

42. COMMISSION DES ETOILES DOUBLES PHOTOMETRIQUES

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INTRODUCTION

For this report, account has been taken of literature and information received up to the end of November, 1963. Thanks are due those members of the Commission and other astronomers who have sent me reprints of papers and who have transmitted reviews or summaries of work completed or in progress. Much reliance has been placed on the *Bibliography for Eclipsing Binaries* issued by the Commission; we are all in the debt of the Contributors to the Bibliography for their efforts: Cester, Kron (K. G.), Plaut, Plavec, Sahade, Schneller, Shulberg. Special thanks are due Dr O'Connell and Dr Wood for their direct help in the preparation of this report.

In accordance with the feeling expressed in the Commission session at Berkeley, this material is presented under the same headings as were used in previous reports. Both the activity in the field and the need of some revision in the headings, are indicated by the fact that nearly eight hundred separate bibliographic entries and two hundred 'summary report' items, had to be handled in the course of construction of the report, most of them under more than one heading and some under as many as three.

OBSERVATIONAL TECHNIQUES AND NEW PHOTOMETRIC DATA

Temperature effects in photomultipliers have been studied by Young (1) and by Fernie and Marlborough (2). Bakos and Dunlap compared a light curve obtained with an image orthicon tube with a photo-electric light curve of the same star (3).

Table 1a is a continuation of Table 1 on page 478 of *Trans IAU 11A*. Activity in photo-electric photometry of eclipsing binaries is still increasing; the number of stars listed in Table 1a is 139, as compared with 110 in the previous report, while the number of references has increased from 186 to 203. It is worthwhile calling attention once more to Tables 2 and 3 on pages 622 and 623 of *Trans. IAU 10*; of the twenty-seven, two-spectra systems listed therein as in need of photo-electric observation, ten are included in the present table, and of the 13 single-spectrum systems, none is included in this report. Attention is again called to Popper's list of 13 double-lined eclipsing binaries needing photo-electric light curves (4). Batten hopes to have up-dated versions of the Tables 2 and 3 mentioned, ready for the Hamburg sessions.

Table 1b indicates in rather summary form the very considerable effort devoted to visual and photographic estimates of magnitude, while valuable products of this effort appear both in this table and as times of minima in Table 3 below.

Table 1a. New photo-electric observations

Star	References
QS Aql	Knipe, G. F. G., (Republic Obs., Johannesburg) (blue, yellow).
V ₃₄₆ Aql	Cristaldi, S., Walter, K., <i>Astr. Nachr.</i> , 287 , 207, 1964.
FU Ara	Cillié, G. G., Lindsay, E. M., <i>Mon. Not. R. astr. Soc.</i> 121 , 333, 1960 (blue, yellow).
RV Ari	Bakos, G. A., Dunlap, J., <i>Astr. J.</i> 68 , 272, 1963 (abstract) (light curve by image orthicon).
RX Ari	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962.
56 Ari	Hardie, R., Schroeder, N. H., <i>Astrophys J.</i> 138 , 350, 1963 (three colors).
T Aur	Walker, M. F., <i>Inf. Bull. Comm. 27 IAU</i> , no. 2, 1962 (Nova Aur = ecl. bin.); <i>Astrophys J.</i> 138 , 313, 1963
SS Aur	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963.
TT Aur	Krasberg, A., (Harvard College Obs.) (light curves, three colors).
WW Aur	Fredrick, L., (Leander-McCormick Obs.) (light curves, blue, yellow).
AR Aur	O'Connell, D. J. K., (Specola Vaticana) (<i>UBV</i>).
BF Aur	Mannino, G., (Loiano) (<i>BV</i>).
EO Aur	Schneller, H., <i>Astr. Nachr.</i> 286 , 97, 1961 (two colors).
ε Aur	Schneller, H., <i>Sterne</i> 37 , 144, 1961. Schneller, H., <i>Astr. Nachr.</i> 287 , 49, 1963.
ζ Aur	Albo, H., <i>Publ. Tartu. astr. Obs.</i> 33 , 311, 1960 (eclipse 1955-57). Flower and Cook Obs. <i>Astr. J.</i> 67 , 775, 1962. Larsson-Leander, G., <i>Ark. Astr.</i> 3 , 17, 1961 = <i>Stockh. Obs. Medd.</i> no. 132, 1961 (outside eclipse).
AC Boo	Dominion Astrophysical Obs., <i>J. Roy. astr. Soc. Can.</i> , 54 , 132, 1960.
44i Boo	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962. Larsson-Leander, G., <i>Ark. Astr.</i> 2 , 413, 1961. Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962. Cristaldi, S., (Oss. astrofis. Catania). Catalano, S., Saitta, T., <i>Mem. Soc. astr. ital.</i> , 35 , 43, 1964. Semeniuk, I., <i>Acta astr.</i> 13 , 118, 1963. Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960 (light curve). Wehlau, W. H., Leung, K.-C., <i>J. Roy. astr. Soc. Can.</i> 56 , 105, 1962.
Y Cam	Broglia, P., (Merate) (<i>BV</i> , nearly completed). Plavec, M., Smetanova, M., Pekny, Z., <i>Bull. astr. Inst. Csl.</i> 12 , 117, 1961.
Z Cam	Mumford, G. S., <i>Astr. J.</i> , 68 , 286, 1963 (abstract).
SV Cam	Nelson, B., <i>Publ. astr. Soc. Pacif.</i> Oct. 1963 (abstract) (blue).
TU Cam	West, R., (Copenhagen) (<i>BV</i>)
S Cnc	Huffer, C. M., Collins, G. W., <i>Astrophys J. Suppl.</i> 7 , 351, 1962.
RZ Cnc	Broglia, P., (Merate) (<i>UBV</i>).
TW Cnc	Huruhata, M., Kitamura, M., <i>Publ. astr. Soc. Japan</i> 12 , 441, 1960 = <i>Tokyo Repr.</i> no. 202 (blue, yellow).
R CMa	Kitamura, M., Takahashi, C., <i>Publ. astr. Soc. Japan</i> 14 , 44, 1962 = <i>Tokyo Repr.</i> no. 231.
UW CMa	Cousins, C. W. J., Warren, P. R., <i>Mon. Not. Astr. Soc. S. Afr.</i> 22 , 65, 1963.
AD CMa	Anderson, L. R., McNamara, D. H., <i>Publ. astr. Soc. Pacif.</i> 72 , 506, 1960.
29 CMa	Bappu, M. K. V., (Kodaikanal) (<i>BV</i>).
YY CMi	Abhyankar, K. D., <i>Z. Astrophys.</i> 54 , 25, 1962 = <i>Nizamiah Obs. Repr.</i> no. 35 (three colors). Abhyankar, K. D., <i>Nizamiah Obs. Contr.</i> no. 1, 1962.
δ Cap	Bappu, M. K. V., (Kodaikanal) (<i>BV</i>). Cousins, A. W. J., Warren, P. R., <i>Mon. Not. astr. Soc. S. Afr.</i> 22 , 65, 1963. Wood, F. B., Lampert, P. A., <i>Publ. astr. Soc. Pacif.</i> 75 , 281, 1963.
ST Car	Sommerville, J., (Mt. Stromlo Obs.) (<i>UBV</i> nearly complete).
EM Car	Feast, M. W., Stoy, R. H., Thackeray, A. D., <i>Mon. Not. R. astr. Soc.</i> 122 , 239, 1961 (<i>UBV</i>).

Star	References
GL Car	Feast, M. W., Stoy, R. H., Thackeray, A. D., <i>Mon. Not. R. astr. Soc.</i> 122 , 239, 1961 (<i>UBV</i>).
RZ Cas	Shao, C.-Y., (Harvard College Obs.). Kruszewski, A., Semeniuk, I., (yellow). Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960. Van Genderen, A. M., <i>Bull. astr. Inst. Netherlds.</i> 17 , 69, 1963.
SX Cas	Gaposchkin, S., <i>Astr. J.</i> 68 , 73, 1963 (p.e. obs. by Shao).
TV Cas	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
AO Cas	Masani, A., <i>Mem. Soc. astr. ital.</i> 32 , 33, 1961.
AR Cas	Huffer, C. M., Collins, G. W., <i>Astrophys J. Suppl.</i> 7 , 351, 1962.
CW Cas	Brogliia, P., <i>Mem. Soc. astr. Ital.</i> , 35 , 1, 1964.
DO Cas	Cester, B., (Trieste).
PV Cas	Geyer, E., <i>Z. Astrophys.</i> 51 , 79, 1961 (two colors).
RR Cen	Knipe, G. F. G., <i>Union Obs. Johannesburg Circ.</i> no. 120, 1961.
VV Cep	Larsson-Leander, G., <i>Ark. Astr.</i> 2 , 301, 1960 (<i>BV</i>); <i>Ark. Astr.</i> 13 , 25, 1962 = <i>Stockh. Obs. Medd.</i> 133 , 1961.
VW Cep	Balasz, J., Detre, L., Kanyo, S., <i>Mitt. Sternw. Budapest</i> no. 49-50, 1961 (four colors). Herczeg, T., Schmidt, H., <i>Veröff. Univ. Sternw. Bonn</i> no. 57, 1960. Kwee, K. K., <i>Veröff. Remeis-Sternw. Bamberg</i> 34 , 38, 1962. Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960. Walter, K., <i>Astr. Nachr.</i> 286 , 186, 1961.
XX Cep	Angione, <i>Publ. astr. Soc. Pacif.</i> Oct. 1963 (abstract). Koch, J. C., Koch, R., <i>Astr. J.</i> 67 , 462, 1962 (no new obs. Old min.). O'Connell, D. J. K., (Specola Vaticana) (<i>UBV</i>).
XZ Cep	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
AH Cep	Nekrasova, S. V., <i>Perem. Zvezdy</i> 13 , no. 3, 1960 (light curve, yellow, blue).
CQ Cep	Chugainov, P. E., <i>Perem. Zvezdy</i> 13 , no. 3, 1960 (three colors).
CW Cep	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
RW Com	Chincarini, G., Margoni, R., (Asiago) (<i>BV</i>).
ε CrA	Knipe, G. F. G., (Republic Obs., Johannesburg) (blue, yellow).
U CrB	Cristaldi, S., (Oss. astrofis, Catania). Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
EM Cyg	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963 (abstract).
GO Cyg	Mannino, G., (Loiana).
V367 Cyg	Heiser, A. M., <i>Astrophys. J.</i> 135 , 78, 1962.
V382 Cyg	Landolt, A. U., (three colors).
V477 Cyg	Chisari, D., Saitta, T., <i>Mem. Soc. astr. Ital.</i> , 35 , 43, 1964. O'Connell, D. J. K., (Specola Vaticana) (<i>UBV</i>).
V478 Cyg	Schneller, H., (Potsdam).
V488 Cyg	Cristaldi, S., (Oss. astrofis. Catania).
V836 Cyg	Furtig, W., <i>Mitt. veränd. Sterne.</i> 2 , 9, 1963. Cester, B., <i>Oss. astr. Trieste. Publ.</i> no. 317.
BV342 Cyg	Schneller, H., (Potsdam).
31 Cyg	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962. Herczeg, T., Schmidt, H., <i>Z. Astrophys.</i> 55 , 161, 1962. Johansen, K. J., <i>Nordisk Astr. Tidsskrift</i> , no. 2, 1962 (English abstract). Kwee, K. K., Van Genderen, A. M., <i>Bull. astr. Inst. Netherlds.</i> 17 , 53, 1963. Larsson-Leander, G., <i>Ark. Astr.</i> 3 , 31, 1961 = <i>Medd. Lunds astr. Obs. I</i> , no. 197. Lindblad, O. Pipping, G., <i>Ark. Astr.</i> , 3 , 307, 1963 = <i>Stockh. Obs. Medd.</i> no. 141. O'Connell, D. J. K., (Specola Vaticana) (<i>UBV</i>). Wright, K. O., <i>J. Roy. astr. Soc. Can.</i> 56 , 172, 1962 (abstract).

