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FINAL REPORT

TABLE OF STELLAR RADIAL VELOCITIES DETERMINED AT THE ALLEGHENY OBSERVATORY  
IN THE YEARS 1906-1917

AD 740730

*(1)*

Wallace R. Beardsley

Astronomer

Allegheny Observatory

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## Stellar Radial Velocities

## Final Report

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A total of 3144 unpublished radial velocity measures of stars were in the files of the Allegheny Observatory. These were all from the era 1906-1917 and constitute a valuable contribution to our knowledge of radial velocities of stars. A total of 130 stars are represented, most of which are binary stars. Many of these binary stars have remained unsolved over the years because of lack of similar published data. The measures, themselves, were mostly raw measures without reduction and velocity calculations. The work of reducing these measures and calculating the respective radial velocities is now complete. Final typing of the manuscript is now in process. Publication will be in the Supplements to the Astrophysical Journal or the Publications of the Allegheny Observatory. Copies of the publication will be submitted to the Geography Branch, Office of Naval Research when available.

Submitted earlier as the final report.

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| Star | HD Number | Name            | RA          | RV    | pe    | Wt. | RV | sec | IS | Wt. Ms'r. | Remarks                             | Spectral Type |
|------|-----------|-----------------|-------------|-------|-------|-----|----|-----|----|-----------|-------------------------------------|---------------|
| No.  | Plate No. | Date            | JD          | RV    | pe    | Wt. | RV | sec | IS | Wt. Ms'r. | Remarks                             | Spectral Type |
| Sky  |           |                 |             |       |       |     |    |     |    |           |                                     |               |
| 1    | 517       | 1907 May 28.190 | 2417724.190 | - 0.9 | ± 1.7 | 7   |    |     |    | B         | HA 0 <sup>h</sup> 46 <sup>m</sup> E | G2V           |
| 2    | 522       | 28.370          | 7724.370    | - 1.8 | ±0.1  | 7   |    |     |    | B         | HA 3 23 W                           |               |
| 3    | 523       | 28.384          | 7724.384    | - 2.6 | 0.5   | 6   |    |     |    | B         | HA 3 53 W                           |               |
| 4    | 525       | 28.426          | 7724.426    | - 0.8 | 0.6   | 5   |    |     |    | B         | HA 4 54 W                           |               |

This series shows an interesting run with hour angle which may be attributed to flexure. It also indicates that intrinsic errors in the spectrograph were small in 1907. These plate measures, as well as those of  $\theta$  Aql and  $\delta$  Ori, represent a selected portion of a lengthy measurement of lines on each plate used by Baker to set up the general reduction table (Publ.A. O. 1, 9, 1907.)

| 2 | HD 1256 | $\theta$ Andromedae | $\alpha = 0^h 11^m 52^s$ | $\delta = +38^\circ 8'$ | A2V         |
|---|---------|---------------------|--------------------------|-------------------------|-------------|
| 1 | 3160    | 1909 Nov 1.595      | 2418612.595              | - 2.8 ± 7.7             | 6           |
| 2 | 3162    | 2.573               | 8613.573                 | -19.9 4.7               | 7           |
| 3 | 3227    | 14.585              | 8625.585                 | - 8.9 1.0               | 5           |
| 4 | 4719    | 1911 Aug 20.843     | 9269.843                 | + 2.9 2.2               | 8           |
| 5 | 5977    | 1913 Sep 1.756      | 2420012.756              | + 8.4 1.5               | 18          |
|   |         |                     | Mean $\pm 1.3$           |                         | J mean of 2 |

Previously published radial velocities also show a range of about +10 to -20 km/sec. This star may possibly be a spectroscopic binary of small amplitude.

|    | HD 1404 |          | $\sigma$ Andromedae | $\alpha = 0^{\text{h}}13^{\text{m}}6^{\text{s}}$ | $\delta = +36^{\circ}14'$ | A2V  |   |   |                                |
|----|---------|----------|---------------------|--------------------------------------------------|---------------------------|------|---|---|--------------------------------|
| 1  | 3702    | 1910 Aug | 5.785               | 2418889.785                                      | -10.4                     | +7.6 | 3 | J |                                |
| 2  | 3719    |          | 11.767              | 8895.767                                         | -19.5                     | 4.8  | 6 | J |                                |
| 3  | 3727    |          | 12.796              | 8896.796                                         | +5.8                      | 4.1  | 5 | J |                                |
| 4  | 3755    |          | 26.741              | 8910.741                                         | +6.6                      | 3.8  | 5 | J |                                |
| 5  | 3762    |          | 27.714              | 8911.714                                         | +2.8                      | 4.3  | 6 | J |                                |
| 6  | 3769    |          | 28.783              | 8912.783                                         | +0.2                      | 6.0  | 4 | J | Comparison weak on one side    |
| 7  | 3798    | Sep      | 11.728              | 8926.728 (+34.2)                                 |                           |      | 2 | J | Weak spectrum; one line only   |
| 8  | 3803    |          | 14.756              | 8929.756                                         | -11.7                     | 3.2  | 3 | J |                                |
| 9  | 3809    |          | 15.712              | 8930.712                                         | -4.5                      | 4.3  | 5 | J |                                |
| 10 | 3822    |          | 21.733              | 8936.733                                         | -7.3                      | 1.7  | 5 | J | Comparison weak                |
| 11 | 3844    |          | 28.728              | 8943.728                                         | -19.3                     | 6.1  | 4 | J |                                |
| 12 | 3860    |          | 30.712              | 8945.712                                         | -12.0                     | 5.4  | 6 | J |                                |
| 13 | 3864    | Oct      | 1.703               | 8946.703                                         | -1.4                      | 23.3 | 2 | J | Spectrum weak; very poor lines |
| 14 | 3870    |          | 2.709               | 8947.709                                         | -19.6                     | 4.9  | 5 | J |                                |
| 15 | 3884    |          | 8.658               | 8953.658                                         | -7.6                      | 4.4  | 6 | J |                                |
| 16 | 3895    |          | 10.681              | 8955.681                                         | -20.4                     | 4.9  | 5 | J |                                |
| 17 | 3906    |          | 11.715              | 8956.715                                         | -22.1                     | 5.8  | 6 | J |                                |
| 18 | 3915    |          | 12.640              | 8957.640                                         | -14.2                     | 7.9  | 3 | J |                                |
| 19 | 3924    |          | 13.676              | 8958.676                                         | +6.7                      | 1.7  | 5 | J |                                |
| 20 | 3932    |          | 14.651              | 8959.651                                         | -14.8                     | 5.2  | 6 | J |                                |

|    |      |                |          |       |      |   |             |
|----|------|----------------|----------|-------|------|---|-------------|
| 21 | 3939 | 15.650         | 8960.650 | +12.3 | +1.6 | 6 | J           |
| 22 | 3945 | 17.594         | 8962.594 | - 1.9 | 4.8  | 4 | J           |
| 23 | 3951 | 18.635         | 8963.635 | -12.9 | 8.7  | 3 | J           |
| 24 | 3957 | 19.670         | 8964.670 | -19.0 | 4.2  | 6 | J           |
| 25 | 3975 | 23.656         | 8968.656 | - 9.9 | 3.6  | 6 | J           |
| 26 | 3983 | 25.656         | 8970.656 | -15.3 | 4.0  | 4 | J           |
| 27 | 3988 | 29.597         | 8974.597 | -17.9 | 2.5  | 4 | J           |
| 28 | 4021 | Nov 8.588      | 8984.588 | -11.1 | 6.1  | 4 | J           |
| 29 | 4040 | 20.584         | 8996.584 | -17.3 | 2.1  | 5 | J           |
| 30 | 4053 | 26.572         | 9002.572 | - 0.2 | 3.9  | 5 | J           |
| 31 | 4079 | Dec 13.574     | 9019.574 | - 4.0 | 1.9  | 4 | J           |
| 32 | 4086 | 14.505         | 9020.505 | -12.8 | 3.6  | 6 | J           |
| 33 | 4104 | 17.490         | 9023.490 | -18.6 | 3.1  | 4 | J           |
| 34 | 4114 | 21.546         | 9027.546 | -11.5 | 6.1  | 5 | J Wide slit |
| 35 | 4121 | 25.488         | 9031.488 | -10.6 | 3.2  | 4 | J           |
| 36 | 4124 | 27.490         | 9033.490 | - 8.4 | 2.9  | 4 | J           |
| 37 | 4134 | 1911 Jan 5.454 | 9042.454 | -10.2 | 1.9  | 5 | J           |

This star is evidently a spectroscopic binary of very short period. One plate per night, despite the good run in October, is insufficient to define the period. The star is being observed on the present program at Allegheny Observatory. Announced as a spectroscopic binary by Lee (Ap.J. 32, 300, 1910).

F8V

 $\delta = +53^{\circ}37'$  $\alpha = 0^h30^m6^s$ 

HD 3240

|   |      |          |        |             |       |      |     |   |
|---|------|----------|--------|-------------|-------|------|-----|---|
| 1 | 3183 | 1909 Nov | 4.664  | 2418615.664 | -14.8 | +3.2 | 7   | D |
| 2 | 3236 |          | 15.591 | 8626.591    | -18.7 | 3.4  | 7   | D |
| 3 | 4711 | 1911 Aug | 19.866 | 9268.866    | -10.2 | 2.7  | 6.5 | D |
| 4 | 4978 | Dec      | 6.552  | 9377.552    | -1.4  | 2.9  | 9   | D |

Mean -10.6

No Discussion

B5V

 $\delta = +47^{\circ}19'$  $\alpha = 0^h38^m9^s$ 

HD 4142

|   |      |          |        |             |       |      |   |   |
|---|------|----------|--------|-------------|-------|------|---|---|
| 1 | 3941 | 1910 Oct | 15.745 | 2418960.745 | -15.6 | +7.3 | 5 | D |
| 2 | 4004 |          | 31.596 | 8976.596    | -87.0 | 4.9  | 5 | D |
| 3 | 4012 | Nov      | 4.684  | 8980.684    | -41.6 | 3.1  | 5 | D |
| 4 | 4929 | 1911 Nov | 10.562 | 9351.562    | -70.1 | 4.5  | 7 | D |
| 5 | 4936 |          | 13.564 | 9354.564    | -57.9 | 3.5  | 7 | D |
| 6 | 4959 |          | 26.553 | 9367.553    | -70.6 | 3.3  | 6 | D |

Mean -58.3

Previously published radial velocities fall within the range -15 to -87 km/sec observed here. This star is probably a spectroscopic binary.

A2m?

 $\delta = +43^{\circ}25'$  $\alpha = 1^h2^m16^s$ 

HD 6653

41 Andromedae

|   |      |          |        |             |      |           |    |   |
|---|------|----------|--------|-------------|------|-----------|----|---|
| 1 | 3228 | 1909 Nov | 14.617 | 2418625.617 | +7.4 | $\pm 2.6$ | 15 | D |
| 2 | 4733 | 1911 Aug | 22.819 | 9271.819    | +7.8 | 3.5       | 11 | D |

|  | 3 | 4876 | 1911 Oct | 19.751 | 2419329.751 | + 3.7 | ±2.7 | 6.5  |  | D | underexposed |
|--|---|------|----------|--------|-------------|-------|------|------|--|---|--------------|
|  | 4 | 4956 | Nov      | 22.642 | 9363.642    | - 4.3 | 1.9  | 10.5 |  | D |              |
|  | 5 | 4965 |          | 30.603 | 9371.603    | + 6.1 | 2.1  | 16   |  | D |              |
|  | 6 | 5998 | 1913 Sep | 9.742  | 2420020.742 | +16.4 | 2.1  | 13   |  | D |              |

Mean + 6.8

No Discussion

| 9  | HD 6972 | 32 Cassiopeiae | $\alpha = 1^h 5^m 10^s$ | $\delta = +64^\circ 29'$ | B8    |      |    |         |  |                        |
|----|---------|----------------|-------------------------|--------------------------|-------|------|----|---------|--|------------------------|
| 1  | 2154    | 1908 Nov       | 9.628                   | 2418255.628              | -10.7 | ±6.8 | 5  | J       |  |                        |
| 2  | 2164    |                | 12.549                  | 8258.549                 | - 1.2 | 3.9  | 7  | J, Sch1 |  | Mean of three measures |
| 3  | 2175    |                | 13.626                  | 8259.626                 | +13.0 | 3.1  | 5  | J       |  |                        |
| 4  | 2198    |                | 20.526                  | 8266.526                 | + 8.3 | 4.2  | 4  | J, Sch1 |  | Mean of two measures   |
| 5  | 2205    |                | 20.720                  | 8266.720                 | + 3.5 | 3.5  | 5  | J, Sch1 |  | Mean of two measures   |
| 6  | 2278    | 1909 Jan       | 1.600                   | 8308.600                 | +11.7 | 3.5  | 3  | J       |  | Seed 23                |
| 7  | 4986    | 1911 Dec       | 7.616                   | 9378.616                 | -13.2 | 1.4  | 13 | J       |  |                        |
| 8  | 4992    |                | 19.618                  | 9390.618                 | +18.8 | 3.4  | 6  | J       |  |                        |
| 9  | 5020    | 1912 Jan       | 13.485                  | 9415.485                 | + 7.5 | 1.4  | 4  | J       |  |                        |
| 10 | 5023    |                | 16.511                  | 9418.511                 | -18.4 | 6.0  | 6  | J       |  |                        |

Mean - 0.9

No Discussion

| 10 | HD 11241 | 1 Persei | $\alpha = 1^h 45^m 25^s$ | $\delta = 54^\circ 39'$ | B2V   |      |   |   |  |
|----|----------|----------|--------------------------|-------------------------|-------|------|---|---|--|
| 1  | 5448     | 1912 Sep | 16.728                   | 2419662.728             | - 5.5 | ±5.5 | 9 | D |  |

|    |      |          |        |             |       |      |    |       |   |                |
|----|------|----------|--------|-------------|-------|------|----|-------|---|----------------|
| 2  | 5457 | 1912 Sep | 20.700 | 9666.700    | -17.6 | +5.2 | 8  | + 4.8 | 2 | D              |
| 3  | 5471 |          | 29.716 | 9675.716    | -29.5 | 4.5  | 8  | -11.7 | 1 | D              |
| 4  | 5504 | Oct      | 14.666 | 9690.666    | - 7.5 | 4.4  | 8  |       | 2 | D              |
| 5  | 5508 |          | 15.647 | 9691.647    | -22.7 | 4.6  | 8  | +19.1 | 1 | D              |
| 6  | 5519 |          | 17.680 | 9693.680    | - 6.8 | 4.4  | 6  |       |   | D              |
| 7  | 5522 |          | 25.753 | 9701.753    | -44.4 | 2.9  | 4  |       |   | D underexposed |
| 8  | 5531 |          | 27.645 | 9703.645    | - 9.4 | 9.7  | 5  | -14.6 | 2 | D              |
| 9  | 5562 | Nov      | 18.588 | 9725.588    | -14.7 | 5.0  | 6  | - 6.1 | 1 | D              |
| 10 | 5588 |          | 30.563 | 9737.563    | -10.3 | 4.4  | 10 | -12.7 | 2 | D              |
| 11 | 5600 | Dec      | 12.538 | 9749.538    | -46.3 | 4.9  | 5  | + 2.0 | 2 | D              |
| 12 | 5607 |          | 13.524 | 9750.524    | -48.9 | 2.3  | 4  |       |   | D              |
| 13 | 5615 |          | 25.564 | 9762.564    | + 2.3 | 4.3  | 8  | -13.1 | 1 | D              |
| 14 | 5627 | 1913 Jan | 9.535  | 9777.535    | -23.7 | 3.2  | 8  | +19.4 | 1 | D              |
| 15 | 5631 |          | 14.510 | 9782.510    | - 8.8 | 5.3  | 7  |       |   | D              |
| 16 | 5963 | Aug      | 27.823 | 2420007.823 | -12.8 | 3.4  | 6  | + 5.2 | 1 | D              |
| 17 | 5966 |          | 29.787 | 0009.787    | -43.2 | 8.1  | 6  |       |   | D              |
| 18 | 5974 |          | 31.823 | 0011.823    | -15.8 | 4.2  | 8  | -14.4 | 1 | D              |
| 19 | 5978 | Sep      | 1.805  | 0012.805    | -20.4 | 6.9  | 7  | +12.6 | 2 | D              |
| 20 | 5995 |          | 8.808  | 0019.808    | + 8.6 | 2.7  | 6  | +29.3 | 1 | D              |
| 21 | 5999 |          | 9.814  | 0020.814    | - 1.8 | 9.3  | 5  |       |   | D              |
| 22 | 6010 |          | 23.733 | 0034.733    | -21.6 | 6.1  | 6  |       |   | D              |
| 23 | 6027 | Oct      | 4.752  | 0045.752    | +43.8 | 6.4  | 5  | + 8.8 | 1 | D              |

|    |      |                 |          |         |      |   |         |   |                         |
|----|------|-----------------|----------|---------|------|---|---------|---|-------------------------|
| 24 | 6030 | 6.785           | 0047.785 | -11.9   | +1.9 | 6 | + 5.1   | 3 | D                       |
| 25 | 6038 | 8.700           | 0049.700 | -27.0   | 3.1  | 8 | +30.6   | 1 | D                       |
| 26 | 6042 | 9.819           | 0050.819 | - 9.3   | 2.3  | 7 |         |   | D                       |
| 27 | 6050 | 14.683          | 0055.683 | + 0.8   | 2.3  | 6 |         |   | D                       |
| 28 | 6053 | 15.681          | 0056.681 | -18.8   | 2.2  | 5 |         |   | D                       |
| 29 | 6058 | 31.712          | 0072.712 | (+23.0) | 14.5 | 5 | - 9.0   | 1 | Broad Dust Ban          |
| 30 | 6063 | Nov 2.688       | 0074.688 | - 2.7   | 2.4  | 6 | -30.7   | 1 | D                       |
| 31 | 6068 | 4.592           | 0076.592 | -11.6   | 3.8  | 8 | + 8.6   | 1 | D                       |
| 32 | 6071 | 5.721           | 0077.721 | - 9.4   | 3.8  | 8 | +33.0   | 1 | D                       |
| 33 | 6077 | 6.714           | 0078.714 | -25.3   | 4.6  | 8 |         |   | D                       |
| 34 | 6080 | 14.552          | 0086.552 | -48.6   | 10.0 | 5 |         |   | D                       |
| 35 | 6088 | 17.669          | 0089.669 | -10.0   | 3.0  | 7 | (-21.7) | 1 | I.S. Possibly<br>a spot |
| 36 | 6092 | 20.644          | 0092.644 | +17.8   | 5.0  | 6 | + 8.1   | 1 | D                       |
| 37 | 6099 | 21.651          | 0093.651 | -14.8   | 5.2  | 4 | +17.7   | 1 | D                       |
| 38 | 6125 | Dec 12.617      | 0114.617 | -12.4   | 6.1  | 7 |         |   | D                       |
| 39 | 6137 | 15.575          | 0117.575 | - 0.8   | 6.8  | 7 | + 7.0   | 2 | D                       |
| 40 | 6144 | 19.581          | 0121.581 | + 4.7   | 6.3  | 5 | -15.3   | 1 | D                       |
| 41 | 6150 | 22.592          | 0124.592 | - 7.0   | 5.3  | 3 |         |   | Underexposed            |
| 42 | 6163 | 1914 Jan 29.556 | 0162.556 | -19.9   | 3.1  | 4 |         |   | D                       |
| 43 | 6166 | Feb 1.510       | 0165.510 | -27.3   | 5.4  | 5 |         |   | D                       |
| 44 | 6514 | Sep 28.830      | 0404.830 | -17.2   | 11.7 | 3 |         |   | D                       |
| 45 | 6538 | Oct 19.798      | 0425.798 | -18.7   | 7.7  | 8 | - 6.4   | 2 | D                       |

|    |      |          |        |           |       |           |    |   |
|----|------|----------|--------|-----------|-------|-----------|----|---|
| 46 | 6556 | Nov      | 2.765  | 0439.765  | - 6.6 | $\pm 3.1$ | 8  | D |
| 47 | 6559 |          | 3.684  | 0440.684  | + 0.6 | 5.0       | 9  | D |
| 48 | 6564 |          | 6.768  | 0443.768  | - 7.2 | 7.2       | 3  | D |
| 49 | 6585 |          | 27.750 | 0464.750  | -23.2 | 4.4       | 7  | D |
| 50 | 6593 | Dec      | 17.639 | 0484.639  | +29.9 | 11.6      | 3  | D |
| 51 | 6600 |          | 28.576 | 0495.576  | +36.3 | 8.5       | 3  | D |
| 52 | 6604 | 1915 Jan | 4.570  | 0502.570  | - 7.2 | 2.8       | 6  | D |
| 53 | 6608 |          | 5.567  | 0503.567  | - 3.6 | 3.7       | 3  | D |
| 54 | 6613 |          | 8.554  | 0506.554  | +33.9 | 5.1       | 6  | D |
| 55 | 6614 |          | 15.538 | 0513.538  | + 5.9 | 8.1       | 6  | D |
| 56 | 6832 | Oct      | 12.798 | 0783.798  | -18.3 | 6.2       | 5  | D |
| 57 | 6840 |          | 21.723 | 0792.723  | - 1.0 | 4.2       | 6  | D |
| 58 | 6865 | Nov      | 9.728  | 0811.728  | -51.8 | 4.6       | 10 | D |
| 59 | 6875 |          | 26.611 | 0828.611  | - 6.1 | 4.3       | 5  | D |
|    |      |          |        | Mean      | -12.1 |           |    |   |
|    |      |          |        | Mean I.S. | + 2.0 |           |    |   |

The velocity variation for this star appears to be real. Published velocities of other observatories (notably Ottawa, Publ. D.O. 4, 253, 1918) show a similar range from about +40 to -60 km/sec. Observations were made at both Allegheny and at Ottawa on September 28, 1914 about 30 minutes apart. The Ottawa velocity is +28 km/sec, the Allegheny velocity as published is -17 km/sec. The Allegheny result is influenced by a strongly negative value for  $H_\gamma$  which appears double. If this line were to be omitted then the velocity would be more nearly 0 km/sec. It is possible that this star has a very short period of variation of about the same order as a  $\beta$  Canis Majoris star. Further investigation is needed.

