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A SPECTROSCOPIC SURVEY OF SOME ZWICKY COMPACT GALAXIES

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ABSTRACT

Spectroscopic observations of 58 compact galaxies identified by Zwicky in two southern fields are described. Half of these show red continua and are either circular, lenticular, or elliptical in shape. They are apparently giant elliptical and S0 galaxies. The remaining blue and very blue galaxies, almost without exception, show emission features. Two of the objects are previously unreported Seyfert galaxies, and a further two appear to be very similar to the isolated extragalactic H II regions described by Searle and Sargent. A comparison of data for all the compact galaxies described here with Holmberg's photometry and dimensions of bright field galaxies suggests that the compacts do not have unusually high average surface brightnesses.

Subject headings: galaxies: photometry — galaxies: Seyfert — galaxies: structure

I. INTRODUCTION

W. L. W. Sargent has kindly made available to the authors finding charts and positions for two fields of the Palomar Sky Survey (plates PS E-1030 at 12^h04^m, $-18°31'$ and PS E-1061 at 13^h12^m, $-18°$) including objects which Zwicky had identified as compact galaxies in the sense defined by him in the foreword to his Catalog of Compact and Posteruptive Galaxies (1971). A total of 348 objects were identified in the 12^h field and 76 in the 13^h field. Of the former, on the basis of eye estimates of color from the PSS charts, 232 could be described as very red, 79 as red, 25 as blue, and 12 as very blue.

The initial intention was to observe all objects in the 13^h field without regard to color in order to obtain a luminosity function for the Zwicky galaxies. However, as noted above, a great preponderance of the objects, some 90%, were red or very red, and generally displayed spectra in which only the absorption lines were visible. With the rapidly deteriorating night-sky conditions at Mount Stromlo, it was found unprofitable to attempt observations of red galaxies fainter than $m_R = 16.5$ mag. Therefore, in the observations of the 12^h field it was decided to concentrate on those objects with blue and very blue continua. The crucial factor in this decision was the lack of suitable night-sky subtraction facilities available when the RCA C33063EP3 image tube was used. The survey is being continued in these fields with linear spectroscopic detectors. We believe it appropriate to present now the results obtained with the image tube. The selection of blue objects in the 12^h field led to an increased yield of measurable redshifts owing to the almost universal presence of emission lines and to a greater diversity of galactic luminosities and spectral characteristics. As will be emphasized later, the outstanding feature of the Zwicky compact galaxies is the great heterogeneity of galaxy types included in the sample.

II. OBSERVATIONS

We obtained 66 spectrograms of compact galaxies in the 12^h and 13^h fields using the Cassegrain spectrograph on the 74 inch (1.9 m) telescope at Mount Stromlo. Most of the spectrograms have a resolution of 7 Å at 20% modulation level and cover the wavelength range 3400–7000 Å. In some cases—II SZ 37, for example—spectrograms have a resolution of 3 Å and were obtained with varying slit orientation to determine the position angle of the rotational axis of the irregular object. In other cases—I SZ 63 and I SZ 182, for example—the slit was aligned with different parts of the object. Many of the spectrograms we obtained are of relatively low weight for the determination of redshifts, as the H and K lines of Ca II were displaced into the region of the Hg I λ4046 (city-lights emission) line. In these cases, in which reliance on the weaker Mg I *b* and Na I D lines was necessary, large probable errors resulted, which in the bad cases are as great as 350 km s^{-1}.

In Tables 1 and 2 we present the positions for epoch 1950.0 (which, as they are accurate to 30″, have been found adequate for locating the source at the telescope), an estimate of the color based on the continuum energy distribution of the spectrum as seen on the spectrograms and based on the appearance on the blue and red PSS charts, the dimensions of the galaxy (based on the PSS charts), a description of the spectral features detected and used in redshift determination, the heliocentric velocity and its standard deviation, a description of the shape of the object, and an estimate of the red magnitude of the galaxy. The sources of the magnitudes are threefold. Magnitudes for the blue compacts were taken largely as the magnitude at 6500 Å of the continuum inside a 30″ diameter aperture using the Stromlo multichannel scanner. For some red and blue compacts, these results were augmented with *UBVR* photometry. These data were used