Star	References
32 Cyg	Botsula, R. A., <i>Bjull. astr. Obs. Engel'gardta</i> no. 37, 1962. Chandra, S., Pandre, M. C., <i>Observatory</i> 80 , 146, 1960. Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962. Fresa, A., <i>Mem. Soc. astr. ital.</i> 32 . Kwee, K. K., Van Genderen, A. M., <i>Bull. astr. Inst. Netherlds.</i> 17 , 53, 1963. Larsson-Leander, G., <i>Ark. Astr.</i> 3 , 31, 1961 = <i>Medd. Lunds astr. Obs. I</i> , no. 197. Lindblad, O. Pipping, G., <i>Ark. Astr.</i> , 3 , 307, 1963 = <i>Stockh. Obs. Medd.</i> no. 141. Wright, K. O., (Dominion astroph. Obs.).
RZ Dra	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962.
TZ Dra	Plavec, M., <i>Bull. astr. Inst. Csl.</i> 14 , 1963; <i>Bull. astr. Inst. Csl.</i> 15 , 1964 (in press) (BV).
UZ Dra	Koch, J. C., Koch, R. H., <i>Astr. J.</i> 67 , 462, 1962 (BV) (no new obs. Old min.). Plavec, M., <i>Bull. astr. Inst. Csl.</i> 15 , 1964 (in press) (BV).
WW Dra	Plavec, M., (Ondřejov).
AI Dra	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962.
S Equ	Mauder, H., <i>Z. Astrophys.</i> 55 , 59, 1962 (two colors). Plavec, M., Mayer, P., <i>Bull. astr. Inst. Csl.</i> 13 , 128, 1962 (BV); <i>Bull. astr. Inst Csl.</i> 14 , 1963 (BV); <i>Bull. astr. Inst. Csl.</i> 15 , 1964 (in press) (BV).
YY Eri	Purgathofer, A. and I., <i>Mitt. Univ. Sternw. Wien</i> , 10 , 10, 1960.
AS Eri	Cillié, G. G., Lindsay, E. M., <i>Contr. Armagh Obs.</i> no. 31, 1960.
U Gem	Krzeminski, W., (UBV). Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963 (abstract).
SZ Her	Brogli, P., <i>Contr. Oss. astr. Milano-Merate</i> , no. 177, 1961.
T'T Her	Van Genderen, A. M., <i>Bull. astr. Inst. Netherlds.</i> 16 , 151, 1962.
AK Her	Bertiau, F. C., (Specola Vaticana). Bookmyer, B. B., <i>Astr. J.</i> , 66 , 24, 1961. Szczepanowska, S., <i>Acta astr.</i> 12 , 200, 1962.
DQ Her	Walker, M., <i>Astrophys. J.</i> 134 , 171, 1961.
NQ Her	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962.
EX Hya	Krzeminski, W., (Lowell and Mt. Stromlo) (integrated and yellow).
FG Hya	Binnendijk, L., <i>Astr. J.</i> 68 , 30, 1963. Smith, H. J., <i>Astr. J.</i> 68 , 39, 1963.
SW Lac	Chou, K. C., <i>Astr. J.</i> , 68 , 342, 1963 (light curve). Brogli, P., <i>Contr. Oss. astr. Milano-Merate</i> , no. 177, 1961 (3 colors). Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962. Widorn, T., <i>Mitt. Univ. Sternw. Wien</i> 11 , 1, 1960-62.
CM Lac	Dyer Obs., <i>Astr. J.</i> 67 , 613, 1962.
UV Leo	Brogli, P., <i>Contr. Oss. astr. Milano-Merate</i> , no. 177, 1961. Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962. Szczepanowska, A., <i>Acta astr.</i> 12 , 200, 1962.
AM Leo	Bookmyer, B. B., <i>Astr. J.</i> 66 , 24, 1961.
RR Lyn	Amherst Obs., <i>Astr. J.</i> 67 , 609, 1962.
EP Lyr	Shao, C.-Y., (Harvard College Obs.).
FL Lyr	Cristaldi, S., (Oss. astrofis. Catania).
β Lyr	Appenzeller, I., (Göttingen Obs.) (polarization measurements). Nekrasova, S. V., Poloshuhina, N. S., <i>Perem. Zvezdy.</i> 13 , no. 1, 1960. Schneller, H., (Potsdam) (in press, three colors).
TU Mus	Knipe, G. F. G., (Republic Obs. Johannesburg) (blue, yellow).
V502 Oph	Magalashvili, N. L., Kumishvili, J. I., <i>Abastumanskaja astrof. Obs. Bjull.</i> no. 28, 1962.
CN Ori	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963 (abstract).
ER Ori	Binnendijk, L., <i>Astr. J.</i> 67 , 86, 1962.
FT Ori	Cristaldi, S., (Oss. astrofis. Catania).
η Ori	Cousins, A. W. J., Walter, K., <i>Astr. Nachr.</i> 287 , 103, 1963.

Star	References
AT Peg	Cristaldi, S., Walter, K., <i>Astr. Nachr.</i> 287 , 103, 1963 (light curve).
AW Peg	Hilton, W. B., McNamara, D. H., <i>Astrophys. J.</i> 134 , 839, 1961.
BX Peg	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962.
DI Peg	Kruszewski, A., (yellow).
EE Peg	Chisari, D., Lacona, G., (Oss. astrofis Catania).
RY Per	Amherst Obs., <i>Astr. J.</i> 67 , 609, 1962.
TZ Per	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963 (abstract).
GK Per	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963 (abstract).
β Per	Borgman, J., <i>Bull. astr. Inst. Netherlds.</i> 17 , 111 (seven wave lengths).
	Fracastoro, M. G., Sobieski, S., (Flower and Cook Obs.).
	Flower and Cook Obs., <i>Astr. J.</i> , 67 , 775, 1962.
	Schneller, H., (Potsdam) (in press).
ζ Phe	Cousins, A. W. J., Warren, P. R., <i>Mon. Not. astr. Soc. S. Afr.</i> 22 , 65, 1963.
X Pic	Sommerville, J., (Mt. Stromlo) (<i>UBV</i>).
RZ Pyx	Kinman, T. D., <i>Observatory</i> 80 , 148, 1960 (<i>UBV</i>).
V Sge	Smak, J., Paczynski, B., (Lick Obs.) (<i>UBV</i>).
WZ Sge	Krzeminski, W., <i>Publ. astr. Soc. Pacif.</i> 74 , 66, 1962.
μ Sge	Cousins, A. W. J., Warren, P. R., <i>Mon. Not. astr. Soc. S. Afr.</i> 22 , 65, 1963.
μ^1 Sco	Cousins, A. W. J., Warren, P. R., <i>Mon. Not. astr. Soc. S. Afr.</i> , 22 , 65, 1963.
V701 Sco	Eggen, O. J., <i>R. Obs. Bull.</i> 27 , 1961 (<i>UBV</i>).
V702 Sco	Eggen, O. J., <i>R. Obs. Bull.</i> 27 , 1961 (<i>UBV</i>).
ER Sct	O'Connell, D. J. K., (Specola Vaticana) (<i>UBV</i>).
W Ser	Fresa, A., <i>Mem. Soc. astr. ital.</i> 33 , 151, 1962.
	Sahade, J., (Mt. Stromlo Obs.).
CV Ser	Hjellming, R. M., Hiltner, W. A., <i>Astrophys. J.</i> 137 , 1080, 1963, (<i>BV</i>) (light curve).
RZ Tau	Binnendijk, L., <i>Astr. J.</i> 68 , 22, 1963.
CD Tau	Plavec, M., Mayer, P., <i>Bull. astr. Inst. Csl.</i> 13 , 128, 1962.
λ Tau	Batten, A. H., <i>Jodrell Bank Ann.</i> 1 , 363, 1960.
RS Tri	Plavec, M., <i>Bull. astr. Inst. Csl.</i> 14 , 1963 (<i>BV</i>).
RW Tri	Walker, K., <i>Astrophys. J.</i> 137 , 485, 1963.
RR TriA	Sommerville, J., (Mt. Stromlo Obs.) (<i>UBV</i>).
W UMa	Bookmyer, B. B., <i>Astr. J.</i> 66 , 24, 1961.
W UMa	Flower and Cook Obs., <i>Astr. J.</i> 67 , 775, 1962.
SU UMa	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963 (abstract).
TX UMa	Batten, A. H., (Dominion Astroph. Obs.).
UX UMa	Kruszewski, A., Bretz, M. C., (light curves) (four colors).
	Krzeminski, W., Walker, M. F., <i>Astrophys. J.</i> 138 , 146, 1963.
CV Vel	Knipe, G. F. G., (Republic Obs. Johannesburg) (blue, yellow).
AG Vir	Flower and Cook Obs., <i>Astr. J.</i> , 67 , 775, 1962.
	Sievers, J., <i>Publ. astr. Soc. Pacif.</i> , Oct. 1963 (abstract).
α Vir	Magalashvili, N. L., Kumishvili, J. I., <i>Abastumanskaja astrof. Obs. Bjull.</i> no. 28, 1962.
BP Vul	Illes-Almar, I., (Budapest).
BD +33° 4245	Mannino, G., (Loiana) (<i>BV</i>).
BD +33° 4252	Cristaldi, S., Catalano, S., (Oss. astrofis. Catania).
	Schneller, H., (Potsdam).
BD +70° 1183	Mannino, G., (Loiano) (<i>BV</i>).
BD +75° 791	Abrami, A., (Trieste).
BD +76° 790	Geyer, E., <i>Z. Astrophys.</i> 51 , 79, 1961 (two colors).
HD 211853	Hjellming, R. M., Hiltner, W. A., <i>Astrophys. J.</i> 137 , 1080, 1963 (<i>UBV</i>) (light curve).

