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A NEARBY GALAXY IN ORION

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ABSTRACT

A report is presented of the detection of a previously unreported galaxy on the edge of the zone of avoidance in the galactic anticenter region. It is a relatively nearby object, characterized by a velocity, corrected for solar motion, of 257 km s^{-1}. Twenty-one cm data are used to determine physical and morphological parameters; some questions are raised which may be solved by optical and infrared observations.

Subject headings: galaxies: individual — radio sources: 21 cm radiation

I. INTRODUCTION

In the course of a high-sensitivity survey at 21 cm, aimed at detecting and studying the properties of high-velocity gas in and around our Galaxy, a nearby galaxy, previously unreported, was detected in the Orion region. Although the field is highly obscured by foreground dust, a coincident extended optical feature is discernible in the prints of the National Geographic and Palomar Sky Survey. In this *Letter*, the properties of the object are described, as derived from radio observations carried on at the telescopes of the National Astronomy and Ionosphere Center and of the National Radio Astronomy Observatory.[1]

II. OBSERVATIONS

The detection was obtained at one of the sampling points of a survey being conducted with the 91.6 m telescope of the NRAO. The H I distribution was subsequently mapped with the 305 m telescope of the Arecibo Observatory and a limited search for possible companions was conducted with the 42.6 m telescope of the NRAO. Figure 1 shows a contour map of the integrated hydrogen, obtained at Arecibo. These observations were made with a feed which has a beamwidth of 3′.3 at half-power points and is characterized by a sidelobe ring 5′.6 in diameter, with a peak response which is approximately 10 dB weaker than the main beam's (for details, see discussion in Haynes, Giovanelli, and Roberts 1979). This feed produces a distortion of the observed distribution, overemphasizing the column densities at the periphery of the source. The map has been deconvolved in order to eliminate the grosser distortions provoked by the sidelobes. Another feed with virtually negligible sidelobes and comparable beam size exists at Arecibo, but was unavailable throughout most of the observing period. It was used in a final phase of the experiment, however, to spot-check the accuracy of the deconvolved map. The velocity field is quite ordered, as shown in Figure 2, a position-velocity contour map constructed on the basis of line profiles taken along the major axis of the H I distribution. The position angle of this axis is outlined in Figure 1 by the oblique string of data points. The effect of sidelobes and beam smearing has not been removed from Figure 2.

An area extending 4° in right ascension and 3° in declination, and centered at R.A. = $05^h42^m30^s$, decl. = +05°00′00″, was searched with the 42.6 m telescope, which has a beamwidth of 21′. The step size of the grid covering the searched area was 30′. No additional detections were obtained.

All the observations were conducted in the usual

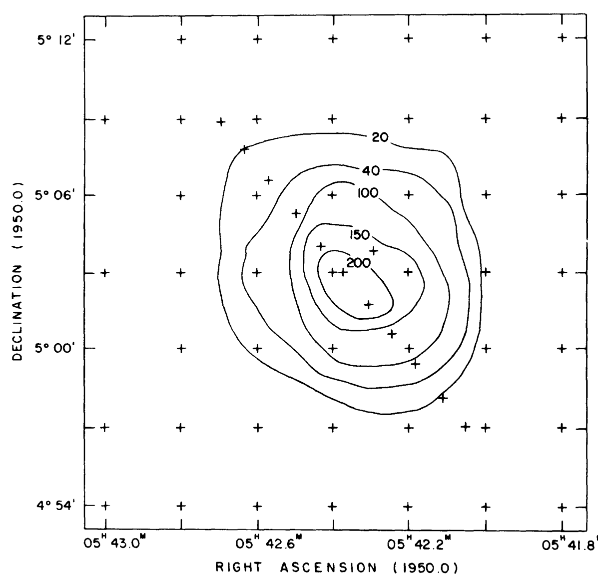

FIG. 1.—Integrated antenna temperature contours obtained at the 305 m telescope. The contour map is corrected for near sidelobe distortion. The crosses correspond to the sampling points. The beamwidth of the telescope is 3′.3.

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[1] The National Radio Astronomy Observatory is operated by Associated Universities, Inc., under contract with the National Science Foundation.

