TABLE I

OBSERVATIONS OF RED VARIABLE STARS

Star	Date of Observation (UT)	Spectral Type	Remarks
SZ And	Oct. 3, 1956	M5e	
SX Cam	Oct. 5, 1956	M6e	1
WX CMi	Oct. 28, 1957	Se	2
U Cap	Nov. 1, 1957	M3e	
RR Cep	Mar. 9, 1956	M5e	
CV Cep	Sep. 15, 1963	S	3
U Crv	Apr. 29, 1957	M5e	
X Dra	Aug. 5, 1956	M5e	4
VY Her	Jun. 17, 1955	M5e	
UZ Hya	Mar. 24, 1955	M4e	
SX Lib	Mar. 22, 1955	M6e	
EE Lib	May 25, 1955	M6e	
BD Oph	Mar. 23, 1955	M6e	
DG Peg	Sep. 24, 1956	M4e	
CN Per	Oct. 13, 1963	Ce	5
Z Tau	Feb. 5, 1957	M7e	6
RU Tau	Feb. 4, 1956	M3.5e	7
AQ Vir	May 23, 1955	M5e	
CF Vir	May 14, 1956	M5e	

Notes to Table I:

1. Keenan's type of S6,3: given in *Ap. J.*, **120**, 484, 1954, and determined from a plate taken by the writer, refers to a neighboring anonymous star.
2. The TiO band strength is equivalent to that of an M6 star. The period of this variable was at first thought to be 419 days, but has recently been considered to be only one-half of that. It seems possible that the original period is more nearly correct.
3. This semi-regular variable has been classified as M4 on an infrared Case plate by Cameron and Nassau, *Ap. J.*, **124**, 346, 1956, but the λ 6474 ZrO band is very well marked on the Curtis Schmidt plate.
4. A type of Me is given by Balz in *Pub. Leander McCormick Obs.*, **13**, pt. I, 1956.
5. The Curtis Schmidt plate shows strong Hα emission in this object, which was first found to be a carbon star at the Warner and Swasey Observatory.
6. This star's flat-bottomed light curve is probably to be accounted for by its faint companion; see *Pub. Lick Obs.*, **21**, pt. II, 1963.
7. Hβ emission is strong. Both the early spectral type and the rather unusual form of the light curve are atypical for Mira-type variables of such a long period (568 days).

SOME SPECULATIONS ON THE MARTIAN CANALS

DEAN JAMISON
Stanford University

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Lederberg and Sagan suggest that small-scale geothermal activity on Mars such as hot springs, fumaroles, and volcanoes could melt a permafrost layer just below the Martian surface and thereby allow exit for water from deeper layers.[1] These relatively warm and humid "microenvironments" would be the most probable abodes of Martian life.

Geothermal activity of this nature on earth occurs most frequently along fault zones and fractures in the earth's crust.[2] Fielder suggests that the Martian canals occur along fault lines.[3] (We need not necessarily accept his view that they are graben.) If so, the low albedo of the canals could be attributed to vegetation existing in the relatively warm, humid environments caused by geothermal activity along crustal fractures. The spotty appearance of the canals can be accounted for by local variations in geothermal activity. The "oases" occur as a result of greater geothermal activity at the junction of two fault lines. (Ref. 2 cites terrestrial analogies.) Seasonal darkening of the canals results from additional water made available by a subliming polar cap. Nonseasonal darkening[4] is a result of abnormal geothermal activity.

This theory makes four predictions: (1) There must be life along the canals. (2) The atmosphere above the canals is more humid than that above the adjacent desert. (3) The temperature of the canals is higher than that of the adjacent desert. (4) By terrestrial analogy, there is considerably more seismic activity in the vicinity of the canals than elsewhere. Predictions 2 and 3 can be checked by flyby probes or orbiters. Unfortunately, Mariner IV is not instrumented to do so.[5] Predictions 1 and 4 can be checked by landing life-detection equipment and seismometers on the canals. Greenfield and Davis implicitly suggest that this might be done by launching a balloon from an entry vehicle as it descends through the atmosphere.[6] If the entry vehicle were descending over a desert, the balloon could be programmed to land on a canal by noting its albedo change. Such an experiment could be performed with a multiple-entry-vehicle Voyager mission such as I have described elsewhere.[7]

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[1] J. Lederberg and C. Sagan, *Proc. Nat. Acad. Sci.,* **46,** 1473, 1962.

[2] "Volcanoes," in *The Encyclopedia Britannica,* Vol. 23 (Chicago: Encyclopedia Britannica, Inc., 1929), pp. 241-242.

[3] G. Fielder, *Pub. A.S.P.,* **75,** 75, 1963.

[4] D. B. McLaughlin, *A. J.,* **60,** 261, 1955.

[5] *NASA Facts,* Vol. 2, No. 9 (Washington, D.C.: National Aeronautics and Space Administration, 1965), p. 2.

[6] S. Greenfield and W. Davis, RAND Corp. Report R-421-JPL, pp. 87-89, 7, 1963.

[7] D. Jamison, in *S.A.M.P.L.E.R.* (Stanford, Calif.: Stanford University Press, 1965), Appendix IV.