Table 1b. New brightness determinations other than photo-electric

Star	References
XZ And	Satanova, E. A., <i>Perem. Zvezdy</i> . 13 , no. 2, 1960. Mandel, O. E., <i>Perem. Zvezdy</i> . 13 , no. 2, 1960. Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
AB And	Mandel, O. E., Sokolova, I. A., Satanova, E. A., <i>Perem. Zvezdy</i> . 13 , no. 3, 1960.
DS And	Alksnis, A. K., <i>Perem. Zvezdy</i> . 13 , no. 4, 1961.
o And	Jackisch, G., <i>Mitt. veränd. Sterne</i> 2 , 13, 1963.
V340 Aql	Groth, H., G., Löchel, K., <i>Mitt. veränd. Sterne</i> 2 , 6, 1963.
CL Aur	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
GX Aur	Tempesti, P., (Collurania Teramo).
S3909 Aur	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 740, 1963.
S5424 Aur	Popowa, M., <i>Astr. Nachr.</i> 286 , 81, 1960.
S5454 Cam	Popowa, M., <i>Astr. Nachr.</i> 286 , 81, 1960.
DP CMA	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 734, 1963.
RZ Cas	Mak, , <i>De Meteor</i> , 19 , 29, 1963; <i>Hemel en Dampkring</i> 61 , 194. Mandel, O. E., <i>Perem. Zvezdy</i> . 13 , no. 3, 1960. Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
AB Cas	Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
MW Cas	Charugin, V., <i>Astr. Cirk.</i> no. 217, 1960.
V375 Cas	Satanova, E. A., <i>Perem. Zvezdy</i> . 13 , no. 2, 1960.
U Cep	Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
SU Cep	Mandel, E. O., <i>Perem. Zvezdy</i> . 13 , no. 3, 1960.
UU Circ	Huth, H., <i>Mitt. veränd. Sterne</i> no. 743, 1963.
RZ Com	Bolokadze, R. D., <i>Perem. Zvezdy</i> . 13 , no. 4, 1961.
RT CrB	Dziewulski, W., <i>Bull. astr. Obs. N. Copern. Univ. Torun.</i> no. 23, 1960.
UZ Cyg	Masnawskas, J., <i>Bull. astr. Obs. Vilnius Univ.</i> no. 1, 1960.
VV Cyg.	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 705, 1962.
V393 Cyg	Sazonov, V., <i>Perem. Zvezdy</i> . 13 , no. 4, 1961.
V519 Cyg	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 735, 1963.
V536 Cyg	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 710, 1962.
V537 Cyg	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 712, 1962.
V541 Cyg	Karpowicz, M., <i>Acta astr.</i> 11 , 51, 1961 = <i>Astr. Obs. Warsaw Univ. Repr.</i> no. 109.
V652 Cyg	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 712, 1962.
V729 Cyg	Sazonov, V., <i>Perem. Zvezdy</i> . 13 , no. 6, 1961.
31 Cyg	Ezer, D., <i>Comm. Fac.Sci. Ankara</i> 11 , 40, 1961.
BV114 Cyg	Sazonov, V., <i>Perem. Zvezdy</i> 13 , no. 6, 1961.
Z Dra	Satanova, E. A., <i>Perem. Zvezdy</i> . 13 , no. 2, 1960.
SX Dra	Kordylewski, K., <i>Acta Astr.</i> 11 , 48, 1961.
BV379 Dra	Döppner, M., <i>Mitt. veränd. Sterne</i> no. 699, 1962.
RX Her	Karetnikov, V. G., <i>Perem. Zvezdy</i> . 13 , no. 6, 1961.
DQ Her	Zitkevicius, V., <i>Bull. astr. Obs. Vilnius Univ.</i> no. 1, 1960.
RT Lac	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 713, 1962.
SW Lac	Satanova, E. A., <i>Perem. Zvezdy</i> . 13 , no. 4, 1961.
VX Lac	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
AR Lac	Karetnikov, V. G. <i>Perem. Zvezdy</i> . 13 , no. 6, 1961. Karle, J. H., <i>Publ. astr. Soc. Pacif.</i> 74 , 244, 1962.
CM Lac	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 714, 1962. Masawskas, J., <i>Bull. astr. Obs. Vilnius Univ.</i> no. 1, 1960.
PY Lac	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 736, 1963.
UV Leo	Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
UX Leo	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
WY Leo	Huth, M., <i>Mitt. veränd. Sterne</i> no. 748, 1963.
EP Lyr	Preston, G. W., Krzeminski, W., Smak, J., Williams, J. A. <i>Astrophys. J.</i> 137 , 429, 1963.

Star	References
EW Lyr	Satanova, E. A., <i>Perem. Zvezdy</i> . 13 , no. 2, 1960.
IQ Lyr	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 737, 1963.
V451 Oph	Ahnert, P., <i>Mitt. veränd. Sterne</i> no. 720, 1962.
UW Ori	Todoran, I., <i>Studii cerc.</i> 7 , 155, 1962.
V341 Ori	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 738, 1963.
RT Per	Mandel, E. O., <i>Perem. Zvezdy</i> . 13 , no. 3, 1960.
RW Per	Kordylewski, K. <i>Acta astr.</i> 11 , 43, 1961.
XZ Per	Szafraniec, R., <i>Acta astr.</i> 10 , 99, 1960.
β Per	Pohl, E., <i>Kl. Veröff Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
II Per	Wenzel, W., <i>Mitt. veränd. Sterne</i> no. 739, 1963.
U Sge	Karetnikov, V. G., <i>Perem. Zvezdy</i> . 13 , no. 6, 1961.
GR58 Sge	Löchel, K., <i>Mitt. veränd. Sterne</i> no. 719, 1962.
C π 3 1307 Sge	Lange, C. A., <i>Astr. Cirk.</i> no. 216, 1960.
W Ser	McLaughlin, D. B., <i>Astr. J.</i> 66 , 351, 1961.
SV Tau	Koshkina, L. B., <i>Perem. Zvezdy</i> . 13 , no. 6, 1961.
Pr2782 Tau	Muller, , <i>Mitt. veränd. Sterne</i> no. 718, 1962.
X Tri	Mandel, E. O., <i>Perem. Zvezdy</i> . 13 , no. 13, 1960.
CM Vir	Kordylewski, K., <i>Acta astr.</i> 11 , 1961.
RS Vul	Karetnikov, V. G., <i>Perem. Zvezdy</i> . 13 , no. 6, 1961.
K 4577	Weber, R., <i>J. Observateurs</i> 46 , 105, 1963.
K 4833	Weber, R., <i>J. Observateurs</i> 46 , 105, 1963.

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 Fernie, F. D., *Astr. J.* **68**, 279, 1963.
 Gaposchkin, S., *Astr. J.* **67**, 360, 334, 358, 1962.
 Harwood, M., *Ann. Sterrew. Leiden* **22**, 8, 1962.
 Hinderer, F., *J. Observateurs* **43**, 161, 1960.
 Hoffleit, D., *Astr. J.* **67**, 228, 1962.
 Hoffleit, D., *Astr. J.* **68**, 207, 1963.
 Hoffmeister, C., *Veröff. Sternw. Sonneberg* **6**, 1, 1963; *Mitt. veränd. Sterne*, no. 213;
Astr. Nachr. **287**, 59, 1963.
 Jarzembowski, *Acta astr.* **10**, 237, 1960.
 Kordylewski, K., *Inf. Bull. Comm.* 27, *IAU*, no. 35, 1963.
 Lukatskaya, F. I., *Astr. Cirk.* no. 216, 1960.
 Miller, W. J., Wachmann, A. A., *Ric. Astr. Spec. Vaticana* **6**, 15.
 Szafraniec, R., *Acta astr. Suppl.* Parts 1, 2, 3, 4, 5.

NEW SPECTROGRAPHIC DATA

In Table 2 are shown the spectrophotometric and radial velocity observations reported, and the principal lists of newly determined spectral types. The number of workers involved is slightly less than for the previous report. Since the observations here listed are in most cases the bases of studies actually discussed in later sections, it should not be concluded that the total effort in this field has suffered any real diminution. It is true, however, that in too few cases are we developing the photo-electric and the spectrographic case histories of eclipsing systems simultaneously and therefore to the greatest total advantage. More programs founded directly on the photometric-spectrographic duality, such as that of Popper at Mt. Wilson and that of Heard and his associates, at David Dunlap Observatory, are much needed. It can be hoped that the new editions of Batten's lists, mentioned earlier, will be an incentive in this direction.