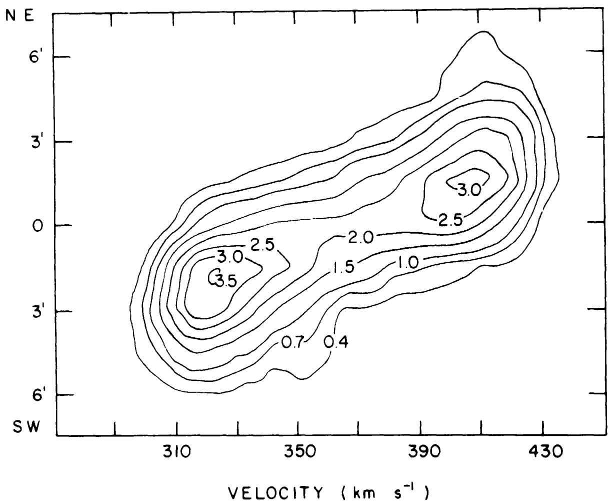

FIG. 2.—Position-velocity contour map along the major axis of the H I distribution. Line profiles contributing to this map correspond to the oblique string of crosses in Fig. 1. Contours are of antenna temperature at the 305 m telescope.

position-switching mode with a bandwidth of 10 MHz. The channel separation of the Arecibo and NRAO spectra is, respectively, 4.1 and 11 km s^{-1}.

Upon request, H. Quintana and J. Melnick kindly obtained a prime-focus red plate (type 098-04, with filter RG610; exposure of 30 minutes) of the source with the 4 m telescope of the Cerro Tololo Inter-American Observatory, which is shown in Figure 3 (Plate L8). Although the nebulous feature appears considerably less extended than the H I distribution in Figure 1, the center and position angle agree well with the radio data.

III. DISCUSSION

The source is identified with a relatively nearby galaxy. Its derived observational parameters are summarized in Table 1. Its low brightness is partly accounted for by the galactic extinction, which is possibly also responsible for the discrepancy between the optical and radio extent. The absorption in the general field of Orion is quite inhomogeneous, and an estimate of the integrated magnitude of the galaxy cannot be properly made without a photometric study of the stars in the field. There is no clear indication in the optical image of any trace of spiral structure or prominent nuclear emission. The axial ratio of the optical image is approximately 0.5. The axial ratio of the H I map in Figure 1 is higher, but that is to be expected, since the beam size, rather large when compared with the source size, has a smoothing effect which "softens" the axial ratio. An axial ratio of 0.5 implies an inclination of approximately 60°. The hydrogen mass of the galaxy, derived from planimetry of the map presented in Figure 1, is $1.77 \times 10^7 D^2$ solar masses, where D is the distance expressed in Mpc; the sensitivity limit introduced by the lowest adopted contour makes the value a lower limit. The uncertainty associated with the beam efficiency value adopted for this particular source-to-beam ratio is estimated to be on the order of 10%. In order to convert the planimetric measurements of Figure 1 into a hydrogen mass, a value of 0.55 was used for the beam efficiency. A value of the hydrogen mass was also derived from the single profile obtained with the 42.6 m telescope, which conceivably shows the integrated emission of the galaxy; it yields a hydrogen mass of $1.90\ (\pm 0.15) \times 10^7 D^2$ solar masses.

A rough estimate of the total mass may be obtained from the following expression (Roberts 1975), based on the assumption that the rotation curve falls at large galactocentric distances:

$$(M_t/M_\odot) = 1.02 \times 10^5 DR'(\Delta V/\sin i)^2 ,$$

where R' is the radial distance in arcminutes where the maximum velocity occurs and ΔV is one-half the full width of the velocity profile at zero intensity. For $R' = 2$ and $\Delta V = 86$ km s^{-1},

$$(M_t/M_\odot) = 2.01 \times 10^9 D .$$

Assuming a Hubble constant of $100h$ km s^{-1} Mpc^{-1}, a distance of $2.8h^{-1}$ Mpc may be obtained. At such a distance one obtains $(M_{\rm H\,I}/M_\odot) = 1.49 \times 10^8 h^{-2}$, $(M_t/M_\odot) = 0.56 \times 10^{10} h^{-1}$, and $(M_{\rm H\,I}/M_t) = 0.027h^{-1}$. The maximum diameter of the H I distribution, shown in Figure 1, is approximately $10h^{-1}$ kpc. The estimate of the morphological type is difficult, although interesting clues are provided by the apparently ordered velocity field and the relatively small line width, which should be weighed against Roberts's (1978) finding that intermediate spirals with narrow line widths are extremely rare.

