NEW PERIOD-DETERMINATIONS FOR EIGHT VARIABLE STARS

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Eight variable stars on which I worked at the Maria Mitchell Observatory the summer of 1974 are listed in Table I. All were in the region of λ Sagittarii. Six of them, V517, V518, V519, V520, V1666 and V1702 Sgr were assigned to me by Dr. Hoffleit for updating their periods, her previous determinations having been based on plates taken prior to 1952. The other two stars, IU Sgr and suspected variable star 4277, I rediscovered with the blink microscope. For period-determination the Nantucket NA plates and Harvard plates of the A, B, and MF series were used. Most of the stars required only slight period corrections.

For IU Sgr the previously published period (Innes 1917) was uncertain. Here is an example of the hazards involved in publishing a period based on few observations and including only one maximum. Innes' period of 382: days disagrees significantly with my calculated period of 268.9 days. This is based on observations on NA plates covering the years 1957-74, and includes five observed maxima and several ascents and descents on the light curve. I tested the 382 and 268.9 day periods for possible spurious period relationships but found none.

Two of the stars are classified as semi-regular. The new observations on V1666 Sgr on NA plates combined with data from previously measured MF plates and my own measurements on A plates, confirm the semi-regularity and the period of 102 days. For V1702 Sgr, I revised the period from 95 to 101.5 days. This correction was based on my observations from NA and A plates, combined with old observations from B and MF plates. The new period does not fit the old observations exactly, but it is very good for the new data which cover a longer time interval. The old period does not fit the new data at all.

Two of the stars required more involved corrections than the others. V519 and V520 Sgr proved to have changing periods, as indicated by the upper graphs in Figures 1 and 2. The abscissae are Julian Days of observed maxima plotted against O-C as ordinates. Here O is the observed (or interpolated) time of maximum. The corresponding computed time is

$$C = JD_O + nP \ , \qquad (1)$$

where JD_O is the time of an observed maximum taken as zero point, P is the "new" period given in Table I, and n is the number of cycles elapsed since JD_O. If the actual period were constant a straight line would best fit the observations. Since a parabola fits the observations more precisely, the period is changing and a more complex formula than (1) must be found for predicting times of maximum. The assumed period in fact represents only the observations close to the horizontal tangent point of the upper curves in Figures 1 and 2. The ordinate at any other point equals kn^2, where n is now counted from the point of tangency, JD_O. Thus $n = (JD-JD_O)/P$, and $k = (O-C)/n^2$. The new formula for predicting the times of maxima is

$$Max = JD_O + nP + kn^2. \qquad (2)$$

The correction factor k can be determined from many points on the curve relating (O-C) for a constant period and JD.

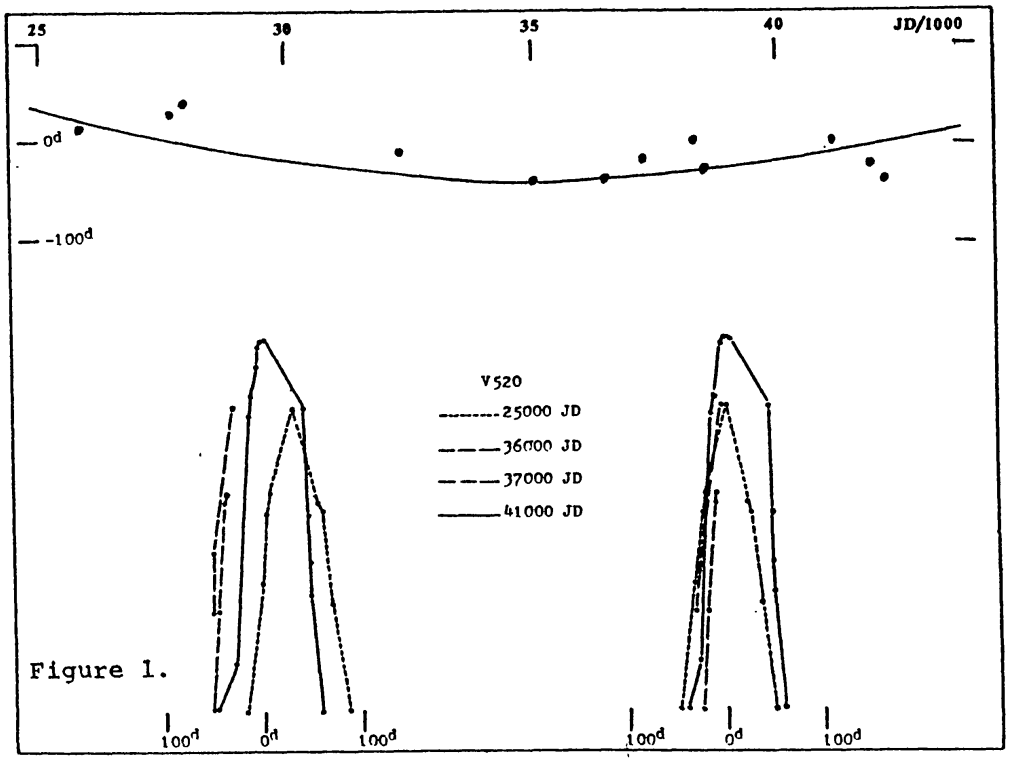

Figure 1.

