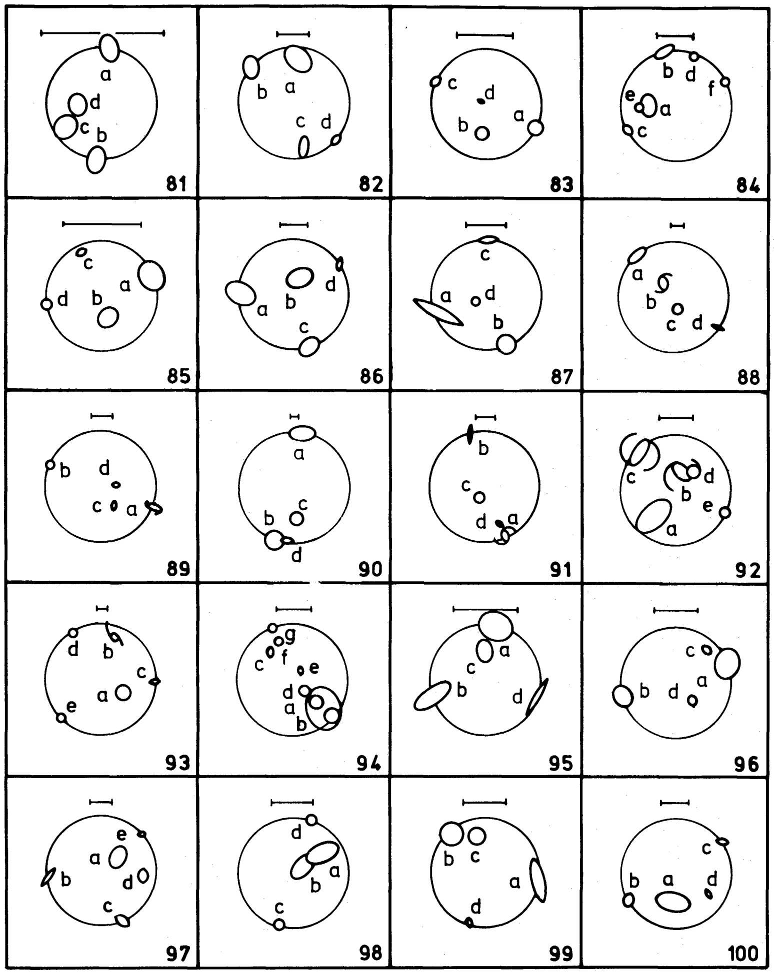

FIG. 1.—*Continued*

Column (*5*).—Number of spirals: the number of galaxies classified as spiral as described in § II*b*.

Column (*6*).—Number of galaxies: the number of galaxies in the brightest three magnitudes.

Column (*7*).—Angular size: angular diameter in arc minutes of the circle containing the group.

Column (*8*).—Total magnitude: total *E* magnitude of galaxies in the top three magnitudes.

Column (*9*).—Brightest galaxy: *E* magnitude of the brightest group galaxy.

Column (*10*).—Mean surface brightness: average *E* surface brightness as defined in § II*a*.

Column (*11*).—Redshift: corrected redshift of brightest galaxy.

Column (*12*).—Names: other designations.

The groups are illustrated schematically in Figure 1 as an aid to identification.

III. MORPHOLOGY

The catalog groups contain 451 galaxies which were classified as follows:

Spiral:	43%
Elliptical:	31%
Other:	26%.

"Other" includes S0s and lens-shaped galaxies without spiral structure or blue color; spirals include blue compact and irregular galaxies. Since ~75% of field galaxies are spiral or irregular (Gisler 1980), it is clear that *the fraction of spirals in compact groups is less than that in the field*. The distribution of galaxy types in a group correlates with mean surface brightness as shown in Figure 2. The mean fraction of spirals decreases from 77% in the least compact groups (lowest mean surface brightness) to 31% in the most compact. There are, however, highly

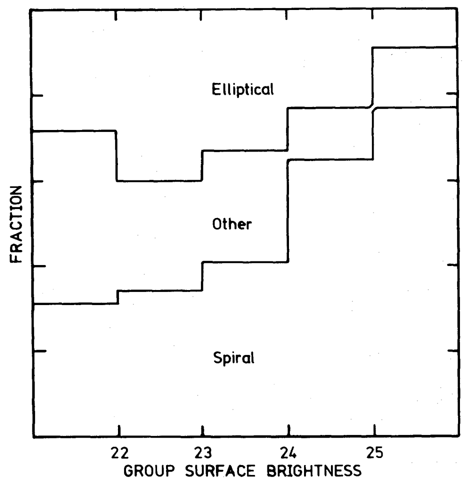

FIG. 2.—Distribution of galaxy types in groups binned according to mean surface brightness $\bar{\mu}_G$. The most compact groups have fewest spirals.

compact groups containing several spirals (groups 40 and 77 for example).