HD 358

 $\alpha$  Andromedae $\alpha = 0^h 3^m 13^s$  $\delta = +28^\circ 32'$ 

B9 p

A series of 34 radial velocities were determined for the season 1915-16. Analysis of these velocities show an apparent  $\delta$ -velocity of -16 km/sec. This suggestion of a possible third body in the system is being further investigated by means of several recent series of this star made here at the Allegheny Observatory. The 1915-16 velocities will be published at a future date in conjunction with the present investigations.

5 HD 4058

 $\pi$  Cassiopeiae $\alpha = 0^h 37^m 56^s$  $\delta = +46^\circ 29'$ 

A5

|    |      |          |        |             |        |           |    |                  |      |     |
|----|------|----------|--------|-------------|--------|-----------|----|------------------|------|-----|
| 1  | 6484 | 1914 Sep | 14.799 | 2420390.799 | -88.8  | $\pm 2.8$ | 11 | +111.7 $\pm 2.2$ | 8    | D   |
| 2  | 6487 |          | 15.729 | 0391.729    | +79.4  | 1.7       | 6  | -63.4            | 6.4  | D   |
| 3  | 6500 |          | 21.794 | 0397.794    | +129.8 | 2.2       | 16 | -111.4           | 2.8  | 10  |
| 4  | 6508 |          | 27.788 | 0403.788    | +124.7 | 6.7       | 7  | -128.6           | 9.2  | 3.5 |
| 5  | 6513 |          | 28.767 | 0404.767    | -113.5 | 7.5       | 9  | +123.1           | 2.0  | 11  |
| 6  | 6522 | Oct      | 1.797  | 0407.797    | +123.8 | 1.8       | 8  | -116.5           | 10.1 | 5   |
| 7  | 6533 |          | 11.776 | 0417.776    | +104.9 | 1.0       | 7  | -102.5           | 2.1  | 3   |
| 8  | 6537 |          | 19.733 | 0425.733    | +85.1  | 2.9       | 8  | -65.8            | 4.6  | 8   |
| 9  | 6542 |          | 20.745 | 0426.745    | -30.5  | 1.3       | 3  | +85.5            | 4.8  | 1   |
| 10 | 6546 |          | 22.728 | 0428.728    | -11.5  | 2.4       | 6  |                  |      | D   |
| 11 | 6555 | Nov      | 2.687  | 0439.687    | +10.2  | 1.6       | 18 |                  |      | D   |
| 12 | 6558 |          | 3.608  | 0440.608    | +12.8  | 1.4       | 17 |                  |      | D   |
| 13 | 6563 |          | 6.683  | 0443.683    | -1.0   | 2.3       | 9  |                  |      | D   |
| 14 | 6567 |          | 9.663  | 0446.663    | +55.4  | 2.7       | 4  | -42.9            | 3.5  | 4   |
| 15 | 6572 |          | 13.644 | 0450.644    | +90.9  | 3.6       | 10 | -71.5            | 3.2  | 9   |
| 16 | 6579 |          | 23.631 | 0460.631    | +120.6 | 3.2       | 11 | -101.0           | 4.2  | 8   |
| 17 | 6584 |          | 27.653 | 0464.653    | +133.6 | 2.2       | 16 | -117.1           | 4.0  | 9   |

D clearly single

D single &amp; narrow

|    |      |                |                 |                    |    |   |                  |
|----|------|----------------|-----------------|--------------------|----|---|------------------|
| 18 | 6589 | Dec 15.626     | 0482.626 + 82.4 | 2 (-179.6)         | 1  | D | both 1 line only |
| 19 | 6592 | 17.566         | 0484.566 +106.0 | +3.0 10 - 89.7 2.7 | 9  | D |                  |
| 20 | 6596 | 22.575         | 0489.575 - 58.0 | 1.6 5 + 84.0 4.3   | 3  | D |                  |
| 21 | 6599 | 27.568         | 0494.568 + 17.3 | 4.3 8 - 50.0       | 1  | D | sec. 1 line only |
| 22 | 6609 | 1915 Jan 7.547 | 0505.547 + 0.3  | 3.1 9              |    | D |                  |
| 23 | 6845 | Oct 22.690     | 0793.690 -111.2 | 2.8 20 +126.4 2.4  | 19 | D |                  |
| 24 | 6864 | Nov 9.656      | 0811.656 - 76.6 | 3.4 16 + 97.2 3.8  | 10 | D |                  |

These velocities, when plotted, show an excellent fit to the orbit of Mannino and Grubisich (Mem. Soc. A. Ital., 27, 65, 1955);  $P = 1.964180$ ,  $e = 0.000$ ,  $T_0 = 2427535.740$  JD,  $K_1 = 120.46$  km/sec.,  $\gamma = +12.86$  km/sec.

|    |         |                |                   |                   |   |   |                                     |                          |     |
|----|---------|----------------|-------------------|-------------------|---|---|-------------------------------------|--------------------------|-----|
| 7  | HD 4727 |                |                   |                   |   |   | $\alpha = 0^h 44^m 18^s$            | $\delta = +40^\circ 32'$ | B5V |
| 1  | 6797    | 1915 Sep 1.833 | 2420742.833 +18.6 | +3.3 19           |   | J |                                     |                          |     |
| 2  | 6804    | 8.820          | 0749.820 -31.7    | 1.6 22            |   | J |                                     |                          |     |
| 3  | 6820    | 28.799         | 0769.799 -89.4    | 3.1 23 +254.3 7.5 | 3 | J | sec. 1 line only                    |                          |     |
| 4  | 6831    | Oct 12.733     | 0783.733 -68.5    | 1.7 20 +231.2     | 1 | J | sec. 1 line only                    |                          |     |
| 5  | 6836    | 19.728         | 0790.728 -28.9    | 2.1 20            |   | J |                                     |                          |     |
| 6  | 6851    | 26.711         | 0797.711 +25.2    | 2.9 14 -137.1     | 1 | J | sec. 1 line only                    |                          |     |
| 7  | 6871    | Nov 22.606     | 0824.606 - 9.1    | 2.2 23            |   | J |                                     |                          |     |
| 8  | 6874    | 26.546         | 0828.546 +13.5    | 2.7 14            |   | J |                                     |                          |     |
| 9  | 6884    | Dec 15.553     | 0847.553 -106.6   | 2.6 20 +111.7 0.5 | 3 | J |                                     |                          |     |
| 10 | 6889    | 21.590         | 0853.590 +50.6    | 4.7 19 -116.4     | 1 | J | comparison lines distorted one side |                          |     |
| 11 | 6894    | 22.513         | 0854.513 -14.1    | 2.2 22            |   | J | comparison lines distorted one side |                          |     |

12 6934 1916 Jan 24.533 0887.533 + 13.6 -8.7 7 J weak

These observations when plotted against the orbit of Jordan (Publ. A.O. 1, 191, 1910) ( $T_0 = 2418155.661$ ) show a reasonable fit despite considerable scatter.

| 11 | HD 12303 | 4 Persei       | $\alpha = 1^h 55^m 38^s$ | $\delta = +54^\circ 00'$ | 88V                                |
|----|----------|----------------|--------------------------|--------------------------|------------------------------------|
| 1  | 3072     | 1909 Oct 6.683 | 2418586.683 + 0.1        | -2.3                     | 10 A,D mean of 2                   |
| 2  | 3083     | 7.737          | 8587.737 - 0.2           | 4.0                      | 9 A,D spark very poor mean of 2    |
| 3  | 3092     | 8.678          | 8588.678 + 2.3           | 2.2                      | 11 A,D spark very poor mean of 3   |
| 4  | 3103     | 9.714          | 8589.714 + 3.8           | 2.2                      | 8 A,D mean of 2                    |
| 5  | 3114     | 12.708         | 8592.708 +25.3           | 3.4                      | 11 A,D mean of 2                   |
| 6  | 3123     | 14.672         | 8594.672 + 5.9           | 2.4                      | 12 A,D, Schl mean of 3             |
| 7  | 3138     | 19.678         | 8599.678 + 3.5           | 3.1                      | 8 A,D, Schl over exposed mean of 3 |
| 8  | 3147     | 30.781         | 8610.781 +14.4           | 3.7                      | 9 A,D, Schl mean of 4              |
| 9  | 3164     | Nov 2.651      | 8613.651 - 7.6           | 1.9                      | 8 A,D, Schl spark poor mean of 2   |
| 10 | 3173     | 3.703          | 8614.703 +7.7            | 1.2                      | 10 A,D mean of 3                   |
| 11 | 3185     | 4.718          | 8615.718 -11.8           | 2.4                      | 11 A,D, Schl mean of 3             |
| 12 | 3194     | 6.658          | 8617.658 - 5.0           | 3.0                      | 10 A,D mean of 2                   |
| 13 | 3205     | 10.667         | 8621.667 -10.8           | 2.8                      | 9 A,D, Schl mean of 3              |
| 14 | 3214     | 11.717         | 8622.717 + 1.2           | 5.3                      | 6 A,D mean of 2                    |
| 15 | 3221     | 13.660         | 8624.660 - 9.7           | 2.7                      | 7 A,D mean of 2                    |
| 16 | 3229     | 14.651         | 8625.651 + 7.6           | 5.3                      | 7 A,D mean of 2                    |

|    |      |                |          |       |     |    |     |                           |
|----|------|----------------|----------|-------|-----|----|-----|---------------------------|
| 17 | 3239 | 19.617         | 8630.617 | -10.3 | 3.2 | 7  | A,D | mean of 2                 |
| 18 | 3245 | 23.576         | 8634.576 | -13.2 | 2.4 | 9  | A,D | mean of 2                 |
| 19 | 3254 | 24.548         | 8635.548 | -17.5 | 1.8 | 7  | A,D | mean of 2                 |
| 20 | 3261 | 25.639         | 8636.639 | -14.6 | 2.1 | 11 | A,D | mean of 2                 |
| 21 | 3273 | 26.578         | 8637.578 | -13.0 | 0.5 | 6  | A,D | mean of 2                 |
| 22 | 3277 | 29.590         | 8640.590 | -24.3 | 1.7 | 12 | A,D | mean of 3                 |
| 23 | 3233 | 30.551         | 8641.551 | -23.8 | 2.8 | 9  | A,D | mean of 2                 |
| 24 | 3290 | Dec 1.556      | 8642.556 | -30.5 | 2.7 | 9  | A,D | mean of 2                 |
| 25 | 3308 | 2.554          | 8643.554 | -24.0 | 2.0 | 10 | A,D | mean of 2                 |
| 26 | 3318 | 19.569         | 8660.569 | -18.5 | 2.6 | 7  | A,D | seed 27<br>mean of 2      |
| 27 | 3329 | 20.582         | 8661.582 | -5.2  | 1.8 | 9  | A,D | seed 27<br>mean of 3      |
| 28 | 3334 | 24.481         | 8665.481 | -13.0 | 1.6 | 8  | A,D | mean of 3                 |
| 29 | 3338 | 1910 Jan 9.583 | 8681.583 | +1.5  | 3.6 | 6  | A,D | mean of 2                 |
| 30 | 3345 | 10.553         | 8682.553 | +7.1  | 1.5 | 8  | A,D | mean of 2                 |
| 31 | 3359 | 16.510         | 8688.510 | -8.0  | 3.9 | 9  | A,D | mean of 2                 |
| 32 | 3363 | 19.564         | 8691.564 | -15.5 | 1.3 | 9  | A,D | mean of 2                 |
| 33 | 3376 | Feb 1.524      | 8704.524 | -7.5  | 2.5 | 12 | A,D | mean of 2                 |
| 34 | 3388 | 4.543          | 8707.543 | +6.9  | 2.7 | 10 | A,D | mean of 2                 |
| 35 | 3393 | 7.530          | 8710.530 | -6.6  | 3.5 | 7  | A,D | mean of 2                 |
| 36 | 3400 | 10.561         | 8713.561 | +12.6 | 5.0 | 6  | A,D | mean of 2                 |
| 37 | 3411 | 19.511         | 8722.511 | +2.3  | 6.3 | 5  | A,D | mean of 2                 |
| 38 | 3414 | 24.542         | 8727.542 | -2.0  | 3.4 | 5  | A,D | underexposed<br>mean of 2 |
| 39 | 3812 | Sep 15.826     | 8930.826 | +9.7  | 1.9 | 10 | A,D | mean of 3                 |

|    |      |                |          |       |      |    |     |                                        |
|----|------|----------------|----------|-------|------|----|-----|----------------------------------------|
| 40 | 3825 | 21.845         | 8936.845 | - 7.4 | +4.3 | 7  | A,D | mean of 2<br>underexposed<br>mean of 2 |
| 41 | 3847 | 28.847         | 8943.847 | -17.7 | 3.6  | 7  | A,D |                                        |
| 42 | 3855 | 29.837         | 8944.837 | - 4.0 | 5.0  | 3  | A,D | mean of 2<br>underexposed<br>mean of 2 |
| 43 | 3881 | Oct 7.837      | 8952.837 | + 4.4 | 1.8  | 12 | A,D |                                        |
| 44 | 3887 | 8.753          | 8953.753 | - 9.5 | 3.1  | 8  | A,D | mean of 2                              |
| 45 | 3898 | 10.764         | 8955.764 | - 3.9 | 2.4  | 9  | A,D | mean of 2                              |
| 46 | 3908 | 11.783         | 8956.783 | +12.7 | 3.4  | 8  | A,D | mean of 2                              |
| 47 | 3934 | 14.771         | 8959.771 | -10.0 | 2.0  | 7  | A,D | mean of 2                              |
| 48 | 3953 | 18.727         | 8963.727 | + 3.1 | 3.7  | 7  | A,D | mean of 2                              |
| 49 | 3959 | 19.760         | 8964.760 | - 3.8 | 3.1  | 8  | A,D | mean of 2                              |
| 50 | 3977 | 23.741         | 8968.741 | + 6.3 | 3.2  | 5  | A,D | mean of 2                              |
| 51 | 4006 | 31.665         | 8976.665 | - 6.7 | 2.0  | 9  | A,D | mean of 2                              |
| 52 | 4024 | Nov 8.696      | 8984.696 | -24.1 | 2.8  | 9  | A,D | mean of 2                              |
| 53 | 4031 | 19.700         | 8995.700 | -18.3 | 1.7  | 6  | A,D | mean of 2                              |
| 54 | 4043 | 20.701         | 8996.701 | -16.5 | 1.9  | 6  | A,D | mean of 2                              |
| 55 | 4055 | 26.653         | 9002.653 | -24.6 | 3.4  | 10 | A,D | mean of 2                              |
| 56 | 4070 | Dec 8.631      | 9014.631 | - 2.9 | 4.4  | 8  | A,D | mean of 2                              |
| 57 | 4081 | 13.649         | 9019.649 | + 6.8 | 3.1  | 5  | A,D | mean of 2                              |
| 58 | 4088 | 14.587         | 9020.587 | -10.8 | 4.2  | 9  | A,D | mean of 2                              |
| 59 | 4106 | 17.547         | 9023.547 | -14.3 | 3.2  | 11 | A,D | mean of 2                              |
| 60 | 4125 | 27.526         | 9033.526 | +11.2 | 2.5  | 9  | A,D | mean of 2                              |
| 61 | 4139 | 1911 Jan 9.536 | 9046.536 | - 4.3 | 2.6  | 6  | A,D | mean of 2                              |
| 62 | 4144 | 23.503         | 9060.503 | + 3.2 | 1.4  | 10 | A,D | plate out of focus<br>mean of 2        |

|    |      |            |          |       |     |    |           |
|----|------|------------|----------|-------|-----|----|-----------|
| 63 | 4740 | Aug 31.819 | 9280.819 | + 3.3 | 4.8 | 10 | D         |
| 64 | 4764 | Sep 4.760  | 9284.760 | + 4.8 | 4.5 | 8  | D         |
| 65 | 4781 | 12.757     | 9292.757 | -13.6 | 4.2 | 6  | D         |
| 66 | 4789 | 13.737     | 9293.737 | + 6.3 | 3.8 | 7  | D         |
| 67 | 4795 | 17.798     | 9297.798 | - 9.3 | 3.3 | 8  | D         |
| 68 | 4805 | 19.713     | 9299.713 | + 7.7 | 4.8 | 10 | D         |
| 69 | 4821 | 24.731     | 9304.731 | + 8.9 | 3.5 | 7  | D         |
| 70 | 4827 | 26.744     | 9306.744 | +11.4 | 7.8 | 7  | D         |
| 71 | 4837 | Oct 2.733  | 9312.733 | +10.7 | 3.9 | 10 | D         |
| 72 | 4846 | 8.721      | 9318.721 | - 3.4 | 4.0 | 10 | D         |
| 73 | 4851 | 12.720     | 9322.720 | -19.3 | 4.5 | 5  | D         |
| 74 | 4859 | 15.697     | 9325.697 | - 6.5 | 2.1 | 10 | D         |
| 75 | 4869 | 18.683     | 9328.683 | -10.9 | 3.9 | 11 | D         |
| 76 | 4885 | 23.676     | 9333.676 | -33.2 | 3.6 | 8  | D         |
| 77 | 4896 | 26.631     | 9336.631 | -10.6 | 8.3 | 7  | D         |
| 78 | 4906 | 28.676     | 9338.676 | -28.0 | 4.8 | 7  | D         |
| 79 | 4924 | Nov 5.599  | 9346.599 | -27.0 | 4.3 | 6  | D         |
| 80 | 4926 | 8.749      | 9349.749 | -21.7 | 2.5 | 12 | D seed 23 |
| 81 | 4931 | 10.669     | 9351.669 | -23.4 | 4.9 | 14 | D seed 23 |
| 82 | 4938 | 13.725     | 9354.725 | - 5.5 | 5.8 | 4  | D         |
| 83 | 4943 | 16.653     | 9357.653 | - 6.4 | 3.7 | 10 | D seed 23 |
| 84 | 4948 | 19.627     | 9360.627 | -14.6 | 2.8 | 9  | D         |
| 85 | 4953 | 21.733     | 9362.733 | - 9.4 | 2.3 | 9  | D         |

|     |      |                |          |       |      |    |              |
|-----|------|----------------|----------|-------|------|----|--------------|
| 86  | 4961 | 26.650         | 9367.650 | -18.9 | +4.0 | 8  | D            |
| 87  | 4966 | 30.650         | 9371.650 | +7.6  | 5.1  | 8  | D            |
| 88  | 4972 | Dec 5.620      | 9376.620 | -11.0 | 2.2  | 10 | D            |
| 89  | 4987 | 7.580          | 9378.580 | -13.4 | 2.4  | 9  | D            |
| 90  | 4993 | 19.667         | 9390.667 | +0.4  | 2.3  | 9  | D            |
| 91  | 5000 | 28.629         | 9399.629 | -1.5  | 4.8  | 7  | D            |
| 92  | 5009 | 1912 Jan 1.556 | 9403.556 | +0.9  | 3.9  | 8  | D            |
| 93  | 5016 | 7.578          | 9409.578 | -10.4 | 5.1  | 8  | D            |
| 94  | 5028 | 21.515         | 9423.515 | +8.3  | 1.9  | 4  | underexposed |
| 95  | 5034 | 31.529         | 9433.529 | -1.8  | 1.0  | 9  | D            |
| 96  | 5040 | Feb. 4.522     | 9437.522 | -5.0  | 3.8  | 11 | D            |
| 97  | 5041 | 5.522          | 9438.522 | -3.0  | 4.7  | 9  | D            |
| 98  | 5052 | 10.504         | 9443.504 | -9.4  | 6.3  | 7  | D            |
| 99  | 5065 | 14.575         | 9447.575 | -8.4  | 2.9  | 10 | D            |
| 100 | 5544 | Nov 3.612      | 9710.612 | -12.1 | 1.8  | 10 | D            |

