a better theoretical explanation of the structure of those systems. For the time being, with respect to W UMa stars, we should to the statement „Variability due to Contact Configurations" still add a questionmark.

References:

BOOKMYER, B. B., 1969, Astronomical J. 74, 1197.
LUCY, L. B., 1968, Astrophys. J. 151, 1123 and 153, 877.
MAUDER, H., 1969, IAU Coll. Budapest, 419.
MERRILL, J. E., 1970, in „Vistas in Astronomy", Vol. 12, 43.
SCHÖFFEL, E., 1970, Veröff. Bamberg, 8, 88.

Discussion to the paper of MAUDER

THOMAS: If W UMa systems are not in contact, how do you think the energy can be transferred from one component to the other?

MAUDER: I have no physical model for this, but as you know, most light curves of W UMa stars suffer some variability. Therefore, due to the thermal energy content of matter it might well be, that occasional mass exchange might transport the excess energy radiated away by the secondary.

HAZLEHURST: Did you imply that the surface brightness may be higher in the region between the stars?

MAUDER: No, I only mentioned, that in this region the normal expressions for limb- and gravity-darkening might well fail to be applicable since those laws are valid only in the case of hydrodynamic equilibrium.

Search for Contracting Close Binaries

R. H. KOCH (Philadelphia)

The selection of close binaries which compose the usual tabulations of solutions has informed us in detail on main sequence stellar atmospheric and interior parameters, and on the theories of the tidal and radiative interactions, and has permitted the creation of the theory of binary evolution. As we have seen, the eruptive doubles are beginning to yield to modern instrumentation. Adding more pairs to those already „understood" will bring continuity into our appreciations of these processes and undoubtedly change them sowewhat. The origins of close pairs, however, remain obscure and one can only say that the theories which describe fission of a proto-star after its core de-couples from the envelope seem promising. The latest presentation of this idea by BODENHEIMER and OSTRIKER (1970) can be viewed as the successor to the indicative theories of ROXBURGH (1966) and CAMERON (1969). In this way of looking at binary origins it is simply a question of when fission occurred in the proto-stellar interval. Observationally, candidate stars are anything but numerous and it is for this reason that we have begun the program described here.

More than 50 plates have been taken of NGC 2264 primarily with the No. 1 91-cm reflector at the Kitt Peak National Observatory. Kodak IIaD emulsion was used and the beam was filtered by a cemented sandwich of 1 mm. BG 18 and of 2 mm. GG 495 A. This gives a response very like the familiar V sensitivity with an effective wavelength perhaps 100 Å shorter than that for V. The five consecutive nights from Kitt Peak used the photoelectrically-guided photographic tailpiece but were of inferior photometric quality. Exposure times were of the order of 20 minutes. Lengthened exposures which attempted to compensate for clouds usually resulted in the nebula becoming detectable and these plates have not been used. The field is about 40′ north-south and about 50′ east-west and is centered at about 17′ south of S Mon. We have initially decided to photometer the 550-odd stars in the region already investigated for proper motions and two graduate students have completed 36 plates using the iris photometer at Columbia University and the Astro Mechanics Cuffey photometer at Colgate University. The partial analysis of these data form the subject of this report.

From WALKER's (1956) photometry at network of 74 stars was chosen to cover the interval $+7 < V < +17$ as the basis of the plate calibration. Telescope time was not available to observe a new magnitude sequence or to re-observe WALKER's stars independently. It was anticipated that some stars thought to be constant may have varied in the interval from 1954 to 1970. This has clearly happened for the stars listed in Table I which were discarded from the calibration.

Table I: Stars Within NGC 2264 Now Shown to be Variable

Walker No.	Δ V (1970—1954)	B—V
57	+ 0.83	+ 2.57
75	— 0.66	+ 1.38
102	+ 0.39	+ 1.39
215	— 0.24	+ 0.08

The mean error of the new measurement is presently of the order of ± 0.02 and ± 0.08 for bright and faint stars, respectively. The objects in Table I were chosen, not to typify the long-term variations, but simply because they are very conspicuous and indicate that there are no systematic variations with B—V or V as might be suspected from dust shell dissipation if it has occurred. There are relatively few stars with $V < +9$ so that the bright end of the photographic calibration is more poorly defined than is desirable. Further, 7 of the 23 brightest stars are either spectroscopic binaries or velocity variables and so might more properly be program stars rather than calibration stars. We plan to turn to photoelectric monitoring of the bright objects in the coming season. We have completed a reconnaissance of stars not known or suspected to vary at the time of WALKER's photometry. About 20% of these can now be shown to have varied in the long time scale, those of Table I being some of the most conspicuous. Of this 20% of the population, the variables are about equally divided between those which have grown brighter and those which have grown fainter.