Table 2. New spectrographic observations

Star	References
QS Aql	Chincarini, G., Margoni, R. (Asiago) (dimensions).
V822 Aql	Heard, J. F., Fitzgerald, M. P., (David Dunlap Obs.) (obs. spec. orb.).
ε Aur	Hack, M. <i>Convegno Celebr. Cinquant. morte Schiaparelli</i> (1960).
ζ Aur	Wright, K. O., Dom. Astroph. Obs. (see reports on cooperative programs).
ZZ Boo	Miner, E., McNamara, D. H., <i>Publ. astr. Soc. Pacif.</i> Aug. 1963 (Spectr. orbit).
EM Car	Feast, M. W., Stoy, R. H., Thackeray, A. D., <i>Mon. Not. R. astr. Soc.</i> 122 , 239.
GL Car	Feast, M. W., Stoy, R. H., Thackeray, A. D., <i>Mon. Not. R. astr. Soc.</i> 122 , 239.
AR Cas	Batten, A. H., <i>J. Roy. astr. Soc. Can.</i> 55 , 120, 1961 (obs., discussions).
U Cep	Batten, A. H., (High-dispersion obs. begun).
VV Cep	Peery, B. F., <i>Astr. J.</i> 67 , 279, 1962.
	Wright, K. O. (Dom. Astroph. Obs.) (obs. being continued).
W Cru	Wolf, N. J., <i>Mon. Not. R. astr. Soc.</i> 123 , 399, 1962 (obs., discussion).
V367 Cyg	Heiser, A. M., <i>Astrophys. J.</i> 134 , 568, 1961.
V380 Cyg	Batten, A. H., <i>Publ. Dom. astroph. Obs.</i> 12 , 91, 1963 (obs., discussion).
31 Cyg	Allegheny Obs., <i>Astr. J.</i> 67 , 608, 1962.
	Faraggiana, R., Hack, M. (in print by <i>Mem. Soc. astr. ital.</i>)
	Hack, M., <i>Publ. astr. Soc. Pacif.</i> 74 , 438, 1962.
	Wright, K. O., <i>J. Roy. astr. Soc. Can.</i> 56 , 172, 1962 (abstract).
	Wright, K. O., Odgers, G. J., <i>J. Roy. astr. Soc. Can.</i> 56 , 149, 1962 = <i>Contr. Dom. astrophys. Obs.</i> no. 77.
32 Cyg	Hack, M., <i>Publ. astr. Soc. Pacif.</i> 74 , 438, 1962.
	Wright, K. O., (Dom. Astroph. Obs.).
ζ Her	Sahade, J., Hernandez, C. A., (in press) (obs., discussion; probably eclipsing).
TT Hya	Miller, E., McNamara, D. H., <i>Publ. astr. Soc. Pacif.</i> Aug. 1963 (obs. mass ration).
HD20336	McLaughlin, D. B., <i>Astrophys. J.</i> 137 , 4, 1963 (rotating shell rather than binary).
δ Lib	Sahade, J., Hernandez, C. A., <i>Astrophys. J.</i> 137 , 845, 1963.
RR Lyn	Douglas, B. C., Popper, D. M., <i>Publ. astr. Soc. Pacif.</i> , Oct. 1963.
β Lyr	Abt, H. A., <i>Astrophys. J.</i> 135 , 424, 1962 (obs., discussion).
	Struve, O., Zebergs, V., <i>Astrophys. J.</i> 134 , 161, 1961 (obs., discussion).
AW Peg	Hilton, W., McNamara, D. H., <i>Astrophys. J.</i> 134 , 839, 1961.
V Pup	Frieboes, H. <i>Astrophys. J.</i> , 135 , 762, 1962.
WZ Sge	Kraft, R. P., <i>Science</i> 134 , 1433, 1961
V526 Sgr	Wesselink, A. J., (Pretoria).
V453 Sco	Sahade, J., Frieboes-Condes, H., <i>Asoc. Argentina Astr. Bol.</i> , no. 4, 35, 1962 (abstract) (obs., disc.).
RW Tau	Plavec, M., <i>Bull. astr. Inst. Csl.</i> 13 , 224, 1962.
BL Tel	Wing, R. F., <i>Mon. Not. R. astr. Soc.</i> 125 , 189, 1963 = <i>Contr. Cambridge Obs.</i> , no. 47.
TX UMa	Batten, A. H., (Dom. Astr. Obs.).
AL Vel	Wesselink, A. J. (Pretoria) (obs., spec. orbit).
γ Vel	Sahade, J., Hernandez, C. A., <i>Asoc. Argentina Astr. Bol.</i> , no. 2, 56, 1960.
HD205372	Batten, A. H., (Dom. Astroph. Obs.).
BV332, BV342,	
BV361, BV241	Heard, J. F., Fitzgerald, M. P., (David Dunlap Obs.) (obs. spectr. orbit).

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- Gaposchkin, S., *Astr. J.*, **67**, 360, 1962 (rad. vel.).
 Popper, D. M., *Publ. astr. Soc. Pacif.* **74**, 129, 1962 (notes on spectra of several eclipsing binaries).
 Götz, W., Wenzel, W., *Mitt. veränd. Sterne nos.* 503–506, 1960; 529–530, 1961; 569–571, 1961; 626–629, 1962; 701–702, 1962 (many spectral types).
 Wachmann, A. A., *Astr. Abh. Hamburg. Sternw.* **6**, 1, 1961; **6**, 2, 1963 (many spectral types).

CO-ORDINATION OF PHOTOMETRIC AND SPECTROGRAPHIC OBSERVATIONS

Further results of the VW Cephei co-ordinated programs have appeared. Balazs, Detre, and Kanyo (5) and Detre and Kanyo (6) describe four-color observations made in 1950 and 1952 as well as in 1959. Walter (7) discussed variations in the light curve as shown by photo-electric observations. At the Bamberg Variable Star Colloquium, 5-7 Sept., 1962, Kwee (8) reported in some detail on the reduction of the observations. Further discussion is being continued at Flower and Cook Observatory by Jurkevich (9).

31 Cyg was intensively observed as part of a co-ordinated program organized by Wright. Publications to date include Ezer (10), Wright (11), Herczeg and Schmidt (12), Wright and Odgers (13), Larsson-Leander (14), Orlov and Rodrigues (15) and Lindblad and Pipping (15a). A more detailed report will be presented at the Commission meetings.

Work was continued on 32 Cyg. Among the reports now available are those of Lindblad and Pipping (15a), Larsson-Leander (16), Hack (17), Fresa (18) and Herczeg and Schmidt (12). Wright observed 32 Cyg spectrographically on ten nights in 1962; his results indicate totality mid-phase was about J.D. 2 437 816.

In addition to observations of 31 Cyg, Gyldenkerne reports observations of ϵ Aur, ζ Aur, and VV Cep. Larsson-Leander has continued work on the β Lyr observations obtained during the 1959 campaign and will be able to report on the results at the Commission meetings.

The ζ Aur program, coordinated by Gyldenkerne, has drawn the attention of a large number of observers, both photometric and spectrographic. A report on this will also be made at the meetings of Commission 42. The W Ser program drew fewer observers, presumably because of the southern declination of the system, and will also be the subject of a report.

TIMES OF MINIMA AND PERIOD VARIATIONS

Several groups of astronomers are making regular observations of times of minima, visually, photographically, or photo-electrically, so that a large amount of material is being accumulated for studies of period variations. A group of Czech amateurs, led by Obúrka, observe visually (19), as do the Berlin amateurs (20). Epochs of minima for very many eclipsing binaries are to be found in parts 2 and 3 of the *Cracow Observations of Variable Stars, 1920-1950*, compiled by Szafraniec (21), in the *Eclipsing Variable Circulars* edited by Kordylewski at Cracow (22), and in the *Information Bulletins* edited at Budapest (23). Szafraniec's charts for southern systems mentioned in the previous report, are now available (24).

Strohmeier and his colleagues have published light elements for many new eclipsing binaries (25). Wachmann has derived light elements for numerous eclipsing binaries, either already known or new discoveries (26). A great deal of work in this field is being done by Hoffmeister and his staff (27). These Bamberg, Hamburg, and Sonneberg lists are summarized for the reader's convenience at the end of Table 3.

D. B. Wood and Forbes (28) programmed an electronic computer to derive, by least squares, sets of values of the constants in the cubic equation: $Min = T_0 + PE + AE^2 + BE^3$ from the published observed minima of 333 eclipsing binaries. This massive piece of work will provide material for many studies of period variation.

Investigations of period variations published since the last report are listed in Table 3, for 186 variables as compared with 77 in the previous report; 31 stars are common to both lists. The mass-transfer hypotheses tested by Huang (29) on β Lyr are outlined in a later section of this report.

Plavec, Smetanova and Pekny, continuing their investigations of the constancy of the periods of eclipsing binaries, studied those detached systems which have undersize sub-giants (30). They find that the periods of TV Cas and Z Her are essentially constant. AR Lac displayed a

sudden jump of period. The variations in the period of RS Cvn are large and appear to be of a periodic character, yet they cannot be explained in terms of a third body, and apsidal motion seems to be at variance with the observations. It is suggested that the large periodic term found for Y Cam may be similar to the 'great inequality' of Algol.

Prikhodko studied the period variations of a large number of eclipsing binaries (31). For 23 systems he found no variation. For 70 others he compared the amplitude of the period variation with various physical parameters of the system. He found definite correlations between the amplitude of the variation and (1) the length of period; (2) the densities of the components; and (3) the semi-axis major of the relative orbit. He also compared his results with the changes of period predicted on the basis of Kwee's hypothesis of a transfer of mass between the components (described in the previous report). He concludes that Kwee's hypothesis does not contradict the observational evidence.

Schneller, from a study of the periods of 40 eclipsing binaries (32) concludes that eclipsing systems of Kopal's classes II and III (semi-detached and contact systems) nearly all have variable periods. These variations are irregular, and not the result of apsidal motion or revolution of the system around a third body. It is thus very difficult to detect apsidal motion in systems of these kinds, since in any case the orbital eccentricity is very small. On the other hand, the orbital periods of detached systems (Kopal's class I) are sensibly constant over long intervals, and it is among systems of this class that apsidal motion, or the influence of a third body, should be sought.

The effect of mass ejection by one or both of the components or of mass transfer from one to the other, on the orbit of the binary, depends not only upon the amount of mass lost or transferred, but also on the mode in which the mass is being lost or transferred. Huang (29) examines three idealized cases of the mass-loss process, and the effect on the period of coupling between orbital motion and axial rotation.

Z. Kordylewski (33) on the basis of the Cracow Catalogue of diagrams of the deviations from linear light elements, found a correlation between the variations of period and the spherical coordinates of variable stars. This appears to imply that the conventional O-C diagrams should be appropriately 'rectified' before being used in discussions of a comparative nature.

Table 3. Light elements and discussions of periods of eclipsing binary systems

Star	References
RT And	Obúrka, O., <i>Bull. astr. Inst. Csl.</i> 14 , 25, 1963.
XZ And	Lange, G. A., <i>Astr. Cirk.</i> no. 217, 1960; no. 228, 1962. Mandel, E. O., <i>Perem. Zvezdy.</i> 13 , no. 3, 1960. Obs. Astr. Univ. Cluj. Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962. Satanova, E. A., <i>Perem. Zvezdy.</i> 13 , no. 2, 1960. Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 33, 1962. Wood, D. B., Forbes, J. E., <i>Astr. J.</i> , 67 , 257, 1963.
AB And	Mandel, E. O., Sokolova, I. A., Satanova, E. A., <i>Perem. Zvezdy.</i> 13 , no. 2, 1960.
DS And	Alksnis, A. K., <i>Perem. Zvezdy.</i> 13 , no. 4, 1961.
RY Aqr	Koch, R. W., Koch, J. C., <i>Astr. J.</i> 67 , 462, 1962.
XZ Aqr	Koch, R. W., Koch, J. C., <i>Astr. J.</i> 67 , 462, 1962.
320 Aqr	Kuklin, G. V., <i>Astr. Cirk.</i> no. 288, 1962.
OO Aql	<i>Sky and Telesc.</i> 26 , 153, 1963.
V337 Aql	Koch, R. H., Koch, J. C., <i>Astr. J.</i> , 67 , 462, 1962.
V346 Aql	Koch, R. H., Koch, J. C., <i>Astr. J.</i> , 67 , 462, 1962.
T Aur	Walker, M. F., <i>Inf. Bull. Comm.</i> 27 IAU no. 2, 1962; <i>Astrophys. J.</i> 138 , 313, 1963.