A time plot of these as well as the published velocities from Ottawa, Harper (Publ. D.O. 4, 317, 1919) show a puzzling decrease in velocity of about 25 km/sec. each fall. We suspect that this may well be a beat phenomena resulting from a ultra-short period. Further observations of this star are desirable.

| 12 | HD 13041 | 58 Andromedae   | $\alpha = 2^h 02^m 27^s$ | $\delta = +37^\circ 23'$ | A5V      |   |
|----|----------|-----------------|--------------------------|--------------------------|----------|---|
| 1  | 3186     | 1909 Nov 4.747  | 2418615.747              | - 6.6                    | +6.4 3.5 | D |
| 2  | 4783     | 1911 Sep 12.829 | 9292.829                 | - 2.2                    | 3.2 5    | D |
| 3  | 5042     | 1912 Feb 5.566  | 9438.566                 | +21.8                    | 2.9 3.5  | D |

|   |      |          |          |             |           |     |   |
|---|------|----------|----------|-------------|-----------|-----|---|
| 4 | 5066 | 14.555   | 9447.555 | + 5.5       | $\pm 6.7$ | 1.5 | D |
| 5 | 5991 | 1913 Sep | 6.816    | 2420017.816 | +22.3     | 3.2 | 7 |

Spectroscopic Binary. Double Lines. No Orbit (Plaskett JRASC 13, 60, 1919; Harper Publ. DAO Z. 1, 1937)

|            |          |             |                          |                          |              |           |     |   |
|------------|----------|-------------|--------------------------|--------------------------|--------------|-----------|-----|---|
| 13         | HD 13869 | 7 Trianguli | $\alpha = 2^h 10^m 01^s$ | $\delta = +32^\circ 54'$ | 89.5V        |           |     |   |
| 1          | 3291     | 1909 Dec    | 1.575                    | 2418642.575              | +18.2        | $\pm 2.4$ | 5   | D |
| 2          | 4847     | 1911 Oct    | 8.766                    | 9318.766                 | - 1.1        | 1.7       | 5   | D |
| 3          | 5056     | 1912 Feb    | 12.538                   | 9445.538                 | <u>+ 3.8</u> | 0.8       | 2.5 | D |
| Mean + 7.6 |          |             |                          |                          |              |           |     |   |

| 14 | HD 14951 | $\epsilon$ Arietis | $\alpha = 2^h 19^m 27^s$ | $\delta = +10^{\circ} 9'$ | B6    |           |     |   |                                          |
|----|----------|--------------------|--------------------------|---------------------------|-------|-----------|-----|---|------------------------------------------|
| 1  | 3231     | 1909 Nov           | 14.717                   | 2418625.717               | -42.7 | $\pm 5.4$ | 6.5 | J |                                          |
| 2  | 5007     | 1911 Dec           | 31.574                   | 9402.574                  | -29.6 | 5.5       | 7   | J | weak                                     |
| 3  | 5640     | 1913 Feb           | 2.549                    | 9801.549                  | -33.3 |           | 1   | J | 1 line only<br>very weak<br>narrow lines |
| 4  | 5642     |                    | 6.526                    | 9805.526                  | +26.9 | 1.7       | 6   | J | narrow lines                             |
| 5  | 6054     | Oct                | 15.765                   | 2420056.765               | - 4.3 | 2.8       | 6   | J | narrow lines                             |
| 6  | 6081     | Nov                | 14.613                   | 0086.613                  | -45.8 | 6.1       | 2   | J | weak spectrum                            |
| 7  | 6105     |                    | 23.681                   | 0095.681                  | +12.9 | 9.0       | 5   | J | narrow lines                             |
| 8  | 6109     | Dec                | 3.605                    | 0105.605                  | +33.5 | 11.4      | 7   | J | weak                                     |
| 9  | 6111     |                    | 4.674                    | 0106.674                  | - 1.0 | 6.2       | 11  | J |                                          |
| 10 | 6113     |                    | 5.591                    | 0107.591                  | +14.8 | 12.7      | 3   | J | very weak                                |
| 11 | 6119     |                    | 11.622                   | 0113.622                  | -13.6 | 11.7      | 5   | J | poor- broad lines                        |

|            |      |                 |          |       |            |    |   |                   |
|------------|------|-----------------|----------|-------|------------|----|---|-------------------|
| 12         | 6138 | 15.662          | 0117.662 | +11.2 | $\pm 10.8$ | 2  | J | weak              |
| 13         | 6145 | 19.649          | 0121.649 | + 8.8 | 15.8       | 3  | J |                   |
| 14         | 6549 | 1914 Oct 25.751 | 0431.751 | -24.8 | 7.4        | 6  | J | broad lines       |
| 15         | 6551 | 30.750          | 0436.750 | -16.3 | 7.6        | 7  | J | narrow lines      |
| 16         | 6560 | Nov 3.756       | 0440.756 | -32.2 | 8.3        | 10 | J | narrow lines      |
| 17         | 6568 | 9.750           | 0446.750 | +24.8 | 5.0        | 3  | J | broad lines       |
| 18         | 6574 | 17.629          | 0454.629 | +17.4 | 8.5        | 9  | J |                   |
| 19         | 6558 | 1915 Nov 4.744  | 0806.744 | +21.9 | 6.9        | 3  | J |                   |
| 20         | 6885 | Dec 15.620      | 0847.620 | +14.5 |            | 1  | J | 1 line only; weak |
| 21         | 6909 | 1916 Jan 2.629  | 0865.629 | -23.9 | 4.3        | 9  | J | comparison weak   |
| Mean - 5.8 |      |                 |          |       |            |    |   |                   |

The spectrum is definitely double, but at 40 Å/mm dispersion the doubling is not resolved. The appearance of the lines on the plates vary from narrow on some plates to very broad on others. These velocities represent settings without regard to any doubling and individually are of little value. The plates need to be remeasured on an oscilloscope line profile machine.

| 15 | HD 16908 | 35 Arletts      | $\alpha = 2^h 37^m 35^s$ | $\delta = +27^\circ 17'$ | B3V             |
|----|----------|-----------------|--------------------------|--------------------------|-----------------|
| 1  | 3126     | 1909 Oct 14.769 | 2418594.769              | +11.6                    | J               |
| 2  | 3216     | Nov 11.770      | 8622.770                 | + 7.6                    | J               |
| 3  | 3240     | 19.656          | 8630.656                 | +23.0                    | J               |
| 4  | 4828     | 1911 Sep 26.793 | 9306.793                 | + 4.4                    | J               |
| 5  | 5480     | 1912 Oct 1.771  | 9677.771                 | +16.0                    | J               |
| 6  | 5552     | Nov 8.677       | 9715.677                 | +33.6                    | J               |
|    |          |                 |                          | $\pm 4.4$                | comparison weak |
|    |          |                 |                          | 3.5                      |                 |
|    |          |                 |                          | 4.1                      |                 |
|    |          |                 |                          | 4.0                      |                 |
|    |          |                 |                          | 3.7                      |                 |
|    |          |                 |                          | 6.3                      |                 |
|    |          |                 |                          | 12                       |                 |
|    |          |                 |                          | 10                       |                 |
|    |          |                 |                          | 8                        |                 |
|    |          |                 |                          | 9                        |                 |
|    |          |                 |                          | 9                        |                 |
|    |          |                 |                          | 7                        |                 |

The range of these observations agree with a range of +1 to +35 in the published observations. This star should be regarded as a possible spectroscopic binary with a period of the order of 1 day.

| 16 | HD 19356 |          |        |             | $\alpha = 3^h 1^m 40^s$ | $\delta = +40^\circ 34'$ | B8V         |
|----|----------|----------|--------|-------------|-------------------------|--------------------------|-------------|
| 1  | 991      | 1907 Nov | 15.692 | 2417895.692 | -26.8                   | +1.2 9                   | S           |
| 2  | 992      |          | 15.711 | 7895.711    | -25.7                   | 1.8 11                   | S           |
| 3  | 993      |          | 15.721 | 7895.721    | -28.2                   | 1.9 12                   | S           |
| 4  | 994      |          | 15.741 | 7895.741    | -20.0                   | 1.3 12                   | S           |
| 5  | 1011     |          | 24.646 | 7904.646    | + 3.0                   | 2.6 12                   | S           |
| 6  | 1012     |          | 24.661 | 7904.661    | + 6.8                   | 2.4 8                    | S           |
| 7  | 1013     |          | 24.669 | 7904.669    | + 2.4                   | 1.3 8                    | S           |
| 8  | 1028     | Dec      | 4.629  | 7914.629    | -22.7                   | 1.7 10                   | S           |
| 9  | 1036     |          | 7.608  | 7917.608    | -24.3                   | 0.6 11                   | S           |
| 10 | 1037     |          | 7.622  | 7917.622    | -20.1                   | 2.0 10                   | S           |
| 11 | 1038     |          | 7.643  | 7917.643    | -20.4                   | 2.3 16                   | S           |
| 12 | 1059     | 1908 Jan | 5.608  | 7946.608    | -46.8                   | 2.2 14                   | S mean of 2 |
| 13 | 1060     |          | 5.640  | 7946.640    | -42.9                   | 2.2 17                   | S           |
| 14 | 1061     |          | 5.653  | 7946.653    | -42.4                   | 2.0 19                   | S mean of 2 |
| 15 | 1075     |          | 10.631 | 7951.631    | +13.8                   | 1.4 14                   | S           |
| 16 | 1076     |          | 10.651 | 7951.651    | +11.2                   | 1.5 14                   | S           |
| 17 | 1077     |          | 10.665 | 7951.665    | +11.3                   | 2.4 11                   | S           |
| 18 | 1088     |          | 16.624 | 7957.624    | -13.1                   | 2.0 7                    | S           |
| 19 | 1089     |          | 16.651 | 7957.651    | +23.9                   | 1.8 13                   | S           |

|    |      |           |          |       |      |      |   |
|----|------|-----------|----------|-------|------|------|---|
| 20 | 1090 | 16.668    | 7957.668 | -19.8 | +2.2 | 12   | S |
| 21 | 1111 | 19.592    | 7960.592 | -14.4 | 1.7  | 17   | S |
| 22 | 1112 | 19.613    | 7960.613 | -12.7 | 1.6  | 15   | S |
| 23 | 1113 | 19.622    | 7960.622 | -11.5 | 2.1  | 13   | S |
| 24 | 1125 | 24.552    | 7965.552 | +35.6 | 1.5  | 15   | S |
| 25 | 1126 | 24.571    | 7965.571 | +42.9 | 1.6  | 14   | S |
| 26 | 1127 | 24.580    | 7965.580 | +43.9 | 1.1  | 21   | S |
| 27 | 1131 | 25.535    | 7966.535 | -27.8 | 1.4  | 12   | S |
| 28 | 1132 | 25.558    | 7966.558 | -35.9 | 1.1  | 14   | S |
| 29 | 1133 | 25.568    | 7966.568 | -31.1 | 0.0  | 15   | S |
| 30 | 1142 | 29.636    | 7970.636 | + 7.0 | 4.0  | 9    | S |
| 31 | 1143 | 29.660    | 7970.660 | +10.2 | 2.0  | 8    | S |
| 32 | 1144 | 29.675    | 7970.675 | + 9.7 | 2.6  | 8    | S |
| 33 | 1149 | 30.559    | 7971.559 | +35.8 | 2.2  | 8    | S |
| 34 | 1150 | 30.597    | 7971.597 | +32.4 | 1.3  | 11   | S |
| 35 | 1151 | 30.628    | 7971.628 | +28.1 | 1.2  | 12   | S |
| 36 | 1155 | Feb 2.524 | 7974.524 | +19.6 | 2.1  | 11   | S |
| 37 | 1156 | 2.549     | 7974.549 | +18.9 | 2.0  | 9    | S |
| 38 | 1157 | 2.557     | 7974.557 | +20.3 | 3.1  | 16   | S |
| 39 | 1161 | 4.628     | 7976.628 | +27.5 | 1.4  | 15.5 | S |
| 40 | 1162 | 4.655     | 7976.655 | +31.2 | 1.5  | 6    | S |
| 41 | 1168 | 8.592     | 7980.592 | -25.5 | 2.5  | 15   | S |
| 42 | 1169 | 8.628     | 7980.628 | -22.9 | 1.7  | 12   | S |

poor guiding

Mean of 2

mean of 2

|    |      |                |          |       |      |    |   |
|----|------|----------------|----------|-------|------|----|---|
| 43 | 1170 | 8.640          | 7980.640 | -26.1 | ±2.6 | 12 | S |
| 44 | 1173 | 9.532          | 7981.532 | -26.3 | 3.8  | 10 | S |
| 45 | 1174 | 9.553          | 7981.553 | -31.9 | 2.7  | 15 | S |
| 46 | 1175 | 9.565          | 7981.565 | -36.1 | 3.3  | 12 | S |
| 47 | 1180 | 10.526         | 7982.526 | +42.8 | 0.9  | 13 | S |
| 48 | 1181 | 10.542         | 7982.542 | +42.2 | 1.3  | 8  | S |
| 49 | 1182 | 10.567         | 7982.567 | +45.9 | 1.3  | 10 | S |
| 50 | 1186 | 11.518         | 7983.518 | -20.7 | 1.8  | 15 | S |
| 51 | 1187 | 11.539         | 7983.539 | -18.3 | 2.1  | 13 | S |
| 52 | 1188 | 11.557         | 7983.557 | -14.8 | 0.9  | 15 | S |
| 53 | 1191 | 20.499         | 7992.499 | -31.0 | 1.3  | 12 | S |
| 54 | 1192 | 20.513         | 7992.513 | -32.5 | 2.9  | 12 | S |
| 55 | 1193 | 20.523         | 7992.523 | -38.4 | 1.7  | 15 | S |
| 56 | 1202 | 1908 Mch 3.503 | 8004.503 | -33.9 | 1.8  | 13 | S |
| 57 | 1203 | 3.518          | 8004.518 | -28.9 | 1.2  | 9  | S |
| 58 | 1204 | 3.525          | 8004.525 | -28.9 | 1.8  | 11 | S |
| 59 | 1210 | 9.506          | 8010.506 | -13.5 | 1.9  | 10 | S |
| 60 | 1211 | 9.518          | 8010.518 | -9.2  | 2.8  | 11 | S |
| 61 | 1212 | 9.524          | 8010.524 | -6.5  | 1.6  | 13 | S |
| 62 | 1224 | 10.547         | 8011.547 | +37.3 | 2.6  | 12 | S |
| 63 | 1225 | 10.569         | 8011.569 | +40.4 | 1.2  | 12 | S |
| 64 | 1226 | 10.576         | 8011.576 | +37.7 | 3.1  | 13 | S |
| 65 | 1236 | 11.503         | 8012.503 | -26.7 | 1.7  | 14 | S |

oiled machine  
poor guiding

|    |      |           |          |       |      |      |    |                           |
|----|------|-----------|----------|-------|------|------|----|---------------------------|
| 66 | 1237 | 11.518    | 8012.518 | -30.5 | ±1.6 | 16   | S. | much overexposed          |
| 67 | 1238 | 11.526    | 8012.526 | -24.0 | 2.1  | 13   | S  | mean of 2                 |
| 68 | 1252 | 20.524    | 8021.524 | -41.9 | 1.7  | 8    | S  |                           |
| 69 | 1253 | 20.535    | 8021.535 | -44.5 | 2.0  | 10   | S  |                           |
| 70 | 1254 | 20.545    | 8021.545 | -35.1 | 2.2  | 10   | S  |                           |
| 71 | 1261 | 21.509    | 8022.509 | +37.9 | 2.1  | 10   | S  |                           |
| 72 | 1262 | 21.517    | 8022.517 | +36.3 | 1.3  | 8    | S  |                           |
| 73 | 1263 | 21.532    | 8022.532 | +43.6 | 1.4  | 15.5 | S  |                           |
| 74 | 1268 | 22.535    | 8023.535 | + 1.2 | 1.7  | 5    | S  |                           |
| 75 | 1270 | 25.508    | 8026.508 | -21.0 | 2.3  | 4    | S  |                           |
| 76 | 1271 | 25.531    | 8026.531 | -18.4 | 2.0  | 12   | S  |                           |
| 77 | 1277 | 27.512    | 8028.512 | +46.5 | 2.9  | 8    | S. | plate very dirty          |
| 78 | 1278 | 27.528    | 8028.528 | +31.3 | 5.5  | 4    | S  |                           |
| 79 | 1999 | Oct 2.743 | 8217.743 | +46.8 | 1.2  | 13   | S  |                           |
| 80 | 2000 | 2.758     | 8217.758 | +49.2 | 2.8  | 9    | S  |                           |
| 81 | 2001 | 2.764     | 8217.764 | +50.5 | 2.1  | 9    | S  |                           |
| 82 | 2013 | 3.719     | 8218.719 | - 9.3 | 1.2  | 14   | S  | doubling at 4471 & 4481?? |
| 83 | 2014 | 3.732     | 8218.732 | - 5.6 | 1.1  | 13   | S  | strong                    |
| 84 | 2015 | 3.736     | 8218.736 | - 7.4 | 3.2  | 11   | S  |                           |
| 85 | 2033 | 9.764     | 8224.764 | -39.8 | 4.1  | 3    | S  |                           |
| 86 | 2034 | 9.779     | 8224.779 | -39.3 | 1.3  | 8    | S  |                           |
| 87 | 2039 | 11.851    | 8226.851 | +36.5 | 1.7  | 11   | S  |                           |
| 88 | 2040 | 11.866    | 8226.866 | +28.5 | 1.3  | 10   | S  |                           |

|     |      |           |          |       |      |    |   |
|-----|------|-----------|----------|-------|------|----|---|
| 89  | 2041 | 11.882    | 8226.882 | +31.5 | ±1.3 | 13 | S |
| 90  | 2045 | 12.711    | 8227.711 | -37.4 | 1.2  | 13 | S |
| 91  | 2046 | 12.734    | 8227.734 | -32.1 | 1.3  | 15 | S |
| 92  | 2047 | 12.743    | 8227.743 | -40.2 | 1.0  | 12 | S |
| 93  | 2057 | 13.718    | 8228.718 | +15.4 | 1.6  | 13 | S |
| 94  | 2058 | 13.730    | 8228.730 | +20.9 | 1.3  | 11 | S |
| 95  | 2059 | 13.741    | 8228.741 | +24.7 | 1.7  | 13 | S |
| 96  | 2106 | 28.711    | 8243.711 | +45.7 | 1.2  | 14 | S |
| 97  | 2113 | Nov 1.679 | 8247.679 | -27.6 | 2.1  | 10 | S |
| 98  | 2114 | 1.701     | 8247.701 | -36.4 | 1.5  | 14 | S |
| 99  | 2115 | 1.716     | 8247.716 | -36.6 | 2.0  | 12 | S |
| 100 | 2122 | 2.725     | 8248.725 | +20.4 | 2.3  | 10 | S |
| 101 | 2123 | 2.738     | 8248.738 | +14.9 | 1.2  | 11 | S |
| 102 | 2124 | 2.751     | 8248.751 | +20.9 | 1.8  | 15 | S |
| 103 | 2133 | 4.763     | 8250.763 | -38.5 | 3.3  | 11 | S |
| 104 | 2134 | 4.782     | 8250.782 | -40.7 | 4.0  | 7  | S |
| 105 | 2135 | 4.799     | 8250.799 | -30.6 | 2.3  | 6  | S |
| 106 | 2138 | 5.626     | 8251.626 | +14.5 | 1.2  | 9  | S |
| 107 | 2139 | 5.646     | 8251.646 | +17.2 | 1.1  | 12 | S |
| 108 | 2140 | 5.662     | 8251.662 | +24.7 | 1.2  | 12 | S |
| 109 | 2146 | 8.747     | 8254.747 | +34.8 | 0.8  | 10 | S |
| 110 | 2147 | 8.780     | 8254.780 | +43.8 | 1.3  | 14 | S |
| 111 | 2148 | 8.794     | 8254.794 | +40.3 | 2.6  | 13 | S |

