

The Ross Variable Stars Revisited. I.

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Abstract Better magnitudes and epochs have been determined for 189 of the 379 confirmed and suspected variable stars discovered by Ross from 1925 to 1931. Accurate positions have been determined for those objects for which unambiguous identifications had been lacking.

1. Introduction

Frank E. Ross of Yerkes Observatory published ten lists of suspected new variable stars between 1925 and 1931 (Ross 1925, 1926a, 1926b, 1927a, 1927b, 1928a, 1928b, 1929, 1930, and 1931). These objects were detected in connection with a search for stars of large proper motion conducted by comparing (blinking) plates taken by Edward E. Barnard from 1904 to 1915 with second epoch plates of similar exposure that Ross took in the period 1924–1930. The ten lists contain 379 objects. Most of the Ross variables have now been confirmed and accurate positions determined. Nevertheless, a number of these objects have yet to be certainly identified and it is still not known if these are indeed variables.

Many of the Ross stars were cases where an object was visible at one epoch but not seen at the other. The plates were taken with the Bruce photographic telescope, which actually consisted of three telescopes on the same mounting: 10-inch and 6-inch refractors for photographs and a guide telescope (Barnard 1905). Both Barnard and Ross obtained simultaneous exposures with the two photographic instruments, and this enabled Ross to confirm that that an object visible at only one epoch was not a plate defect. However, Ross realized that some of his suspects visible at just a single epoch could be minor planets (Ross 1926b). First Bedient (2003) and then Marsden (2007) were able to identify fifteen such cases using modern orbital elements for known minor planets. Their work left about forty of the Ross variables still unconfirmed or awaiting identification.

While engaged in another project using Yerkes Observatory plates, we discovered Ross had marked his variable discoveries on the plates he utilized. Shortly thereafter, we came across a box containing Ross's original note cards for this work. The box contained two sets of cards. The first set has a card for each object giving the plates that were compared that led to the suspected variability, the star number marked on the plate, the two magnitude estimates, and a finding chart; the chart often also identifies one or more comparison stars that Ross used

to determine his magnitudes. For many of the earlier discoveries the back of the card contains notes showing the star was subsequently examined on other plates or observed visually with the Yerkes 40-inch refractor. The second card set contains the summarized information that Ross later published: assigned variable number, 1875 coordinates, adopted magnitudes, and dates.

2. The project

A number of the unconfirmed Ross variables lie in crowded fields in the Milky Way, and Ross's coordinates are not sufficiently accurate to unambiguously identify the correct object. Our discovery of Ross's finding charts resolved this problem, and we decided to re-examine the plates to obtain reliable identifications.

We elected to examine all the Ross variables, not just those needing confirmation. This was done because in most cases these observations are earlier than any of those archived in the variable star databases (such as that of the AAVSO) and the expanded time range of observations may prove useful. Also, Ross's published magnitudes are known to be systematically 1–2 magnitudes too bright for photographic ones (Marsden 2007), and modern sky survey data permitted us to determine magnitudes approximately on the B system. At the same time, we obtained better epochs for the observations. Ross published only the local dates of the plates. His observing log, however, gives the local astronomical start and end times of his exposures. Barnard's observing log lacks the times of his exposures, but we found he recorded his start and end times on the plates themselves and these were recorded as we re-examined the plates.

3. Procedure

As a project evolves, a researcher gains experience and the later work generally is carried out in a better and more systematic fashion. Our first steps on this project quickly revealed that Ross's early notes were less detailed and contained more errors than those made later. We therefore began our work with his higher-numbered variables, only returning to the initial ones once we ourselves had gained experience with Ross's methods (such as his notation codes). As a consequence, while this paper presents results for the stars in six of Ross's ten lists, they are lists 1, 2, and 7–10. The results from work on lists 3–6 will be published in a subsequent paper.

Our procedure was to use ALADIN (Bonnarel *et al.* 2000; available at <http://aladin.u-strasbg.fr/aladin.gml>) to produce a sky survey print (when possible a POSS I blue one) of the region of the Ross star. The same plate pair used by Ross was examined and, using his finding chart, the correct star and its variability were confirmed. The epochs of the two plates were then noted and several convenient comparison stars adopted and used to eye-estimate the variable's brightness on the two plates. The comparison stars' approximate B magnitudes were later

obtained by averaging the values from the *USNO B1.0* (Monet *et al.* 2003) and *GSC 2.3* (Bucciarelli *et al.* 2008) catalogs and these were used to derive the B magnitude of the variable. Finally, the star's position was checked for known variables and other identifications (such as IRAS sources).

