Some variable stars in the field of M31

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The variable stars discovered by van den Bergh (1966) and van den Bergh *et al.* (1973) in a field around M31 have been examined on plates of the Asiago Observatory. The most interesting object (variable m) is probably a U Geminorum star of UV Persei type. A new variable star has been discovered.

INTRODUCTION

SOME variable objects discovered by van den Bergh (1966) and van den Bergh *et al.* (1973) near M31 have been examined in a series of plates obtained with the 67-cm Schmidt telescope from 1965 to 1975. A new variable star (GR 273) has been discovered by stereoscopic comparisons of five pairs of plates. An identification chart of this star is given in Plate I (p. 381).

Most of the plates are 103a-O + GG 13; only a few plates have been taken without filter. Some yellow plates (103a-D + GG 14), obtained with the same instrument, have been used for the determination of $B - V$ colors of GR 273 and of b variable.

Since the plate limit is about 19.5, only variable stars brighter than 19 have been examined.

With the Becker iris photometer the comparison sequences were obtained by transfers from the stars of Baade and Swope's (1963) Field IV of M31, whose photoelectric magnitudes were given by Arp.

Table I lists the variables, their positions, and magnitudes. The names of the stars are those used by van den Bergh (1966) and van den Bergh *et al.* (1973).

THE VARIABLES

Variable m: van den Bergh has seen this star only in two plates taken in blue and yellow light on the same night (26 August 1971). He has suggested that the variable might be a supernova or a flare star.

In the present series of plates the star is always below the plate limit (<19.5), except in the same period of time, around 26 August 1971, when van den Bergh observed the variable near the maximum at about 12.5, as we have estimated the star in the figure published by van den Bergh *et al.* (1973).

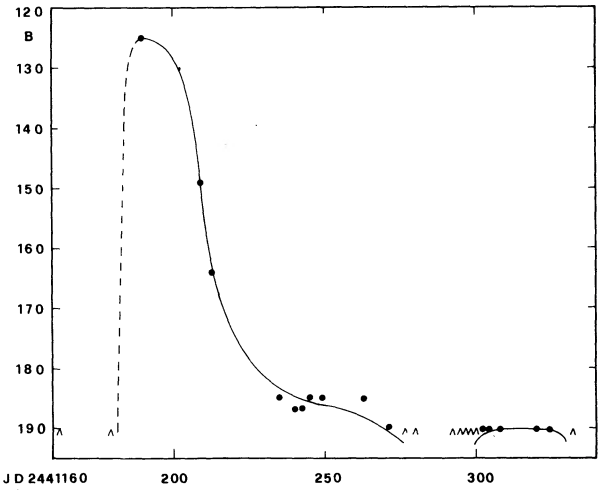

FIG. 1. Light curve of variable m.

Table II lists our observations at the time of the outburst.

On the blue and red charts of the Palomar Sky Survey the variable is at limit of visibility (~20.5) and its color is almost white.

The amplitude of variation, as seen in Fig. 1, is high:

TABLE I. Position and magnitudes of variable stars.

Var.	R.A. 1950	D	Max.	Min.
m	$0^h29^m28^s$	+41°41'37"	12.9:	20:
a	0 37 05.9	42 52 44	18.6	<19.0
GR 273	0 37 22	42 49 00	17.3	<19.0
b	0 40 49.8	39 40 27	17.5	<19.0
h	0 42 28.5	39 37 20	18.7	<19.0
k	0 43 36.5	39 15 35	18.9	<19.0
7	0 43 53	39 15	18.0	const?
c	0 44 02.2	39 22 11	17.6	18.7
5	0 44 20	39 28.2	19.0	const?

TABLE II. Magnitudes of variable m.

JD	B	JD	B
2441179	<19.0	2441292	<19.0
2441209	14.9	2441294	<19.0
2441212	16.4	2441296	<19.0
2441235	18.5	2441298	<19.0
2441240	18.7	2441300	19.0:
2441242	18.7	2441302	19.0
2441245	18.5	2441304	19.0
2441249	18.5	2441308	19.0
2441263	18.5:	2441320	19.0:
2441271	19.0	2441324	19.0
2441276	<19.0	2441332	<19.0
2441280	<19.0		

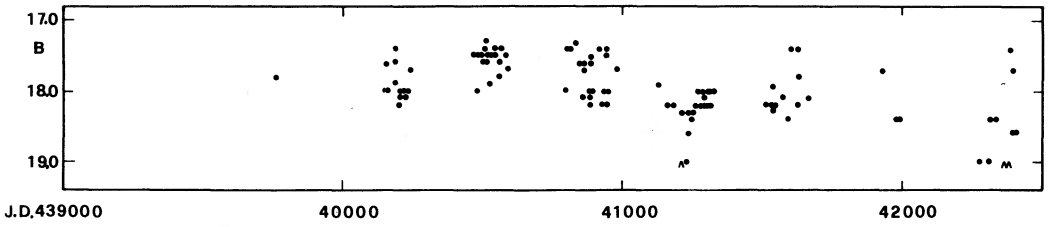

FIG. 2. Light curve of GR 273.

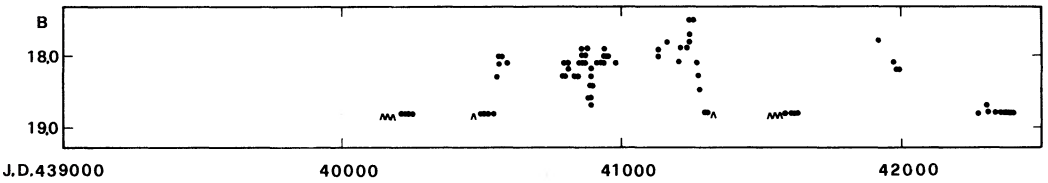

FIG. 3. Light curve of variable b.

