

Variable Star Bulletin

No.26-27

Dec. 1997

9 NEW VARIABLE STARS DISCOVERED FROM PATROL FILMS

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Received 1997 Dec. 4

1. Introduction

The author started a visual search for comets in 1968, then turned to photographic patrol in 1994. Since then, I have also paid attention to stellar objects such as novae, supernovae and variable stars. During the course of the patrol, I have discovered 11 new variable stars, which I reported on individual occasions to FSPACE (NIFTY-Serve) and the VSOLJ Mailing List.

In this paper, I report on 9 variables out of 11, with accurate coordinates, suggested types and elements of variability, and identification charts. The summary of the 9 new variable stars is given in Table 1.

Table 1. New variable stars

Desig.	R.A. (J2000.0)	Decl.	max	min	type	period	epoch*
TmzV01	10 ^h 39 ^m 37 ^s .55	+12 ^o 23'22".2	10.5	12.2p	SR	150:	-
TmzV02	20 59 36.85	+26 28 34.2	10.3	13.0p	M:	-	-
TmzV04	22 31 14.66	+06 22 49.0	11.5	(15.5p)	M	224	49600
TmzV05	20 52 39.27	-20 19 59.8	11.2	12.8p	L	-	-
TmzV06	17 15 45.64	-04 30 22.2	13.0	(15.5p)	M	205:	49780:
TmzV07	19 39 20.30	+23 44 18.0	12.1	(15.0p)	M	280	50610
TmzV08	18 50 40.50	-16 33 21.9	12.4	15.0p	M	214	50600
TmzV09	06 20 36.30	+23 46 27.0	12.2	15.2p	M:	-	-
TmzV11	06 34 12.20	+14 16 34.7	11.7	14.4p	M	460	50450:

* JD-2400000.

The observations done at Saku Observatory (Saku-machi, Nagano, Japan), using twin 10-cm patrol cameras (PENTAX 100SDUF, f=400mm) and T-Max400 films. The magnitudes were determined against neighboring GSC stars.

2. TmzV01

TmzV01 is identical with GSC 842:327 = IRAS 10369+1239 = DO2976. The observed range of variability was 10.5-12.2p (Table 1), but the actual range might be slightly larger due to the limited number of observations around minimum. The type of variability is SR (Takamizawa 1995a).

Table 2. Observations of TmzV01

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49401.147	11.4	49795.944	11.0	50212.972	10.7
49472.991	10.6	49827.955	11.3	50538.020	11.1
49507.019	10.8	49855.979	11.6	50597.015	10.5
49660.273	11.5	50012.297	11.5	50730.304	11.5
49686.238	11.1	50023.274	11.6	50750.306	12.1
49716.144	10.9	50040.267	11.1	50751.294	12.1
49756.186	10.6	50084.315	10.9	50754.274	12.2
49771.097	10.8	50179.942	10.8		

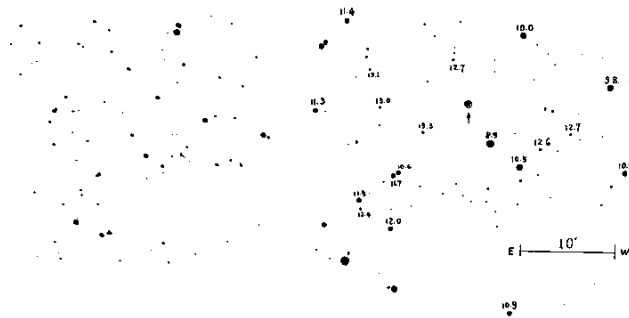


Figure 1. Photograph and finding chart of TmzV01

3. TmzV02

TmzV02 is identical with GSC 2180:1553 = IRAS 20574+2616. The observed range of variability was 10.3-13.0p (Table 1). Although the range is rather small due to the limited number of observations, the range suggests the Mira-type. The period and the epoch of maximum were not determined from the available data. A star of 12.6 mag lies 2' north of the variable (Takamizawa 1995b).