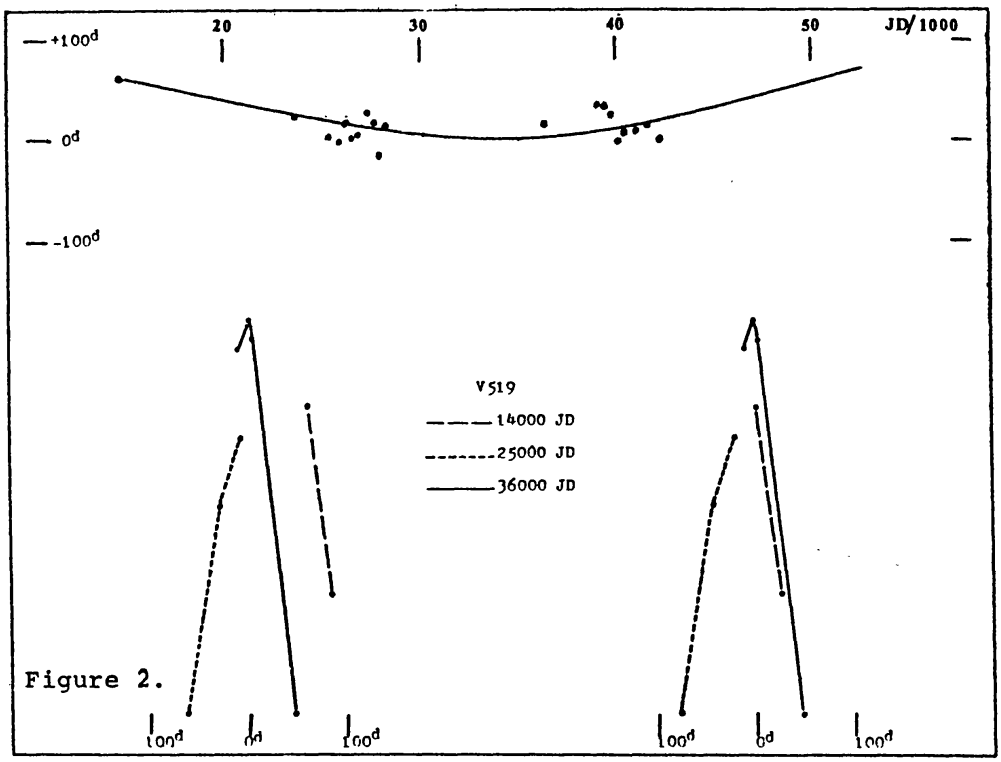

Figure 2.

Figures 1 and 2. Upper diagram in each Figure: O - C of maxima plotted against JD. The curves are parabolas that fit the observations. Lower left hand curves: for several discrete cycles, the O - C computed for a constant period, plotted against magnitude. The curves on the right show how the parabolic corrections to the phases result in more satisfactory composite light curves.

If the points do indeed all fall on a parabola all the determinations of k will be the same within the uncertainties of ascertaining the times of observed maximum. The values found for V519 and V520 Sgr imply that the periods of both stars are getting progressively shorter. In the case of V520 the rate of shortening, 0.068 day/cycle, is consistent with the difference shown in Table I between the old and the new period determinations. For V519 the change is only 0.005 day/cycle; but the fact that the earlier determination is the smaller is simply a reflection on the lower accuracy of that determination, which moreover, did not include the very early A-plate observations at about JD 14850.

That formula (2) represents the observations better than formula (1) is illustrated in the lower graphs of the Figures. The left-hand graphs show a few selected cycles plotted in such a way that the computed times of maxima are on the zero axis. The right hand diagrams show how the term kn^2 has shifted the points so that a better composite curve may be obtained. Ordinates represent magnitudes, abscissae phase.

The period for variable suspect S4277 (first discovered by W Luyten) was determined only from observations on NA plates. It is outside the fields covered by the other available plates. It varies from approximately 12.3 to 14.2 pg.

REFERENCES

Innes, R. 1917, Union Obs. Circ. No. 37, 300.
Kukarkin, B.V. et al. 1969, General Catalog of Variable Stars, Moscow.

TABLE I
Previously Published and Newly Derived Periods

Variable	Type	Old Period	New Period	k
IU Sgr	M	382:	268.9	
V517	M	280	281.5	
V518	M	160	159.5	
V519	M	177	178.25	0.0046
V520	M	263	260	0.051
V1666	SR	102	102	
V1702	SR	95	101.5	
S4277	M	-	144.5	