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SIX SUSPECTED VARIABLE STARS IDENTIFIED AS ASTEROIDS

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In 1926-31, F. E. Ross published in the *Astronomical Journal* 10 lists of new variable stars he detected while blinking photographic plates during the search for his famous high-proper-motion stars. No classifications were given; his observations consisted of pairs of observations from plates he made and a series taken by E. E. Barnard about 15 years earlier. In the years since, most of his variables have been followed up or independently rediscovered and assigned permanent designations in the General Catalogue of Variable Stars (Kholopov et al., 1998). Ross' variables have been found to run the gamut of types: Miras, semi-regulars, RR Lyrae, Cepheids, and at least one active galaxy nucleus, SV* R 200¹ (Baumert and Cudworth, 1981).

A significant fraction of Ross' detections remain catalogued as suspected variables, or uncatalogued other than in Ross' original papers. Ross himself noted that some of his detections, particularly those detected at one epoch and not at the other, were "open to question" and possibly asteroids (1926b). He noted further that proving a detected variable was actually an asteroid "would be an exceedingly difficult matter". In 2003, this is no longer the case. The Solar System Dynamics Group of the Jet Propulsion Laboratory has made available via the Internet tools to rapidly identify small solar system bodies in a given field at any epoch after the year 1800, and to quickly calculate fully-perturbed n-body coordinates for any of over 71,000 objects (Chamberlin, 2002).

To search for possible asteroids misidentified as suspected variable stars, objects were selected from Ross' lists, with the following characteristics:

1. Only seen at one epoch
2. Not near an obvious candidate star on Digital Sky Survey images
3. Not associated with an IRAS or bright 2MASS source (possible LPV)
4. Not associated with a ROSAT X-ray source (possible CV)

Applying these criteria resulted in 24 candidates being selected. Of the 24, 6 (Table 1) were positively determined to be asteroids by comparing the suspected variable position with the results of a search for asteroids present near that position at the stated epoch. The positions given below for the asteroids are those of closest approach to Ross' position during hours of darkness at the observing site. All positions given are equinox J2000; all times and dates are UT.

¹In order to avoid confusion with Ross' proper motion stars, I refer to his variables by the SIMBAD-style designation, SV* R NNN.

Table 1: Table 1: Ross Variables Identified as Asteroids

Ross No.	NSV No.	Asteroid
SV* R 038	4748	(24) Themis
SV* R 039	4796	(39) Laetitia
SV* R 089	13752	(115) Thyra
SV* R 136	308	(137) Meliboea
SV* R 206	5338	(26) Proserpina
SV* R 352	1982	(451) Patientia

Details on specific objects:

SV* R 038 = NSV 4748. Not seen (to magnitude 15) on Barnard's plate, 1904 November 9²; seen on Ross' plate, 1925 March 31:

Datum	RA	Dec.	Magnitude
Ross (1926a)	10 ^h 08 ^m 14 ^s	+12°28'0	10.0
(24) Themis at 01:00	10 ^h 08 ^m 14 ^s .16	+12°28'01".5	11.44

SV* R 039 = NSV 4796. Not seen (to magnitude 15) on Barnard's plate, 1907 March 9; seen on Ross' plate, 1925 March 31:

Datum	RA	Dec.	Magnitude
Ross (1926a)	10 ^h 15 ^m 27 ^s	+12°10'5	11.5
(39) Laetitia at 02:50	10 ^h 15 ^m 27 ^s .26	+12°10'29".3	10.90

SV* R 089 = NSV 13752. Visible on Barnard's plate on 1904 June 20; not seen (to magnitude 15) on Ross' plate, 1925 August 20:

Datum	RA	Dec.	Magnitude
Ross (1926a)	21 ^h 31 ^m 18 ^s	-17°47'4	11
(115) Thyra at 07:15	21 ^h 31 ^m 18 ^s .85	-17°47'24".1	11.47

SV* R 136 = NSV 308 = SV* P 27 = CSV 96. Not seen on Barnard's plate, 1906 September 21, also not detected on 44 plates in the Sonneberg collection taken between 1930 October 19 and 1939 August 24 (Sandig, 1950); visible on Ross' plate, 1925 November 14:

Datum	RA	Dec.	Magnitude
Ross (1926b)	00 ^h 49 ^m 19 ^s	+04°51'4	12
(137) Meliboea at 04:45	00 ^h 49 ^m 19 ^s .17	+04°51'21".9	12.55

²Ross' papers give the local date of the observation.

SV* R 206 = NSV 5338. Visible on Barnard's plate, 1909 April 10; not seen on Ross' plate, 1927 April 6:

Datum	RA	Dec.	Magnitude
Ross (1927)	11 ^h 47 ^m 43 ^s	+05°31'1	11
(26) Proserpina at 03:00	11 ^h 47 ^m 43 ^s .07	+05°31'16".5	11.12

SV* R 352 = AAVSO 0520+26 = NSV 1982. Not seen (to magnitude 15) on Barnard's plate, 1906 October 13, visible on Ross' plate, 1927 February 22:

Datum	RA	Dec.	Magnitude
Ross (1929)	05 ^h 26 ^m 37 ^s	+26°43'5	11
(451) Patientia at 03:00	05 ^h 26 ^m 38 ^s .29	+26°43'24".3	11.12

The combination of absence on one plate, presence on the other and close correlation in time and magnitude to predicted asteroid positions demonstrate that these 6 suspected variables are not stars at all, but solar system objects in Barnard and Ross' fields.

A further 10 candidates (Table 2) were found *not* to be solar system objects using the same process, with no asteroid found. These 11 were relatively bright (magnitude 12 or less), and the population of asteroids this bright is well enough known to be considered complete.

Table 2: Table 2: Ross Variables Not Identified as Asteroids

SV* R 040	SV* R 166	SV* R 168
SV* R 199	SV* R 230	SV* R 243
SV* R 329	SV* R 349	SV* R 369
SV* R 376		

The remaining 8 (Table 3) had ambiguous search results, possibly due to position errors. Examination of the original plates and further database work will be required to positively identify the nature of these objects.

Table 3: Table 3: Ross Variables that Cannot be Characterized

SV* R 025	SV* R 029	SV* R 130
SV* R 160	SV* R 225	SV* R 231
SV* R 331	SV* R 344	

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