Table 3. Observations of TmzV02

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49458.237	12.3	49809.273	11.3	50517.296	11.2
49479.214	12.5	50063.894	10.3	50693.063	10.9
49546.160	13.0	50280.192	11.2	50747.040	10.4
49658.960	11.9				

4. TmzV04

The star is identical with GSC 573:974. This star is a Mira-type variable star with a range of 11.5-(15.5p, and a period of 224 d (Takamizawa 1996a).

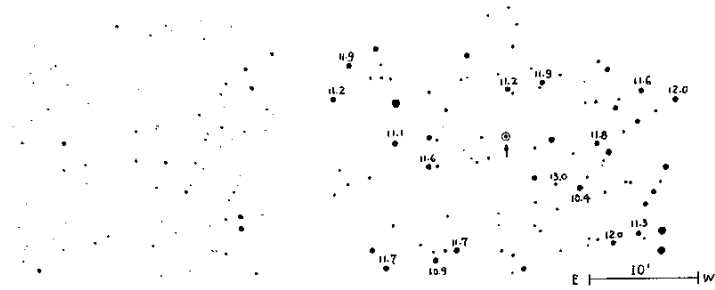


Figure 2. Photograph and finding chart of TmzV02

Table 4. Observations of TmzV04

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49479.237	(15.5)	50018.047	13.5	50277.174	12.1
49489.245	(15.5)	50045.988	(15.0)	50330.029	13.9
49539.144	15.3	50072.935	(15.0)	50633.206	(14.0)
49575.182	12.1	49834.269	11.9	50688.116	12.2
49600.045	11.5	49950.099	(15.4)	50720.010	11.5
49626.115	12.0				

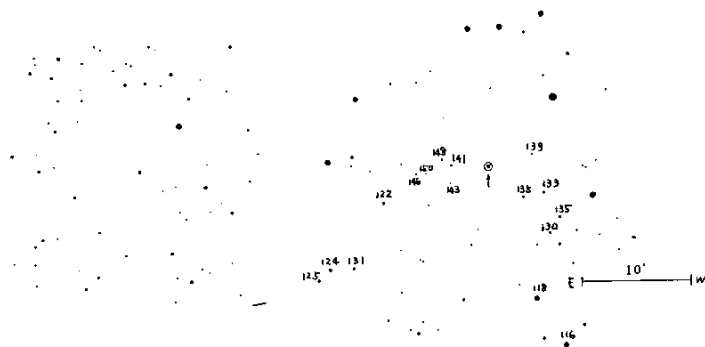


Figure 3. Photograph and finding chart of TmzV04

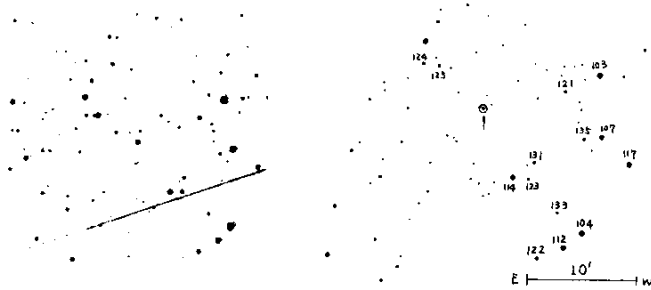


Figure 4. Photograph and finding chart of TmzV05

5. TmzV05

The star is identical with GSC 6352:1154. The range of variability was 11.2-12.8p, without detectable regularity. I have judged the type of variability as L (Takamizawa 1996b).

Table 5. Observations of TmzV05

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49457.285	12.2	49575.130	12.6	50197.289	12.8
49485.243	11.7	49626.034	12.3	50311.049	11.6
49488.224	11.2	49683.900	12.5	50636.185	11.9
49902.160	12.3	49922.153	11.9	50747.017	11.5
49568.083	12.8	50010.940	12.8		

6. TmzV06

The star is identical with GSC 5074:435. The star is a Mira-type variable with a range of 13.0-15.5p, and a period of 205 d. The star is visible at mag \sim 17 on Real-Sky CD (Takamizawa 1997a).