4. Results

Our results are given in Table 1 for the stars in Ross's first and second lists and in Table 2 for the stars in his lists 7–10. The tables present the Ross number and corresponding variable star name if a named variable, the Julian Dates (actually $JD - 2400000.0$) and B magnitudes for the two compared plates, and (if needed) another identification. As recommended by Eastman *et al.* (2010), the epochs have not been converted to heliocentric ones. Following each table are notes for many of the stars; these give such information as errors detected in Ross's papers and comments on the identification.

Our magnitudes are, of course, not strictly B ones but are much closer to the B system than Ross's published values. He apparently used visual magnitudes for his determinations although his plates had blue-sensitive emulsions. We estimate our magnitudes are accurate to ± 0.2 . The epochs have been determined from the dates and times of mid-exposure, assuming that the recorded times were Central Standard Time (or occasionally Pacific Time for those plates taken when the telescope was temporarily moved to Mt. Wilson). As a check, we compared our derived values of UT with those derived by Marsden (2007) from the best fits of Ross's positions to the orbits for those objects found to be minor planets; our agreement with Marsden was excellent, confirming our time determinations.

Our results can be used to derive some general facts about Ross's data. The published coordinates for the stars, precessed from 1875 to J2000 and neglecting (the usually unknown) proper motion, compared to modern precise ones show that his positions are typically within 25 arcsec of the true location. There are a few cases of large arc-minute errors. The difference between Ross's published magnitudes and our B ones varies with location on the plate and from field to field, but on average the published values are 1.8 magnitudes brighter.

As mentioned in the introduction, Ross's note cards contain comments for a number of the earlier variable discoveries, including the results from visual observations by him or his colleagues with the Yerkes 40-inch refractor. While no doubt mainly of historical interest, this material is presented in Appendix A (Table A) so it will not be lost.

This paper gives our results for 189 of the 379 Ross variables. Of these, 151 are named variables, seventeen are suspected variables listed in the NSV catalog (Kholopov *et al.* 1982, Kazarovets *et al.* 1998), ten are suspects not in the NSV, eight were observations of minor planets, two are the result of erroneous brightness variations due to plate flaws, and one is probably an erroneous star identification produced by a Ross copying error.

5. Acknowledgements

This research made use of the SIMBAD database, operated at CDS, Strasbourg, France, and the Digitized Sky Surveys (DSS) produced at the Space Telescope Science Institute under U.S. Government grant NAG W-2166. The DSS images are from photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope through funding provided by The National Geographic Society, the National Science Foundation, the Sloan Foundation, the Samuel Oschin Foundation, the Eastman Kodak Corporation, and the UK Science and Engineering Research Council.

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Ross, F. E. 1926b, *Astron. J.*, **36**, 167 (third list).
Ross, F. E. 1927a, *Astron. J.*, **37**, 91 (fourth list).
Ross, F. E. 1927b, *Astron. J.*, **37**, 155 (fifth list).
Ross, F. E. 1928a, *Astron. J.*, **38**, 99 (sixth list).
Ross, F. E. 1928b, *Astron. J.*, **38**, 144 (seventh list).
Ross, F. E. 1929, *Astron. J.*, **39**, 140 (eighth list).
Ross, F. E. 1930, *Astron. J.*, **40**, 34 (ninth list).
Ross, F. E. 1931, *Astron. J.*, **41**, 88 (tenth list).

Table 1. Identifications and improved data for Ross Variables 1–104.