mean of 2; weak

weak

comparison weak

|     |      |        |          |       |      |      |   |
|-----|------|--------|----------|-------|------|------|---|
| 112 | 2155 | 9.656  | 8255.656 | +23.6 | +1.6 | 16   | S |
| 113 | 2156 | 9.672  | 8255.672 | +26.0 | 2.0  | 17   | S |
| 114 | 2157 | 9.685  | 8255.685 | +27.0 | 2.5  | 16   | S |
| 115 | 2166 | 12.622 | 8258.622 | +20.1 | 3.0  | 14   | S |
| 116 | 2167 | 12.646 | 8258.646 | +14.1 | 2.2  | 15   | S |
| 117 | 2168 | 12.666 | 8258.666 | + 2.4 | 2.1  | 10   | S |
| 118 | 2176 | 13.646 | 8259.646 | -30.6 | 2.0  | 15   | S |
| 119 | 2177 | 13.662 | 8259.662 | -32.0 | 1.2  | 16   | S |
| 120 | 2178 | 13.675 | 8259.675 | -28.9 | 1.0  | 13.5 | S |
| 121 | 2180 | 15.586 | 8261.586 | -13.6 | 1.9  | 12   | S |
| 122 | 2181 | 15.622 | 8261.622 | -16.2 | 1.2  | 15   | S |
| 123 | 2189 | 16.792 | 8262.792 | -18.9 | 2.1  | 11   | S |
| 124 | 2142 | 18.738 | 8264.738 | -24.0 | 1.7  | 14   | S |
| 125 | 2194 | 18.775 | 8264.775 | -25.8 | 1.9  | 9    | S |
| 126 | 2201 | 20.617 | 8266.617 | +52.5 | 1.4  | 14   | S |
| 127 | 2202 | 20.626 | 8266.626 | +55.1 | 1.8  | 23   | S |
| 128 | 2203 | 20.635 | 8266.635 | +52.0 | 1.6  | 14   | S |
| 129 | 2212 | 25.569 | 8271.569 | + 8.6 | 1.6  | 13   | S |
| 130 | 2213 | 25.593 | 8271.593 | +11.5 | 1.3  | 11   | S |
| 131 | 2214 | 25.611 | 8271.611 | +11.2 | 2.3  | 11   | S |
| 132 | 2217 | 26.561 | 8272.561 | +46.2 | 2.3  | 14   | S |
| 133 | 2218 | 26.583 | 8272.583 | +45.5 | 1.0  | 11   | S |
| 134 | 2219 | 26.601 | 8272.601 | +44.6 | 1.3  | 11   | S |

mean of 2

comparison weak

|     |      |                 |          |       |      |    |     |                 |
|-----|------|-----------------|----------|-------|------|----|-----|-----------------|
| 135 | 2256 | Dec 27.519      | 8303.519 | +35.6 | ±2.7 | 12 | S   |                 |
| 136 | 2257 | 27.538          | 8303.538 | +32.5 | 0.9  | 16 | S   |                 |
| 137 | 2258 | 27.552          | 8303.552 | +35.8 | 1.0  | 16 | S   |                 |
| 138 | 2272 | 30.644          | 8306.644 | +44.7 | 1.8  | 14 | S   | comparison weak |
| 139 | 2273 | 30.661          | 8306.661 | +42.8 | 1.8  | 13 | S   |                 |
| 140 | 2274 | 30.674          | 8306.674 | +43.6 | 1.5  | 15 | S   |                 |
| 141 | 2296 | 1909 Jan 18.543 | 8325.543 | -40.8 | 2.9  | 8  | S   |                 |
| 142 | 2297 | 18.563          | 8325.563 | -44.9 | 2.9  | 10 | S   |                 |
| 143 | 2312 | Feb 6.549       | 8344.549 | +14.0 | 2.8  | 14 | S   |                 |
| 144 | 2343 | 6.558           | 8344.558 | +12.7 | 2.2  | 12 | S   |                 |
| 145 | 2362 | 18.554          | 8356.554 | -25.9 | 0.3  | 3  | S   |                 |
| 146 | 2373 | 22.499          | 8360.499 | - 7.4 | 3.0  | 6  | S   |                 |
| 147 | 2374 | 22.514          | 8360.514 | - 0.7 | 2.6  | 11 | S   |                 |
| 148 | 2408 | Mar 17.534      | 8383.534 | - 1.0 | 2.7  | 8  | S   |                 |
| 149 | 2892 | Sep 1.881       | 8551.881 | -51.5 | 1.9  | 14 | S,T | mean of 2       |
| 150 | 2893 | 1.891           | 8551.891 | -49.3 | 1.9  | 14 | S   |                 |
| 151 | 2915 | 7.840           | 8557.840 | -45.7 | 2.2  | 13 | S,T | mean of 2       |
| 152 | 2916 | 7.854           | 8557.854 | -48.1 | 2.8  | 15 | S,T | mean of 2       |
| 153 | 2933 | 10.845          | 8560.845 | -35.1 | 2.4  | 13 | S,T | mean of 2       |
| 154 | 2934 | 10.865          | 8560.865 | -35.2 | 1.8  | 12 | S,T | mean of 2       |
| 155 | 2945 | 11.831          | 8561.831 | +38.9 | 3.6  | 14 | S,T |                 |
| 156 | 2946 | 11.851          | 8561.851 | +42.0 | 1.4  | 15 | S,T | mean of 2       |
| 157 | 2954 | 13.808          | 8563.808 | -27.9 | 2.3  | 18 | S,T | mean of 2       |

|     |      |           |          |       |     |    |     |           |
|-----|------|-----------|----------|-------|-----|----|-----|-----------|
| 158 | 2955 | 13.826    | 8563.826 | -24.3 | 2.8 | 14 | S,T | Mean of 2 |
| 159 | 3050 | Oct 4.719 | 8584.719 | +37.6 | 1.9 | 18 | S,T | mean of 2 |
| 160 | 3061 | 5.740     | 8585.740 | -24.4 | 1.3 | 8  | S,T | mean of 2 |
| 161 | 3084 | 7.773     | 8587.773 | +34.1 | 1.0 | 5  | S   |           |
| 162 | 3093 | 8.700     | 8588.700 | -20.4 | 4.9 | 7  | T   |           |
| 163 | 3104 | 9.736     | 8589.736 | -10.0 | 2.7 | 13 | S,T | mean of 2 |
| 164 | 3115 | 12.7      | 8592.731 | + 2.2 | 3.5 | 12 | S,T | mean of 2 |
| 165 | 3129 | 18.751    | 8598.751 | +28.5 | 2.7 | 12 | S,T | mean of 2 |
| 166 | 3139 | 19.697    | 8599.697 | +16.7 | 2.6 | 15 | S,T | mean of 2 |
| 167 | 3148 | 30.806    | 8610.806 | +41.2 | 3.2 | 13 | S,T | mean of 2 |
| 168 | 3154 | 31.689    | 8611.689 | -41.2 | 3.0 | 8  | S   |           |
| 169 | 3165 | Nov 2.682 | 8613.682 | +36.6 | 2.2 | 6  | S   |           |
| 170 | 3174 | 3.747     | 8614.747 | -44.4 | 1.5 | 7  | S   |           |
| 171 | 3187 | 4.792     | 8615.792 | + 6.3 | 1.8 | 10 | S   |           |
| 172 | 3196 | 6.703     | 8617.703 | -47.3 | 3.5 | 9  | S,T | mean of 2 |
| 173 | 3206 | 10.706    | 8621.706 | +18.6 | 1.7 | 12 | S,T | mean of 2 |
| 174 | 3215 | 11.744    | 8622.744 | +22.0 | 1.6 | 4  | S,T | mean of 2 |
| 175 | 3230 | 14.683    | 8625.683 | -10.6 | 1.3 | 4  | S,T | mean of 2 |
| 176 | 3246 | 23.610    | 8634.610 | -23.5 | 1.8 | 13 | S,T | mean of 2 |
| 177 | 3256 | 24.588    | 8635.588 | -13.8 | 2.4 | 11 | S,T | mean of 2 |
| 178 | 3262 | 25.676    | 8636.676 | +38.0 | 1.8 | 12 | S,T | mean of 2 |
| 179 | 3278 | 29.685    | 8640.685 | -38.0 | 3.0 | 11 | S,T | mean of 2 |
| 180 | 3284 | 30.623    | 8641.623 | +20.0 | 2.8 | 13 | S,T | mean of 2 |

|     |      |          |        |          |       |      |    |     |                  |
|-----|------|----------|--------|----------|-------|------|----|-----|------------------|
| 181 | 3292 | Dec      | 1.588  | 8642.588 | +24.0 | +2.2 | 12 | S,T | mean of 2        |
| 182 | 3309 |          | 2.574  | 8643.574 | -15.1 | 1.9  | 15 | S,T | mean of 2        |
| 183 | 3319 |          | 19.594 | 8660.594 | -44.1 | 4.0  | 7  | S,T | mean of 2        |
| 184 | 3320 |          | 19.606 | 8660.606 | -41.2 | 2.4  | 10 | S,T | mean of 2        |
| 185 | 3330 |          | 20.618 | 8661.618 | +12.8 | 3.1  | 9  | S,T | mean of 2        |
| 186 | 3346 | 1910 Jan | 10.576 | 8682.576 | +42.5 | 2.5  | 14 | S,T | mean of 2        |
| 187 | 3347 |          | 10.588 | 8682.588 | +43.7 | 3.6  | 14 | S,T | mean of 2        |
| 188 | 3352 |          | 15.509 | 8687.509 | +20.2 | 4.6  | 5  | S,T | mean of 2        |
| 189 | 3360 |          | 16.537 | 8688.537 | +26.8 | 3.5  | 10 | S,T | mean of 2        |
| 190 | 3361 |          | 16.560 | 8688.560 | +12.5 | 1.5  | 12 | S,T | mean of 2        |
| 191 | 3387 | Feb      | 4.518  | 8707.518 | +15.6 | 3.4  | 12 | S,T | mean of 2        |
| 192 | 3399 |          | 10.501 | 8713.501 | +37.1 | 3.8  | 13 | S,T | mean of 2        |
| 193 | 3410 |          | 18.522 | 8721.522 | - 8.2 | 5.8  | 8  | S,T | mean of 2        |
| 194 | 3412 |          | 19.621 | 8722.621 | +47.0 | 2.2  | 5  | S,T | mean of 2 - poor |
| 195 | 3997 | Oct      | 30.717 | 8975.717 | -12.2 | 2.8  | 14 | S,T | mean of 2        |
| 196 | 4008 |          | 31.751 | 8976.751 | -12.2 | 2.3  | 5  | S   |                  |
| 197 | 4014 | Nov      | 4.808  | 8980.808 | +45.4 | 2.1  | 4  | S   |                  |
| 198 | 4032 |          | 19.729 | 8995.729 | -14.6 | 3.4  | 9  | S   |                  |
| 199 | 4050 |          | 23.724 | 8999.724 | -11.4 | 2.7  | 9  | S   |                  |
| 200 | 4056 |          | 26.677 | 9002.677 | - 6.0 | 3.2  | 7  | S   |                  |
| 201 | 4072 | Dec      | 8.753  | 9014.753 | +40.7 | 2.1  | 7  | S   |                  |
| 202 | 4074 |          | 12.693 | 9018.693 | -19.5 | 2.4  | 8  | S   |                  |
| 203 | 4082 |          | 13.679 | 9019.679 | -23.3 | 1.2  | 9  | S   |                  |

|     |      |                 |          |       |      |    |   |
|-----|------|-----------------|----------|-------|------|----|---|
| 204 | 4090 | 14.695          | 9020.695 | +37.0 | +2.2 | 15 | S |
| 205 | 4094 | 15.627          | 9021.627 | -27.3 | 1.9  | 12 | S |
| 206 | 4097 | 16.670          | 9022.670 | -21.3 | 1.1  | 9  | S |
| 207 | 4408 | 17.645          | 9023.645 | +33.0 | 1.2  | 9  | S |
| 208 | 4117 | 21.698          | 9027.698 | -42.3 | 1.9  | 8  | S |
| 209 | 4426 | 27.558          | 9033.558 | -48.2 | 2.3  | 12 | S |
| 210 | 4427 | 30.610          | 9036.610 | -45.8 | 5.8  | 7  | S |
| 211 | 4472 | 1911 Feb 23.518 | 9091.518 | -13.8 | 0.9  | 10 | S |
| 212 | 4492 | 27.494          | 9095.494 | +21.0 | 1.9  | 13 | S |
| 213 | 4203 | 28.542          | 9096.542 | -55.0 | 5.5  | 7  | S |
| 214 | 4209 | Mar 1.515       | 9097.515 | +11.7 | 1.8  | 9  | S |
| 215 | 4211 | 4.528           | 9100.528 | +16.4 | 1.7  | 8  | S |
| 216 | 4782 | Sep 12.796      | 9292.796 | +39.1 | 1.8  | 12 | S |
| 217 | 4791 | 13.846          | 9293.846 | -26.6 | 2.9  | 15 | S |
| 218 | 4796 | 17.833          | 9297.833 | -20.5 | 1.9  | 8  | S |
| 219 | 4807 | 19.826          | 9299.826 | -32.4 | 2.3  | 13 | S |
| 220 | 4812 | 20.822          | 9300.822 | -14.3 | 1.4  | 6  | S |
| 221 | 4829 | 26.822          | 9306.822 | +16.1 | 1.3  | 10 | S |
| 222 | 4839 | Oct 2.857       | 9312.857 | +34.3 | 1.9  | 9  | S |
| 223 | 4848 | 8.797           | 9318.797 | +40.6 | 2.4  | 10 | S |
| 224 | 4861 | 15.817          | 9325.817 | -42.0 | 1.8  | 9  | S |
| 225 | 4871 | 18.803          | 9328.803 | -44.0 | 2.4  | 10 | S |
| 226 | 4877 | 19.795          | 9329.795 | +24.2 | 1.8  | 9  | S |

Mean of 2

overexposed

underexposed

comparison weak  
on one side

strong

dust line  
across star

|     |      |                 |          |       |           |    |   |
|-----|------|-----------------|----------|-------|-----------|----|---|
| 227 | 4891 | 25.788          | 9335.788 | +36.3 | $\pm 3.2$ | 7  | S |
| 228 | 4898 | 26.779          | 9336.779 | - 7.3 | 1.1       | 6  | S |
| 229 | 5030 | 1912 Jan 27.588 | 9429.588 | -31.1 | 1.1       | 6  | S |
| 230 | 5035 | 31.567          | 9433.567 | +50.4 | 0.7       | 10 | S |
| 231 | 5038 | Feb 2.636       | 9435.636 | - 6.3 | 3.4       | 8  | S |
| 232 | 5043 | 5.590           | 9438.590 | +13.5 | 2.0       | 10 | S |
| 233 | 5051 | 9.617           | 9442.617 | +35.1 | 1.0       | 7  | S |
| 234 | 5053 | 10.543          | 9443.543 | -41.8 | 2.1       | 11 | S |
| 235 | 5057 | 12.569          | 9445.569 | +29.0 | 1.8       | 10 | S |
| 236 | 5061 | 13.482          | 9446.482 | -39.2 | 1.8       | 6  | S |
| 237 | 5067 | 14.581          | 9447.581 | +43.3 | 1.9       | 11 | S |
| 238 | 5073 | 15.572          | 9448.572 | + 8.6 | 3.6       | 9  | S |
| 239 | 5081 | 17.474          | 9450.474 | +46.6 | 3.1       | 13 | S |
| 240 | 5090 | 23.500          | 9456.500 | +47.6 | 2.4       | 12 | S |
| 241 | 5106 | Mar 13.530      | 9475.530 | -21.8 | 1.5       | 11 | S |
| 242 | 5112 | 16.509          | 9478.509 | -12.1 | 4.5       | 6  | S |
| 243 | 5119 | 17.543          | 9479.543 | +42.2 | 5.9       | 5  | S |
| 244 | 5123 | 18.514          | 9480.514 | -22.6 | 2.6       | 11 | S |

17 HD 23302

17 Tauri

 $\alpha = 3^h 38^m 56^s$  $\delta = +23^\circ 48'$ 

B6111

1

1067 1907 Jan 6.684

2417582.684 - 1.5

 $\pm 3.8$ 

8

T

|            |      |          |        |          |       |           |   |   |                       |
|------------|------|----------|--------|----------|-------|-----------|---|---|-----------------------|
| 2          | 3015 | 1909 Sep | 24.808 | 8574.808 | +20.2 | $\pm 3.6$ | 7 | T |                       |
| 3          | 3063 | Oct      | 5.782  | 8585.782 | +14.7 | 3.4       | 2 | T | poor plate; dust line |
| 4          | 3074 |          | 6.743  | 8586.743 | +8.2  | 6.4       | 4 | T |                       |
| Mean + 5.1 |      |          |        |          |       |           |   |   |                       |

The range observed here is consistent with the range of +33 to -4 in the published observations. This star warrants further investigation.

HD 23324      18 Tauri       $\alpha = 3^h 39^m 12^s$        $\delta = +24^\circ 32''$       B8V

|   |      |          |        |             |       |            |   |   |  |
|---|------|----------|--------|-------------|-------|------------|---|---|--|
| 1 | 1103 | 1908 Jan | 18.688 | 2417959.688 | +35.1 | $\pm 13.8$ | 1 | T |  |
|---|------|----------|--------|-------------|-------|------------|---|---|--|

HD 23338      19 Tauri       $\alpha = 3^h 39^m 15^s$        $\delta = +24^\circ 9''$       B6V

|            |      |          |        |             |         |           |   |   |                                                    |
|------------|------|----------|--------|-------------|---------|-----------|---|---|----------------------------------------------------|
| 1          | 1062 | 1908 Jan | 5.692  | 2417946.692 | +20.0   | $\pm 6.9$ | 6 | T |                                                    |
| 2          | 3065 | 1909 Oct | 5.842  | 8585.842    | -1.7    | 5.3       | 5 | T | dust line                                          |
| 3          | 3095 |          | 8.753  | 8588.753    | +0.3    | 4.5       | 6 | T |                                                    |
| 4          | 3116 |          | 12.760 | 8592.760    | (+40.1) | 4.8       | 3 | T | underexposed; two lines. spot on one of the lines. |
| Mean + 6.7 |      |          |        |             |         |           |   |   |                                                    |

HD 23630       $\eta$  Tauri       $\alpha = 3^h 41^m 32^s$        $\delta = +23^\circ 48''$       B7III

|   |      |          |        |             |       |           |   |   |           |
|---|------|----------|--------|-------------|-------|-----------|---|---|-----------|
| 1 | 1068 | 1907 Jan | 5.733  | 2147581.733 | +1.8  | $\pm 2.0$ | 2 | T |           |
| 2 | 2965 | 1909 Sep | 14.849 | 8564.849    | +20.5 | 4.5       | 3 | T | weak      |
| 3 | 2966 |          | 14.859 | 8564.859    | +40.8 | 4.7       | 2 | T | very weak |
| 4 | 2973 |          | 16.811 | 8566.811    | -2.1  | 4.0       | 8 | T | mean of 3 |

|    |      |            |          |       |           |     |   |                           |
|----|------|------------|----------|-------|-----------|-----|---|---------------------------|
| 5  | 3014 | 24.788     | 8574.788 | + 7.2 | $\pm 4.3$ | 5   | T | mean of 2<br>very weak    |
| 6  | 3024 | 26.780     | 8576.780 | +25.2 | 2.5       | 4   | T |                           |
| 7  | 3042 | Oct 2.768  | 8582.768 | +10.7 | 3.1       | 8.5 | T |                           |
| 8  | 3053 | 4.817      | 8584.817 | - 3.4 | 8.9       | 4   | T | dust line                 |
| 9  | 3062 | 5.760      | 8585.760 | - 3.4 | 0.3       | 2   | T |                           |
| 10 | 3073 | 6.719      | 8586.719 | + 8.1 | 4.4       | 7   | T | mean of 3<br>over exposed |
| 11 | 3085 | 7.792      | 8587.792 | + 8.3 | 4.1       | 3   | T |                           |
| 12 | 3130 | 18.781     | 8598.781 | +16.1 | 2.4       | 10  | T | mean of 2                 |
| 13 | 3140 | 19.749     | 8599.749 | + 0.7 | 4.1       | 9   | T | 2                         |
| 14 | 3241 | Nov 19.697 | 8630.697 | +8.1  | 5.0       | 3   | T |                           |

Mean + 8.7

HD 23848      42 Persei       $\alpha = 3^h 43^m 13^s$        $\delta = +32^\circ 47'$       A2V

30

|    |      |                 |             |       |           |   |   |  |
|----|------|-----------------|-------------|-------|-----------|---|---|--|
| 1  | 5523 | 1912 Oct 25.833 | 2419701.833 | -35.3 | $\pm 4.3$ | 6 | D |  |
| 2  | 5546 | Nov 3.810       | 9710.810    | -43.7 | 6.0       | 5 | D |  |
| 3  | 5554 | 9.694           | 9716.694    | +11.6 | 2.8       | 6 | D |  |
| 4  | 5557 | 12.726          | 9719.726    | + 7.6 | 1.9       | 5 | D |  |
| 5  | 5563 | 18.669          | 9725.669    | - 5.4 | 8.3       | 3 | D |  |
| 6  | 5568 | 19.667          | 9726.667    | -54.8 | 2.8       | 6 | D |  |
| 7  | 5582 | 28.649          | 9735.649    | -46.5 | 2.1       | 6 | D |  |
| 8  | 5589 | 30.617          | 9737.617    | -14.3 | 2.7       | 7 | D |  |
| 9  | 5601 | Dec 12.589      | 9749.589    | -47.9 | 1.2       | 9 | D |  |
| 10 | 5623 | 30.649          | 9767.649    | -29.8 | 3.3       | 4 | D |  |
| 11 | 5634 | 1913 Jan 21.588 | 9789.588    | + 9.4 | 2.8       | 6 | D |  |

|    |      |          |        |             |       |      |    |               |
|----|------|----------|--------|-------------|-------|------|----|---------------|
| 12 | 5645 | Feb      | 7.528  | 9806.528    | +13.1 | +2.3 | 8  | D             |
| 13 | 5694 | 1914 Dec | 15.716 | 2420482.716 | -13.8 | 3.3  | 6  | D             |
| 14 | 5690 |          | 17.712 | 0484.712    | + 6.3 |      | 2  | D 1 line only |
| 15 | 6605 | 1915 Jan | 4.676  | 0502.676    | +19.7 | 5.5  | 6  | D             |
| 16 | 6610 |          | 7.642  | 0505.642    | -11.4 | 4.6  | 6  | D             |
| 17 | 6615 |          | 15.615 | 0513.615    | - 9.7 | 2.9  | 7  | D             |
| 18 | 6619 |          | 25.638 | 0523.638    | +21.3 | 2.6  | 6  | D             |
| 19 | 6622 |          | 28.575 | 0526.575    | -34.8 | 7.6  | 7  | D             |
| 20 | 6629 | Feb      | 4.522  | 0533.522    | -21.5 | 3.4  | 5  | D             |
| 21 | 6634 |          | 17.561 | 0546.561    | +15.6 | 2.4  | 10 | D             |

The range of about +20 to -50 km/sec. observed here agrees with the range of the published observations. The star is a spectroscopic binary with a short period.

