

## SEARCH FOR FAINT COMPANIONS TO M31

SIDNEY VAN DEN BERGH\*

David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada

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### ABSTRACT

Three faint objects that are probably Sculptor-like dwarf galaxies have been found near the Andromeda Galaxy. If these objects are at the same distance as M31, they have  $M_V \approx -11$  and  $0.5 \leq D(\text{kpc}) \leq 0.9$ .

### I. INTRODUCTION

Two dwarf spheroidal galaxies (Draco and Ursa Minor) are known to be located within 70 kpc. It seems highly probable that these objects are satellites of the Galaxy.<sup>1</sup> This suggests that it might be worthwhile to search for dwarf spheroidal galaxies associated with M31.

### II. OBSERVATIONS

Casual inspection of the prints of the *Palomar Sky Survey* did not reveal any objects with images similar to those expected for distant dwarf spheroidal galaxies. It was therefore decided to rephotograph M31 and its surroundings on IIIa-J emulsion (Marchant and Millikan 1965), which makes it possible to record much fainter objects than can be detected on the 103a-O plates that were used for the *Palomar Sky Survey*. A set of nine  $14 \times 14$  in. ( $36 \times 36$  cm) IIIa-J + Wratten 2C plates of M31 and its surroundings was therefore obtained with the 48-inch (126 cm) Schmidt in 1970. A second set of IIIa-J plates of the same area (see Fig. 1) was obtained in 1971 October. The total area covered by these nine plates amounts to about 350 square degrees.

Three faint smudges with a very low central concentration of light were found in the area surveyed during the present investigation. The appearance of these images is very similar to that of the Sculptor and Fornax systems on plates obtained with the Mount Stromlo 8-inch (20 cm) Schmidt, which were kindly loaned to me by Dr. David Sher. Data on the three probable dwarf spheroidal systems found near M31 are listed in Table 1. The objects And I and And II are marginally visible on both the red *and* blue prints of the *Palomar Sky Survey*. This observation shows that these objects have quite red integrated colors. Andromeda III is too faint to be visible on the *Sky Survey* prints.

### III. DISCUSSION

Visual comparison of And I (see Fig. 2 [Pl. L1]) with M31, for which surface photometry by de Vaucouleurs (1958) is available, yields an *estimated* integrated magnitude  $B \approx 14.4$ . If And I is at the same distance as M31, it has  $(m - M)_B = 24.7$  so that  $M_B \approx -10.3$ . Assuming  $B - V = 0.7$  then yields  $M_V \approx -11.0$ . The integrated magnitudes of And II and And III (which do not occur on the same plate as M31) are estimated to be similar to that of And I. Table 2 shows a comparison between And I and the Sculptor system. The data in this table show that these two objects have similar luminosities and dimensions.

\* Guest investigator at the Hale Observatories.

<sup>1</sup> If dwarf spheroidal galaxies were distributed uniformly throughout the Local Group, then a sphere with a radius of 700 kpc, which is equal to the distance to M31, would be expected to contain 2000 dwarf spheroidals!