<i>Ross Note</i> (*)	<i>Variable</i>	<i>First JD</i> 2400000.0+	<i>B</i>	<i>Second JD</i> 2400000.0+	<i>B</i>	<i>Other</i> <i>identification</i>
1	BB And	18298.576	<16.9	24090.577	13.9	
2	FI Per	16740.830	13.3	24144.554	15.2	
3	AQ Per	16786.669	<15.7	24165.556	14.3	
4	* NSV 1436	16786.669	12.8	24165.556	16.4	
5	* NSV 1488	16740.830	<16.5	24144.554	15.0	
6	*	17236.581	13.8	24195.565	13.8	GSC1 0714-00599 (plate flaw)
7	V962 Ori	17236.581	15.1	24195.565	13.8	
8	CL Ori	17236.581	13.7	24195.565	15.3	
9	FQ Ori	17236.581	<15.5	24195.565	12.1	
10	*	16903.727	11.3	24195.673	11.2	BD-10 2106 (plate flaw)
11	* NSV 2913			24198.628	13.3	Minor planet (449) <i>Hamburga</i>
12	ZZ Gem	16767.799	14.8	24198.628	13.4	
13	CD Gem	16767.799	<15.8	24198.628	13.0	
14	AY Aur	16936.663	12.1	24199.550	<16.0	
15	DT Ori	16900.705	<16.2	24224.595	13.0	
16	* CM Ori	16900.705	13.0	24224.595	14.0	
17	V1796 Ori	16900.705	<16.3	24224.595	14.8	
18	RX Ser	18122.720	15.0	24320.766	<16.0	
19	RY Ser	19158.816	14.4	24320.766	15.4	
20	SV Ser	18122.720	<15.9	24320.766	13.3	
21	V405 Ser	19158.816	14.3	24320.766	<15.7	
22	SX Ser	19158.816	<15.0	24320.766	13.4	
23	CU Ser	19158.816	<15.7	24320.766	14.7	
24	V406 Ser	18122.720	14.9	24320.766	<15.5	
25	* NSV 9194	18122.720	14.6	24320.766	<16.3	2MASS 17353909- 1442210
26	V407 Ser	18122.720	14.2	24320.766	<14.4	
27	AD Ser	18122.720	13.9	24320.766	16.1	
28	VX Ser	18122.720	16.0	24320.766	13.2	
29	* NSV 9437	19158.816	15.0	24320.766	<15.3	2MASS 17400077- 1454108
30	V408 Ser	18122.720	15.4	24320.766	<15.3	
31	BG Oph	18122.720	<14.0	24320.766	12.6	
32	V836 Oph	18122.720	15.5	24320.766	<15.9	
33	AE Ser	18122.720	13.5	24320.766	<16.2	

Table continued on following pages

Table 1. Identifications and improved data for Ross Variables 1–104, cont.

Ross	Note	Variable	First JD	B	Second JD	B	Other
	(*)		2400000.0+		2400000.0+		identification
34		LU Ser	18122.720	<15.8	24320.766	14.7	
35		FK Sgr	18122.720	13.4	24320.766	<14.8	
36	*	NSV 9668	19158.816	14.7	24320.766	<16.5	
37		FV Ser	18122.720	<15.8	24320.766	12.7	
38	*	NSV 4748			24240.588	12.3	Minor planet (24) <i>Themis</i>
39	*	NSV 4796			24240.644	12.3	Minor planet (39) <i>Laetitia</i>
40	*	NSV 4849	17666.577	13.5			Minor planet (162) <i>Laurentia</i>
41		V2643 Oph	17060.755	14.7	24342.679	<15.0	
42		BH Oph	16644.711	14.0	24384.637	12.5	
43		AZ Oph	17037.920	<16.0	24354.684	14.5	
44		V2090 Oph	18476.751	15.4	24354.684	15.0	
45		AV Her	16644.711	<14.4	24384.637	12.4	
46		V2204 Oph	16644.711	13.7	24384.637	<15.9	
47		BI Oph	16644.711	11.9	24384.637	14.2	
48		AG Ser	17037.920	14.0	24354.684	<16.8	
49		DS Her	16644.711	<13.0	24384.637	13.2	
50		BK Oph	17037.920	15.6	24354.684	12.4	
51	*	V648 Oph	17037.920	<15.6	24354.684	14.0	
52		V652 Oph	17037.920	12.4	24354.684	<16.4	
53		AX Lyr	17470.601	<16.0	24329.667	13.8	
54		SV Lyr	17470.601	13.4	24329.667	16.8	
55		FN Sgr	16654.831	14.0	24384.601	11.0	
56		FQ Sgr	18117.785	14.4	24414.569	12.8	
57	*	BP Lyr	17470.601	13.1	24329.667	14.8	
58		V2113 Sgr	18117.785	12.6	24414.569	<14.7	
59		V2130 Sgr	18117.785	14.3	24414.569	<15.9	
60		AI Lyr	16621.803	<15.0	24381.656	13.7	
61		DF Sgr	18117.785	14.2	24414.569	15.8	
62		V925 Sgr	18117.785	<16.2	24414.569	13.4	
63	*		18117.785	12.8	24414.569	15.6	Probably TT Sgr
64	*	V2141 Sgr	18117.785	<15.4	24414.569	13.9	
65		EN Sgr	18117.785	13.9	24414.569	15.4	
66	*		18117.785	14.6	24414.569	15.6	2MASS 19240756- 1957360

Table continued on following pages

Table 1. Identifications and improved data for Ross Variables 1–104, cont.