31

| HD 23850 |      | 27 Tauri |        | $\alpha = 3^h 43^m 13^s$ |       | $\delta = +23^\circ 45'$ |            | B61Vnm |           |
|----------|------|----------|--------|--------------------------|-------|--------------------------|------------|--------|-----------|
| 1        | 1066 | 1907 Jan | 6.618  | 2417582.618              | - 4.9 | +4.6                     | 4          | T      | mean of 2 |
| 2        | 2974 | 1909 Sep | 16.834 | 8566.834                 | +37.3 | 3.6                      | 5          | T      | mean of 2 |
| 3        | 2975 |          | 16.860 | 8566.860                 | +12.8 | 4.3                      | 7          | T      | mean of 2 |
| 4        | 2992 |          | 18.770 | 8568.770                 | + 6.4 | 4.1                      | 4          | T      | mean of 2 |
| 5        | 3286 | Nov      | 30.656 | 8641.656                 | +12.7 | 2.4                      | 6          | T      | mean of 2 |
| 6        | 3294 | Dec      | 1.640  | 8642.640                 | + 7.7 | 3.0                      | 4          | T      | mean of 2 |
| 7        | 3312 |          | 2.641  | 8643.641                 | - 2.0 | 1.5                      | 3          | T      |           |
| 8        | 3315 |          | 18.747 | 8659.747                 | + 0.9 | 15.9                     | 2          | T      |           |
|          |      |          |        |                          |       |                          | Mean +11.0 |        |           |

Further observations will be necessary to either confirm or reject the existence of a variation in velocity for this star.

HD 23862

28 Tauri

$\alpha = 3^h 43^m 14^s$

$\delta = +23^\circ 50'$

3

T

$\pm 12.7$

$\pm 32.3$

9.681

Jan

1072 1908

1

Based on 2 lines one of which is fair only ( $H_\delta - 41$ : wt. 2,  $H_\gamma - 19$ , wt. 1).

HD 24760

$\epsilon$  Persei

$\alpha = 3^h 51^m 8^s$

$\delta = +39^\circ 43'$

4

broken plate  
mean of 2

$\pm 1.9$

$\pm 1.0$

15.760

Nov

995 1907

1

broken plate  
mean of 2

$\pm 3.0$

$\pm 13.2$

15.797

Nov

996 1907

2

broken plate  
mean of 2

$\pm 2.5$

$\pm 23.3$

16.801

Nov

1003 1907

3

broken plate  
mean of 2

$\pm 3.1$

$\pm 11.2$

16.836

Nov

1004 1907

4

broken plate  
mean of 2

$\pm 1.8$

$\pm 11.2$

6.743

Dec

1034 1907

5

broken plate  
mean of 2

$\pm 2.2$

$\pm 8.7$

23.631

Nov

3247 1909

6

broken plate  
mean of 2

$\pm 4.1$

$\pm 1.0$

24.619

Nov

3257 1909

7

broken plate  
mean of 2

$\pm 2.2$

$\pm 3.8$

25.692

Nov

3263 1909

8

broken plate  
mean of 2

$\pm 4.4$

$\pm 10.2$

26.611

Nov

3274 1909

9

broken plate  
mean of 2

$\pm 2.2$

$\pm 5.7$

29.706

Nov

3279 1909

10

broken plate  
mean of 2

$\pm 2.0$

$\pm 13.6$

30.635

Nov

3285 1909

11

broken plate  
mean of 2

$\pm 2.5$

$\pm 18.5$

1.615

Dec

3293 1909

12

broken plate  
mean of 2

$\pm 1.8$

$\pm 13.8$

2.586

Nov

3310 1909

13

broken plate  
mean of 2

$\pm 2.1$

$\pm 13.0$

19.621

Nov

3321 1909

14

broken plate  
mean of 2

$\pm 2.5$

$\pm 27.3$

20.638

Nov

3331 1909

15

A also meas. as double  
pri-40.6, sec +81.2

|    |      |                 |          |       |       |    |       |       |
|----|------|-----------------|----------|-------|-------|----|-------|-------|
| 16 | 3348 | 1910 Jan 10.609 | 8682.609 | +11.6 | * 0.9 | 11 |       | D     |
| 17 | 3355 | 15.606          | 8687.606 | - 9.4 | 3.0   | 9  | -42.5 | 1 D   |
| 18 | 3365 | 19.608          | 8691.608 | +10.5 | 2.4   | 10 |       | D     |
| 19 | 3389 | Feb 4.562       | 8707.562 | -12.0 | 3.9   | 10 | - 9.3 | 1 D   |
| 20 | 3394 | 7.569           | 8710.569 | + 0.5 | 1.8   | 10 | - 2.7 | 0.5 D |
| 21 | 3409 | 18.540          | 8721.540 | + 0.2 | 5.3   | 7  |       | D     |
| 22 | 3900 | Oct 10.815      | 8955.815 | + 7.1 | 4.8   | 7  | +34.1 | 0.5 D |
| 23 | 3919 | 12.833          | 8957.833 | -15.5 | 2.9   | 11 | + 2.5 | 0.5 D |
| 24 | 3955 | 18.819          | 8963.819 | +13.6 | 3.1   | 11 |       | D     |
| 25 | 3961 | 19.836          | 8964.836 | + 8.3 | 4.8   | 10 |       | D     |
| 26 | 3968 | 20.719          | 8965.719 | +19.0 | 4.4   | 10 | +25.6 | 1 D   |
| 27 | 3998 | 30.740          | 8975.740 | +13.2 | 3.5   | 9  |       | D     |
| 28 | 4015 | Nov 4.836       | 8980.836 | +12.3 | 1.8   | 8  | +13.0 | 1 D   |
| 29 | 4033 | 19.753          | 8995.753 | +24.2 | 4.1   | 6  | + 7.0 | 1 D   |
| 30 | 4059 | 26.750          | 9002.750 | +13.9 | 2.4   | 8  | +12.5 | 1 D   |
| 31 | 4083 | Dec 13.699      | 9019.699 | +15.5 | 3.9   | 8  | + 6.2 | 1 D   |
| 32 | 4095 | 15.644          | 9021.644 | +28.9 | 2.5   | 16 | - 9.7 | 1.5 D |
| 33 | 4098 | 15.693          | 9022.693 | +17.5 | 2.7   | 11 | + 9.8 | 1 D   |
| 34 | 4109 | 17.665          | 9023.665 | - 1.0 | 2.6   | 11 | - 9.6 | 1 D   |
| 35 | 4118 | 21.723          | 9027.723 | - 2.0 | 1.8   | 11 |       | D     |
| 36 | 4128 | 30.638          | 9036.638 | + 1.7 | 4.1   | 8  | +13.6 | 1 D   |
| 37 | 4146 | 1911 Jan 23.590 | 9060.590 | + 8.3 | 2.7   | 10 | +47.3 | 0.5 D |
| 38 | 4152 | 24.496          | 9061.496 | + 9.4 | 2.9   | 10 | - 1.7 | 0.5 D |

mean of 2

|    |      |                 |          |       |       |    |       |     |   |
|----|------|-----------------|----------|-------|-------|----|-------|-----|---|
| 39 | 4156 | 24.685          | 9061.685 | +23.0 | ± 2.0 | 12 |       |     | D |
| 40 | 4160 | 28.497          | 9065.497 | + 3.3 | 3.5   | 11 | -17.7 | 0.5 | D |
| 41 | 4162 | 30.486          | 9067.486 | - 5.1 | 3.9   | 11 | -25.1 | 0.5 | D |
| 42 | 4165 | Feb 1.667       | 9069.667 | -17.8 | 4.5   | 3  | +10.2 | 0.5 | D |
| 43 | 4166 | 9.481           | 9077.481 | + 6.8 | 1.9   | 11 | + 5.2 | 1   | D |
| 44 | 4173 | 23.542          | 9091.542 | +14.4 | 1.7   | 7  | +10.2 | 0.5 | D |
| 45 | 4181 | 24.539          | 9092.539 | +17.7 | 2.9   | 9  | - 3.8 | 1   | D |
| 46 | 4193 | 27.517          | 9095.517 | -15.5 | 5.1   | 8  | - 7.8 | 1   | D |
| 47 | 4204 | 28.564          | 9096.564 | - 6.6 | 3.3   | 10 | -28.8 | 0.5 | D |
| 48 | 4210 | Mar 1.537       | 9097.537 | -19.4 | 4.0   | 11 |       |     | D |
| 49 | 4212 | 4.552           | 9100.552 | + 1.5 | 3.9   | 10 |       |     | D |
| 50 | 4218 | 6.496           | 9102.496 | + 3.8 | 1.7   | 13 | - 0.3 | 1   | D |
| 51 | 4227 | 10.494          | 9106.494 | +11.3 | 3.2   | 10 | + 3.1 | 1   | D |
| 52 | 4236 | 13.499          | 9109.499 | -14.7 | 1.6   | 13 | + 0.5 | 0.5 | D |
| 53 | 4258 | 21.519          | 9117.519 | + 9.9 | 2.9   | 10 | + 0.9 | 1   | D |
| 54 | 4892 | 1911 Oct 25.812 | 9335.812 | - 6.8 | 2.6   | 13 | - 0.4 | 1   | D |
| 55 | 4899 | 26.808          | 9336.808 | + 3.6 | 1.9   | 11 |       |     | D |
| 56 | 4913 | 29.730          | 9339.730 | + 5.1 | 11.7  | 12 |       |     | D |
| 57 | 4933 | Nov 10.809      | 9351.809 | -11.3 | 1.8   | 13 |       |     | D |
| 58 | 4944 | 16.724          | 9357.724 | +16.0 | 2.9   | 9  |       |     | D |
| 59 | 4964 | 26.816          | 9367.819 | + 2.4 | 3.0   | 11 | +25.4 | 1   | D |
| 60 | 4975 | Dec 5.780       | 9376.780 | -15.2 | 2.6   | 12 |       |     | D |
| 61 | 4980 | 6.681           | 9377.681 | -15.6 | 2.4   | 12 | -13.2 | 1   | D |

|    |      |                |            |       |       |    |                 |     |   |
|----|------|----------------|------------|-------|-------|----|-----------------|-----|---|
| 62 | 4990 | 13.722         | 9384.722   | - 2.6 | ± 1.8 | 13 |                 |     | D |
| 63 | 4994 | 19.704         | 9390.704   | -12.1 | 2.8   | 14 | +23.4           | 0.5 |   |
| 64 | 5001 | 28.673         | 9399.673   | + 7.6 | 1.8   | 12 |                 |     | D |
| 65 | 5008 | 31.637         | 9402.637   | +30.0 | 3.0   | 11 | -18.7           | 1   | D |
| 66 | 5017 | 1912 Jan 7.628 | 9409.628   | + 6.1 | 2.0   | 11 | - 8.5           | 1   | D |
|    |      |                | Mean + 3.3 |       |       |    | Mean I.S. + 2.2 |     |   |

Despite the quantity of material here presented, it is still difficult to make any definitive statement as to the nature of this star. Frost and Adams (Ap. J. 19, 152, 1904) note that there are differences in the appearance of the same lines on different plates which has been attributed to line doubling by others. These differences in appearance of certain lines is apparent on a number of Allegheny plates. A notable example is  $\lambda 4026$ . On plate 3321 the appearance is asymmetric with the profile stopping gradually on the violet side and rising abruptly on the red side. On plate 3389, the profile shows a pronounced core on the violet side with no abrupt rise on the red side. The work of Henroteau indicates that the star may have a rapid velocity fluctuation. More investigation in this direction is needed.

5 52 57 HD 25204  $\lambda$  Tauri  $\alpha = 3^h 55^m 8^s$   $\delta = +12^\circ 12'$  B3V

Ebbighausen and Struve (Ap. J. 124, 507, 1956) have remeasured all the Allegheny plates of this star using modern wavelengths. A total of 133 radial velocities are given including 7 plates previously unpublished.

6 HD 27309 56 Tauri  $\alpha = 4^h 13^m 41^s$   $\delta = +21^\circ 32'$  Asf

|   |      |                 |             |       |       |    |   |
|---|------|-----------------|-------------|-------|-------|----|---|
| 1 | 2207 | 1908 Nov 20.794 | 2418266.794 | +10.0 | ± 1.5 | 13 | J |
| 2 | 2407 | 1909 Mar 15.545 | 8381.545    | + 1.9 | 1.7   | 15 | J |
|   |      |                 | Mean + 5.7  |       |       |    |   |

Four plates were grouped in the plate file under the heading 51 Tau. The Keeler Reflector did not have a

large field finder in those days and some confusion evidently resulted between 51 Tau and the near by star 56 Tau. Inspection of the plates revealed that the two listed above were actually the Asi star 56 Tau. These had been measured and published by Jordan under the heading of "51 Tau" (Publ. A.O. 1, 113, 1909 - note error in plate number). They are republished here as a correction and revision.

27 HD 27176 51 Tauri  $\alpha = 4^h 12^m 28^s$   $\delta = +21^\circ 20'$  dA8 not measured

1 2220 1908 Nov 26.639 2418272.639  
2 2409 1909 Mar 20.542 8386.542 +33.0  $\pm$  4.6 9 J

See discussion for 56 Tauri.

28 HD 30614  $\alpha$  Camelopardi  $\alpha = 4^h 44^m 6^s$   $\delta = +66^\circ 10'$  09.51a

|    |      |                 |             |                 |     |   |                                        |
|----|------|-----------------|-------------|-----------------|-----|---|----------------------------------------|
| 1  | 3332 | 1909 Dec 20.677 | 2418661.677 | + 6.0 $\pm$ 1.9 | 8   | J | mean of 2 comp. weak                   |
| 2  | 3356 | 1910 Jan 15.639 | 8687.639    | +21.8           | 3.0 | 4 | J                                      |
| 3  | 3970 | Oct 20.766      | 8965.766    | +23.9           | 6.2 | 3 | J Lumiere $\Sigma$                     |
| 4  | 4000 | 30.803          | 8975.803    | +14.0           | 2.6 | 5 | J                                      |
| 5  | 4061 | Nov 26.788      | 9002.788    | +23.6           | 3.5 | 6 | J                                      |
| 6  | 4091 | Dec 14.726      | 9020.726    | - 7.3           | 2.9 | 5 | J                                      |
| 7  | 4110 | 17.692          | 9023.692    | +25.2           | 7.4 | 6 | J                                      |
| 8  | 4129 | 30.669          | 9036.669    | - 1.9           | 2.4 | 7 | J comp. weak                           |
| 9  | 4137 | 1911 Jan 5.590  | 9042.590    | +28.4           | 1.0 | 4 | J                                      |
| 10 | 4141 | 9.651           | 9046.651    | +12.9           | 5.6 | 6 | J                                      |
| 11 | 4147 | 23.623          | 9060.623    | - 0.3           | 4.0 | 6 | J overexposed seed 23                  |
| 12 | 4155 | 24.653          | 9061.653    | +10.4           | 2.1 | 6 | J seed 23                              |
| 13 | 4161 | 28.648          | 9065.648    | +11.8           | 2   | J | J 1 line only, spectrum and comp. weak |

|    |      |            |          |       |                 |   |       |   |           |
|----|------|------------|----------|-------|-----------------|---|-------|---|-----------|
| 14 | 4205 | Feb 28.596 | 9096.596 | - 1.1 | 7.5             | 5 | - 2.4 | 6 | J         |
| 15 | 4908 | Oct 28.790 | 9338.790 | +10.8 | 2.2             | 9 | - 6.1 | 5 | J seed 23 |
| 16 | 4914 | 29.766     | 9339.765 | +14.4 | 2.5             | 9 | - 5.9 | 6 | J seed 23 |
|    |      |            | Mean     | +11.2 |                 |   |       |   |           |
|    |      |            |          |       | Mean I.S. - 5.3 |   |       |   |           |

appears to be due to pulsation. These velocities fit Plaskett's pulsation curve reasonably well with phases computed from  $P = 21.90$  and  $T_0 = \text{JD} 2417961.000$ .