The brightest galaxies in each group show no preference for a particular morphological type and, in general, show no obvious peculiarities. Fifty-one groups were classified as S type, having a spiral first-ranked galaxy. Thus, approximately *half of all first-ranked galaxies in compact groups are spiral*, a fraction marginally (but not significantly) greater than that for faint galaxies.

The mean surface brightness for each group type is shown in Table 2. We see that the mean surface brightness of S-type groups is 0.84 mag lower than that of E-type groups. This spread is 6 times the standard error $\sigma/\sqrt{N}$ in each class and must be considered significant. This is the same trend as was seen in Figure 2. *Groups which contain bright spirals are on the average less compact than groups which do not.*

From Table 2 we also see that within the S and E types there is no significant variation of mean surface brightness with subtype. Because the subtypes reflect the magnitude difference between first-ranked and second-ranked galaxies, it follows that *there is no correlation between group compactness and the prominence of the first-ranked galaxy.*

TABLE 2
STATISTICS OF GROUP TYPES

Type	N	$\langle\bar{\mu}_G\rangle$	$\sigma/\sqrt{N}$
EI	10	22.97	0.21
EII	17	22.78	0.21
EIII	22	22.57	0.23
SI	14	23.71	0.30
SII	19	23.18	0.24
SIII......	18	23.82	0.22
All E ...	49	22.72	0.13
All S	51	23.56	0.15

IV. LUMINOSITY FUNCTION

As redshifts are not known for the majority of these groups, a direct determination of galaxy luminosities is not possible. If it is assumed that all members of a group are at the same distance, the ratio of each luminosity to that of the brightest (a quantity that is independent of distance) may be derived from the observed magnitude differences. The frequency with which a particular ratio occurs may then be compared with the frequency predicted by theoretical luminosity functions. This technique requires no knowledge or model of distances to the observed groups but assumes only that all galaxies (including the first ranked) are described by the same luminosity function. The results of this analysis for these groups is shown in Figure 3. The frequency of observed values of $m - m_a = 2.5 \log L_a/L$ is plotted in 0.5 mag bins for E-type and S-type groups. The curves are predictions of the Schechter (1976) luminosity function $f(L) \approx L^\alpha \exp(-L)$ for $\alpha = 0$, -0.5, and -1.0. They were computed by drawing luminosities at random from the theoretical distribution to make 5000 imaginary "groups" and then computing the corresponding distribution of magnitude differences.

E groups appear to contain fewer large magnitude differences than S groups—there is only a 1% probability (based on the Kolmogorov-Smirnov criterion) that the two distributions differ by chance. Since large magnitude differences result from faint galaxies (compared to the first ranked), it appears that *groups that contain a*

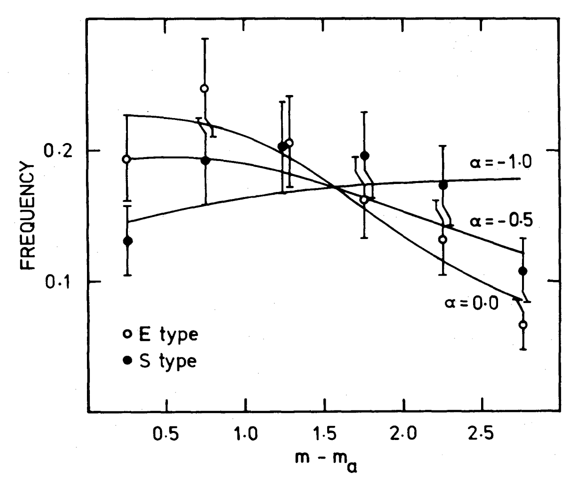

FIG. 3.—Distribution of relative galaxy luminosities. Points indicate the observed distribution of magnitude differences between the brightest galaxy (m_a) and other galaxies in each group. Error bars indicate 1 σ. Solid lines are the predicted distributions of luminosity ratios $2.5 \log L_a/L$ for the Schechter luminosity function $F(L) \approx L^\alpha \exp(-L)$.