<i>Ross Note</i>	<i>Variable</i>	<i>First JD</i>	<i>B</i>	<i>Second JD</i>	<i>B</i>	<i>Other</i>
(*)		2400000.0+		2400000.0+		identification
67 *		18117.785	14.0	24414.569	14.7	2MASS 19254760-2131216
68	ET Sgr	18117.785	12.8	24414.569	14.3	
69 *	V926 Sgr	18117.785	14.1	24414.569	15.2	
70	V1316 Sgr	18117.785	<15.0	24414.569	12.3	
71	EX Sgr	18117.785	14.3	24414.569	12.5	
72 *		18117.785	13.5	24414.569	14.5	2MASS 19363760-1436197
73	EZ Sgr	18117.785	15.0	24414.569	13.5	
74 *	V731 Sgr	18117.785	<14.6	24414.569	13.2	
75 *	YZ Vul	18066.781	12.1	24381.656	15.3	
76 *		16706.838	13.9	24407.657	15.1	2MASS 19550819+4620450
77 *	NSV 12634	16706.838	13.3	24407.657	15.9	
78	NSV 12676	16706.838	13.7	24407.657	15.0	
79 *	NSV 12682	16706.838	15.3	24407.657	<16.4	
80	V452 Cyg	17058.944	<16.3	24381.660	13.9	
81	AU Vul	17755.657	13.2	24433.557	11.8	
82 *	V346 Cyg	17755.657	11.6	24433.557	13.2	
83	AV Vul	17755.657	12.1	24433.557	11.1	
84	V837 Aql	17800.655	15.2:	24414.638	12.3	
85	RZ Cap	17800.655	14.0	24414.638	15.3	
86	FF Cyg	17058.944	<15.4	24382.660	11.9	
87	V517 Cyg	16706.838	12.9	24407.657	14.5	
88	VY Aqr	17800.655	10.2	24414.638	<14.3	
89 *	NSV 13752	16651.818	11.8			Minor planet (115) Thyra
90	PY Cep	16738.792	15.4	24463.560	<16.2	
91	YY Cep	16738.792	<15.9	24463.560	13.7	
92	RZ Cep	16738.792	12.1	24463.560	14.0	
93	BH Lac	17795.595	12.8	24410.599	11.7	
94	BX Cep	16682.819	13.8	24385.674	<14.4	
95	OQ Cep	16681.805	14.3	24450.593	15.7	
96	V397 Cas	16681.805	15.9	24450.593	14.2	
97	AO And	18535.729	14.6	24475.599	13.4	
98	AI And	18535.729	16.2	24475.599	13.7	

Table continued on following pages

Table 1. Identifications and improved data for Ross Variables 1–104, cont.

Ross	Note (*)	Variable	First JD 2400000.0+	B	Second JD 2400000.0+	B	Other identification
99		AK And	18535.729	12.6	24475.599	<15.1	
100	*	AL And	18535.729	13.3	24475.599	<16.8	
101		V339 And	18535.729	14.3	24475.599	<16.9	
102		EY And	18535.729	<15.9	24475.599	14.9	
103	*		18535.729	14.4	24475.599	15.6	2MASS 23491886+ 4751319
104		AM And	18535.729	15.0	24475.599	11.9	

Notes

R4: Ross's note card has his 1925 estimated magnitude as 14, not 15 as published. Our more complete study of this star has been published elsewhere (Brown et al. 2010).

R5: Marsden (2007) showed this suspected variable was not a minor planet observation.

R6: Ross (1927b) said the suspected variability was due to a plate defect. We confirmed the apparent variation as due to the 1906 plate having a defect that gave an anomalously bright value. Magnitude given here for that epoch is from the 6-inch plate.

R10: Ross (1926a) said this listing was an error. His note card has "B-132 [Barnard plate 132] shows this star = 10 m (same as R-28); a defect in B-148 (desensitized area) accounts for its non-appearance there." and we confirmed this. First magnitude is from 6-inch plate.

R11: Marsden (2007) showed object seen in 1925 was a minor planet.

R16: Ross's published magnitudes are reversed from what was correctly noted on his card.

R25: Marsden (2007) showed this suspected variable was not a minor planet observation.

R29: Marsden (2007) showed this suspected variable was not a minor planet observation.

R36: Marsden (2007) showed this suspected variable was not a minor planet observation.

R38: Bedient (2003) and Marsden (2007) showed object seen in 1925 was a minor planet.

R39: Bedient (2003) and Marsden (2007) showed object seen in 1925 was a minor planet.

R40: Marsden (2007) showed object seen in 1907 was a minor planet.

R51: Date of first plate is 1905 July 10, not July 2 as published by Ross.

R57: Ross published that star was not visible on 1925 plate, but card has "not certainly visible" and we see star faintly on plate.

R63: Ross's published magnitudes disagree with those of the star he marked on his finding chart, which we do not find variable. Ross's magnitudes are consistent with this being TT Sgr. and we suggest he miscopied his notes for the star he labeled 17 on the plate (TT Sgr) as being for the star marked 19.