HD 35411       $\alpha = 5^h 19^m 27^s$        $\delta = -02^\circ 29'$       B0.5V

$\psi$  Orionis

A total of 44 radial velocities are available from the epochs 1908-09 and 1914-15. The presence of a third body in the system was noted by Beal (P.A.S. 3 117, 1915) from the 1914-15 series. These 44 velocities will be published separately as part of a more extended analysis using recent Allegheny Observatory velocities as well as astrometric residuals.

| HD 35715 |      | $\psi$ Orionis  |             | $\alpha = 5^h 21^m 36^s$ |      | $\delta = +3^\circ 1'$ |                  | B21V  |                             |
|----------|------|-----------------|-------------|--------------------------|------|------------------------|------------------|-------|-----------------------------|
| 1        | 2264 | 1908 Dec 27.714 | 2418303.714 | +119.0                   | +3.3 | 14                     | -164.0 $\pm 7.0$ | 7     | J                           |
| 2        | 3080 | 1909 Oct 6.876  | 8586.876    | +145.4                   | 2.7  | 13                     | -178.5 9.5       | +13.2 | 9 J                         |
| 3        | 3149 | 30.844          | 8610.844    | -119.3                   | 2.8  | 7                      |                  | - 1.6 | J                           |
| 4        | 3200 | Nov 6.810       | 8617.810    | + 52.0                   | 4.2  | 7                      |                  | +14.8 | J spectrum weak             |
| 5        | 3218 | 11.842          | 8622.842    | + 64.7                   | 2.7  | 11                     |                  | - 6.3 | J                           |
| 6        | 3225 | 13.850          | 8624.850    | +166.8                   | 4.1  | 4                      | -179.2 8.6       |       | J spectrum weak mean of 2   |
| 7        | 3232 | 14.764          | 8625.764    | - 78.2                   | 3.9  | 8                      | +137.6           | +24.1 | 1 J sec. 1 line only        |
| 8        | 3249 | 23.759          | 8634.759    | +132.2                   | 4.4  | 9                      | -170.9 20.5      | +27.0 | 3 J spectrum weak mean of 2 |
| 9        | 4075 | 12.747          | 9018.747    | +145.6                   | 3.2  | 10                     | -190.3 8.7       | -11.8 | 4 J                         |
| 10       | 4092 | 14.754          | 9020.754    | + 10.9                   | 4.2  | 11                     |                  |       | J comp. weak                |
| 11       | 4130 | 30.717          | 9036.717    | +135.9                   | 4.4  | 9                      | -211.1 12.8      | +43.4 | 5 J                         |
| 12       | 4174 | 1911 Feb 23.581 | 9091.581    | + 17.3                   | 3.1  | 12                     |                  | +23.0 | J                           |
| 13       | 4195 | 27.577          | 9095.577    | - 39.8                   | 4.4  | 8                      |                  | - 4.5 | J                           |
| 14       | 4915 | Oct 29.812      | 9339.812    | +156.7                   | 3.7  | 10                     | -182.9 3.2       | +23.1 | 5 J                         |

|    |      |                 |             |        |      |    |        |      |       |    |                 |
|----|------|-----------------|-------------|--------|------|----|--------|------|-------|----|-----------------|
| 15 | 4982 | Dec 6.743       | 9377.743    | +156.6 | +3.5 | 15 | -232.4 | +8.3 | +18.4 | 6' | J               |
| 16 | 4991 | 13.767          | 9384.767    | + 87.3 | 4.6  | 8  |        |      | +36.3 |    | J               |
| 17 | 4995 | 19.746          | 9390.746    | + 44.9 | 3.9  | 10 |        |      | +29.9 |    | J               |
| 18 | 5022 | 1912 Jan 13.635 | 9415.635    | +130.1 | 5.8  | 9  | -207.3 | 15.0 | +32.4 | 2  | J               |
| 19 | 5025 | 16.600          | 9418.600    | + 29.7 | 3.5  | 13 |        |      | -12.7 |    | J               |
| 20 | 5045 | Feb 8.526       | 9441.526    | - 12.8 | 3.3  | 12 |        |      | -32.3 |    | J               |
| 21 | 5054 | 10.580          | 9443.580    | +124.3 | 4.3  | 11 | -158.0 | 5.6  | +56.0 | 8  | J               |
| 22 | 5083 | 17.612          | 9450.612    | +129.6 | 4.8  | 13 | -205.8 | 8.0  | +17.4 | 4  | J               |
| 23 | 5591 | Nov 30.700      | 9737.700    | -130.1 | 2.8  | 10 | +290.6 |      | -13.9 | 1  | J               |
| 24 | 5603 | Dec 12.680      | 9749.680    | - 2.6  | 2.7  | 11 |        |      | -11.8 |    | J               |
| 25 | 5612 | 22.744          | 9759.744    | + 9.9  | 1.7  | 14 |        |      | - 8.0 |    | J               |
| 26 | 5621 | 28.652          | 9765.652    | - 94.1 | 3.2  | 14 | +179.8 |      | -12.2 | 1  | J               |
| 27 | 6065 | 1913 Nov 2.772  | 2420074.772 | +167.0 | 4.3  | 8  | -215.5 |      | +14.5 | 2  | J               |
| 28 | 6084 | 14.755          | 0086.755    | + 5.0  | 6.9  | 9  |        |      |       |    | J spectrum weak |
| 29 | 6096 | 20.839          | 0092.839    | +103.8 | 4.5  | 12 | -145.1 | 6.3  |       | 5  | J               |
| 30 | 6129 | Dec 12.795      | 0114.795    | +109.4 | 5.5  | 10 |        |      |       |    | J               |
| 31 | 6159 | 1914 Jan 13.680 | 0146.680    | -104.8 | 5.5  | 9  |        |      |       |    | J               |
| 32 | 6168 | Feb 1.593       | 0165.593    | +154.7 | 4.3  | 14 | -207.8 | 4.7  |       | 8  | J comp. weak    |
| 33 | 6172 | 2.664           | 0166.664    | - 86.0 | 2.5  | 9  | +161.8 |      |       | 1  | J spectrum weak |
| 34 | 6552 | Oct 30.811      | 0436.811    | - 27.0 | 3.1  | 16 |        |      | -31.4 |    | J               |
| 35 | 6575 | Nov 17.721      | 0454.721    | - 98.7 | 8.5  | 9  | +260.9 |      |       | 1  | J spectrum weak |

This system is described by Batten (Publ. D A O 13, 196, 1967, No. 173) as having a possible rotation of the line of apsides with a period of 40 or 50 years. A third body is suspected by the authors and observations are

being continued.

13 HD 36695 VV Orionis  $\alpha = 5^h 28^m 27^s$   $\delta = -10^\circ 14'$  B1V

A total of 17 observations exist for the 1915-16 epoch and for which velocities have been derived. These velocities will be published elsewhere in conjunction with a more extensive analysis employing recent velocities also determined at Allegheny. Daniel (Publ. A. C. 3, 179, 1915) and Struve and Luyten (Ap. J. 110, 160, 1949) suspected the presence of a third body. Observations are being continued.

| 4 | HD 37043 | Orionis         | $\alpha = 5^h 30^m 32^s$ | $\delta = -5^\circ 59'$ | 09III   |           |                                |
|---|----------|-----------------|--------------------------|-------------------------|---------|-----------|--------------------------------|
| 1 | 968      | 1907 Nov 11.829 | 2417891.829              | +25.1                   | +2.1 11 | +21.7 1.5 | J                              |
| 2 | 997      | 15.826          | 7895.826                 | +36.8                   | 3.3 6   | +39.9 1   | J                              |
| 3 | 998      | 15.873          | 7895.873                 | +30.6                   | 4.8 7   | +18.2 2   | J                              |
| 4 | 3339     | 1910 Jan 9.684  | 8681.684                 | +27.0                   | 11.5 10 | +20.5 3   | J                              |
| 5 | 3350     | 10.672          | 8682.672                 | +47.9                   | 1.7 12  | +24.2 2   | J                              |
| 6 | 3367     | 19.659          | 8691.659                 | +76.2                   | 4.9 7   | +22.2 6   | J                              |
| 7 | 3413     | Feb 19.568      | 8722.568                 | +136.4                  | 2       | +55.4 0.5 | J 1 line only<br>spectrum weak |
| 8 | 3415     | 24.583          | 8727.583                 | -60.7                   | 3.7 7   | +31.5 2   | J                              |
| 9 | 3466     | Mar 25.522      | 8756.522                 | -59.5                   | 4.7 8   | +28.0 2   | J                              |

These velocities show a reasonable fit to the orbital curve of Plaskett and Harper (Ap. J. 27, 276, 1908).

5 HD 37438 125 Tauri  $\alpha = 5^h 33^m 32^s$   $\delta = +25^\circ 50'$  B2V

1 6184 1914 Feb 21.609 2420185.609 + 7.8 +3.9 11 D

|    |      |                 |          |       |      |    |                                              |
|----|------|-----------------|----------|-------|------|----|----------------------------------------------|
| 2  | 6576 | Nov 17.757      | 0454.757 | + 9.1 | +2.5 | 9  | D                                            |
| 3  | 6580 | 23.767          | 0460.767 | + 3.7 | 4.2  | 10 | D                                            |
| 4  | 6598 | Dec 25.769      | 0492.769 | - 0.4 | 3.6  | 10 | D                                            |
| 5  | 6626 | 1915 Jan 29.641 | 0527.641 | +67.3 | 4.0  | 11 | D                                            |
| 6  | 6642 | Feb 19.555      | 0548.555 | + 4.5 | 4.3  | 13 | D                                            |
| 7  | 6646 | 28.587          | 0557.587 | +29.6 | 6.9  | 10 | D                                            |
| 8  | 6654 | Mar 9.568       | 0566.568 | - 2.6 | 6.9  | 8  | D                                            |
| 9  | 6658 | 12.587          | 0569.587 | +41.3 | 1.1  | 21 | D, J                                         |
| 10 | 6859 | Nov 4.813       | 0806.813 | +60.8 | 2.7  | 19 | Graflex plate full of black spots; mean of 2 |
| 11 | 6897 | Dec 22.733      | 0854.733 | + 7.5 | 5.1  | 11 | D                                            |

These velocities fit well on Cannon's orbit (Publ. D.O. 3, 424, 1916). Plate 6626 was taken very near to the time of periastron passage and is somewhat more positive than Cannon's orbit at that point. This plate shows a suggestion of a secondary spectrum in both  $H_\alpha$  and  $H_\gamma$  as well as  $\lambda 4226$ . The separation is approximately 120 km/sec.

| HD 41357 | 40 Aurigae      | $\alpha = 5^h 59^m 41^s$ | $\delta = +38^\circ 29'$ | Am      |   |
|----------|-----------------|--------------------------|--------------------------|---------|---|
| 1 6189   | 1914 Feb 24.645 | 2420188.645              | +21.7                    | +1.1 26 | D |
| 2 6200   | 27.635          | 0191.635                 | +33.5                    | 1.5 25  | D |
| 3 6211   | Mar 12.630      | 0204.630                 | +28.4                    | 1.6 21  | D |
| 4 6238   | Apr 10.562      | 0233.562                 | +28.0                    | 1.2 22  | D |
| 5 6240   | 12.544          | 0235.544                 | +24.6                    | 1.5 20  | D |
| 6 6244   | 13.545          | 0236.545                 | +25.6                    | 2.2 24  | D |
| 7 6602   | Dec 31.760      | 0498.760                 | + 4.4                    | 2.1 21  | D |
| 8 6617   | 1915 Jan 15.731 | 0513.731                 | +22.3                    | 1.9 18  | D |

|    |      |     |        |          |       |      |    |  |   |
|----|------|-----|--------|----------|-------|------|----|--|---|
| 9  | 6631 | Feb | 4.674  | 0533.674 | +11.5 | ±6.0 | 9  |  | D |
| 10 | 6639 |     | 18.630 | 0547.630 | +25.9 | 1.5  | 23 |  | D |
| 11 | 6650 | Mar | 1.575  | 0558.575 | +26.7 | 1.0  | 22 |  | D |

These velocities, when plotted on the orbit of Young (Publ. D.O. 4, 95, 1917) show a reasonable fit. Blending with the secondary spectrum is apparent.

| HD 42560 |      | $\xi$ Orionis |     | $\alpha = 6^h 6^m 15^s$ |             | $\delta = +14^\circ 14'$ |      | 83V             |   |
|----------|------|---------------|-----|-------------------------|-------------|--------------------------|------|-----------------|---|
| 1        | 2130 | 1908          | Nov | 2.938                   | 2418248.938 | +26.9                    | ±3.8 | 6               | J |
| 2        | 2290 | 1909          | Jan | 7.768                   | 8314.768    | +20.9                    | 6.1  | 5               | J |
|          |      | Mean          |     | +24.2                   |             |                          |      | Mean I.S. + 8.0 |   |

Three additional spectra remain unmeasured.

| HD 47105 |     | $\gamma$ Geminorum |     | $\alpha = 6^h 31^m 56^s$ |             | $\delta = +16^\circ 29'$ |      | A01V |                     |
|----------|-----|--------------------|-----|--------------------------|-------------|--------------------------|------|------|---------------------|
| 1        | 333 | 1907               | Mar | 11.598                   | 2417646.598 | - 8.3                    | ±1.9 | 15   | B seed 27           |
| 2        | 357 |                    |     | 23.631                   | 7658.631    | -13.9                    | 1.0  | 53   | B L.S. Excellent    |
| 3        | 365 |                    |     | 25.610                   | 7660.610    | -12.2                    | 0.9  | 41   | B L.S.              |
| 4        | 378 |                    | Apr | 2.532                    | 7668.532    | -12.2                    | 1.2  | 35   | B L.S.              |
| 5        | 379 |                    |     | 2.571                    | 7668.571    | -11.0                    | 1.8  | 27   | B L.S.              |
| 6        | 384 |                    |     | 3.572                    | 7669.572    | -10.5                    | 1.9  | 38   | B L.S.              |
| 7        | 390 |                    |     | 20.596                   | 7686.596    | - 9.1                    | 1.8  | 22   | B L.S. underexposed |
| 8        | 395 |                    |     | 21.544                   | 7687.544    | - 7.0                    | 2.6  | 22   | B L.S.              |
| 9        | 402 |                    |     | 24.549                   | 7690.549    | -17.6                    | 1.9  | 21   | B L.S. underexposed |

These velocities are consistent with the period of 12.4 years. A final orbit combining both spectroscopic and astrometric results is in preparation. A preliminary discussion was presented in Proc. I.A.U. Symp. No. 30, 189, 1967.

| HD 47839              | 15 Monocerotis | $\alpha = 6^h 35^m 28^s$ | $\delta = +9^\circ 59'$ | 07                       |
|-----------------------|----------------|--------------------------|-------------------------|--------------------------|
| 1 2021 1908 Oct 3.901 | 2418218.901    | +13.4                    | +20.4                   | 4 J mean of 2            |
| 2 2289 1909 Jan 7.731 | 8314.731       | +23.1                    | +26.2                   | 4 J comp. weak mean of 2 |
| 3 2300                | 18.716         | +7.4                     | +18.0                   | 3 J mean of 2            |
| 4 2308                | 20.790         | +31.1                    | +13.6                   | 3 J comparison weak      |
| 5 2319                | 24.714         | +12.8                    | +34.4                   | 1 J comparison weak      |
| 6 2332                | Feb 1:729      | +9.2                     | +15.2                   | 2 J                      |
| 7 2344                | 6.593          | +13.9                    | +16.5                   | 2 J                      |
| 8 2352                | 7.716          | -11.8                    | +2.7                    | 2 J spark weak           |
| 9 2358                | 11.707         | +21.1                    | +9.2                    | 3 J                      |
| 10 3018               | Sep 24.889     | +20.8                    | +30.6                   | 1 J                      |
| 11 3055               | Oct 4.884      | +7.1                     | +18.8                   | 2 J                      |
| 12 3066               | 5.878          | +8.3                     | +24.8                   | 1 J comparison weak      |
| 13 3098               | 8.863          | +1.0                     | +5.7                    | 1 J                      |
| 14 3119               | 12.861         | +18.5                    | +15.4                   | 2 J                      |
| 15 3132               | 18.869         | +12.2                    | +9.6                    | 1 J                      |
| 16 3143               | 19.838         | +12.1                    | +19.5                   | 2 J                      |
| 17 3158               | 31.815         | +35.0                    |                         | J comparison overexposed |
| 18 3201               | Nov 6.854      | +12.2                    | +13.2                   | 2 J                      |
| 19 3219               | 11.881         | +7.8                     | +25.7                   | 2 J                      |

|    |      |                 |          |       |      |     |       |   |   |                        |
|----|------|-----------------|----------|-------|------|-----|-------|---|---|------------------------|
| 20 | 3226 | 13.897          | 8624.897 | +15.4 | +4.9 | 6.5 | +32.0 | 1 | J |                        |
| 21 | 3252 | 23.846          | 8634.846 | + 7.5 | 6.5  | 6.5 | +22.3 | 3 | J |                        |
| 22 | 3266 | 25.792          | 8636.792 | +37.3 | 2.7  | 3   | +21.6 | 3 | J |                        |
| 23 | 3280 | 29.774          | 8640.774 | +22.4 | 2.1  | 2.5 | - 1.0 | 2 | J | comparison weak        |
| 24 | 3316 | Dec 18.771      | 8659.771 | +20.2 | 5.6  | 7   | +55.7 | 1 | J |                        |
| 25 | 3326 | 19.719          | 8660.719 | + 6.7 | 4.4  | 6   |       |   | J |                        |
| 26 | 3342 | 1910 Jan 9.747  | 8681.747 | +25.6 | 2.9  | 6   | +27.5 | 2 | J |                        |
| 27 | 3371 | 19.776          | 8691.776 | +20.0 | 6.6  | 7   | +11.4 | 2 | J |                        |
| 28 | 3381 | Feb 1.706       | 8704.706 | +23.0 | 4.1  | 11  | +21.6 | 3 | J |                        |
| 29 | 3384 | 3.729           | 8706.729 | +22.2 | 7.2  | 3.5 | - 3.4 | 2 | J |                        |
| 30 | 3395 | 7.617           | 8710.617 | +22.9 | 6.6  | 5   | + 5.3 | 2 | J |                        |
| 31 | 3401 | 10.618          | 8713.618 | -10.1 | 5.6  | 5   | +11.1 | 2 | J |                        |
| 32 | 3418 | Mar 1.565       | 8732.565 | +11.6 | 5.0  | 5   |       |   | J | comparison weak        |
| 33 | 3421 | 2.675           | 8733.675 | +46.7 | 0.0  | 2   |       |   | J | doubtful spectrum weak |
| 34 | 3423 | 3.633           | 8734.633 | +17.2 | 5.8  | 9   | +29.6 | 2 | J |                        |
| 35 | 3431 | 5.524           | 8736.524 | +12.8 | 3.4  | 5   | + 7.4 | 2 | J |                        |
| 36 | 3438 | 10.557          | 8741.557 | + 7.3 | 3.2  | 5   | + 5.3 | 2 | J |                        |
| 37 | 3446 | 15.561          | 8746.561 | +24.3 | 11.0 | 8   | +13.6 | 3 | J |                        |
| 38 | 3461 | 21.568          | 8752.568 | +15.6 | 2.7  | 7   | +63.9 | 2 | J |                        |
| 39 | 3479 | Apr 1.540       | 8763.540 | +36.6 | 6.3  | 8   | +18.6 | 4 | J | comparison weak        |
| 40 | 3482 | 2.530           | 8764.530 | +25.9 | 5.7  | 7   | +38.6 | 3 | J | comparison weak        |
| 41 | 4131 | Dec 30.747      | 9036.747 | +29.7 | 12.7 | 5   | +13.5 | 2 | J |                        |
| 42 | 4171 | 1911 Feb 21.634 | 9089.634 | +26.5 | 6.1  | 2.5 | +23.1 | 1 | J |                        |

|    |      |           |          |       |      |     |       |   |   |                 |
|----|------|-----------|----------|-------|------|-----|-------|---|---|-----------------|
| 43 | 4176 | 23.642    | 9091.642 | + 0.8 | ±6.7 | 6.5 | +21.7 | 2 | J |                 |
| 44 | 4183 | 24.601    | 9092.601 | +34.3 | 7.6  | 5   | + 8.5 | 2 | J |                 |
| 45 | 4214 | Mar 4.616 | 9100.616 | -22.8 | 8.3  | 1.5 | +10.5 | 2 | J | comparison weak |
| 46 | 4229 | 10.594    | 9106.594 | +14.8 | 5.6  | 11  | +11.3 | 6 | J |                 |
| 47 | 4238 | 13.594    | 9109.594 | +25.0 | 2.2  | 7   | - 0.2 | 2 | J | comparison weak |
| 48 | 4245 | 18.586    | 9114.586 | +11.6 | 7.9  | 5   | +11.2 | 1 | J |                 |
| 49 | 4247 | 19.614    | 9115.614 | +11.5 | 4.5  | 6   | +16.0 | 1 | J |                 |
| 50 | 4249 | 20.513    | 9116.513 | +29.1 | 7.0  | 4   | +18.1 | 2 | J |                 |
| 51 | 4264 | 24.517    | 9120.517 | + 1.5 | 12.5 | 7   | +14.6 | 2 | J |                 |
| 52 | 4272 | 25.533    | 9121.533 | +28.9 | 5.4  | 5   | -10.3 | 2 | J |                 |
|    |      |           |          |       |      |     |       |   |   | Mean I.S. ±17.0 |

This star might be expected to show a pulsation mode in radial velocity. The large scatter would appear to be evidence of this but no regularity in the velocity variations is apparent.