The radial velocity corrected for the solar motion with respect to the Local Group (de Vaucouleurs, Peters, and Corwin 1977) is 257 km s^{-1}. Given its radial velocity and location, the galaxy is most likely not a member of the Local Group (see, for example, the discussion on Local Group membership of Yahil,

TABLE 1

OBSERVATIONAL PARAMETERS OF THE GALAXY

R.A. (1950)	$05^h42^m22^s$
Decl. (1950)	05°02′30″
l^{II}	200°.62
b^{II}	−12°.30
V(LSR)	365±3 km s^{-1}
V_0*	257 km s^{-1}
ΔV	86 km s^{-1}
Axial ratio (optical)	~0.5
Max. diameter of H I distribution	~12′
R'	2′(+1′, −0′.5)
$(M_{\rm H\,I}/M_\odot)$†	$1.77 \times 10^7 D^2$
$(M_{\rm H\,I}/M_\odot)$‡	$1.90(\pm 0.15) \times 10^7 D^2$
$(M_T/M_\odot)$	$\sim 2.01 \times 10^9 D$
$M_{\rm H\,I}/M_T$	$\sim 0.01\ D$

* Velocity corrected for solar motion with respect to the Local Group, using the restricted solution of de Vaucouleurs *et al.*

† By planimetry from Fig. 1.

‡ From integrated profile of 42.6 m telescope.