TABLE 1

SPECTROSCOPIC OBSERVATIONS OF BLUE COMPACT GALAXIES IN SOUTHERN ZWICKY FIELD NUMBER I

Galaxy	(1950.0) R.A.	Dec.	Continuum Color	Dimensions (arc sec)	Dimensions (kpc)	Spectrum, Emission, E Absorption, A	Identified Lines	Radial Velocity Helio-Centric (km s^{-1})	Standard Deviation (km s^{-1})	Shape	m_R
I SZ 15a	$11^h53^m.0$	$-19°15'$	Blue		8 x 6	E,A	[OII],CaII H,K	18,000:	250	Elliptical	16.4
I SZ 18	$11^h52^m.8$	$-18°34'$	Blue		4.3	E		7,050:	210	Irregular	15.4
I SZ 23	$11^h53^m.6$	$-18°42'$	Blue		4.0	A		9,900:	400	Spherical	16.6
I SZ 37	$11^h51^m.9$	$-16°13'$	Blue		4.1	E	Hβ,[OIII], [OII]	6,593	120	Spherical	16.0
I SZ 38	$11^h53^m.1$	$-16°09'$	Blue		3.2 x 2.7	E	Hα, Hβ, [OII],[OIII] [NII]	6,671	89	Elliptical	16.2
I SZ 54	$11^h54^m.4$	$-20°20'$	Very Blue		5.0	E	Hα, Hβ, [OII] [NII], Hγ, [OIII]	9,314	162	Elliptical	16.9
I SZ 57	$11^h54^m.4$	$-19°35'$	Blue	8 x 7		A	Unidentified absorption lines present	-	-	Elliptical	16.6
I SZ 59	$11^h54^m.9$	$-19°20'$	Blue		1.4	E	Hα, Hβ, Hδ, Hε	1,781	41	Spherical	15.5
I SZ 60	$11^h55^m.8$	$-19°15'$	Blue		1.4 x 1.0	E	Hα, Hβ[OIII], [OII]	1,491	86	Spherical (extension to N.E.)	15.5
I SZ 63	$11^h56^m.4$	$-18°45'$	Blue		1.1 x 1.5	E	Hα, Hβ, Hδ, Hε, H	1,016	47	Elliptical (double nuclei)	15.1
I SZ 74	$11^h55^m.6$	$-17°37'$	Blue		1.0 x 1.7	E	Hα, β,	2,374	76	Elliptical (significant halo)	15.9
I SZ 80	$11^h54^m.8$	$-16°58'$	Blue	12 x 17		Continuum only		-	-	Elliptical (strongly asymmetric nucleus	15.4
I SZ 91	$11^h57^m.2$	$-21°06'$	Blue		2.2 x 1.1	E	Hα, Hβ, [OIII], [OII] [NII]	2,800	143	Elliptical bar in p.a. 135°	14.8

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TABLE 1—*Continued*

Galaxy	R.A. (1950.0)	Dec. (1950.0)	Continuum Color	Dimensions (arc sec)	Dimensions (kpc)	Spectrum Emission, E Absorption, A	Identified Lines	Radial Velocity Heliocentric (km s^{-1})	Standard Deviation (km s^{-1})	Shape	m_R
I SZ 94	$11^h58^m.6$	$-20°52'$	Blue			Continuum only		-	-	Spherical	17.0
I SZ 96	$11^h58^m.1$	$-20°34'$	Blue		24.6 x 18.8 x 7.2	E	Hα, Hβ, [OIII], [OII]	18,639	142	Irregular	14.7
I SZ 105	$11^h58^m.5$	$-19°43'$	Blue	16 x 10		Continuum only		-	-	Elliptical	16.5
I SZ 108A	$11^h57^m.3$	$-19°01'$	Blue		9.7 x 10.2	E	Hα, [NII]	6,260	230	Irregular, low surface brightness	14.8
I SZ 109	$11^h57^m.0$	$-18°59'$	Blue		12.3 x 10.1	E,A	Hα, Hβe,a	1,563	58	High Surface Brightness	11.6
I SZ 114	$11^h58^m.5$	$-17°41'$	Blue		16.2	E	Hα, [OII]	17,380	146	Elliptical, light	15.4
I SZ 122	$11^h57^m.9$	$-15°42'$	Blue		3.8 x 3.1	E	Hα, Hβ, Hδ [OIII], [OII]	1,604	130	S Ba(s)	13.2
I SZ 143	$12^h00^m.8$	$-18°59'$	Very Red			Continuum only		-	-		16.8
I SZ 182	$12^h01^m.9$	$-18°15'$	Blue		15.5 x 5.5, 22.2 apart	E	Hα, Hβ, Hδ [SII], [OIII], [OII]	14,508	72	Irregular, Double nucleus	16.0
I SZ 369	$12^h16^m.4$	$-19°43'$	Blue		12 x 8	A	CaII, H, K, CHg, MgIb	6,000	210	Elliptical	13.2
I SZ 371	$12^h14^m.2$	$-19°53'$	Blue		7.2 x 5.8	E	Hα, [OIII], [OII], [SII]	11,600	300	Spherical	16.5
I SZ 399	$12^h17^m.4$	$-17°07'$	Blue		1.2 x 0.8	E	Hα, Hβ, [OIII], [OII] [SII], [NII]	900	120	Elliptical	14.2