| HD 57103 |      | 19 Lyncis A |        | $\alpha = 7^h 14^m 42^s$ |        | $\delta = +55^{\circ} 28'$ |     | 88     |      |     |   |
|----------|------|-------------|--------|--------------------------|--------|----------------------------|-----|--------|------|-----|---|
| 1        | 5691 | 1913 Mar    | 17.636 | 2419844.636              | +81.6  | ±3.6                       | 7   | -138.3 | 12.2 | 4.5 | J |
| 2        | 5695 |             | 18.622 | 45.622                   | -61.6  | 6.1                        | 7   | +247.9 |      |     | J |
| 3        | 5700 |             | 19.601 | 46.601                   | +102.9 | 10.6                       | 5   | -297.7 |      | 2   | J |
| 4        | 5705 |             | 22.598 | 49.598                   | -54.3  | 4.7                        | 9   | -344.9 |      | 2   | J |
| 5        | 5709 |             | 28.612 | 55.612                   | +111.5 | 0.7                        | 8.5 | -181.4 | 18.8 | 4   | J |
| 6        | 5714 | Apr         | 1.550  | 59.550                   | +15.0  | 4.0                        | 11  |        |      |     | J |
| 7        | 5720 |             | 7.574  | 65.574                   | -81.9  | 5.3                        | 6   |        |      |     | J |
| 8        | 5725 |             | 16.553 | 74.553                   | -64.3  | 3.6                        | 6.5 | +138.8 | 19.9 | 2   | J |

|    |      |                 |             |        |       |     |   |                     |
|----|------|-----------------|-------------|--------|-------|-----|---|---------------------|
| 10 | 5736 | 19.566          | 77.566      | +12.5  | +10.6 | 5.5 | J |                     |
| 11 | 5739 | 20.555          | 78.555      | +73.4  | 10.6  | 3   | J | spectrum weak       |
| 12 | 5744 | 21.557          | 79.557      | -22.6  | 9.8   | 2   | J | spectrum weak       |
| 13 | 5748 | 23.553          | 81.553      | -103.5 | 3.5   | 1.5 | J | spectrum weak       |
| 14 | 5752 | 24.564          | 82.564      | +121.9 | 6.6   | 5   | J | spectrum weak       |
| 15 | 6170 | 1914 Feb 1.726  | 2420165.726 | + 8.9  | 4.4   | 7   | J |                     |
| 16 | 6194 | 25.688          | 0189.688    | +49.9  | 6.1   | 5   | J |                     |
| 17 | 6204 | Mar 3.661       | 0195.661    | - 4.1  | 4.2   | 4   | J | second. 1 line only |
| 18 | 6217 | 15.641          | 0207.641    | - 6.8  | 11.0  | 3.5 | J | poor; spectrum weak |
| 19 | 6248 | Apr 17.573      | 0240.573    | -26.7  | 5.5   | 4.5 | J | poor                |
| 20 | 6607 | 1915 Jan 4.804  | 0502.804    | .0.6   | 7.9   | 2   | J |                     |
| 21 | 6612 | 7.747           | 0505.747    | +10.7  | 6.7   | 6.5 | J | spectrum weak       |
| 22 | 6618 | 15.799          | 0513.799    | + 9.0  | 1.8   | 2.5 | J | very weak           |
| 23 | 6621 | 25.764          | 0523.764    | +15.6  | 3.5   | 2.5 | J | poor - weak         |
| 24 | 6633 | Feb 16.690      | 0545.690    | -42.0  |       | 2   | J | 1 line - weak       |
| 25 | 6640 | 18.706          | 0547.706    | -17.5  | 2.2   | 9   | J |                     |
| 26 | 6643 | 19.642          | 0548.642    | + 3.0  | 1.6   | 9   | J |                     |
| 27 | 6930 | 1916 Jan 22.722 | 0885.722    | +29.4  | 13.5  | 2   | J | weak                |

These observations fit the orbit of Harper (Publ. D. O. 4, 235, 1918),  $P = 2.25960$ ,  $T_0 = 2419031.632$ ,  $K_1 = 106.4$ .

HD 58343

$\alpha = 7^h 20^m 09^s$

$\delta = -16^\circ 00'$

B3Ve

1 2269 1908 Dec 28.756 2418304.756 -15.2  $\pm 4.5$  6 + 0.5 0.5 J

|    |      |             |        |             |       |      |    |       |     |             |
|----|------|-------------|--------|-------------|-------|------|----|-------|-----|-------------|
| 2  | 3419 | 1910 Mar    | 1.615  | 8732.615    | - 0.4 | *6.5 | 6  | -17.2 | 1'  | J           |
| 3  | 3433 |             | 5.610  | 8736.610    | - 2.8 | 6.4  | 10 |       |     | J           |
| 4  | 3445 |             | 15.524 | 8746.524    | -15.3 | 1.7  | 13 |       |     | J           |
| 5  | 5004 | 1911 Dec    | 28.799 | 9400.799    | -14.9 | 5.1  | 16 |       |     | J           |
| 6  | 5033 | 1912 Jan    | 27.737 | 9430.737    | -42.3 | 4.0  | 8  |       |     | J           |
| 7  | 5093 | Feb 23.666  |        | 9457.666    | - 4.8 | 3.2  | 11 |       |     | J weak      |
| 8  | 5605 | Dec 12.790  |        | 9750.790    | -15.2 | 1.9  | 9  |       |     | J           |
| 9  | 5636 | 1913 Jan    | 21.741 | 9790.741    | - 0.4 | 4.0  | 8  |       |     | J weak      |
| 10 | 5651 | Feb. 12.656 |        | 9812.656    | -1.7  | 2.2  | 21 |       |     | J           |
| 11 | 5655 |             | 13.649 | 9813.649    | -14.0 | 1.7  | 23 | - 5.0 | 0.5 | J           |
| 12 | 5664 |             | 19.672 | 9819.672    | - 9.3 | 1.7  | 3  |       |     | J faint     |
| 13 | 5674 |             | 25.649 | 9825.649    | + 2.0 | 1.6  | 12 |       |     | J           |
| 14 | 5681 | Mar 11.609  |        | 9838.609    | -11.2 | 3.8  | 25 |       |     | J           |
| 15 | 6185 | 1914 Feb    | 21.673 | 2420186.673 | - 7.4 | 3.2  | 14 |       |     | J           |
| 16 | 6627 | 1915 Jan    | 29.714 | 0528.714    | -26.9 | 2.5  | 2  |       |     | J very weak |
| 17 | 6636 | Feb 17.690  |        | 0547.690    | -29.0 | 4.1  | 16 |       |     | J           |
|    |      |             |        | Mean        | -11.6 |      |    |       |     |             |
|    |      |             |        | Mean I.S.   | - 9.7 |      |    |       |     |             |

The range is small (+2 to -42). From the early spectral type and the absence of any pronounced variation in the published velocities we conclude that this star is not a spectroscopic binary.

HD 61497      24 Lyncis       $\alpha = 7^h 34^m 33^s$        $\delta = +58^\circ 57'$       A3III

3 HD 63975  $\epsilon$  Canis Minoris  $\alpha = 7^h 46^m 31^s$   $\delta = +20^\circ 01'$  B8

|            |      |                 |             |       |           |   |   |
|------------|------|-----------------|-------------|-------|-----------|---|---|
| 1          | 5070 | 1912 Feb 14.687 | 2419447.687 | + 3.3 | $\pm 1.9$ | 3 | D |
| 2          | 5107 | Mar 13.568      | 9475.568    | + 8.9 | 3.2       | 3 | D |
| 3          | 5187 | Apr 19.572      | 9512.572    | - 1.7 | 14.2      | 6 | D |
| 4          | 5676 | 1913 Mar 5.619  | 9832.619    | + 4.1 | 1.7       | 6 | D |
| Mean + 8.1 |      |                 |             |       |           |   |   |
| 1          | 2476 | 1909 Apr 17.553 | 2418414.553 | +18.4 | $\pm 5.2$ | 5 | J |
| 2          | 4983 | 1911 Dec 6.789  | 9377.789    | +25.4 | 3.3       | 9 | J |
| 3          | 5069 | 1912 Feb 14.635 | 9447.635    | +29.9 | 3.4       | 8 | J |
| 4          | 5172 | Apr 11.559      | 9504.559    | +30.9 | 7.0       | 5 | J |
| 5          | 6603 | 1914 Dec 31.822 | 2420498.822 | +27.5 | 4.0       | 4 | J |
| Mean +26.6 |      |                 |             |       |           |   |   |

4 HD 67006 27 Lyncis  $\alpha = 8^h 0^m 56^s$   $\delta = +51^\circ 48'$  A2V

|                                               |      |                 |             |       |           |   |   |
|-----------------------------------------------|------|-----------------|-------------|-------|-----------|---|---|
| 1                                             | 1104 | 1908 Jan 18.732 | 2417959.732 | +46.0 | $\pm 9.5$ | 4 | B |
| 2                                             | 1228 | Mar 10.661      | 8011.661    | +12.3 | 14.0      | 3 | B |
| 3                                             | 1255 | 20.610          | 8021.610    | +12.4 | 10.5      | 4 | B |
| 4                                             | 2321 | 1909 Jan 24.803 | 8331.803    | +28.7 | 6.7       | 2 | B |
| 5                                             | 2383 | Feb. 25.677     | 8363.677    | - 8.0 | 3.5       | 5 | B |
| 6                                             | 2399 | Mar 7.649       | 8373.649    | +18.3 | 11.0      | 4 | B |
| +31.0 if H <sub>8</sub> is omitted; $\pm 6.0$ |      |                 |             |       |           |   |   |

The range of +46 to -8 as well as the published range of +30 to -15 indicates a possible spectroscopic binary.

HD 78316

 $\alpha = 9^h 02^m 20^s$  $\delta = +11^\circ 04'$ 

Ap

 $\kappa$  Cancri

|    |      |          |        |             |       |     |      |                |
|----|------|----------|--------|-------------|-------|-----|------|----------------|
| 1  | 3383 | 1910 Feb | 1.768  | 2418704.768 | +40.3 | 2.2 | 18   | J,D            |
| 2  | 3385 |          | 3.769  | 8706.769    | -46.2 | 2.9 | 9.5  | J,D            |
| 3  | 3403 |          | 10.740 | 8713.740    | -33.2 | 2.2 | 13.5 | J,D            |
| 4  | 3407 |          | 13.743 | 8716.743    | +64.7 | 2.2 | 6    | D underexposed |
| 5  | 3428 | Mar      | 3.725  | 8734.725    | +65.8 | 2.2 | 11.5 | D              |
| 6  | 4151 | 1911 Jan | 23.817 | 9060.817    | +64.7 | 3.0 | 13   | J,D            |
| 7  | 4177 | Feb      | 23.692 | 9091.692    | +19.1 | 2.5 | 10.5 | J,D            |
| 8  | 4196 |          | 27.627 | 9095.627    | - 2.6 | 3.5 | 7    | D              |
| 9  | 4221 | Mar      | 6.643  | 9102.643    | -41.6 | 1.4 | 13   | J,D            |
| 10 | 4230 |          | 10.645 | 9106.645    | +73.9 | 2.8 | 13   | D              |
| 11 | 4239 |          | 13.627 | 9109.627    | -59.9 | 1.9 | 9    | D              |
| 12 | 4284 |          | 19.684 | 9115.684    | -57.0 | 7.3 | 3    | D underexposed |
| 13 | 6160 | 1914 Jan | 13.746 | 2420146.746 | +28.2 | 3.3 | 7    | D              |
| 14 | 6171 | Feb      | 1.802  | 0165.802    | +21.4 | 1.6 | 16   | D              |
| 15 | 6176 |          | 8.795  | 0172.795    | +60.4 | 4.1 | 6    | D underexposed |
| 16 | 6186 |          | 21.732 | 0185.732    | +53.6 | 3.6 | 3.5  | D underexposed |
| 17 | 6190 |          | 24.737 | 0188.737    | - 7.0 | 2.0 | 15   | D              |
| 18 | 6195 |          | 25.774 | 0189.774    | -55.3 | 3.7 | 3    | D underexposed |
| 19 | 6201 |          | 27.701 | 0191.701    | +40.5 | 2.2 | 14   | D              |
| 20 | 6207 | Mar      | 11.676 | 0203.676    | - 5.4 | 4.2 | 4    | D underexposed |
| 21 | 6218 |          | 15.729 | 0207.729    | - 1.0 | 4.3 | 4    | D underexposed |
| 22 | 6222 |          | 20.656 | 0212.656    | +71.9 | 1.5 | 16   | D              |

KQ

|    |      |                 |          |       |      |     |   |              |
|----|------|-----------------|----------|-------|------|-----|---|--------------|
| 23 | 6228 | 27.627          | 0219.627 | + 4.4 | ±4.7 | 4   | D | underexposed |
| 24 | 6232 | Apr 3.635       | 0226.635 | +37.7 | 2.8  | 6   | D |              |
| 25 | 6235 | 5.638           | 0228.638 | -43.2 | 3.1  | 13  | D |              |
| 26 | 6239 | 10.646          | 0233.646 | -15.7 | 3.1  | 14  | D |              |
| 27 | 6241 | 12.634          | 0235.634 | + 3.7 | 3.0  | 10  | D |              |
| 28 | 6245 | 13.607          | 0236.607 | +43.8 | 2.8  | 14  | D |              |
| 29 | 6249 | 17.653          | 0240.653 | -42.4 | 4.0  | 5   | D | underexposed |
| 30 | 6252 | 21.597          | 0244.597 | +71.4 | 3.8  | 8.5 | D | underexposed |
| 31 | 6253 | 23.525          | 0246.625 | -32.7 | 5.1  | 4   | D |              |
| 32 | 6254 | 26.598          | 0249.598 | -27.5 |      | 2   | D | underexposed |
| 33 | 6255 | 27.596          | 0250.596 | -15.6 | 2.7  | 3   | D | underexposed |
| 34 | 6257 | 29.615          | 0252.615 | - 3.9 | 4.7  | 7   | D |              |
| 35 | 6258 | 30.585          | 0253.585 | -51.2 | 2.0  | 12  | D |              |
| 36 | 6628 | 1915 Jan 29.788 | 0527.788 | - 8.3 | 8.2  | 7   | D | underexposed |
| 37 | 6637 | Feb 17.783      | 0546.783 | -11.4 | 3.0  | 14  | D |              |
| 38 | 6641 | 18.794          | 0547.794 | -46.6 | 1.3  | 14  | D |              |
| 39 | 6644 | 19.743          | 0548.743 | -25.6 | 9.2  | 5   | D |              |
| 40 | 6647 | 28.688          | 0557.688 | +72.2 | 3.3  | 8   | D |              |
| 41 | 6651 | Mar 1.698       | 0558.698 | +45.9 | 2.6  | 15  | D |              |
| 42 | 6655 | 9.725           | 0566.725 | -45.9 | 2.0  | 11  | D |              |
| 43 | 6663 | 13.671          | 0570.671 | +77.3 | 2.8  | 7   | D |              |
| 44 | 6665 | 16.706          | 0573.706 | -50.4 | 4.1  | 13  | D |              |
| 45 | 6945 | 1916 Feb 7.756  | 0901.756 | +59.2 | 4.0  | 8   | D |              |

|    |      |                 |             |       |      |    |   |
|----|------|-----------------|-------------|-------|------|----|---|
| 46 | 6953 | 14.756          | 0908.756    | +54.8 | *6.0 | 7  | D |
| 47 | 6957 | 21.254          | 0915.754    | +75.0 | 1.6  | 18 | D |
| 48 | 6960 | Mar 2.722       | 0925.722    | -12.7 | 2.2  | 4  | D |
| 49 | 6964 | 10.730          | 0933.730    | +53.1 | 1.9  | 18 | D |
| 50 | 6967 | 11.691          | 0934.691    | +80.3 | 3.2  | 16 | D |
| 51 | 6970 | 17.669          | 0940.669    | +69.1 | 2.7  | 7  | D |
| 52 | 6973 | 19.651          | 0942.651    | +24.6 | 2.3  | 19 | D |
| 53 | 6977 | 23.655          | 0946.655    | +62.8 | 1.9  | 16 | D |
| 54 | 6979 | 30.656          | 0958.656    | +64.5 | 3.8  | 3  | D |
| 55 | 6982 | 1916 Apr 14.590 | 2420958.590 | +23.4 | 2.9  | 14 | D |
| 56 | 6987 | 9.625           | 0963.625    | -53.1 | 2.0  | 15 | D |
| 57 | 6989 | 10.583          | 0964.583    | - 2.8 | 1.8  | 13 | D |
| 58 | 6992 | 11.597          | 0965.597    | +50.5 | 4.3  | 10 | D |
| 59 | 6994 | 15.567          | 0969.567    | -56.0 | 1.5  | 24 | D |
| 60 | 6996 | 17.625          | 0971.625    | +30.0 | 2.3  | 18 | D |
| 61 | 6999 | 18.576          | 0972.576    | +66.6 | 2.2  | 17 | D |

These velocities when plotted on the orbit of Ichinohe (Ap. J. 25, 318, 1907) agree very well for  $P = 6^d.39316$  and  $T_0 = 2416482.947$  JD.

| HD 79439 |      | 18 Ursae Majoris |             | $\alpha = 9^h 9^m 0^s$ |      | $\delta = +54^\circ 26'$ |  | A5V |
|----------|------|------------------|-------------|------------------------|------|--------------------------|--|-----|
| 1        | 2378 | 1909 Feb 22.702  | 2418360.702 | - 8.8                  | *4.0 | 3.5                      |  | J   |
| 2        | 2388 | 28.717           | 8366.717    | -15.7                  | 3.7  | 4                        |  | J   |
| 3        | 2430 | Mar 22.653       | 8388.653    | -11.5                  | 2.3  | 4                        |  | J   |

|    |      |                 |          |       |      |            |   |                 |
|----|------|-----------------|----------|-------|------|------------|---|-----------------|
| 4  | 2451 | 26.670          | 8392.670 | +18.4 | +9.8 | 8          | J |                 |
| 5  | 2468 | Apr 11.631      | 8408.631 | - 7.4 | 7.8  | 4          | J |                 |
| 6  | 3435 | 1910 Mar 5.668  | 8736.668 | -78.7 | 5.4  | 5          | J |                 |
| 7  | 3472 | 26.619          | 8757.619 | -15.3 | 6.7  | 5          | J | comparison weak |
| 8  | 3483 | Apr 2.566       | 8764.566 | -50.6 | 14.3 | 4          | J |                 |
| 9  | 3489 | 9.617           | 8771.617 | -27.0 | 9.9  | 3          | J |                 |
| 10 | 3543 | May 5.550       | 8797.550 | -19.5 | 0.3  | 4          | J |                 |
| 11 | 4184 | 1911 Feb 24.627 | 9092.627 | + 8.1 | 10.7 | 3          | J |                 |
| 12 | 4197 | 27.675          | 9095.675 | + 6.6 | 4.0  | 8          | J |                 |
| 13 | 4215 | Mar 4.752       | 9100.752 | -16.7 | 1.7  | 2          | J |                 |
| 14 | 4240 | 13.668          | 9109.668 | -30.8 | 5.6  | 2.5 +143.2 | J | 0.5             |
| 15 | 4246 | 18.691          | 9114.691 | -27.0 | 9.3  | 4          | J | spectrum weak   |
| 16 | 4266 | 24.616          | 9120.616 | -24.3 | 7.4  | 3          | J |                 |
| 17 | 4286 | Apr 10.548      | 9137.548 | -30.3 | 2.1  | 3          | J | overexposed     |
| 18 | 4294 | 17.549          | 9144.549 | -34.1 | 2.4  | 6          | J |                 |
| 19 | 4301 | 20.552          | 9147.552 | + 2.6 | 7.2  | 8          | J | seed 23         |
| 20 | 4303 | 23.579          | 9150.579 | -15.9 | 9.4  | 6          | J |                 |
| 21 | 4306 | 24.550          | 9151.550 | -21.6 | 3.6  | 5          | J | overexposed     |
| 22 | 4320 | 26.545          | 9153.545 | -41.7 | 9.8  | 2          | J |                 |
| 23 | 4326 | May 4.575       | 9161.575 | -12.4 | 4.4  | 13         | J | seed 23         |
| 24 | 5048 | 1912 Feb 8.720  | 9441.720 | -25.4 | 5.3  | 11         | J |                 |
| 25 | 5059 | 12.756          | 9445.756 | -14.9 | 1.8  | 13         | J |                 |
| 26 | 5071 | 14.763          | 9447.763 | -15.7 | 4.5  | 10         | J |                 |