R64: Ross's published magnitudes for the two plates are reversed.

R66: Not listed in NSV catalog.

Table 1. Identifications and improved data for Ross Variables 1–104, cont.

R67: Not listed in NSV catalog.

R69: Simbad identifies this as V926 Sgr, but R69 is not that star but 2MASS 19272423-1852224. Star identified in Simbad as V926 is faint on our plates but does seem to vary slightly.

R72: Not listed in NSV catalog.

R74: Simbad identifies this as V931 Sgr, but R74 is not that star but likely 2MASS 19382061-1405267.

R75: Date of first plate is 1908 June 4, not June 24 as published by Ross.

R76: Not listed in NSV catalog.

R77: Marsden (2007) showed this suspected variable was not a minor planet observation.

R79: Marsden (2007) showed this suspected variable was not a minor planet observation. Probably 2MASS 20000260+4600323.

R82: Ross's published right ascension has a 15' error but his finding chart and our reexamination of the plates confirms this identification.

R89: Bedient (2003) and Marsden (2007) showed object seen in 1904 was a minor planet.

R100: Ross's card has *nv* (not visible) for 1925 plate, so published magnitude should have been <15.

R103: Not listed in NSV catalog.

Table 2. Identifications and improved data for Ross Variables 295–379.

Ross	Note	Variable	First JD	B	Second JD	B	Other
	(*)		2400000.0+		2400000.0+		identification
295	*		19277.792	14.9	25233.567	15.5	2MASS 01563501+4123466
296		AH And	19277.792	12.1	25233.567	<16.0	
297		CG Her	17732.690	<15.7	25172.554	14.1	
298	*	AO Lyr	17732.690	12.5	25172.554	15.0	
299		AZ Her	17732.690	15.9	25172.554	12.7	
300	*		17732.690	14.9	25172.554	13.8	2MASS 18224071+2931163
301	*	NSV 10876	17732.690	<15.4	25172.554	14.7	2MASS 18280925+2724041
302		AP Lyr	17732.690	13.0	25172.554	14.7	
303	*		17732.690	16.7	25172.554	15.0	2MASS 18323706+2709256
304	*	V643 Her	17732.690	15.2	25172.554	14.1	
305		AB Lyr	17708.749	14.7	25169.565	12.7	

Table continued on following pages

Table 2. Identifications and improved data for Ross Variables 295–379, cont.

Ross	Note	Variable	First JD	B	Second JD	B	Other
	(*)		2400000.0+		2400000.0+		identification
306	*	BU Lyr	17708.749	12.9	25169.565	13.3	
307	*	FP Aql	18119.758	12.2	25173.558	14.1	
308		V1213 Aql	18119.758	14.7	25173.558	<15.6	
309		V816 Aql	18119.758	14.7	25173.558	<15.7	
310	*	NSV 11971	18119.758	14.8	25173.558	<16.3	2MASS 19233640-0215347
311		FT Aql	18119.758	<15.9	25173.558	13.5	
312		ZZ Aql	18119.758	15.1	25173.558	13.4	
313		FW Aql	18119.758	<15.3	25173.558	14.1	
314		V820 Aql	18119.758	<16.0	25173.558	14.1	
315		V924 Aql	18119.758	15.8:	25173.558	14.1	
316		FS Cyg	17708.749	13.0	25173.558	<14.5	
317	*		18119.758	14.7	25173.558	14.7	GSC2.3 S9YZ000896
318		V601 Aql	18119.758	15.3	25173.558	13.3	
319		CE Aql	18119.758	15.2	25173.558	<17.0	
320		V1698 Aql	18119.758	14.4	25173.558	13.5	
321		V1715 Aql	18119.758	<15.2	25173.558	13.0	
322		V543 Aql	18119.758	<14.5	25173.558	12.8	
323	*	NSV 12985	20750.615	13.5	25171.585	<15.1	
324	*	NSV 13021	20750.615	14.4	25171.585	<16.4	
325		V363 Cyg	19217.797	<15.3	25173.558	14.3	
326	*	NSV 13047	19217.797	<17.0	25173.558	15.3	
327		V365 Cyg	19217.797	16.4	25173.558	14.2	
328	*	SY Cap	20750.615	14.3	25171.585	16.0	
329	*	NSV 13179			25171.585	14.2	Minor planet (24) <i>Themis</i>
330		V518 Cyg	19217.797	15.0	25173.558	15.6	
331	*	NSV 13449	18502.663	<16.4	25178.551	15.7	
332		V376 Cyg	18502.663	<16.3	25178.551	14.1	
333		V377 Cyg	18502.663	14.6	25178.551	15.8	
334		CT Cyg	18502.663	16.0	25178.551	14.1	
335		AK Vul	18502.663	18:	25178.551	14.2	
336	*	NSV 13592	18502.663	14.9	25178.551	14.8	USNO B1.0 1190-0542073
337		V472 Cyg	18502.663	<16.3	25178.551	13.9	
338		V363 Cyg	18502.663	<16.2	25178.551	13.9	
339		V598 Cyg	18502.663	15.1	25178.551	<15.3	

Table continued on following pages

Table 2. Identifications and improved data for Ross Variables 295–379, cont.