bright elliptical galaxy tend to contain fewer relatively faint galaxies than do groups that contain a bright spiral galaxy. This effect might be seen if first-ranked spiral galaxies were systematically brighter than first-ranked ellipticals. The mean *m* for S-type groups is brighter than for E-type groups in this catalog, but by less than 0.3 mag. Both observed distributions, however, contain fewer large magnitude differences than the $\alpha = -1.0$ theoretical curve. This disagreement is only marginal for S-type groups, but is significant ($<10^{-3}$ chance probability) for the E-type groups. Since field and cluster galaxies are found to fit a luminosity function with $\alpha \lesssim -1.0$ (Felton 1977), we tentatively conclude that *compact groups contain relatively fewer fainter galaxies than does a comparable sample of field or cluster galaxies*. Although this result is very preliminary (a better determination can be made when redshifts are available), devised indicating the type and prominence of the brightest galaxy. A study of these data indicates:

V. SUMMARY AND DISCUSSION

One hundred compact groups of galaxies have been identified from the Palomar Observatory Sky Survey prints on the basis of high mean surface brightness and isolation. Galaxy magnitudes and morphological types were estimated and a group classification system was devised indicating the type and prominence of the brightest galaxy. A study of these data indicates:

1. The fraction of spiral galaxies in compact groups is less than that in the field.
2. Groups that contain a bright spiral galaxy are on the average significantly less compact than those that do not.
3. Half of all first-ranked galaxies are spiral.
4. There is no correlation between group density and the prominence of the first-ranked galaxy.
5. Compact groups appear to contain relatively fewer faint galaxies than does a comparable sample of field or cluster galaxies.
6. Groups that contain a bright elliptical galaxy appear to contain fewer relatively faint galaxies than groups that contain a bright spiral galaxy.

What are the implications of these results for our understanding of the formation and dynamical evolution of compact groups? Since the space density of galaxies in these groups is comparable to that in the center of great clusters, it is generally believed that the dynamical processes responsible for the peculiar characteristics of brightest cluster galaxies (Hoessel 1980) also operate in compact groups. McGlynn and Ostriker (1980) suggest that galaxy mergers have occurred in a sample of 21 Turner-Gott (1976) groups that they studied. Since the average galaxy density in the present catalog is an order of magnitude larger, effects of mergers should be evident here. We might expect that the first-ranked galaxy (the primary candidate for a merged galaxy) might have a different structure or morphology than the fainter galaxies and that the relative brightness of this galaxy might depend on the local space density of galaxies or, equivalently, on the compactness of the group. Some groups do contain an unusually large galaxy (group 22, for example), and some contain interacting or disrupted galaxies (groups 79, 92, 94, to name a few). However, the majority of the first-ranked galaxies appear to be quite normal, and there is no evidence of a correlation with group compactness as suggested above. Furthermore, if the first-ranked galaxies were products of mergers, the merging process would have to produce spiral galaxies with the same frequency that they are observed in fainter galaxies. We know of no numerical studies that regularly produce spiral galaxies from mergers and thus conclude that *there is no evidence that a large fraction of the first-ranked galaxies in these groups are products of galaxy mergers*.

There is little doubt that galaxy structure is being modified by encounters. Several galaxies appear to be disrupted or tidally extended, and many galaxies are compact or tidally truncated. These effects increase with group compactness as would be expected for a dynamical process. Perhaps when mergers occur, the group transforms itself relatively rapidly to a system or object that would not satisfy the compact group selection criteria.

The trend of decreasing spiral content with compactness may be due to galaxy interactions or conditions at the time of galaxy formation. Spiral structure might be destroyed by ram pressure stripping of gas during collisions (Spitzer and Baade 1951). However, several very compact groups contain many spirals which must have survived collisions. Of course, there may be fewer spirals in compact groups simply because conditions in protogroups somehow favored the production of gas-poor galaxies.

The apparent deficiency of faint galaxies in these groups is surprising. A possible cause is the effect of sample selection in which groups with fewer bright galaxies may not be as readily apparent on the sky survey prints. For this reason care was taken to examine galaxy pairs and triples for fainter members. The presence of foreground or background galaxies in the groups (groups 55, 79, and 92 contain a galaxy whose redshift is discrepant) does not explain the result since their effect is to increase the number of large magnitude differences. Correcting for them would then imply a luminosity function with even fewer faint galaxies.

Preferential destruction or ejection of fainter galaxies by interactions might produce the observed effect. In this case the extent of the faint galaxy deficit would be expected to correlate with group compactness. Since the observed effect is greater in E-type groups and these are, on average, more compact than the S types, such a correlation may exist. It will be important to obtain redshifts for as many groups as possible in order to better determine the luminosity function and any such correlations.

I thank J. Auman, J. Kormendy, P. Schecter, and S. White for helpful discussions. This work was supported by a Canada Council Killam Fellowship and by the Natural Sciences and Engineering Research Council of Canada.

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