Notes to Table 1

I SZ 15A 15A is the brighter of a pair of compact ellipticals 30″ apart. 15B is in p.a. 40°. [O II] is very weak.

I SZ 18 No emission or absorption lines apart from weak Hα were detected at a resolution of 8 Å.

I SZ 23 A high-surface-brightness object, but our spectrum shows only very weak absorption near λ4080, which we tentatively attribute to Ca II H and K.

I SZ 37 A high-surface-brightness object with medium-strength Balmer-line emission. (Hβ) = ([O II]) ≫ ([O III]).

I SZ 38 Moderate-strength Balmer emission on a blue continuum; ([O III]) > ([O III]) > (Hβ) > ([O III]).

I SZ 54 Relatively weak, sharp Balmer and forbidden-line emission; ([O II]) > (Hβ) = ([O III]).

I SZ 57 A peculiar absorption spectrum, with a strong absorption line at λ = 4160 Å and a weak line at λ = 4020 Å. There is a suggestion, with a signal-to-noise ratio of 1, of emission at λ3901, but no Balmer emission is seen at the redshifted velocity of 14,000 km s^{-1} if the emission is identified as [O II].

I SZ 59 Strong sharp lines on a very blue continuum. The emission spectrum is characteristic of a high-excitation H II region and bears great similarity to the "isolated extragalactic H II regions" of Searle and Sargent.

I SZ 60 Medium-strength emission lines on an only moderately blue continuum: ([O II]) = ([O III]) > (Hβ).

I SZ 63 Strong sharp lines on a very blue continuum. While He I λ5876 is not visible because of Na I contamination, [Ne III] λ3869 is present. This object is unique in that the maximum intensity of the continuum is displaced by 20″ from that of the lines. A considerable body of spectrophotometric data and a more extensive analysis of I SZ 63 and 59 will be presented in a later paper; I SZ 63 is classifiable as an isolated extragalactic H II region.

I SZ 74 A moderately blue continuum; (Hβ) = ([O III]) < ([O II]). This galaxy has a significantly bright halo in contrast to most blue Zwicky objects.

I SZ 80 While the galaxy outline is elliptical, the brightness distribution is strongly asymmetrical. The continuum, in which we could detect no lines, is moderately blue.

I SZ 91 The outline of the galaxy is elliptical, but there is a pronounced bar in p.a. 135° with spiral arms at each end of the bar.

I SZ 94 A stellar appearance at the telescope and an only moderately blue continuum. Absorption features due to sky, or to an F-type star, appear in the continuum.

I SZ 96 A class 1 Seyfert-type spectrum, with [O III] and [O II] relatively sharp (~400 km s^{-1} wide) and Hα and Hβ broad (3000 km s^{-1} total width). The galaxy has an irregular outline of reasonably uniform brightness and does not show any marked spiral features.

I SZ 108A A blue continuum. There appears to be a weak, unidentified emission feature at 5370 Å.

I SZ 109 NGC 4027, studied by de Vaucouleurs, de Vaucouleurs, and Freeman (1968). Our velocity is consistent with their measurement of the velocity and its dispersion in the galaxy.

I SZ 114 Elliptical in outline with a slight flare to the east. Balmer emission is very weak, and ([O II]) ≫ ([O III]).

I SZ 122 An asymmetric barred spiral. The emission originates largely in the arms, but the continuum of the nucleus is blue. In the SW arm ([O III]) > ([O II]), but in the nucleus ([O II]) > ([O III]).