Ross	Note	Variable	First JD	B	Second JD	B	Other
	(*)		2400000.0+		2400000.0+		identification
340		GS Cyg	18502.663	<14.6	25178.551	12.3	
341		WW Aqr	20724.500	<15.7	25179.801	12.0	
342		DN Peg	20724.500	12.3	25179.801	11.3	
343	*	DM Aqr	20775.613	<14.7	25210.531	13.0	
344	*	NSV 14721			25210.531	13.3	Minor planet (59) <i>Elpis</i>
345		TU Psc	20688.844	14.5	25255.531	13.5	
346		AR And	17872.525	<14.8	24933.544	12.6	
347		NSV 998	20120.566	15.4	25257.601	13.3	
348	*	V719 Tau	17496.782	13.4	24933.601	<14.2	
349	*	NSV 1797	17496.782	13.1	24933.601	<15.0	
350		X Lep	17856.879	11.7	24931.569	16.3	
351		ST Lep	17856.879	13.9	24931.569	13.2	
352	*	NSV 1982			24933.601	12.4	Minor planet (451) <i>Patentia</i>
353		AQ Lep	20128.666	<15.0	25286.604	13.8	
354		SY Lep	20128.666	<15.1	25286.604	13.0	
355		VV Hya	20463.893	<15.0	24934.672	13.9	
356		CL Lib	18448.690	14.3	25001.797	15.6	
357		XX Ser	16606.688	12.5	25433.663	11.7	
358		CW Her	16697.684	13.5	25388.674	12.1	
359	*	V854 Oph	19160.820	15.4	25443.676	12.8	
360		V856 Oph	19160.820	14.1	25443.676	<15.9	
361		V850 Oph	19160.820	12.7	25443.676	14.7	
362		V1482 Oph	16972.857	13.7	25437.670	16.2	
363		V2600 Oph	16972.857	13.4	25437.670	12.1	
364	*	V862 Oph	16972.857	13.0	25437.670	<15.4	
365		V1898 Oph	19160.820	<15.0	25443.676	14.3	
366	*	V2554 Oph	16972.857	14.2	25437.670	13.6	
367		OU Aql	17783.615	13.2	25490.658	15.1	
368	*		16986.692	12.9	24993.701	13.3	2MASS 13101752- 2508253
369		V436 Hya	16986.692	13.7	24993.701	<15.7	
370		CF Vir	17349.703	13.3	24998.688	15.8	IRAS 14130-0538
371	*	V867 Sco	18096.723	14.3	24999.795	12.8	
372		M4 V28	18096.723	14.4	24999.795	13.3	
373		FT Ser	16693.638	14.5	24999.869	13.8	
374	*	CU Ser	16693.638	14.1	24999.869	<16.5	

Table continued on following pages

Table 2. Identifications and improved data for Ross Variables 295–379, cont.

Ross	Note	Variable	First JD	B	Second JD	B	Other
	(*)		2400000.0+		2400000.0+		identification
375	*	BD Ser	16693.638	13.9	24999.869	16.0	
376		CY Ser	16693.638	15.6	24999.869	13.4	
377		MV Her	18446.767	13.3	26128.747	<15.6	
378		V471 Her	18446.767	15.7	26128.747	14.3	
379		LU Her	18446.767	13.4	26128.747	15.1	

Notes

R295: Not listed in NSV catalog. Star has different brightnesses on the two 10-inch plates, but the second plate set does not go deep enough to confirm variability.

R298: Ross marked the star just to the east of AO Lyr on his chart but our examination of his plates confirms AO Lyr as the variable he detected.

R300: Not listed in NSV catalog. X-ray source ROTSE1 J182240.62+293115.0.

R301: Marsden (2007) showed this suspected variable was not a minor planet observation.

R303: Not listed in NSV catalog.

R304: Ross did not identify the variable on his finding chart, but V643 Her is in the center of his charted field and confirmed as the variable on re-examination of plate pair.

R306: Date of first plate is 1907 May 12, not March 12 as published by Ross.