Table 6. Observations of TmzV06

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49454.297	(15.0)	49759.292	13.2	50213.090	14.6
49479.184	(15.5)	49775.265	13.0	50254.066	(15.5)
49507.142	15.2	49834.167	(15.5)	50492.310	(15.0)
49518.002	15.3	50003.906	15.1	50606.150	13.8
49620.960	(15.0)	50109.328	(15.0)	50631.030	14.0
49647.885	(15.5)	50135.294	14.9	50746.895	(15.0)
49745.328	13.3				

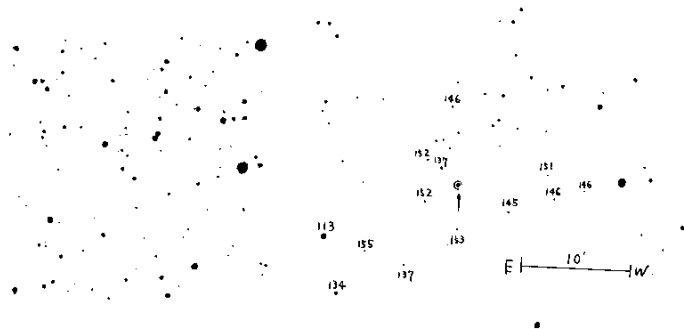


Figure 5. Photograph and finding chart of TmzV06

7. TmzV07

The star is identical with IRAS 19372+2337. The star is a Mira-type variable with a range of 12.1-(15.0)*p*, and a period of 280 d. The star is visible at mag \sim 13.5 on Real-Sky CD (Takamizawa 1997b).

Table 7. Observations of TmzV07

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49488.189	13.7	49860.197	(15.0)	50372.960	13.9
49561.997	(14.5)	49886.011	(14.0)	50415.869	(14.5)
49658.892	(15.0)	49888.067	(14.5)	50516.301	(14.5)
49681.922	(15.0)	49919.070	(14.0)	50551.229	(14.5)
49705.863	(14.0)	49934.135	(15.0)	50613.110	12.1
49759.322	13.9	49945.026	(14.0)	50629.075	12.3
49775.297	14.1	50004.960	(14.5)	50683.022	13.7
49788.310	14.2	50060.881	13.7	50697.012	(14.3)
49805.236	(14.0)	50133.338	(14.5)	50740.958	(14.0)
49827.267	14.3	50286.055	(14.0)	50771.941	(14.0)
49834.193	14.5	50361.990	13.5		

8. TmzV08

The star is a Mira-type variable with a range of 12.4-15.0*p* and a period of 214 d (Takamizawa 1997c).

9. TmzV09

The star is identical with IRAS 06175+2347. The star has a range of 12.2-15.2*p*. The range suggests a Mira-type classification, but the possibility of SR-type is not excluded. The star is visible at \sim 13.5 on Real-Sky CD. A star of 15.5 mag lies \sim 10' west of the variable (Takamizawa 1997d).

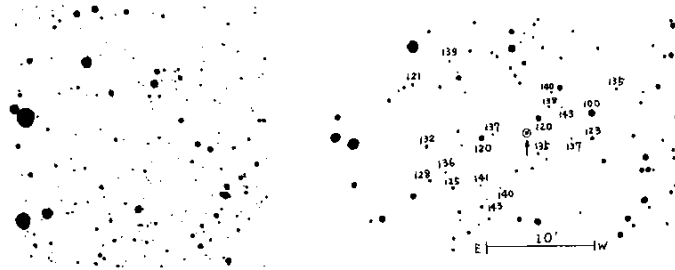


Figure 6. Photograph and finding chart of TmzV07

Table 8. Observations of TmzV08

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49485.207	14.6	49934.101	13.3	50372.916	12.4
49518.176	13.2	49945.973	12.6	50515.319	14.2
49537.068	12.5	49950.069	12.7	50551.254	13.6
49575.063	13.4	49973.971	12.5	50570.186	(13.1)
49621.015	(13.5)	50015.910	13.5	50578.199	12.8
49648.915	(14.0)	50197.246	12.5	50597.087	12.4
49759.346	12.5	50229.198	(14.0)	50633.162	12.9
49809.248	14.0	50254.156	14.7	50634.090	12.8
49815.235	(14.0)	50277.107	14.5	50636.124	13.2
49834.224	15.0	50296.022	(13.1)	50682.992	13.8
49870.175	(14.5)	50309.999	(14.5)	50746.940	(13.5)
49922.090	(14.0)				