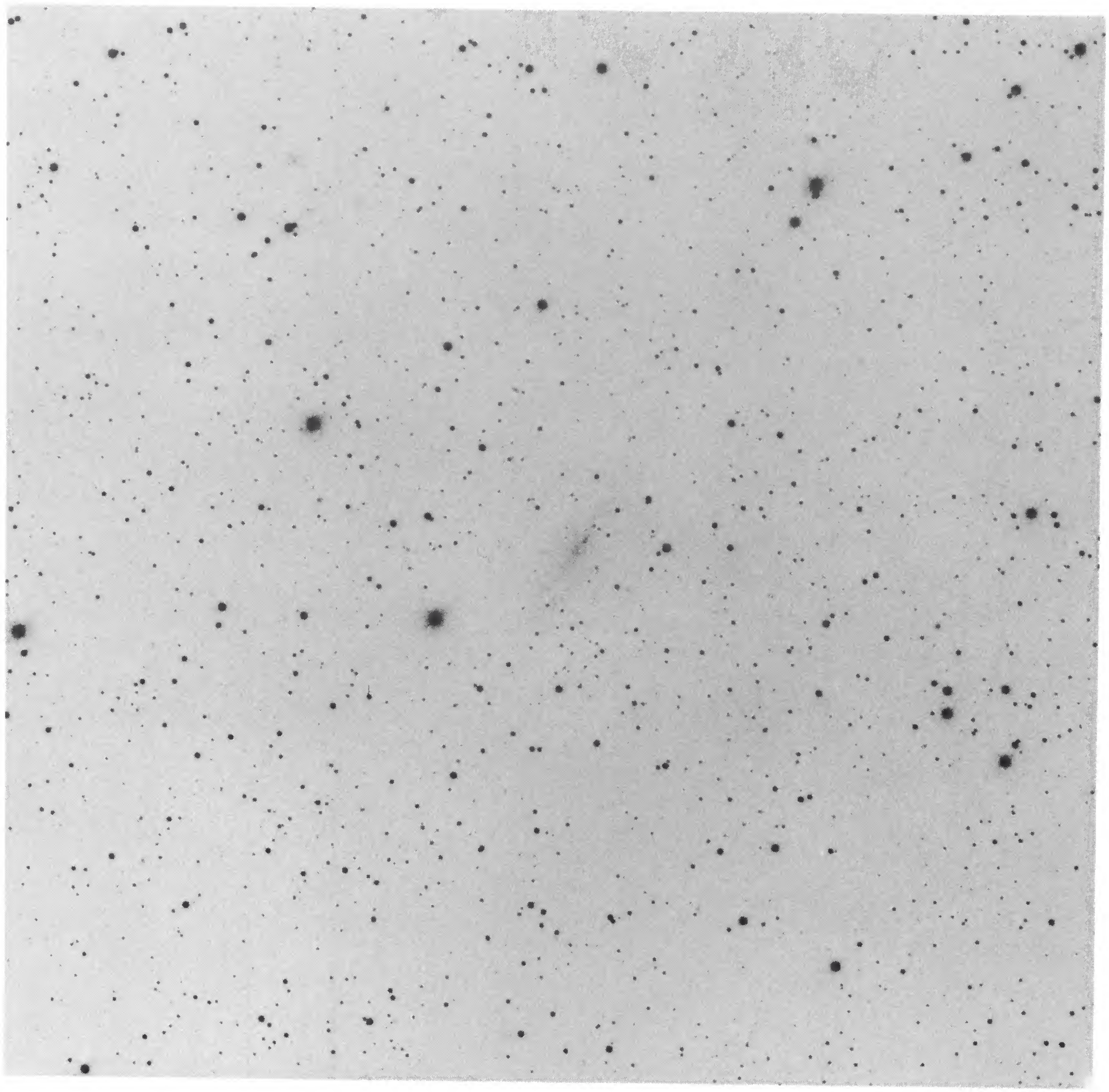

FIG. 3.—Print of 4 m prime-focus plate at CTIO obtained by Quintana and Melnick; plate type 098-04 with filter RG610; 30 minute exposure; center of galaxy corresponds to center of H I distribution; scale is 6″ mm^{-1}; N is top, E is right.

GIOVANELLI (*see* page L126)

Tammann, and Sandage 1977). On the other hand, there are no nearby groups of galaxies, characterized by velocities (corrected for solar motion) smaller than 1000 km s^{-1}, within less than 50° from the Galaxy (de Vaucouleurs 1975). The two closest, low-redshift objects to the Galaxy in Fisher and Tully's (1975) list are DDO 34 ($l = 197\overset{\circ}{.}5, b = 26\overset{\circ}{.}9$) and DDO 47 ($l = 203\overset{\circ}{.}1$, $b = 18\overset{\circ}{.}5$), the latter a suspected member of the small group of NGC 2863.

Additional information on this galaxy and on the possibility that other galaxies—with which it may form a group—may be hidden in the zone of avoidance should be obtained by means of further radio and infrared observations.

The kindness of H. Quintana and J. Melnick in taking the plate shown in Figure 3 is greatly appreciated, as are helpful discussions with M. P. Haynes.

REFERENCES

de Vaucouleurs, G. 1975, in *Galaxies and the Universe*, ed. A. Sandage, M. Sandage, and J. Kristian (Chicago: University of Chicago Press), p. 557.
de Vaucouleurs, G., Peters, W. L., and Corwin, H. G., Jr. 1977, *Ap. J.*, **211**, 319.
Fisher, J. R., and Tully, R. B. 1975, *Astr. Ap.*, **44**, 151.
Haynes, M. P., Giovanelli, R., and Roberts, M. S. 1979, *Ap. J.*, **229**, in press.
Roberts, M. S. 1975, in *Galaxies and the Universe*, ed. A. Sandage, M. Sandage, and J. Kristian (Chicago: University of Chicago Press), p. 309.
———. 1978, preprint.
Yahil, A., Tammann, G. A., and Sandage, A. 1977, *Ap. J.*, **217**, 903.