I SZ 182 Complex in structure. The northern part shows only very weak Hα emission on a very blue continuum. The southern part shows strong emission of the Balmer series, [S II], [O III], and [O II]. There is a differential velocity of 700 ± 200 km s^{-1} between the two components. In the southern part [O III] λ4363 is very weak. Extensive spectrophotometry of this object will be presented in a later paper.

I SZ 369 While the PSS charts suggest that this object is blue, our observations of the spectrum show it to have a red continuum and absorption-line strengths typical of an elliptical galaxy. The surface brightness is not symmetrical, and there is an indication of spiral structure.

to directly relate eye estimates of the interpolated brightness of the remaining red compacts. We believe these magnitudes to be correct to ±0.5 mag and in most cases to be much better. The red magnitude system of the PSS was used because it enabled a comparison of emission-line and non–emission-line galaxies to be made without precise knowledge of emission strengths and because at the high galactic latitude of the two fields ($b \approx 45°$) absorption corrections to the red apparent magnitudes could be neglected. The effect of a fixed aperture of 30″ diameter was corrected for by using a growth curve kindly supplied by N. Visvanathan, with effective diameters taken from the PSS charts to an estimated limiting brightness of $m_R = 24.0$ mag arcsec^{-2}. Redshift effects on the magnitudes are small. The red magnitudes were taken as the continuum brightness between 6500 and 6600 Å in the galaxy rest frame; the bandwidth effect, $2.5 \log (1 + z) \leq 0.07$ mag, was neglected.

Descriptions of the peculiarities of each object and its spectrum are given in more detail in the notes to Tables 1 and 2. In the tables and notes, reference is made to projected dimensions in kiloparsecs. The derivation of the distance and of the projected dimensions is based on a value $H_0 = 75$ km s^{-1} Mpc^{-1}, so that the derived luminosities and dimensions in our sample of galaxies are directly comparable to those described by Sargent (1970). Galactocentric velocities were used in the distance calculations.

III. SURFACE BRIGHTNESS

The question of the definition of compact galaxies and compact parts of galaxies given by Zwicky is discussed by Sargent (1970) and Kormendy (1977*a*, *b*); the Kormendy studies are concerned almost exclusively with red compact galaxies. Kormendy explicitly discusses the question of the global properties of the red compacts; he concludes that the red compacts are qualitatively E and S0 galaxies having mean brightnesses within the 23.0 mag arcsec^{-2} contour which are normal. Our data are not so intensive as those of Kormendy, but we can also use them to compare the mean properties of blue and red compacts with those of ordinary early-type systems. Zwicky (1971) defined compacts as having parts where the surface brightness exceeds 20 mag arcsec^{-2}; but as Kormendy remarks in his study of the luminosity profiles of the red objects, the surface brightness at the center of these objects exceeds 20 mag arcsec^{-2}, as it also does in

TABLE 2

Spectroscopic Observations of Red Compact Galaxies in Southern Zwicky Field Number II