For those stars formerly known to vary, 9 are now clearly brighter than before, 14 are fainter and 16 are still within the spread of the 1950-epoch observations. A few of these are now fainter than the faintest calibration star and we have actually photometered 137 stars too faint for the present calibration. We make no assertion about the cluster membership of these stars.

The photometry is 70% completed; reduction and analysis are about 20% completed and thus we can make only fragmentary scrutiny for the short-period variables which could be the progenitors of main sequence close binaries if mass loss is not severe. At this time, there are about 40 such candidates including 4 which have varied on the long time scale. Of this total of 40, 7 are faint known variables of large positive B—V so that the short-term variability is presumably intrinsic. There could, of course, be a geometrical contribution to this variability. If these characteristics are used as criteria to suggest eclipses in the brighter cluster members, four stars with $V < +14$ survive scrutiny at this stage as short-term variables.

We plan to push the photometry to completion as soon as possible, to add a few plates of NGC 2264 in the coming season and to begin similar searches in two other young clusters.

References:

BODENHEIMER, P., and OSTRIKER, J. P., 1970, Astrophy. J. 161, 1101.
CAMERON, A. G. W., 1969, in Low Luminosity Stars (ed. S. S. Kumar, Gordon and Breach Science Pub., New York), p. 423.
ROXBURGH, I., 1966, Astrophys. J. 143, 111.
WALKER, M. F., 1956, Astrophys. J. Supp. Ser. 2, 365.

HALL: In extrapolating main sequence binaries backwards, what exactly did you do?

KOCH: We permitted the sample stars, such as Y Cyg, AR Aur, and others, to move back along EZER-CAMERON tracks until they achieved contact with each other. In this simple-minded, limiting way of doing things, neither mass nor momentum loss is permitted.

LLOYD EVANS: There are several known eclipsing binaries in young clusters, e. g. V 702 Sco in NGC 6383.

KOCH: Thank you. There are also assorted binaries within the fields of several associations.

Variations of the Period of AH Virginis

GUSTAV A. BAKOS (Waterloo)

AH Virginis was discovered by GUTHNICK and PRAGER (1929) and since that time the system was observed photographically, visually and, more recently, photoelectrically. The variable belongs to the class of eclipsing binaries of the W UMa type. It has a period of 0.41 days and spectrographic as well as photometric elements have been derived by CHANG (1948) and BINNENDIJK (1960), respectively. The most interesting result of discussions by KWEE (1958), BINNENDIJK (1960), HERCZEG (1962), and PURGATHOFER and PROCHAZKA (1967) is the fact that the residuals between the observed and the computed epochs of minima cannot be represented by a linear relation and show the tendency of producing sudden variations in the period of the system.

Recent photoelectric observations made by the writer in 1970 and again in 1971 and represented by a mean curve in Fig. 1 show clearly that the light curve changed significantly during one year. It also shows that it is not possible to combine observations over extended time intervals and sometimes not even over a few observing nights.

Since observations of AH Vir extend for about 40 years involving nearly 40,000 revolutions the residuals of the epochs of minima should provide important information about the changes of the period of the system. A plot of the O — C's of the primary and secondary minima versus time is shown in Figs. 2 and 3 respectively. Although there is a large scatter of points apparent in the graphs, especially among the visual observations, one may see that adopting the mean period of 0.40751846 days the relation between J. D. 2425000 and J. D. 2435000 is best represented by a downsloping line, or in other words, that the average period became shorter by 0.040 seconds as compared with the adopted value. At about J. D. 2435000 a change in the period occurred, at this time in the opposite direction making the average period longer by 0.35 seconds. The change of the period is considerable making the actual period equal to 0.40752189 days. With this new period a nearly horizontal line can be fitted to the O — C's as seen in the inserts to Figs. 2 and 3. However, indications are that since 1970 (the last three points in the inserts) a further increase of the period might have occurred.

From spectroscopic determinations of the orbital period the mass of the two stars is given as 1.36 and 0.57 solar masses. Since the semimajor axis of the system is also known one finds, by differentiating Kepler's harmonic law formula that

$$-\frac{\Delta P}{P} = \frac{2 \Delta m}{m}$$

where m is the total mass of the system. From observations the value of Δ P/P is 9×10^{-6} and, therefore, the mass loss is given as 2×10^{28} grams. This amount of mass loss is of the same order as observed in nova outbursts, and, consequently, should lead to optical phenomena associated with nova like objects. Since no appreciable increase in brightness of AH Vir has ever been reported the validity of this estimate of mass loss seems to be in doubt. On

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