R307: Ross did not identify the variable on his finding chart, but FP Aql is in the center of his charted field and confirmed as the variable on re-examination of plate pair.

R310: Marsden (2007) showed this suspected variable was not a minor planet observation.

R317: Not listed in NSV catalog and perhaps not variable. Star appears fainter on 1927 10-inch plate than on the 1908 plate but at about the same brightness on the two 6-inch plates; examination of other plates suggests a small variation.

R323: Marsden (2007) showed this suspected variable was not a minor planet observation.

R324: Marsden (2007) showed this suspected variable was not a minor planet observation.

R326: Marsden (2007) showed this suspected variable was not a minor planet observation.

R328: 1927 plate was exposed for 20 minutes on October 16 and then for 71 minutes more on October 17 with images superimposed; JD refers to October 17.

R329: Marsden (2007) showed object seen in 1927 was a minor planet.

Table continued on following page

Table 2. Identifications and improved data for Ross Variables 295–379, cont.

R331: Marsden (2007) showed this suspected variable was not a minor planet observation; object seen by Ross is at about R.A. $20^{\text{h}} 59^{\text{m}} 39^{\text{s}}$ Dec. $+29^{\circ} 29.7'$ (J2000) but there is no obvious counterpart on POSS images.

R336: Only a small variation but confirmed on 6-inch plates.

R343: Date of first plate is 1915 October 4, not October 11 as published by Ross.

R344: Marsden (2007) showed object seen in 1927 was a minor planet.

R348: Variable seen by Ross is not the star identified in Simbad as V719 Tau; approximate J2000 coordinates are R.A. $04^{\text{h}} 48^{\text{m}} 46^{\text{s}}$ Dec. $+25^{\circ} 13.8'$ (J2000), but no obvious counterpart on POSS images; position is close to radio source NVSS J044852+251452; possibly a minor planet.

R349: Marsden (2007) showed this suspected variable was not a minor planet observation; approximate J2000 position is R.A. $05^{\text{h}} 00^{\text{m}} 30^{\text{s}}$ Dec. $+26^{\circ} 40.3'$; no obvious counterpart on POSS images.

R352: Bedient (2003) and Marsden (2007) showed object seen in 1927 was a minor planet.

R359: Ross's note card indicates the 1928 magnitude should have been published as 11, not 10.

R364: POSS images show two stars 14" apart where variable was seen; both stars are IR sources; Simbad has the southern star identified as the variable, but Ross's chart seems to indicate the northern star.

R366: Ross's published declination has a 2.5' error but his finding chart and our re-examination of the plates confirm this identification.

R368: Not listed in NSV catalog. There are two nearby stars at Ross's indicated position but 2MASS 13101752-2508253 was confirmed as the variable.

R371: Our magnitude estimates are uncertain.

R374: This is Ross 23 rediscovered on a second plate pair.

R375: Ross's published coordinates have arc-minute errors but his finding chart and our re-examination of the plates confirm this identification.

Appendix

Many of Ross's cards for his earlier discoveries contain notes showing that additional work on these objects was carried out. The cards for his second list of objects reveal that one suspected variable was later identified as the minor planet (41) *Daphne*. Ross then realized that some of his suspects visible at just a single epoch would be minor planets, and a number of cards have a notation such as "variable or asteroid." Other notes give the results from examining the stars visually with the Yerkes 40-inch refractor.

The following table gives this supplementary material. Ross's comments are reproduced verbatim (omitting the common indication that the object might be an asteroid). A "v" refers to the variable while letters (a, b, c) refer to comparison stars that are indicated on Ross's finding charts. For those cases where a visual magnitude estimate was made, we follow the reproduced comments with the approximate Julian Date of the observation and V magnitude, derived by using modern magnitude values for the comparison stars.

Table A. Ross's notes and derived V magnitude estimates.