Galaxy	R.A. (1950.0)	Dec. (1950.0)	Continuum Color	Dimensions (arc sec) (kpc)	Spectrum Emission, A Absorption, E	Identified Lines	Radial Velocity, Heliocentric (km/s)	Standard Deviation (km s^{-1})	Shape	m_R
II SZ 1	$13^h06^m.0$	$-10°45'$	very red	9.8	A	CaII K,H,CHg,	21129	150	Circular	16.5
II SZ 2	$13^h05^m.7$	$-11°08'$	red	5.5	A	CHg,	11900	300	Circular	16.6
II SZ 3	$13^h05^m.7$	$-11°33'$	red	8.3 x 6.5	A	CaII K, H, CHg, Mglb, NaID	11246	130	Elliptical	15.8
II SZ 4	$13^h05^m.5$	$-12°42'$	very red	6.6	A	CaII K, H	12335	300	Circular	15.9
II SZ 6 } NGC 4984 }	$13^h06^m.3$	$-15°14'$	blue	4.7 x 5.2	A E	CaII, K, H, CHg, Hα, [NII]	1233	160	Lenticular	11.8
II SZ 8	$13^h09^m.8$	$-15°31'$	red	7 x 19.5	A	CaII K, H	6400	500	Lenticular	12.9
II SZ 10	$13^h10^m.5$	$-10°52'$	very blue	6.3	E	Hα, Hβ, [NeIII], [OIII], [OIII]	10210	350	Circular	15.9
II SZ 11	$13^h10^m.6$	$-15°05'$	red	9.3	A E	CaII K, H, CHg, [OII]	11965	150	Circular	15.4
II SZ 12	$13^h11^m.2$	$-11°52'$	red	20.2 x 8.1	A	CaII K, H	14147	650	Elliptical	15.3
II SZ 13	$13^h11^m.8$	$-12°15'$	red	14.5	A	CaII K, H, Mglb	23085	210	Circular, slight flare to north	15.7
II SZ 15	$13^h12^m.3$	$-13°15'$	red	14.1 x 18.5	A	CaII K, H,	13867	500	Elliptical	15.2
II SZ 17	$13^h13^m.6$	$-14°53'$	red	7.4	A	CaII K, H,	9580	400	Circular	15.6
II SZ 18	$13^h13^m.9$	$-15°01'$	red	11 x 9.5	A	CaII K, H	10282	500	Elliptical	14.7
II SZ 19	$13^h12^m.9$	$-14°18'$							Star superimposed on galaxy	
II SZ 22	$13^h12^m.7$	$-10°19'$	red	12.1 x 10	A	CaII K, H	14163	300	Elliptical	15.6
II SZ 25	$13^h13^m.9$	$-13°24'$	red	7.0	A	CaII K, H, CHg, Mglb	6405	110	Circular	15.1
II SZ 32	$13^h15^m.7$	$-12°42'$	red	5.0 x 5.8	A E	CaII K, H, CHg, [OII]	10638	85	Elliptical	16.3

TABLE 2—*Continued*

Galaxy	R.A. (1950.0)	Dec. (1950.0)	Continuum Color	Dimensions (arc sec)	Dimensions (kpc)	Spectrum Emission Absorption	Identified Lines	Radial Velocity Heliocentric (km/s)	Standard Deviation	Shape	m_R
II SZ 33	$13^h16^m.9$	$-14^\circ30'$	red		13.0	A	CaII K, H, CHg, Mglb, NaID	10452	295	Circular	14.4
II SZ 34	$13^h16^m.8$	$-14^\circ52'$	blue		1.9 x 3.0	E	Hα, Hβ [OII], [OIII],	2832	120	Elliptical	15.5
II SZ 36	$13^h17^m.7$	$-12^\circ49'$	red		5.4 x 9.7	A E	CaII K, H, CHg, [OII]	7000	200	Elliptical	14.5
II SZ 37	$13^h18^m.4$	$-12^\circ12'$	blue		1.7 x 0.8	E	Hα, Hβ, Hγ [OIII]	2268	80	Irregular	
II SZ 38	$13^h18^m.5$	$-10^\circ38'$	red		7.0 x 5.6 (nucleus) 14.0 x 10.5 (halo)	A	CaII K, H	8990	500	Elliptical with faint extended halo	15.7
II SZ 39	$13^h18^m.5$	$-13^\circ23'$	red		4.5 x 5.5	A	CaII K, H, CHg,	6538	500	Elliptical	15.6
II SZ 40	$13^h20^m.2$	$-11^\circ06'$	blue		7.8 x 9.5	E	Hα, Hβ [OII], [OIII]	7174	154	Elliptical	14.5
II SZ 41	$13^h20^m.7$	$-11^\circ05'$	blue		11 x 4.9	E	Hβ, Hδ [OII], [OIII]	7180	200	Elliptical	14.9
II SZ 43	$13^h21^m.3$	$-10^\circ24'$	blue/red		3.2 x 7.5	A	CaII K, H, Mglb, NaID	2939	250	Lenticular	13.1
II SZ 44	$13^h23^m.2$	$-14^\circ03'$	red		8.1 x 8.9	A	CaII K, H, CHg, Mglb	10384	380	Nearly Circular	15.3
II SZ 45	$13^h22^m.8$	$-12^\circ53'$	red		4.8 x 5.9	A	CaII K, H, CHg,	6882	400	Elliptical	15.3
II SZ 47	$13^h23^m.3$	$-11^\circ55'$	red		7.5 x 9.5	A	CaII K, H, CHg, Mglb, NaID	6477	240	Elliptical	14.2
II SZ 49	$13^h24^m.4$	$-11^\circ19'$	red		3.3 x 2.9	A E	CaII K, H, Mglb [OII]	4300	200	Elliptical	15.2
II SZ 50	$13^h24^m.9$	$-12^\circ14'$	red		5.0	A	CaII K, H, CHg,	5838	500	Circular	15.0
II SZ 51	$13^h25^m.4$	$-11^\circ50'$	red	13 x 15.5		continuous spectrum				Elliptical	15.4
II SZ 66	$13^h28^m.5$	$-13^\circ02'$	red		9.0 x 8.1	A	CaII K, H, CHg, , NaID	11599	1000	Elliptical	15.4