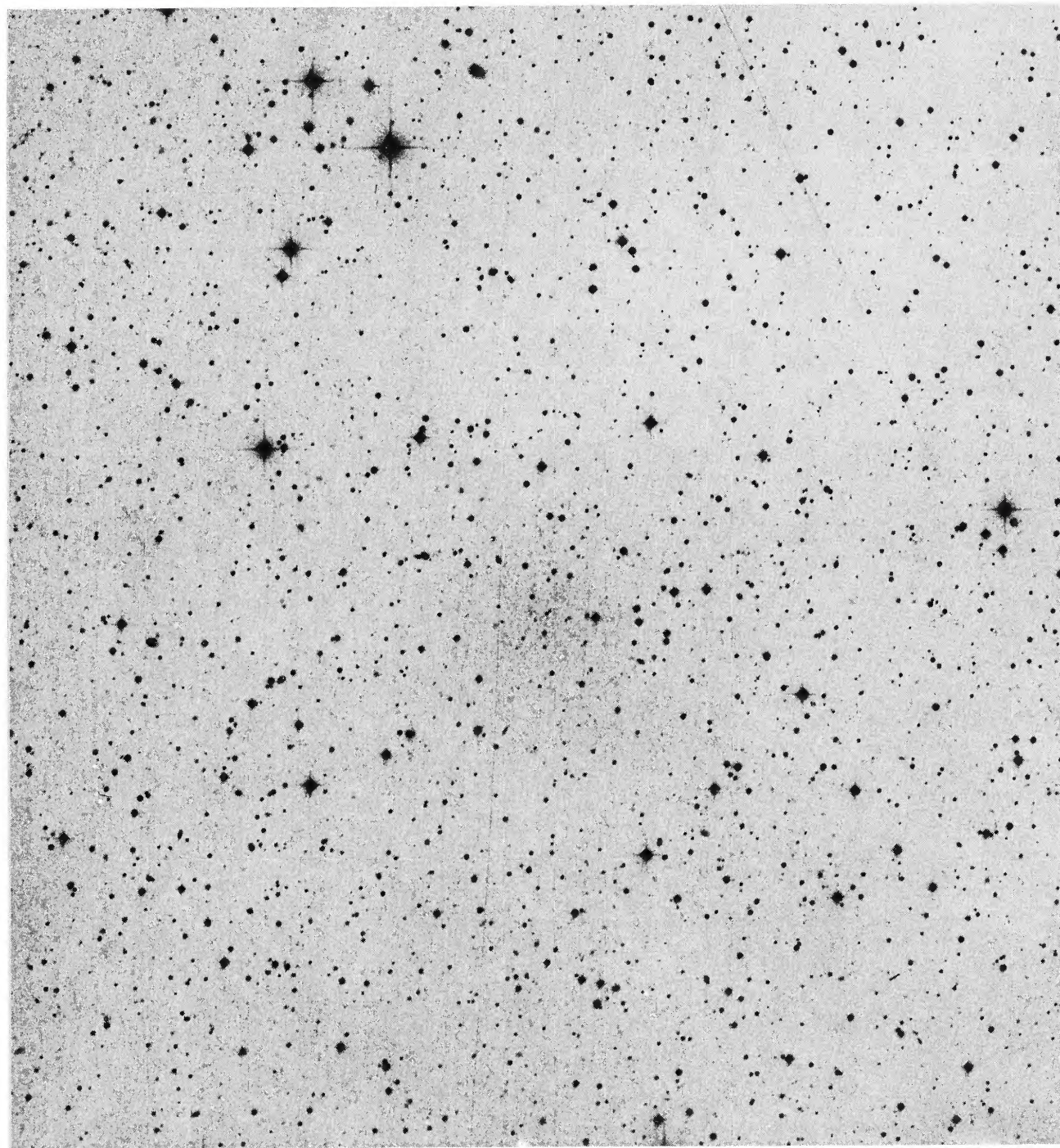


FIG. 2.—Very high contrast print from a 3-hour exposure of And I by Dr. René Racine on IIIa-J emulsion behind a Wratten 4 filter ( $\lambda\lambda 4650-5450$ ).

VAN DEN BERGH (*see* page L31)

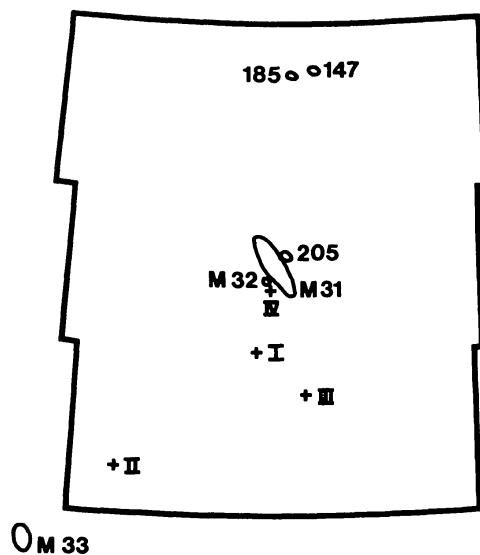


FIG. 1.—Outline of area searched for dwarf spheroidal galaxies. Note that all objects found during this survey lie between M31 and M33.

TABLE 1  
COMPANIONS TO M31

Name	$\alpha$ (1950)	$\delta$ (1950)	Size	Diameter (kpc)	Type	Projected Distance from M31 (kpc)
And I. ....	0 <sup>h</sup> 43 <sup>m</sup> 0	+37°44'	2.5×2.5	0.5 × 0.5	DSph	40
And II. ....	1 13.5	+33 09	3.5×3.5	0.7 × 0.7	DSph	125*
And III. ....	0 32.6	+36 14	3.0×4.5	0.6 × 0.9	DSph	60
And IV. ....	0 39.8	+40 18	0.7×1.0	0.15×0.2	?	10

\* Distance from And II to M33 is only 55 kpc.

TABLE 2  
COMPARISON BETWEEN ANDROMEDA I  
AND SCULPTOR

Name	$M_V$	$D$ (kpc)
And I. ....	-11	0.5×0.5*
Sculptor. ....	-11.7	0.3×0.4†

\* Distance of 700 kpc assumed.

† From inspection of a IIIa-J plate obtained with the 48-inch (126 cm) Schmidt.

The object And IV is probably not a dwarf spheroidal galaxy. It is smaller and bluer than the other objects in Table 1. Furthermore, And IV has a much higher surface brightness than do the other galaxies in this table. This suggests that And IV, which is located very close to M31, might be a relatively old star cloud in the outer disk of M31. Alternatively it might be a background dwarf galaxy.

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#### REFERENCES

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