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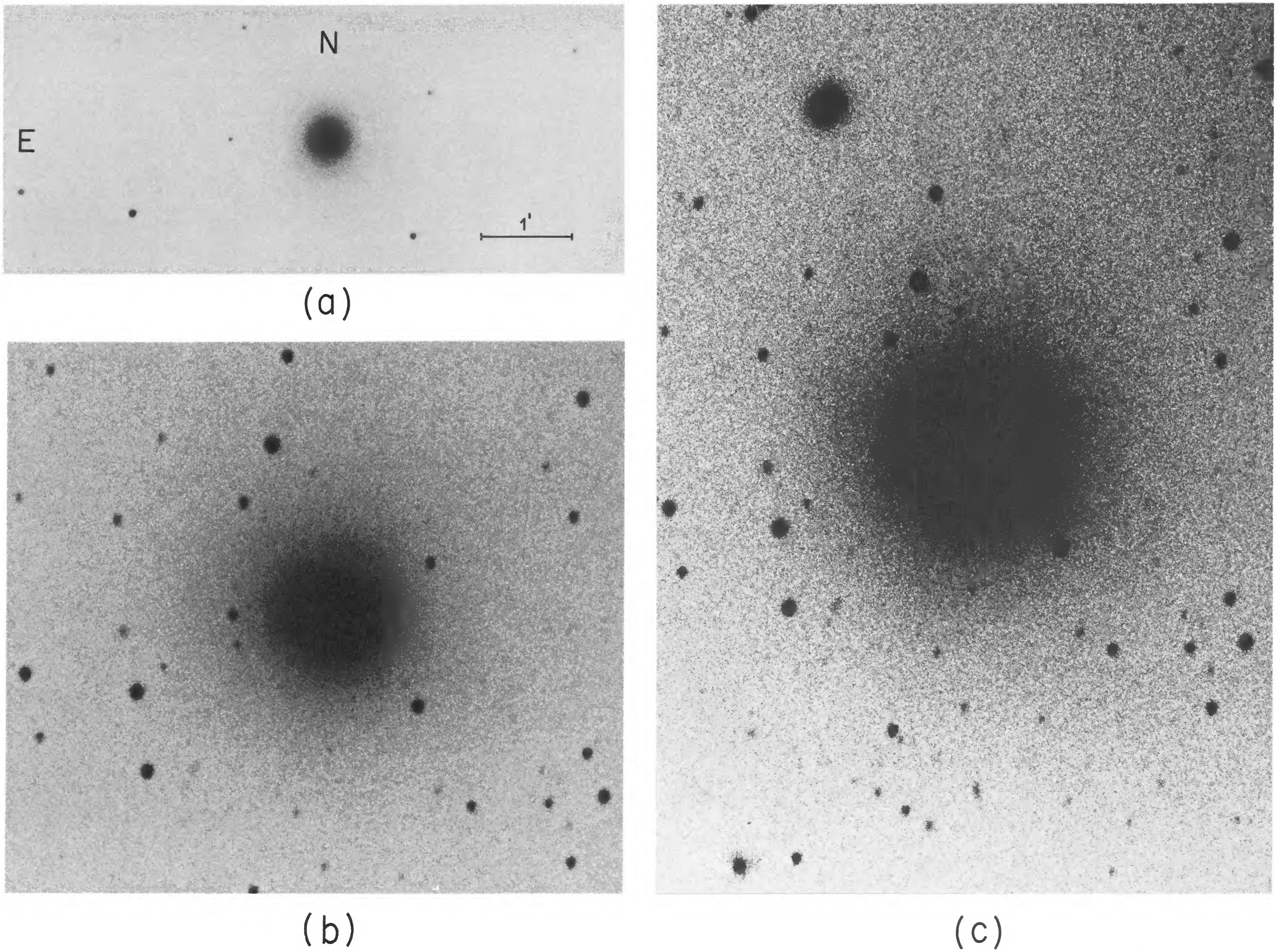

FIG. 3.—(*a*) A 10 minute exposure of NGC 7213, taken on a baked IIIa-J plate through a GG385 filter, with the CTIO Curtis Schmidt. (*b*) A 90 minute exposure (baked IIIa-J + GG385) of NGC 7213 taken with the Curtis Schmidt. (*c*) The same 90 minute plate of NGC 7213, printed at high contrast. The darkening of the plate to the northwest is due to a nearby 2d mag star. All three prints have the same orientation and scale.

PHILLIPS (*see* page L123)