Star	References
SS Aur	Mumford, G. S., <i>Astr. J.</i> , 68 , 286, 1963.
TT Aur	Karetnikov, V. G., <i>Astr. Cirk.</i> no. 217, 1960; <i>Perem. Zvezdy</i> , 14 , no. 1, 1962.
WW Aur	Senina, G., <i>Astr. Cirk.</i> no. 215, 1960.
BF Aur	Schneller, H., <i>Astr. Nachr.</i> 286 , 97, 1961.
CL Aur	Szafraniec, R., <i>Acta. Astr.</i> 13 , 79, 1963.
EO Aur	Schneller, H., <i>Astr. Nachr.</i> 287 , 49, 1963.
S5424 Aur	Popowa, M., <i>Astra Nachr.</i> 286 , 81, 1960.
SU Boo	Szafraniec, R., <i>Acta. astr.</i> 13 , 79, 1963.
TU Boo	Szafraniec, R., <i>Acta. astr.</i> 13 , 79, 1963.
	Koch, R. H., Koch, J. G., <i>Astr. J.</i> 67 , 462, 1963.
AD Boo	Strohmeier, W., <i>Inf. Bull. Comm.</i> 27, IAU, no. 26.
44i Boo	Herczeg, T., <i>Veröff. Univ. Sternw. Bonn</i> 63 , 1962.
	Karetnikov, V. G., <i>Astr. Cirk.</i> no. 216, 1960.
	Plavec, M., Mayer, P., <i>Bull. astr. Inst. Csl.</i> 13 , 128, 1962.
	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 6, 1962.
	Semeniuk, I., <i>Acta Astr.</i> 13 , 118, 1963.
Y Cam	Plavec, M., Smetanova, M., Pekny, Z., <i>Bull. astr. Inst. Csl.</i> 12 , 117, 1961.
	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 28, 1962.
Z Cam	Mumford, G. S., <i>Astr. J.</i> 68 , 286, 1963.
SV Cam	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 29, 1962.
SZ Cam	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 34, 1962.
TU Cam	West, R. (Copenhagen).
S5454 Cam	Popowa, M., <i>Astr. Nachr.</i> 286 , 81, 1960.
S Cnc	Plavec, M., Smetanova, M., Pekny, Z., <i>Bull. astr. Inst. Csl.</i> 12 , 117, 1961.
R CMa	Wood, D. B., Forbes, J. E., <i>Astr. J.</i> 68 , 257, 1963.
	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 32, 1962.
UW CMa	Cousins, A. W. J., Warren, P. R., <i>Mon. Not. astr. Soc. S. Afr.</i> 22 , 65, 1963.
YY CMi	Abhyankar, A. D., <i>Z. Astrophys.</i> 54 , 25, 1961 = <i>Nizamiah Obs. Repr.</i> no. 35.
RS CVn	Plavec, M., Smetanova, M., Pekny, Z., <i>Bull. astr. Inst. Csl.</i> 12 , 117, 125, 1961.
	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 30, 1962.
δ Cap	Batten, A. H., <i>Publ. Dom. astrophys. Obs.</i> 11 , 395, 1961.
	Cousins, A. W. J., Warren, P. R., <i>Mon. Not. astr. Soc. S. Afr.</i> 22 , 65, 1963.
GL Car	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 12, 1962.
RZ Cas	Ashbrook, J., <i>Sky and Telesc.</i> 21 , 218, 1961.
	Karetnikov, V. G., <i>Astr. Cirk.</i> no. 215, 1960.
	Kruszewski, A., Sememiuk, I., (yellow).
	Lange, G. A., <i>Astr. Cirk.</i> no. 217, 1960 and no. 228, 1962.
	Mandel, E. O., <i>Perem. Zvezdy</i> , 13 , no. 3, 1960.
	Marks, A. A., <i>Acta. astr.</i> 12 , 138, 1962.
	Migatsh, J., <i>Astr. Cirk.</i> no. 227, 1962.
	Obůrka, O., <i>Bull. astr. Inst. Csl.</i> 14 , 25, 1963.
	Plavec, M., Smetanova, M., Pekny, Z., <i>Bull. astr. Inst. Csl.</i> 12 , 117, 1961.
	Plavec, M., Mayer, P., <i>Bull. astr. Inst. Csl.</i> 13 , 128, 1962; 14 , 1963.
	Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> , 134 , 133, 1962.
	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 23, 1962.
	Senina, G., <i>Astr. Cirk.</i> no. 215, 1960.
	Shao, C-y, (Harvard College Obs.).
	Szafraniec, R., <i>Acta. astr.</i> 13 , 79, 1963.
	Wood, D. B., Forbes, J. E., <i>Astr. J.</i> 68 , 257, 1963.
TV Cas	Karetnikov, V. G., <i>Astr. Cirk.</i> no. 217, 1960.
	Koch, R. H., Koch, J. C., <i>Astr. J.</i> 67 , 462, 1962.
	Lavrov, M., Poljakov, , <i>Trud. Gor. astr. Obs. Kazan</i> , 33 , 33, 93, 1961.
	Oburka, O., <i>Bull. astr. Inst. Csl.</i> 14 , 25, 1963.
	Plaveč, M., Smetanova, M., Pekny, Z., <i>Bull. astr. Inst. Csl.</i> 12 , 117, 1961.
	Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 35, 1962.

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| ZZ Cas | Koch, R. H., Koch, J. C., <i>Astr. J.</i> 67 , 462, 1962. |
| AB Cas | Todoran, I., <i>Stud. Cerc. Astr. Seism., Bucuresti</i> 4 , 369-81, 1959.
Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962. |
| AR Cas | Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 19, 1962. |
| EG Cas | Scheneikh, V., <i>Perem. Zvezdy</i> . 13 , no. 5, 1961. |
| GC Cas | Lavrov, M., <i>Trud. Gor. astr. Obs. Kazan.</i> 33 , 104, 1961. |
| GT Cas | Lavrov, M., <i>Trud. Gor. astr. Obs. Kazan.</i> 33 , 104, 1961. |
| KR Cas | Lavrov, M., <i>Trud. Gor. astr. Obs. Kazan.</i> 33 , 104, 1961. |
| KT Cas | Lavrov, M., <i>Trud. Gor. astr. Obs. Kazan.</i> 33 , 104, 1961. |
| QX Cas | Erleksova, G. E., Lange, G. A., Perova, N. B., Satanova, E. A., Kholopov, P. N.,
Tsarevsky, G. S., <i>Perem. Zvezdy</i> . 13 , no. 1, 1960. |
| V375 Cas | Satanova, E. A., <i>Perem. Zvezdy</i> . no. 2, 1960. |
| SV Cen | Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 11, 1962. |
| KT Cen | Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 11, 1962. |
| U Cep | Obürka, O., <i>Bull. astr. Inst. Csl.</i> 14 , 25, 1963.
Pohl, E., <i>Kl. Veröff. Remeis-Sternw. Bamberg</i> 34 , 133, 1962.
Schneller, H., <i>Mitt. Sternw. Budapest</i> 53 , 34, 1962. |
| SU Cep | Wood, D. B., Forbes, J. E., <i>Astr. J.</i> 68 , 257, 1963. |
| VV Cep | Mandel, E. O., <i>Perem. Zvezdy</i> . 13 , no. 3, 1960. |
| VW Cep | Wright, K. O., (Dom. Astroph. Obs.).
Herczeg, T., Schmidt, H., <i>Veröff. Univ. Sternw. Bonn</i> no. 57, 1960.
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Heft 8, 1960 : BD + 70° 751, BD + 57° 1942, BV 345, BD + 30° 3884, V787 Cyg,

CD Eri, BD + 0° 1812, IZ Per, BD + 70° 751, BD + 57° 1942

Heft 11, 1961 : BV 40, BV 88, RT UMi, BV 233, BV 299, BV 114

Heft 12, 1961 : DS And, V337 Aql, V375 Cas, Y Cyg, V512 Cyg, NQ Her, Z Ori, V UMa,
 DR Vul, BP Vul, +70° 618

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S95	S3376	UW Hya	S3374	S3406
S3347	VY Vul	S3415	S3378	CP Sge
S3348	S3383	UY Hya	S3382	S3412
S3349	S3385	AL Cas	S3384	S3421
DP Vul	S3393	S3350	S3390	S136
S3362	S3403	S3357	DE Sge	S3387

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CVS 1508	564	515.1936	573	VV Cet	592
DL Del	565	595.1936	574	BV 318	594
FY Lyr	565	XZ Cnc	576/7	EP Lyr	608
IX Her	565	DX Cyg	585	S4111	681
DT Lyr	565	DY Cyg	585	679.1935	681
DN Lyr	565	EE Cyg	585	S4093	681
61.1930	565	HL Cyg	585	S3792	681
DZ Lyr	565	AF Vul	585	HW Per	681
Y Leo	568	S4155	585	HZ Per	681
UX Leo	568	EP Lyr	586		

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FS Mon	624	S7590	661	DK Mon	693
FY Aur	630	S7590	663	BV379 Dra	699
ZZ Aur	630	S7591	661	VV Cyg	705/6
RS CMi	634	S7591	663	DL Cyg	706/7
BH Gem	635	AG Leo	665/6	MR Cyg	707
RW Gem	638	BH Mon	668	V536 Cyg	710
SX Gem	639	TV Cep	669	V537 Cyg	712
WW Gem	640	PR Mon	672	V652 Cyg	713
UW Ori	642	S4604	675	RT Lac	714
CP Ori	643	SVS 832	676	CM Lac	714
SV Tau	647	S4605	676/7	EW Tau	717
WY Tau	647	GR 78 Cep	678/9	CVS699 Tau	718
+67°1485	649	GR 78 Cep	681	GR 58 Sge	719/20
-12°294	650	KL Per	682/3	V346 Aql	720
-7°277	651	AV Mon	684	SU Cep	720
S7585	659	EQ Ori	686	V451 Oph	720
S7585	663	V413 Aql	690	X Tri	720
S7589	661	MS Mon	691	Z Vul	720
S7589	663	DR Mon	692		

Strohmeier, W., *et al.*, *Mitt. veränd. Sterne, Bamberg*, 1, 1963

DP CMa	734/5	HX Mon	737	EE CMa	741
EE CMa	735	V341 Ori	738/9	130.1943	741
V519 Cyg	735/6	II Per	739/40	UU Cnc	743
DY Lac	736	S3909	740/41	WY Leo	747/8
IQ Lyr	737				

Wachmann, A. A., *Astr. Abh. Hamburg. Sternw. 6*, 1, 1962

SY Cyg	HBV237 Cyg	HBV259 Cyg	HBV272 Cyg
DX Cyg	HBV238 Cyg	HBV260 Cyg	HBV273 Cyg
EN Cyg	HBV243 Cyg	HBV267 Cyg	372.1928 Cyg
V370 Cyg	HBV248 Cyg	HBV268 Cyg	425.1934 Cyg
V463 Cyg	HBV251 Cyg	HBV269 Cyg	HBV241 Vul
V541 Cyg	HBV253 Cyg	HBV270 Cyg	HBV242 Vul
HBV233 Cyg	HBV256 Cyg	HBV271 Cyg	HBV244 Vul
HBV235 Cyg	HBV258 Cyg		

Wachmann, A. A., *Astr. Abh. Hamburg. Sternw. 6*, 2, 1963

V466 Cyg	HBV304 Cyg	HBV317 Cyg	AB Vul
V483 Cyg	HBV305 Cyg	HBV318 Cyg	HBV311 Vul
V687 Cyg	HBV308 Cyg	HBV321 Cyg	HBV316 Vul
HBV298 Cyg	HBV309 Cyg	HBV325 Cyg	HBV327 Vul
HBV302 Cyg	HBV310 Cyg	HBV326 Cyg	HBV328 Vul
HBV303 Cyg	HBV313 Cyg	HBV330 Cyg	HBV329 Vul

- Hoffmeister, C., *Mitt. veränd. Sterne* no. 696, 1962
 S7639 Ara, S7640 Ara, S7643 Ara, S7644 Ara, S7646 Ara, S7648 Ara
- Hoffmeister, C., *Veröff. Sternw. Sonneberg*, 6, 2, 1963
 S5111 Mic, S6773 Mic, S6773 Mic, S6802 Mic
- Hoffmeister, C., *Veröff. Sternw. Sonneberg* 4, 5, 1960
 V366 Her, V381 Her, V387 Her, S5287 Her, V403 Her, 162.1936, V412 Her, V423 Her,
 V426 Her, S5300, S5302

APSIDAL MOTION

In Table 4 are listed the investigations of apsidal motion that have been published since the last report.