NOTES TO TABLE 2

II SZ 1	Very red E0 galaxy.
II SZ 3	Red E2 galaxy.
II SZ 4	E0 galaxy with a very red continuum. Only Ca II H and K lines were measurable.
II SZ 6	NGC 4984. It is lenticular in appearance and is classified by de Vaucouleurs, de Vaucouleurs, and Corwin (1976) as S0 ($T = -1$). The heliocentric velocity measured by us agrees well with the value $v_H = +1259$ km s^{-1} given by Sandage (1971). The spectroscopic continuum is relatively blue.
II SZ 8	Lenticular galaxy with red continuum. The only lines measurable were Ca II H and K.
II SZ 10	The image of this very blue Seyfert galaxy is nearly circular. There is a faint flare to the SW. Sharp (800 km s^{-1} FWHM) emission lines of [Ne III] and [O III] are visible, while the Balmer lines have a characteristic width of 2100 km s^{-1}.
II SZ 11	This E0 galaxy has a red continuum, with the lines of [O II] λ3727 visible.
II SZ 12	This lenticular galaxy has a red spectroscopic continuum.
II SZ 13	E0.
II SZ 15	E2.
II SZ 17	E0.
II SZ 18	E2.
II SZ 19	At the resolution of the PSS plates, a star is superposed on the galaxy, and no spectrum uncontaminated by starlight was obtainable with the 1.9 m telescope.
II SZ 22	E1 galaxy with red continuum. Only Ca II H and K were measurable.
II SZ 25	E0.
II SZ 32	This E1 galaxy has a red continuum with weak [O II] λ3727.
II SZ 33	This E0 galaxy has a red continuum.
II SZ 34	This elliptically shaped galaxy has a blue continuum with no obvious absorption lines; the emission lines are sharp (FWHM ≤ 200 km s^{-1}).
II SZ 36	Lenticular galaxy with red nucleus; faint extensions SE and NW. Sharp [O II] λ3727 emission is visible.
II SZ 37	A blue triangular galaxy. The emission lines, in which I([O II]) ≈ I(Hβ) ≈ I([O III]), are tilted on unwidened spectra with a maximum velocity gradient in p.a. 45° ± 20°. The continuum is blue, and no absorption lines have been detected.
II SZ 38	An elliptical nucleus and a faint, extended elliptical halo. The spectroscopic continuum is red; only Ca II H and K were measurable.
II SZ 39	E3.
II SZ 40	This blue elliptical galaxy appears to have uniform surface brightness. The emission lines of the Balmer series as well as [O III] and [O II] are sharp. I([O II]) > I(Hβ) ≫ I([O III]).
II SZ 41	This galaxy appears to be very similar to II SZ 40, having an identical redshift, a similar blue continuum, a similar degree of excitation of the emission spectrum, and a similar near-uniformity of surface brightness. The equivalent widths of all emission lines in II SZ 41 are greater than in II SZ 40.
II SZ 43	This lenticular galaxy has a *relatively* blue continuum and high surface brightness.
II SZ 44	E2.
II SZ 45	E1.
II SZ 47	This E2 galaxy has a red continuum and a fainter irregular companion 25″ to the NE.
II SZ 49	E2.
II SZ 50	E0.
II SZ 51	The red continuum of this E1 elliptical shows no measurable absorption lines.
II SZ 66	E2.

most nondwarf elliptical and lenticular galaxies. The question to be addressed is not only whether Zwicky's criterion of high surface brightness at some location in a galaxy is met in practice but also whether such a criterion differentiates between compact galaxies as a class and the majority of objects, say, those listed in the Shapley-Ames catalog. Holmberg (1966, 1975) has presented a relation between the maximum linear dimension and the absolute magnitude within a limiting isophote of $m_{pg} = 26.5$ mag arcsec^{-2}. Following the precepts of de Vaucouleurs, de Vaucouleurs, and Corwin (1976), one can correct this relation to a limiting surface brightness of $m_R = 24.0$ mag arcsec^{-2}, which we estimate to be that of the PSS film copies.