<i>Ross</i>	<i>Comments on Ross's note cards reproduced verbatim</i>	<i>JD</i> 2400000.0+	<i>m(V)</i>
1	1925 Aug 31: v reddish; v = b = c	24394.6	11.7
2	1925 Dec 7: 40"; v = a + .2 = 13±; Reddish	24492.6	11.9
3	1925 Dec 7: 40"; v = a = 13±; reddish	24492.6	13.2
4	1925 Dec 7: (40"); v = a - .2 (ftr) = 14±	24492.6	14.8
5	1925 Dec 7: (40"); v = a = abt 14m	24492.6	12.7
6	1925 Dec 17: 40"; v = a = 15m	24502.6	13.3
7	1925 Dec 17: 40"; v = a + .2 = 14m	24502.6	13.7
8	1925 Dec 17: 40"; v = 1/2(a + b) = 15m	24502.6	14.1
9	1925 Dec 17: 40"; v = a - .2 = 12½m = reddish	24502.6	11.4
11	1926 Jan 11: 40"; star <u>a</u> not vis v = b = 14m; repeat on better night	24527.6	13.4
12	1926 Jan 11: 40"; v very <u>red</u> = 9½ m; v = a + 0.4	24527.6	10.5
13	1926 Jan 11: 40"; v = a = 14m, conditions v.p.	24527.6	13.5
14	1926 Jan 11: 40"; v not vis, but conditions v.p.; limit being about m=14	24527.6	<13.3
15	1925 Dec 17: 40"; v = 15m = c	24502.6	14.9
16	1925 Dec 17: 40"; v = a <u>Discard this as variation</u> <u>not confirmed.</u> ea night it appears as bright as <u>a</u> and <u>a</u> & <u>b</u> do not appear to differ much in magnitude. Keep on program	24502.6	11.7
17	1925 Dec 17: 40"; v not visible	24502.6	<13.5:
18	40" for a very clear night; get 8 x 10 plate at $\alpha = 17\ 56\ \delta = -22.6$; rich field, stars of all magn		

Table continued on following page

Table A. Ross's notes and derived V magnitude estimates, cont.

<i>Ross</i>	<i>Comments on Ross's note cards reproduced verbatim</i>	<i>JD</i> 2400000.0+	<i>m(V)</i>
20	1925 June 29: $v = a + .2 = b + .2$	24331.6	13.4
23	1925 June 29: $v = a = b = c$	24331.6	13.6
26	1925 July 20: $v \approx a + .2 \approx b - .3$	24352.6	13.8:
27	1925 July 20: $v \approx a$	24352.6	13.9
28	1925 June 29: Slightly reddish; $v = a + .1$; $v < b$	24331.6	11.5
29	1925 July 20: $v \approx a - .2$	24352.6	14.0
37	1925 June 29: v and b are both reddish; $v \approx a \approx b + .2$	24331.6	11.2
38	1926 Apr 16: 40"; Var. n.s.; condition v. poor		
39	1926 Apr 16: 40"; Var n.s.—condition v. poor; Strongly suspect this is an <u>asteroid</u>		
40	1926 Apr 16: 40"; v . not vis—condition v. poor; ? an asteroid at s.p.		
43	1925 Aug 27: $v = a + 0.2$; $v = 14m \pm$	24390.6	12.4
44	1925 Aug 27: $v = a$; $v = 15m$	24930.6	13.8
47	Appears to be an unusual v . Seems from 3 plates of constant magn (= 11) until 1925 July 22. In one month it had fallen <u>one</u> magn. Follow closely.		
48	1925 Aug 27: v not vis in 40"; sky very transparent		
50	1925 Aug 27: v slightly reddish; $v = a = 13m$.	24390.6	11.1
51	1925 Aug 27: $v = a - 0.1 = 15m$	24390.6	13.9
52	1925 Aug 27: v is not vis in 40"; sky very transp.		
53	1925 Aug 31: $v = b - .2$ (v fainter)	24394.6	14.9
54	1925 Aug 31: $v = a$ (est $14\frac{1}{2}$)	24394.6	13.2
55	1925 Aug 31: $v = c + .2$ (+ means brighter)	24394.6	11.3
57	1925 Aug 31: 40"; $v = a - .3$ fainter; $= b + .2$ brighter	24394.6	14.3
77	1925 Sept 24: (40"); not seen. <u>a</u> was just visible	24418.6	<15.9
78	1925 Sept 24: $v = \underline{b}$ or $\underline{c} + .2$ (brighter)	24418.6	11.7
79	1925 Sept 24: 40"; $v = a = 15\frac{1}{2}m$	24418.6	14.9
80	1925 Aug 31: (40"); $v =$ reddish; $= a + .2$ (brighter)	24394.6	11.4
86	1925 Aug 31: (40"); $v =$ <u>very</u> red; $= a + .2$ (v brighter)	24394.6	10.5
87	1925 Sept 24: (40"); $v = a = 14 \pm m$	24418.6	14.3
88	<u>Shapley</u> says this is a <u>nova</u>		
90	1925 Dec 7: (40"); Not visible in 40"; Not on Barnard plate No 304, of 1905 Sept 2; Hence this is probably an asteroid		
98	1925 Dec 7: 40"; $v = c$	24492.6	12.5
99	1925 Dec 7: (40"); $v =$ barely visible = $16 \pm m$; Shapley finds this is a l.p. variable; see his letter	24492.6	12.5