Batten finds that apsidal motion in V380 Cyg is very much slower than supposed by Luyten, if it is present at all. He believes that the apparent apsidal motion indicated by the light curve is an effect of the adoption of an incorrect value for the period. He states that there remain, however, difficulties in reconciling the light and velocity curves which, when and if resolved, may affect the question of apsidal motion. In his report to Commission 42 he writes 'I would like to emphasize the extreme desirability of obtaining a modern *UBV* light curve of this system. Despite the long period and shallow eclipses I believe that any observer will find this system rewarding.'

Schneller confirms the apsidal motion of DR Vul found by Erleksova and Wachmann that of SY Cyg, both of which had been disputed.

Semeniuk is investigating the apsidal motion of V889 Aql, AR Cas, V380 Cyg, V470 Cyg, V477 Cyg, DI Her, and DR Vul, and O'Connell that of HH Car, V477 Cyg and V526 Sgr.

Table 4. Investigations of apsidal motion

Star	References
Y Cyg	Schneller, H., <i>Astr. Nachr.</i> 287 , 186, 1963.
SY Cyg	Wachmann, A. A., <i>Astr. Abh. Hamburg. Sternw.</i> 6 , 88, 1961.
V380 Cyg	Batten, A. H., <i>Publ. Dom. astrophys. Obs.</i> 12 , 91, 1963.
UW Lac	Strohmeier, W., <i>Z. Astrophys.</i> 52 , 7, 1961.
RU Mon	Prikhodko, A. E., <i>Sov. Astr.</i> 5 , 712, 1962; <i>Astr. Zu.</i> 38 , no. 5, 1961.
DR Vul	Schneller, H., <i>Astr. Nachr.</i> 287 , 184, 1963.
HBV242 Vul	Wachmann, A. A., <i>Astr. Abh. Hamburg. Sternw.</i> 6 , 33, 1961.

DETERMINATION OF PHOTOMETRIC ORBITS

In Table 5 are listed those systems for which photometric orbits have been published (or, in a few cases, completed) since the last report, and those for which differential limb darkening in two colors, has been studied. The number of new conventional solutions is about the same as for the previous report, but there has been a marked and welcome increase in the attention given to other aspects of the problem of light curve interpretation.

First, Shulberg has derived orbital elements for SX Cas and for UX Mon (34) and Lukatskaia and Rubashevskii for RT And, SX Cas, RX Gem and AW Peg (35), on the assumption of the presence of extended atmospheres. While care should be taken not to use this hypothesis as 'the easy way out', over-reluctance to try such solutions when the situation seems to warrant it, can only retard our progress in the understanding of many eclipsing pairs. Because the procedures are still in the trial stages, some of the same light curves could profitably be analyzed with Linnell's new tables as well, for comparisons in results and in efficiency.

Second, Serkowski (36) has derived the differences in limb darkening for Kron's YZ Cas red and blue observations and Irwin (37) has demonstrated the power and the simplicity of the direct approach to determination of differential limb darkening, using Huffer's S Cancri material.

Third, Grygar (38) has shown, by study of Huffer's observations of AR Aur, that a slight improvement in the 'least-squares fit' may sometimes be achieved by use of a non-linear law of limb darkening. He concludes that in many cases the difference in closeness of fit would be so slight that a valid choice would hardly be possible, at the present level of observational accuracy.

Fourth, conscious effort to obtain satisfactory solutions, strictly on a Russell model, and thereafter (not before), to consider the departures or modifications needed *and justified by the observational material*, should contribute significantly to our knowledge. Koch's study (39) of TX UMa, for example, shows the value of this approach.

Table 5. New solutions of photometric curves

Star	References
RT And	Lukatskaia, F. I., Rubashevskii, A. A., <i>Perem. Zvezdy</i> . 13 , no. 5, 1961.
V340 Aql	Cristaldi, S., (in press).
WW Aur	Abrami, A., <i>Mem. Soc. astr. ital.</i> 33 , 397, 1962.
AR Aur	Grygar, J., <i>Bull. astr. Inst. Csl.</i> 14 , 127, 1963.
BF Aur	Schneller, H., <i>Astr. Nachr.</i> 286 , 97, 1961.
EO Aur	Schneller, H., <i>Astr. Nachr.</i> 287 , 49, 1963.
GX Aur	Tempesti, P., Collurania (Teramo), (pg, l.c.).
S Cnc	Irwin, J. B. (Goethe Link Obs.) (differential limb darkening). Huffer, C. M., Collins, G. W., <i>Ap. J. Suppl.</i> 7 , 351, 1962 (pe obs., orb. elements).
YY CMi	Abhyankar, K. D., <i>Z. Astrophys.</i> 25 , 1961 (3 colors).
TW Cnc	Hurahata, M., Kitamura, M., <i>Publ. astr. Soc. Japan</i> 12 , 441, 1960.
RS CVn	Chisari, D. (Catania Obs.) (in preparation).
δ Cap	Mt. Stromlo Obs. (UBV, analysis under way).
SX Cas	Lukatskaia, F. I., Rubashevskii, A. A., <i>Perem. Zvezdy</i> . 13 , no. 5, 1961. Shulberg, A., <i>Perem. Zvezdy</i> . 13 , no. 6, 1961; <i>Astr. Cirk.</i> no. 222, 1961.
YZ Cas	Serkowski, K., <i>Astr. J.</i> 66 , 405, 1961 (Differential limb darkening).
AR Cas	Huffer, C. M., Collins, G. W., <i>Ap. J. Suppl.</i> 7 , 351, 1962.
CW Cas	Broglia, P. (Merate), New geom. el. (in press) (3 colors).
PV Cas	Geyer, E., <i>Z. Astrophys.</i> 51 , 79, 1961 (2 colors).
VW Cep	Jurkevich, I., Ph.D. Thesis, Univ. of Penna. (analysis by computing machine of photometric obs. made during the the 1959 campaign).
AH Cep	Nekrasova, S. V., <i>Perem. Zvezdy</i> . 13 , no. 3, 1960 (yellow, blue) (yellow and blue) (λ 5100 and λ 4200).
RW Com	Chincarini, G., Margoni, R., Asiago (B, V).
RZ Com	Bolokadze, R. D., <i>Perem. Zvezdy</i> . 13 , no. 4, 1961. Broglia, P., <i>Contr. oss. astr. Milano Merate</i> no. 165 (New geom. el.).
U CrB	Cristaldi, S., (Catania) (in preparation).
GO Cyg	Mannino, G., (Bologna) <i>Mem. Soc. astr. ital.</i> 34 , 191, 1963.
V367 Cyg	Fresa, A., (Capodimonte) (in preparation).
V382 Cyg	Landolt, A. U., (Louisiana Univ.) (3 colors).
RW Dor	Hogg, A. R., (Mt. Stromlo Obs.) (in preparation).
RZ Dra	Flower and Cook Obs. <i>Astr. J.</i> 67 , 775, 1962.
AI Dra	Mauder, H., <i>Z. Astrophys.</i> 55 , 59, 1962 (3 colors).
RX Gem	Lukatskaia, F. I., Rubashevskii, A. A., <i>Perem. Zvezdy</i> . 13 , no. 5, 1961.
SZ Her	Broglia, P., <i>Contr. oss. astr. Milano Merate</i> no. 177.
TT Her	Van Genderen, A. M., <i>Bull. astr. Inst. Nerthlds.</i> 16 , 151, 1962.
UX Her	Gordon, K. C., Kron, G. E., <i>Publ. astr. Soc. Pacif.</i> Oct. 1963 (abstract) (yellow, blue).

- ν Her Merrill, J. E., in *Photo-electric Astronomy for Amateurs*, N.Y., Macmillan, 1963, Chapter 7. (blue measures by Ruiz).
- SW Lac Broglia, P., *Mem. Soc. astr. ital.* **33**, 43, 1962; *Contr. oss. astr. Milano Merate* no. 190, 1962 (3 colors).
- δ Lib Sahade, J., Hernandez, C. A., *Asoc. Argentina Astr. Bol.* no. 4, 34, 1962 (abstract); *Inf. Bull. South. Hemisph.* no. 2, 1962.
Koch, R. H., *Astr. J.* **67**, 130, 1962 (3 colors).
- FL Lyr Cristaldi, S., (Catania) (in preparation).
- β Lyr Nekrasova, S. V., Polosuhina, N. S., *Perem. Zvezdy.* **13**, no. 1, 1960 (3 colors).
- UX Mon Shulberg, A., *Astr. Cirk.* no. 229, June 1962.
- AT Peg Cristaldi, S., Walter, K., *Astr. Nachr.* **287**, 103, 1963.
- AW Peg Fresa, A., (Napoli-Capodimonte).
Lukatskaia, F. I., Rubashevskii, A. A., *Perem. Zvezdy.* **13**, no. 5, 1961.
Hilton, W. B., McNamara, D. H., *Ap. J.* **134**, 839, 1961.
- BX Peg Flower and Cook Obs., *Astr. J.* **67**, 775, 1962.
- EE Peg Fresa, A., (Capodimonte) (in preparation).
- β Per Flower and Cook Obs. *Astr. J.* **67**, 775, 1962.
- W Ser Fichera, E., *Atti Riunione Soc. astr. ital.*, Oct. 1962.
- RZ Tau Binnendijk, L., *Astr. J.* **68**, 22, 1963.
- SV Tau Koshkina, L. N., *Perem. Zvezdy.* **13**, no. 6, 1961 (pg., l.c.).
- V Tuc Mt. Stromlo Obs. (*UBV*, analysis under way).
Wood, F. B., McCluskey, G. E., *Astr. J.* **66**, 413, 1961.
- TX UMa Koch, R. H., *Astr. J.* **66**, 230, 1962 (departures from the Russell model).
- α Vir Magalashvili, N. L., Kumsishvili, J. J., *Abastumanskaja astrof. Obs. Bjull.* no. 28, 1962.
- ER Vul Abrami, A., Cester, B., *Oss. astr. Trieste. Pubbl.*, 320, 1963.
- BD + 76° 790 Geyer, E., *Z. Astrophys.* **51**, 79, 1961 (2 colors).