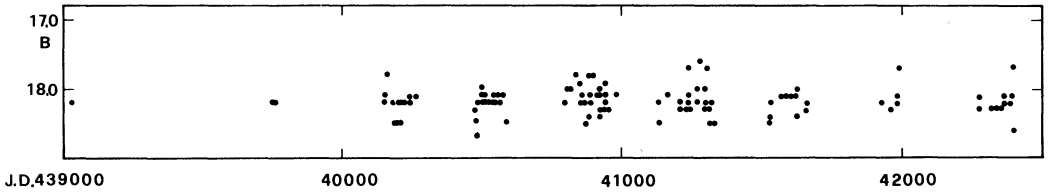

FIG. 4. light curve of variable c.

7 or 8 mag. This fact, associated to the color and shape of light curve, seems to exclude a flare star and also a supernova; in fact, no galaxy is visible near the star. We suggest that possibly the object may be a U Geminorum star of the UV Persei type.

It would be of interest to have long series of observations of this very interesting object.

Variable a: Probably a short-period variable, most of the time this star is below the plate limit; only few maxima (18.6) have been observed. On the Palomar blue and red charts the star seems to be red. Dates of observed maxima are given in Table III.

GR 273: This variable shows changes of brightness between $B = 17.3$ and $B < 19.5$. The $B - V$ color index on JD 2441989 was + 0.30.

The light curve (Fig. 2) shows that the star undergoes irregular variations sometimes rapid (1 mag in three or four days). The star probably belongs to the class of irregular variables of early spectral type.

Variable b: The color index in JD 2440916 is $B - V = + 1.57$.

The light curve (Fig. 3) indicates that the star is an irregular red variable with some rapid variations of brightness near JD 2440880 and JD 2441250. The star varies between 17.5 and <19.0.

TABLE III. Epochs of maximum of variable a.

JD	*B*	JD	*B*
2439759	<19.0	2440511	18.6
2439761	18.7	2440513	18.7
2440153	<19.0	2440524	<19.0
2440157	18.7	2440527	18.7
2440159	<19.0	2440529	18.7
2440499	<19.0	2440541	<19.0
2440501	18.7	2441249	<19.0
2440504	18.6	2441263	18.6
2440507	<19.0	2441271	<19.0

TABLE IV. Magnitudes of variable h.

JD	*B*	JD	*B*
2440159	<19.0	2440886	18.9
2440184	18.8	2440888	<19.0
2440186	18.7:	2440889	18.7
2440188	18.7	2440913	<19.0
2440201	<19.0	2440914	18.7
2440504	18.9	2440915	18.7:
2440507	<19.0	2440916	<19.0
2440511	18.9	2440921	18.7
2440513	<19.0	2440922	<19.0
2440799	<19.0	2441271	18.7
2440803	18.9	2441298	<19.0
2440804	18.7	2441302	18.9
2440810	<19.0	2441304	<19.0
2440836	18.7	2441596	18.7
2440850	18.7	2441975	18.7
2440854	18.7	2442303	18.7
2440881	18.7	2442316	18.9:
2440882	19.0	2442337	<19.0
2440884	18.7	2442385	18.9
2440885	18.7	2442391	<19.0

Variable h: This very faint star is a short-period variable. With the present material it is not possible to derive a period. At maximum the star reaches $B = 18.7$; at minimum it is invisible. Comparison of the blue and red Palomar prints shows that the variable has white color.

The magnitudes observed are listed in Table IV.

Variable k: It has not been possible to derive the type of variability of the star, which is very near the plate limit or invisible. On the Palomar prints this star seems white.

Variable 7: Discovered as a faint object by van den Bergh and suspected of variability (1966), this object appears nearly constant at $B = 18.0$ in the present series of observations.

Variable c: Irregular variable star between 17.6 and 18.7. The light curve (Fig. 4) presents some rapid fluctuations. The blue and red Palomar prints shows that this star is white.

Variable 5: According to van den Bergh this is a blue variable object; in our plates, the star appears to be constant at about 19.0.

More of these variable objects are very interesting and it would be important to obtain other optical observations for a best classification of their type of variability.

REFERENCES

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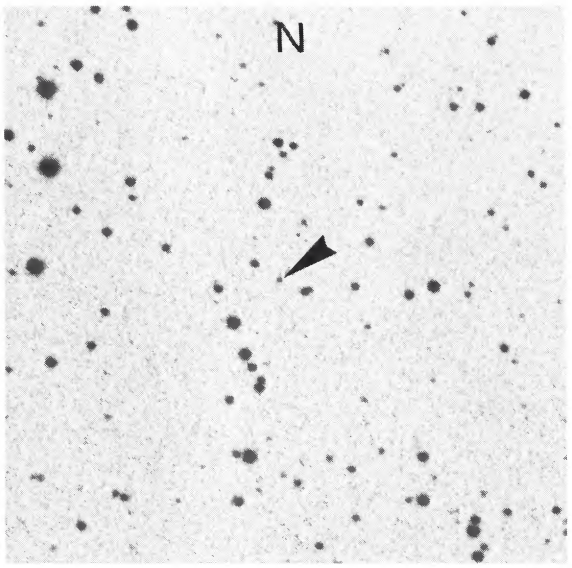

PLATE I (Romano, p. 319). Finding chart of GR 273 (10′ of side).