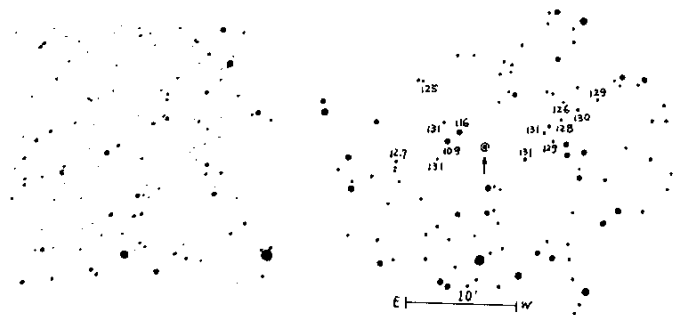


Figure 7. Photograph and finding chart of TmzV08

Table 9. Observations of TmzV09

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49414.074	14.5	50071.081	15.0	50693.260	12.9
49443.000	14.3	50124.978	14.1	50720.257	13.0
49606.281	15.2	50150.944	14.5	50756.233	12.8
49684.144	14.5	50372.234	13.5	50758.215	12.8
49751.990	13.8	50423.083	13.2	50762.165	12.9
49767.963	14.2	50475.944	13.8	50776.093	12.2
50012.270	15.1	50672.267	12.9		

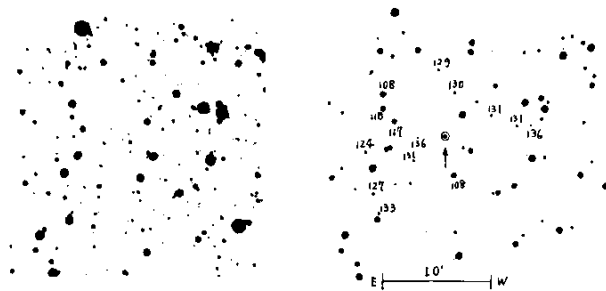


Figure 8. Photograph and finding chart of TmzV09

10. TmzV11

This star is identical with GSC 745:1464 = IRAS 06313+1418. This star is a Mira-type variable with a range of 11.7-14.4p, and a period of 460 d (Takamizawa 1997e).

Table 10. Observations of TmzV11

JD-2400000	mag	JD-2400000	mag	JD-2400000	mag
49414.066	12.0	49988.276	12.2	50475.944	11.7
49442.996	13.5	50012.263	12.3	50672.276	(13.0)
49472.996	(13.0)	50071.081	13.0	50693.269	13.5
49581.277	12.3	50124.978	13.3	50720.257	13.3
49606.285	13.1	50150.931	13.6	50756.241	12.8
49684.132	13.8	50373.242	12.5	50762.165	12.5
49751.990	14.4	50424.083	11.8	50776.093	12.7
49767.955	14.2				

Among variables reported in this paper, I hope I will continue observations and report on TmzV02 and TmzV09 (unknown period) and objects with insufficiently determined periods. I would also like to report and make follow-up observations on occasions when additional variable star are found from patrol films.

Acknowledgments. The author is grateful to Taichi Kato (Kyoto University) for helpful suggestions and reading the manuscript.

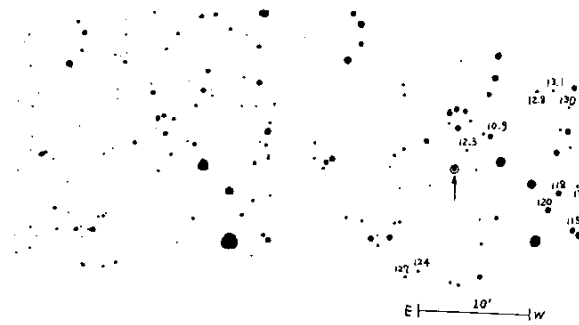


Figure 9. Photograph and finding chart of TmzV11

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Add in proof

After this paper accepted, I noticed identification of TmzV04 = MN Peg and TmzV07 = V350 Vul.

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