ABSOLUTE DIMENSIONS OF ECLIPSING SYSTEMS

In Table 6 are listed the determinations of absolute dimensions published since the last report. The number of determinations, 14, is considerably below the 24 for the previous three years. This reflects the slight decrease in number of spectrographic observers reporting, mentioned in connection with Table 2. It is also, however, much affected by the fact that a good deal of spectrographic effort has been concentrated (very profitably) in the coordinated campaigns.

In Popper's program of critical examination of the masses and radii of those systems deemed likely to provide absolute dimensions, two additional papers have appeared (40, 41). Popper and Walker (42) find that the faint system KU Cyg presents some interesting aspects. In particular, if one accepts the radial velocity variation of the fainter component observed during total eclipse as resulting from true orbital motion, then the mass of the F-type primary is about 30 solar masses and its absolute magnitude about -1 , a pair of results even more extreme than those proposed for the F-type component of β Lyr by Abt (43) and Huang (44).

The Krons (45) find UX Her unusual in several respects: first, the period is well known to be variable; second, it has a high γ velocity, -58.6 km/sec according to Sanford (46). Third, combining Sanford's spectrographic results with their photometric ones, and assuming a mass of $2.35\odot$ for the main-sequence A3 component, they find that the radii of both components are very nearly 2 solar radii but the mass of the later type sub-giant is only 0.55 times that of the Sun. They note further, however, that elements derived by least squares from their observations in one color will not satisfy the observations in the other. This occurs fairly often with observations of precision; this problem and possible ways of meeting it in some cases are mentioned also in the section of this report just preceding. New values are from papers in press.

Turning to 'normality' for a moment, Heard and Morton (47) show that the present evidence

indicates that both components of V805 Aql and both components of V451 Oph are in all probability very 'normal' stars. This very fact makes both systems serious candidates for re-observation, especially photometrically, in the near future; both light curves show significantly displaced secondary eclipses, and V805 Aql is plagued with a close companion, which might however turn out to be a blessing in disguise a few decades hence.

Table 6. New determinations of absolute dimensions of eclipsing binaries

Star	References
V805 Aql	Heard, J. F., Morton, D. M., <i>Publ. D. Dunlap Obs.</i> 2 , no. 8, 1962.
ζ Aur	Popper, D. M., <i>Astrophys. J.</i> 134 , 828, 1961.
ε Aur	Morris, S. C., <i>J. Roy. astr. Soc. Can.</i> 56 , 210, 1962.
RS Cvn	Popper, D. M., <i>Astrophys. J.</i> 133 , 148, 1961.
SX Cas	Shulberg, A., <i>Perem. Zvezdy.</i> 13 , no. 6, 1961.
AH Cep	Nekrasova, S. V., <i>Perem. Zvezdy.</i> 13 , no. 3, 1960 (λ 5100 and λ 4200).
KU Cyg	Popper, D. M., Walker, M. F., <i>Astrophys. J.</i> , 139 , 143, 1964.
V380 Cyg	Batten, A. H., <i>Publ. Dom. astrophys. Obs.</i> 12 , 91, 1963.
UX Her	Gordon, K. C., Kron, G. E., <i>Publ. astr. Soc. Pacif.</i> Oct. 1963.
u Her	Merrill, J. E., In Chapter 7 of <i>Photo-electric Astronomy for Amateurs</i> , Macmillan, N.Y., 1963.
β Lyr	Huang, S. S., <i>Astrophys. J.</i> 136 , 903, 1962 (mass).
V451 Oph	Heard, J. F., Morton, D. M., <i>Publ. D. Dunlap Obs.</i> 2 , no. 8, 1962.
AW Peg	Hilton, W. B., McNamara, D. H., <i>Astrophys. J.</i> 134 , 839, 1961.

THEORETICAL AND DYNAMICAL INVESTIGATIONS

Many theoretical and dynamical investigations have been carried out during the past three years. West, working with Gyldenkerne, has elaborated a technique for orbital computation of binaries by means of the GIER electronic computer. Jurkevich is discussing means of rectifying and solution using a computer of moderate size. Blitzstein has developed a program for reduction of observations including all necessary corrections. Popper has rediscussed the material on various systems (48). Serkowski has discussed differential limb darkening from multicolor observations (49). In a study of CQ Cep, Chugainov has obtained a color system identical with the *UBV*. Kwee at the Bamberg Colloquium also discussed the color corrections needed in reducing the VW Cep observations (50). V444 Cyg was studied by Rublev (51) with respect to color temperature and by Limber (52) as an example of a Wolf Rayet star. Merrill (53) developed a streamlined method of solution in discussing the observations of *u* Her made by Ruiz in 1957.

Many papers have appeared discussing β Lyr. Among them are those by Huang (54), Gaposchin (55), Herczeg (56), Abt, Jeffers, Gibson, and Sandage, (57), and Feibelman (58). Hinderer (59) and van't Veer (60) have discussed W UMa systems. Koch (61) discussed departures from the Russell model in the case of TX UMa. Abrami (62) discussed rectification for reflection in the light curves of eclipsing binaries and the study of the light curve in a partial eclipse.

Batten (63) wrote concerning stellar eclipses and stellar interiors. Chandrasekhar (64) discussed a general variational principle governing the radial and non-radial oscillations of gaseous masses; Chandrasekhar and Roberts (65) considered the ellipticity of a slowly rotating configuration; Chandrasekhar and Lebovitz (66) wrote on the stability of the Jacobi ellipsoids; Chandrasekhar (67) discussed the oscillations of the MacLaurin spheroids belonging to the third harmonics and the points of bifurcation along MacLaurin, Jacobi, and Jeans sequences; Chandrasekhar and Lebovitz (66) wrote on the equilibrium and stability of the Jeans spheroid.

Davis has worked out a machine computation of the p -functions (68). Eggen discussed the period-color relation for contact binaries (69), and Fernie (70) considered the effects of unresolved binaries on a photometric system. Gdomski (71) wrote on the ecological spheres of some binaries.

The sixth volume in the series *Stars and Stellar Systems* (72) contains various sections of interest to this Commission. These include: section 2.5 of Chapter 6, *Non-thermal Phenomena in Stellar Atmospheres*, by Biermann and Lüst; Chapter 8, *Stellar Rotation and Atmospheric Turbulence*, by Huang and Struve; Chapter 11, *Eclipses by Extended Atmospheres*, by Wilson; and Chapter 12, *Composite and Combination Spectra*, by Sahade.

Gyldenkerne considers that one result of his color measures may be important in the field of close binaries. He writes: 'We measure four spectrophotometric quantities. Three of them give three physical-chemical parameters for single stars; when measuring four quantities duplicity for systems with different spectra of the components is sensitively detected. Maybe we will be able to find even the types of the components if we make a test by means of binaries with known spectra. The method should be useful for giants earlier than K2, and may have statistical importance if we make a large scale investigation in a program with bright stars. . . .'

Huang (73) discussed the geometric broadening of spectral lines and applied the results to the study of the differential rotation of an eclipsed star. Irwin (74) surveyed the principal basic methods of solution for the spherical model.

Jaschek and Jaschek (75) discuss spectroscopic binaries and evolution. Grygar (76) studied limb darkening of early-type components of eclipsing binaries. An analysis of Wesselink's photographic light-curve of SZ Cam indicates that the predominant source of continuous opacity in the O9.5 primary is electron scattering. Actual theoretical models of stellar atmospheres lead to laws for limb darkening which are often considerably non-linear. Grygar attempted to apply these laws directly. It appears that a certain improvement can in this way be introduced into the problem of the determination of the elements, but only when the system is geometrically and physically simple.

Plavec, Sehnal, and Mikulas (77) have calculated a series of gas particle orbits in a close binary. A simple restricted problem of three bodies was taken as a basis, and the parameters were chosen to fit the case of RW Tau. For the first time trajectories in three-dimensional space have been computed. In particular, a family of trajectories were calculated starting with the same initial velocity from the inner Lagrangian point, but diverging in various directions. A strong dependence of the shape and length of the particle orbits has been found on the direction of the initial ejection. With an initial velocity of 110 km/sec, for example, some of the trajectories form a few loops around the primary. A kind of ring can thus be formed by direct orbits, but in each case the lifetime of the particle orbit is very short (of the order of the length of the period of the system), the eccentric orbits must lead to collisions, and the ring must be an unstable phenomenon. This is in agreement with Joy's observations on the emission lines.

Plavec and Kratochvil (78) prepared rather extensive tables of the most important parameters of the Roche model of a close binary, the argument being the mass ratio, the interval covered 0.1 to 1, the step 0.02. Similar tables are being computed for the cases of non-synchronized rotation of the components.

Plavec (79) discusses the problem of classification of eclipsing binaries. For the W UMa systems, the undersize sub-giants, and systems like μ^1 Sco and V Pup he finds that a classification of close binaries should be two-dimensional, the parameters being the position of the components on the H-R diagram (Sahade's criterion) and their size relative to the corresponding critical Roche lobe (Kopal's criterion). Some further statistical investigations are under way at Ondřejov. Preliminary calculations indicate that selection effects play a large role in our statistics of properties of eclipsing variables of various types.

Johnson (80) discussed the orientation of binary orbits. Kawabata (81) discussed the atmospheres of the late-type components of ζ Aur stars. Kruszewski (82) is investigating problems dealing with the exchange of matter in close binary systems. The qualitative problem described in *Acta. astr.* 13, has been confirmed by computations made with the URAL II electronic computer.

Linnell has considered eclipsing binary extinction errors (83) and has published his second paper on atmospheric eclipses (84).

Lukatskaia and Rubashevskii (85) presented a method for solving light curves for the case of an atmospheric eclipse. Masini (86) considered a polytrope of index 3 for the study of the internal constitution of a star belonging to a close binary system. Mauder (87) discussed the computation of orbits of close binaries with an electronic computer. Ovenden (88) discussed the effect of reflection on elements derived from spectroscopic observations. Piotrowski has written on the light unit and the third body in the computation of elements of eclipsing binaries (89).