In Figure 1*a* we plot the absolute red magnitude against the largest projected dimension for the blue

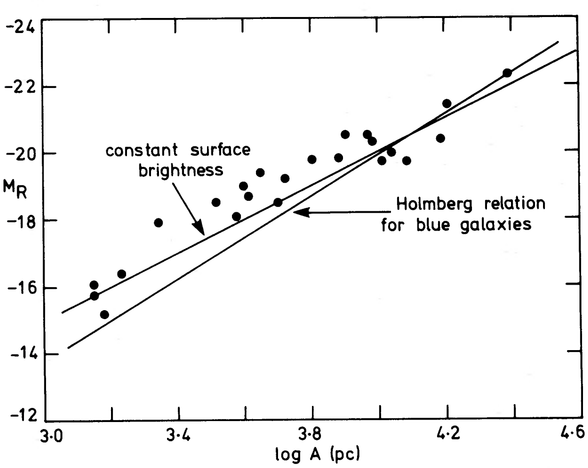

FIG. 1*a*

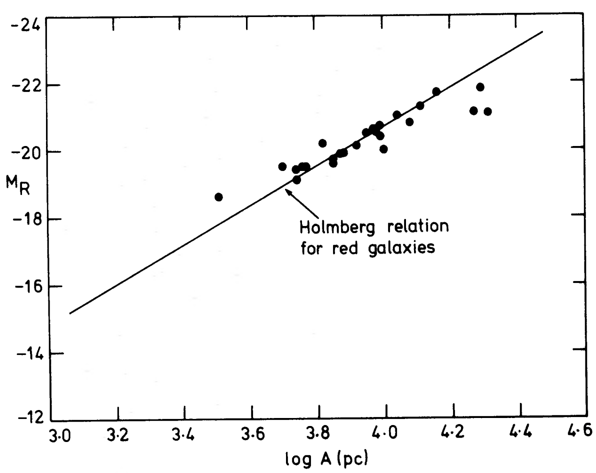

FIG. 1*b*

FIG. 1.—(*a*) The absolute red magnitude M_R for the blue compact galaxies plotted against log A, where A is the largest dimension of each object. No correction has been made for Galactic absorption. The solid lines represent constant surface brightness and the Holmberg relation for field galaxies corrected for the $B - R$ color of the blue galaxies and a limiting surface brightness of 24.0 mag. (*b*) M_R for the red compact galaxies plotted against log A. The solid line represents the corrected Holmberg relation.

galaxies, and in Figure 1*b* we plot the same quantities for the red galaxies. The blue galaxies, ranging in type from the isolated extragalactic H II regions at the low-luminosity end to Seyfert galaxies at the high-luminosity limit, demonstrate the heterogeneity of the compact galaxy sample. It appears that, on average, these galaxies are a little brighter than the "normal" galaxies defining the Holmberg relation. Indeed, there is an indication that the blue galaxies define a line of constant surface brightness. While the range in intrinsic luminosities is smaller than that for the blue galaxies, the red compact galaxies appear to follow the Holmberg relation very closely. The transformation of the Holmberg relation to red magnitudes was made through the results of photometry by Sandage and Visvanathan (1978) for E and S0 galaxies, while for the blue galaxies multichannel scanner observations were used to determine $B - R_R$ colors for the least luminous objects ($B - R_R = 0.3$) and for the high-luminosity galaxies ($B - R_R = 0.5$). Figure 1*b* supports the results of Kormendy (1977*a*, *b*) in their suggestion that there is nothing unique in surface brightness in the red compact galaxy sample. The mean red surface brightness represented by the galaxies in Figure 1*b* is about 20.7 mag arcsec^{-2} within the 20.4 mag arcsec^{-2} isophote. No lenticular galaxies with early-type spectra, the prototypes of which were discovered by Kormendy (1977*a*), were found in our survey.

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