Popper points out that the problem of adjusting the spectrographic elements, T , e , and ω of an eclipsing binary by the times of minima of the light curve has not been referred to in either of the recent compendia; the earlier work by Carpenter (90) has therefore been revised and extended by Popper (91).

Roberts (92) has published two papers on highly rotating polytropes. Sahade (93) gave a discussion of the masses of the components of the systems that were included in the so-called 'R CMa group' and alternative models were suggested. The conclusion was reached that mass ratios should not be derived by imposing conditions that are related to the relative sizes of the star and the corresponding lobe of the first critical equipotential surface.

In two papers (93), Smak considered sub-giants in close binary systems, including evolutionary problems. Broglia is preparing a program for analysis of light curves on the IBM 1620 using Wellman's method. Struve summarized our knowledge of contact binaries (94). Van't Veer has completed an extensive study of limb darkening (95).

Other theoretical work includes that of Varsavsky (96). A book (97), ed. F. B. Wood, devotes two chapters to eclipsing stars. Other chapters describe the place of photometry in astronomy, how to construct a photo-electric photometer, filters and color systems, how to identify the stars to be studied and how to reduce the observations, and a chapter on intrinsic variables.

Walter (98) considered the distribution of energy in cases of differential rotation in close binary systems. Wood (99) discussed a possible course of evolution of close binaries. Hogg (100) has reviewed the present status of theories of evolution of close binaries.

STATISTICAL AND SPECTROPHOTOMETRIC INVESTIGATIONS

The mass and the space motion vectors of β Aur were studied by Eggen (101). Hack wrote concerning the nature of the companion of ϵ Aur (102), and Kumaigorodskaja and Kopylov published a study of spectrophotometric observations of the same system (103). Morris used plates by Wright to derive a new spectrographic orbit and to study physical conditions in the shell using a curve-of-growth technique. From the $H\beta$ profiles he concluded that the emission occurs between the stars. His calculations suggest that the F star has an absolute magnitude of -7.3 , and the secondary star an absolute magnitude of -3 . He suggests that the system originated on the main sequence as a pair of O-type stars, probably with a mass ratio in excess of the currently derived value of 1.13. The more massive star has evolved into an F super-giant and is undergoing mass ejection, while the less massive star has not moved far from the main sequence. Presumably part of the mass ejected from the F star remains around it while part has passed through the inner Lagrangian point and forms a disk around the less massive star. The inner region of the disk is totally ionized by the central star; the intermediate region is

heated sufficiently to become virtually opaque near the central plane; the outermost zone remains transparent and produces the shell spectrum observed during eclipse.

Wright began observations of ζ Aur well in advance of the December-January eclipse; plates taken 1963 August 16 and 17, show some differences in the K-line. Wright continues observations on VV Cep (2-3 plates per year) in the photographic region and, more frequently, in the red in order to observe changes in the spectrum and also for radial velocities. The region near 4233 Å does not seem to change. Attempts have been made to find the mass ratio, but although the same techniques were used as for 31 Cyg, no helium lines have been detected in the B star and the hydrogen lines appear in emission. The high-dispersion spectrograms obtained during the chromospheric phases of the 1956 eclipse have now been traced and a preliminary survey of the results is expected soon.

Kwee's description of the results of the VW Cep program was mentioned earlier in this report. Popper and Walker have some interesting results of their study of KU Cyg (104). A large ultra-violet excess at primary minimum of about 0.8 mag, is the result of a strong continuum setting in at about 4000 Å. This is not a result of Balmer emission. RZ Oph, a somewhat similar system, also shows appreciable ultra-violet excess during totality.

Wright and his collaborators at Victoria have taken plates through a complete cycle of the orbit of 31 Cyg; they plan to publish the spectroscopic elements in the near future. The orbit will be based on high dispersion, 4.5 and 3.2 Å/mm, spectrograms obtained between 1952 and 1963. Morris programmed the data for the computer and preliminary elements have been obtained. When the period was included, a P of 3800 days gave lower residuals than the 3784.3 period found from the eclipse data, but the latter must be quite close. A few observations lie as much as 2 km/sec from the mean curve; there may be some outbursts producing these effects throughout the cycle. The eccentricity is somewhat larger than that found by Vinter Hansen, but her observations fit the Victoria data reasonably well. The star was followed closely during the 1961-62 eclipse and the results for the K-line were quite rewarding. The results of the ingress phase have been given by Wright and Odgers (105). The egress data have not yet been studied in detail. During ingress the equivalent widths of the K-line were compared with the 1951 data, and it was found that the 1961 intensities were greater, especially within six weeks of totality. Numerous spectra show satellite lines as long as five months before totality. In some cases these lines are completely separated and of comparable strength, which shows that relatively large masses of gas are moving with relative velocities of 50 km/sec or more between the observer and the B star.

Batten has completed his observations of V380 Cyg (106). The secondary spectrum has been detected and measured, providing a way to estimate the absolute dimensions of the system. The spectroscopic absolute magnitude has been estimated and agrees well with distance estimates based on K-line intensity velocity. The star is not as bright as supposed by Kopal. Both the depths and durations of minima are in conflict with the absolute dimensions deduced spectrophotometrically. There seems to be some evidence for gas streaming, which is being investigated spectrographically.

Azimov (107) made a spectrophotometric study of S Cnc. Sahade (108) gave a general discussion of R CMA systems. Azimov (109) also published spectrophotometric observations of RS Cvn.

Batten obtained new spectroscopic elements for δ Cap. He reports that there is no significant difference between these elements and those obtained by Miss Stewart. He suggests that the smaller value of K found by Crump is a result of the wavelength system employed. The spectrum of only one component is visible and it is deduced that the secondary component must be at least three magnitudes fainter than the primary. The absolute visual magnitude of the primary component is estimated to be +2.2.

Two general discussions of U Cep have been given by Struve (110), and Azimov has presented spectrophotometric observations of the same system (111). Petrie and Plavec are each making spectrographic studies of S Equ. Eggen has discussed the mass and the space motion vectors of RR Lyr (112).

Abt (113) discussed non-periodic spectroscopic changes in β Lyr; Struve and Zebergs (114) discussed the spectrum of the B8 component. AW Peg was studied by Hilton and McNamara (115). Azimov made spectrophotometric studies of RY Per (116) and of U Sge (116). Hack and Pasinetti made a quantitative analysis of the hydrogen-poor star, ν Sgr (117).

The asymmetry of the radial-velocity curve of RW Tau has been confirmed by Petrie's observations at Victoria, made in the years 1939-40 and 1946-47. These observations are in excellent agreement with those published by Hiltner and Hardie in 1949, according to Plaveč (118). The radial velocity is obviously distorted by gas streams. The presence of circumstellar gas makes itself evident both by the asymmetry of the profiles and also by abnormally low residual central intensities of the hydrogen lines at certain phases (119). It is difficult to derive the true radial velocity curve because the total range of velocity changes is rather small. A similar problem is presented by S Equ; an extensive series of Petrie's spectrograms is being studied in detail by Plavec.

Batten has nearly completed an orbit for TX UMa. The high eccentricity reported by Pearce is not confirmed. Several runs through eclipse are being made to look for the ζ Aur effect reported by Hiltner. Recent photometric work by Koch will be of considerable help in interpreting the observations.

Azimov (120) made a spectrophotometric investigation of the surface temperatures of stars of types B and A in eclipsing binary systems. Baize (121) constructed a catalogue of double stars having one variable component; this included eclipsing variables which are a component of a visual binary. Wright *et al.* (121a) have published tables on Line Intensity Standards, and have also made a study of all known observations of U CrB. They find strong evidence for large scale changes in the light curve which seem to be associated with period changes.

Giannuzzi discussed the mean densities of binary systems as part of the Schiaparelli symposium. Kawabata (122) discussed the atmospheres of the late-type components of ζ Aur stars. Light-time curves were discussed by Illes-Almar and Almar (123).

Koch, Sobieski, and Wood published the fourth edition of *A Finding List for Observers of Eclipsing Variables* (124). Kordylewski continued the annual publication of *Ephemerides of Eclipsing Binaries* (125). Kukarkin edited the first supplement to the second *General Catalogue of Variable Stars* together with an English version of the remarks.

Kumaigorodskaia and Kopylov carried out spectrophotometrical observations of ϵ Aur during the 1955-57 eclipse (126). Sixteen spectrograms with a dispersion of 23 Å/mm at H γ were obtained. Detailed investigations of the physical conditions for the F-component and their variations during and out of eclipse have been performed.

Kwee (127) made a redetermination of the maximum and minimum brightness of many variables in the direction of the galactic center.

Schneller produced the *Geschichte und Literatur des Lichtwechsels der veränderlichen Sterne*, Zweite Ausgabe, Fünfter Band. This contains the stars named between 1938 and 1958, Phoenix through Vulpecula. Compilations of various properties of eclipsing binaries appear in Chapter 15 by Harris, Strand, and Worley and Chapter 19 by Wood in Volume 3 of *Basic Astronomical Data* (128).

Sahade considered evolutionary effects in close binary systems (129). In this paper a discussion is made of maximum stellar masses where the data from β Lyr and other spectroscopic binaries are analyzed. Various early type systems are discussed from the point of view of stellar

evolution. Sahade and Davila (130) gave a list of eclipsing variables that are certain, probable, and possible members of galactic clusters.

Semeniuk made a search for eclipsing binaries in O-B associations (131). Seventeen eclipsing binaries were identified as probably being association members. Shulberg (132) gave a list of eclipsing binaries showing bright lines in their spectra. Szafraniec (133) gave an exhaustive discussion on the so-called Nordmann-Tikhov effect using photo-electric observations. McLaughlin (134) worked on the Be spectrum of HD 20336.

In studying the masses of giant stars, Popper presents the following results:

<i>Star</i>	<i>Type</i>	<i>Mass</i>
α Aur	G8 III	2.3 – 3.1
RZ Cnc	K1 III	3.2 \pm 0.3
TW Cnc	G8 III	2.0 – 4.0
ζ Aur	K4 II	8.3 \pm 1.5

Popper writes that comparison of results now available for eclipsing binaries with Eggen's work shows that main-sequence eclipsing binaries of types A-G populate closely the 'Sirius group' sequence of Eggen in the mass-luminosity plane rather than the sequence of the Hyades cluster. Metallic-line stars (WW Aur, RR Lyn) appear to be somewhat more luminous for their masses than interpolation along the 'Sirius group' sequence would predict. Luminosities assigned to Z Her and RR Lyn by Eggen on the basis of their presumed membership in moving groups are appreciably lower than those computed from their radii and surface temperatures.

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