|    |      |           |          |       |      |    |   |                    |
|----|------|-----------|----------|-------|------|----|---|--------------------|
| 27 | 5075 | 15.731    | 9448.731 | -10.9 | +4.4 | 8  | J |                    |
| 28 | 5078 | 16.671    | 9449.671 | -11.5 | 4.9  | 11 | J |                    |
| 29 | 5084 | 17.669    | 9450.669 | -12.9 | 7.9  | 8  | J |                    |
| 30 | 5087 | 22.737    | 9455.737 | -16.6 | 7.2  | 9  | J |                    |
| 31 | 5094 | 23.729    | 9456.729 | -61.0 | 11.4 | 4  | J |                    |
| 32 | 5098 | Mar 5.668 | 9467.668 | -50.4 | 5.3  | 7  | J |                    |
| 33 | 5101 | 10.679    | 9472.679 | -19.1 | 5.4  | 9  | J |                    |
| 34 | 5109 | 13.709    | 9475.709 | -19.8 | 3.5  | 4  | J |                    |
| 35 | 5115 | 16.689    | 9478.689 | - 9.8 | 7.5  | 5  | J | comparison weak    |
| 36 | 5122 | 17.709    | 9479.709 | -11.3 | 2.5  | 3  | J | spectrum weak      |
| 37 | 5125 | 18.723    | 9480.723 | - 1.5 | 1.5  | 4  | J | spectrum very weak |
| 38 | 5129 | 22.694    | 9484.694 | -21.9 | 4.3  | 11 | J |                    |
| 39 | 5134 | 25.661    | 9487.661 | - 7.7 | 2.8  | 5  | J |                    |
| 40 | 5144 | 30.624    | 9492.624 | - 9.2 | 8.9  | 4  | J |                    |
| 41 | 5152 | Apr 3.684 | 9496.684 | -38.4 | 4.5  | 4  | J |                    |
| 42 | 5156 | 4.609     | 9497.609 | +14.0 | 7.9  | 8  | J |                    |
| 43 | 5188 | 19.645    | 9512.645 | + 3.0 | 7.3  | 12 | J |                    |
| 44 | 5189 | 20.545    | 9513.545 | -19.5 | 3.0  | 13 | J |                    |
| 45 | 5197 | 21.569    | 9514.569 | -35.6 | 4.0  | 18 | J |                    |
| 46 | 5201 | 23.548    | 9516.548 | -18.9 | 2.8  | 13 | J |                    |
| 47 | 5208 | 24.548    | 9517.548 | -15.6 | 5.1  | 17 | J |                    |
| 48 | 5219 | May 1.575 | 9524.575 | - 8.3 | 3.8  | 16 | J |                    |
| 49 | 5229 | 8.572     | 9531.572 | + 0.6 | 4.4  | 11 | J |                    |

|    |      |                 |             |       |      |    |   |                              |
|----|------|-----------------|-------------|-------|------|----|---|------------------------------|
| 50 | 5232 | 9.596           | 9532.596    | -34.0 | ±3.3 | 8  | J |                              |
| 51 | 5637 | 1913 Jan 21.799 | 9789.799    | -37.0 | 6.3  | 9  | J | comparison weak<br>pfer side |
| 52 | 5652 | Feb 12.721      | 9811.721    | -17.7 | 4.4  | 5  | J |                              |
| 53 | 5665 | 19.761          | 9816.761    | -28.6 | 15.6 | 4  | J |                              |
| 54 | 5688 | Mar 15.607      | 9842.607    | -38.1 | 8.6  | 4  | J | spectrum weak                |
| 55 | 5701 | 19.620          | 9846.620    | -20.6 | 4.9  | 18 | J |                              |
| 56 | 5706 | 22.615          | 9849.615    | -31.3 | 4.9  | 11 | J |                              |
| 57 | 5710 | 28.674          | 9855.674    | -25.3 | 4.3  | 8  | J |                              |
| 58 | 5715 | Apr 1.601       | 9859.601    | -35.0 | 5.5  | 10 | J |                              |
| 59 | 5721 | 7.638           | 9865.638    | -28.9 | 5.3  | 13 | J | spectrum weak                |
| 60 | 6666 | 1915 Apr 4.560  | 2420592.560 | -23.9 | 5.8  | 19 | J |                              |
| 61 | 6667 | 8.542           | 0596.542    | -14.5 | 5.0  | 23 | J |                              |
| 62 | 6669 | 8.662           | 0596.662    | -26.7 | 6.6  | 8  | J |                              |
| 63 | 6670 | 8.719           | 0596.719    | -20.2 | 4.9  | 11 | J |                              |

The lines in the spectrum of this star are very broad. These plates should be remeasured on an ocillographic measuring engine.

|          |                      |                           |                          |           |   |                         |                            |
|----------|----------------------|---------------------------|--------------------------|-----------|---|-------------------------|----------------------------|
| HD 85235 | $\phi$ Ursae Majoris | $\alpha = 9^h 45^m 18^s$  | $\delta = +54^\circ 32'$ | A35       |   |                         |                            |
| 1 1107   | 1908 Jan 18.842      | 2417959.842               | -27.5                    | $\pm 1.9$ | 8 | B                       | identity of star uncertain |
| HD 90882 | $\beta$ Sextantis    | $\alpha = 10^h 25^m 11^s$ | $\delta = -0^\circ 07'$  |           |   | B6V                     |                            |
| 1 1216   | 1908 Mar 9.707       | 2418010.707               | +23.9                    | $\pm 3.3$ | 9 | Sch1, 3 measures<br>B,J |                            |

|    |      |          |        |          |       |      |     |                         |
|----|------|----------|--------|----------|-------|------|-----|-------------------------|
| 2  | 1283 | Apr      | 4.649  | 8036.649 | - 3.2 | *2.9 | 10  | Schl, 3 measures<br>B,J |
| 3  | 1338 |          | 27.584 | 8059.584 | + 1.2 | 3.0  | 14  | B,J 2 "                 |
| 4  | 2334 | 1909 Feb | 1.801  | 8339.801 | +18.0 | 4.9  | 10  | B,J 2 "                 |
| 5  | 2402 | Mar      | 7.792  | 8373.792 | +19.5 | 4.3  | 13  | B,J 2 "                 |
| 6  | 2424 |          | 21.729 | 8387.729 | +20.1 | 1.7  | 12  | B,J 2                   |
| 7  | 2440 |          | 23.633 | 8389.633 | +16.7 | 2.3  | 11  | B,J 2 "                 |
| 8  | 3440 | 1910 Mar | 10.677 | 8741.677 | +14.0 | 3.9  | 9   | D                       |
| 9  | 3517 | Apr      | 13.618 | 8775.618 | + 2.3 | 2.9  | 7   | D                       |
| 10 | 4178 | 1911 Feb | 23.744 | 9091.744 | - 6.5 | 6.5  | 4   | D                       |
| 11 | 4207 |          | 28.743 | 9096.743 | +15.2 | 5.9  | 7   | D                       |
| 12 | 4222 | Mar      | 6.926  | 9102.926 | +16.1 | 7.8  | 4   | J comparison weak       |
| 13 | 4231 |          | 10.947 | 9106.947 | + 3.1 | 5.4  | 8   | J comparison weak       |
| 14 | 4260 |          | 21.670 | 9117.670 | -11.4 | 12.5 | 2.5 | D underexposed          |
| 15 | 4267 |          | 24.894 | 9120.894 | - 3.0 | 6.3  | 7   | J                       |

55

The small range (+20 to -11) and the early spectral type are indications that this star is probably not a spectroscopic binary.

| HD 91312 |      | $\alpha = 10^{\text{h}}27^{\text{m}}24^{\text{s}}$ |          | $\delta = +40^{\circ} 56'$ |      | A7V |     |
|----------|------|----------------------------------------------------|----------|----------------------------|------|-----|-----|
| 1        | 1256 | Mar 20.652                                         | 8021.652 | +12.4                      | *8.0 | 10  | B   |
| 2        | 1305 | Apr 13.601                                         | 8045.601 | + 7.7                      | 2.4  | 6   | B   |
| 3        | 1352 | May 10.572                                         | 8072.572 | +16.1                      | 2.9  | 4   | S   |
| 4        | 2458 | 1909 Mar 31.628                                    | 8397.628 | + 9.4                      | 4.5  | 5   | B   |
| 5        | 2465 | Apr 10.623                                         | 8407.623 | +35.6                      | 3.8  | 9   | B,0 |

|    |      |          |         |          |       |      |    |   |
|----|------|----------|---------|----------|-------|------|----|---|
| 6  | 2549 | Jun      | 5.587   | 8463.587 | + 5.7 | ±2.3 | 5  | B |
| 7  | 2563 |          | 11.605  | 8469.605 | + 6.8 | 2.9  | 3  | B |
| 8  | 3442 | 1910 Mar | 10.764  | 8741.764 | -11.2 | 3.1  | 9  | B |
| 9  | 3450 |          | 17.662  | 8748.662 | + 7.6 | 5.2  | 6  | D |
| 10 | 3499 | Apr      | 10.579. | 8772.579 | - 2.0 | 3.8  | 9  | D |
| 11 | 4159 | 1911 Jan | 24.825  | 9061.825 | -24.4 | 4.2  | 8  | D |
| 12 | 4185 | Feb      | 24.653  | 9092.653 | + 3.9 | 4.1  | 14 | D |
| 13 | 4198 |          | 27.699  | 9095.699 | - 2.4 | 4.3  | 10 | D |
| 14 | 4208 |          | 28.785  | 9096.785 | - 6.2 | 5.7  | 6  | D |
| 15 | 4216 | Mar      | 4.750   | 9100.750 | -22.1 | 2.4  | 7  | D |
| 16 | 4223 |          | 6.701   | 9102.701 | + 4.3 | 2.2  | 4  | D |
| 17 | 4232 |          | 10.724  | 9106.724 | -10.3 | 4.6  | 12 | D |
| 18 | 4247 |          | 18.727  | 9114.727 | -16.8 | 5.6  | 7  | D |
| 19 | 4251 |          | 20.619  | 9116.619 | + 0.7 | 2.4  | 9  | D |
| 20 | 4261 |          | 21.718  | 9117.718 | + 6.7 | 4.8  | 8  | D |
| 21 | 4275 |          | 25.691  | 9121.691 | - 2.0 | 4.0  | 5  | D |
| 22 | 4277 |          | 28.668  | 9124.668 | - 3.5 | 1.9  | 8  | D |
| 23 | 4279 |          | 31.562  | 9127.562 | + 0.3 | 2.6  | 12 | D |
| 24 | 4282 | Apr      | 9.676   | 9136.676 | - 1.8 | 3.3  | 9  | D |
| 25 | 4295 |          | 17.594  | 9144.594 | - 2.9 | 2.8  | 12 | D |
| 26 | 4327 | May      | 4.624   | 9161.624 | + 9.7 | 5.3  | 8  | D |
| 27 | 5060 | 1912 Feb | 12.819  | 9445.819 | + 1.0 | 3.5  | 14 | D |
| 28 | 5072 |          | 14.815  | 9447.815 | - 1.0 | 4.4  | 8  | D |

- 74.1

1

|    |      |           |          |       |     |    |   |
|----|------|-----------|----------|-------|-----|----|---|
| 29 | 5076 | 15.784    | 9448.784 | - 0.7 | 4.8 | 11 | D |
| 30 | 5079 | 16.733    | 9449.733 | + 2.8 | 2.3 | 10 | D |
| 31 | 5085 | 17.718    | 9450.718 | +11.9 | 2.6 | 10 | D |
| 32 | 5088 | 22.785    | 9455.785 | + 4.1 | 2.1 | 11 | D |
| 33 | 5095 | 23.781    | 9456.781 | + 4.5 | 2.5 | 14 | D |
| 34 | 5099 | Mar 5.712 | 9467.712 | - 3.7 | 1.3 | 10 | D |
| 35 | 5102 | 10.727    | 9472.727 | +14.1 | 3.3 | 20 | D |
| 36 | 5110 | 13.750    | 9475.750 | +10.0 | 2.1 | 14 | D |
| 37 | 5116 | 16.730    | 9478.730 | + 8.3 | 1.8 | 16 | D |

This star is a spectroscopic binary. Efforts to find a period have so far been unsuccessful. A recent series taken at Allegheny Observatory shows a range of +52 to -28 km/sec. There is some evidence of a long-period variation in both this series as well as the recent series. A period of 292.56 suggested by Abt (Ap. J. Suppl. 11, 429, 1912) does not fit this series. Observations are being continued.

| 0 | HD 92825             | 41 Leonis Minoris | $\alpha = 10^h 37^m 59^s$ | $\delta = +23^\circ 43'$ | A2V |              |
|---|----------------------|-------------------|---------------------------|--------------------------|-----|--------------|
| 1 | 1247 1908 Mar 12.698 | 2418013.698       | +26.0                     | 46.3                     | 4   | B            |
| 2 | 1257                 | 20.690            | 8021.690                  | + 9.8                    | 2   | B            |
| 3 | 1288                 | Apr 6.606         | 8038.606                  | +14.6                    | 1   | S 1 line     |
| 4 | 2493 1909 May 12.628 | 8439.628          | +19.3                     | 5.5                      | 5   | J            |
| 5 | 4179 1911 Feb 23.788 | 9091.788          | +37.8                     | 14.6                     | 4   | J            |
| 6 | 4186                 | 24.678            | 9092.678                  | + 5.3                    | 3   | J            |
| 7 | 5162 1912 Apr        | 5.638             | 9498.638                  | +17.1                    | 3   | J poor plate |
| 8 | 5167                 | 10.617            | 9503.617                  | +32.9                    | 3   | J            |
| 9 | 5190                 | 20.583            | 9513.583                  | - 1.0                    | 4   | J            |

|    |      |        |          |       |      |   |   |
|----|------|--------|----------|-------|------|---|---|
| 10 | 5204 | 23.667 | 9516.667 | + 1.7 | ±3.9 | 6 | J |
| 11 | 5215 | 27.549 | 9520.549 | - 3.7 | 1.5  | 6 | J |

The range in velocity for this series is in agreement with the published range of +43 to -1. This star is probably a spectroscopic binary.

| 51 | HD 93152 | 42 Leonis Minoris | $\alpha = 10^h 40^m 18^s$ | $\delta = +31^\circ 13'$ | B9V   |           |   |                |
|----|----------|-------------------|---------------------------|--------------------------|-------|-----------|---|----------------|
| 1  | 5648     | 1913 Feb          | 7.769                     | 2419806.769              | +15.3 | $\pm 6.1$ | 5 | D              |
| 2  | 5662     |                   | 18.717                    | 19817.717                | - 4.0 | 12.4      | 3 | D underexposed |
| 3  | 5666     |                   | 19.822                    | 19818.822                | + 5.9 | 0.6       | 3 | D              |
| 4  | 6648     | 1915 Feb          | 28.873                    | 20557.873                | +27.6 | 9.8       | 1 | J              |
| 5  | 6652     | Mar               | 1.785                     | 20558.785                | + 4.3 | 5.0       | 3 | D              |

51

Mean + 8.3

| 52 | HD 94334 | $\omega$ Ursae Majoris | $\alpha = 10^h 48^m 13^s$ | $\delta = +43^\circ 43'$ | A1V   |      |    |                |
|----|----------|------------------------|---------------------------|--------------------------|-------|------|----|----------------|
| 1  | 398      | 1907 Apr               | 21.704                    | 2417687.704              | -19.6 | ±2.0 | 16 | D              |
| 2  | 399      |                        | 21.778                    | 7687.778                 | - 8.0 | 1.9  | 8  | D              |
| 3  | 408      |                        | 27.577                    | 7693.577                 | -19.8 | 1.3  | 18 | D              |
| 4  | 409      |                        | 27.646                    | 7693.646                 | -15.5 | 2.5  | 18 | D              |
| 5  | 412      |                        | 28.688                    | 7694.688                 | -27.2 | 6.7  | 5  | D underexposed |
| 6  | 415      | May                    | 1.598                     | 7697.599                 | -31.4 | 3.9  | 9  | D              |
| 7  | 416      |                        | 1.642                     | 7697.642                 | -28.1 | 3.4  | 6  | D              |
| 8  | 431      |                        | 9.567                     | 7705.601                 | - 8.0 | 2.7  | 14 | D              |
| 9  | 432      |                        | 9.601                     | 7705.642                 | - 2.2 | 1.5  | 11 | D              |
| 10 | 440      |                        | 11.575                    | 7707.575                 | -13.0 | 2.9  | 13 | D              |

|    |      |          |          |       |      |    |   |
|----|------|----------|----------|-------|------|----|---|
| 11 | 455  | 13.568   | 7709.568 | -25.3 | ±2.5 | 12 | D |
| 12 | 456  | 13.597   | 7709.597 | -33.0 | 3.3  | 11 | D |
| 13 | 466  | 14.611   | 7710.611 | -36.1 | 7.0  | 7  | D |
| 14 | 5163 | 1912 Apr | 5.678    | -23.3 | 1.7  | 23 | D |
| 15 | 5221 | May      | 3.582    | +10.6 | 2.1  | 24 | D |
| 16 | 5224 |          | 4.566    | + 2.1 | 3.1  | 23 | D |
| 17 | 5239 |          | 10.576   | -33.1 | 1.8  | 25 | D |

Phase RV plot compares with Ebbighasen, Publ. of D.A.O., Vol. 11, p. 268, 1963.  
 These observations fit the orbit of Parker (J.R.A.S. Can., 5, 377, 1911).

53 HD 98058  $\phi$  Leonis  $\alpha = 11^h 11^m 35^s$   $\delta = -3^\circ 06'$  A7 III-IV

|   |      |          |        |             |       |      |   |
|---|------|----------|--------|-------------|-------|------|---|
| 1 | 2504 | 1909 May | 17.647 | 2418444.647 | - 6.1 | ±7.0 | 3 |
| 2 | 2558 | Jun      | 10.575 | 8465.575    | -15.3 | 9.3  | 4 |
| 3 | 3491 | 1910 Apr | 9.605  | 8771.605    | +19.2 | 5.9  | 7 |
| 4 | 3545 | May      | 5.625  | 8797.625    | + 0.4 | 3.4  | 2 |
| 5 | 4180 | 1911 Feb | 23.834 | 9091.834    | +13.6 | 10.5 | 3 |
| 6 | 4187 |          | 24.703 | 9092.703    | - 2.5 | 5.5  | 3 |

The published range (+27 to -18) is indicative of a spectroscopic binary. A possible very long period variation exists. This star is a possible spectroscopic binary.

54 HD 98292 55 Ursae Majoris  $\alpha = 11^h 13^m 41^s$   $\delta = +38^\circ 44'$  A2V

|   |      |          |        |             |       |      |    |   |
|---|------|----------|--------|-------------|-------|------|----|---|
| 1 | 2267 | 1908 Dec | 27.878 | 2418303.878 | -11.5 | ±1.8 | 26 | J |
|---|------|----------|--------|-------------|-------|------|----|---|

|    |      |                 |          |       |      |     |   |                                 |
|----|------|-----------------|----------|-------|------|-----|---|---------------------------------|
| 2  | 2270 | 28.847          | 8304.847 | +30.5 | +5.9 | 5   | J |                                 |
| 3  | 2292 | 1909 Jan 7.849  | 8314.849 | +11.5 | 3.2  | 5   | J |                                 |
| 4  | 2335 | Feb 1.842       | 8339.842 | - 5.3 | 3.4  | 12  | J |                                 |
| 5  | 2347 | 6.754           | 8344.754 | + 5.2 | 5.2  | 10  | J |                                 |
| 6  | 2369 | 20.783          | 8358.783 | +10.6 | 6.3  | 6   | J |                                 |
| 7  | 2384 | 25.729          | 8363.729 | +12.2 |      | 1   | J | spectrum weak<br>one line       |
| 8  | 2390 | 28.796          | 8366.796 | - 1.3 | 7.9  | 6   | J |                                 |
| 9  | 2401 | Mar 7.753       | 8373.753 | - 0.3 | 5.7  | 7   | J |                                 |
| 10 | 2413 | 20.710          | 8386.710 | +19.0 | 5.7  | 6   | J |                                 |
| 11 | 2420 | 21.645          | 8387.645 | - 9.4 |      | 4   | J |                                 |
| 12 | 2433 | 22.722          | 8388.722 | + 4.7 |      | 1   | J |                                 |
| 13 | 2442 | 23.707          | 8389.707 | -10.0 | 5.1  | 6   | J |                                 |
| 14 | 4188 | 1911 Feb 24.727 | 9092.727 | -25.6 | 3.5  | 12  | J |                                 |
| 15 | 4199 | 27.722          | 9095.722 | -11.1 | 3.4  | 16  | J |                                 |
| 16 | 4217 | Mar 4.786       | 9100.786 | - 6.4 | 2.0  | 11  | J |                                 |
| 17 | 4224 | 6.726           | 9102.726 | -55.0 | 6.6  | 4   | J | spectrum and<br>comparison weak |
| 18 | 4233 | 10.750          | 9106.750 | -31.3 | 13.1 | 2.5 | J | comparison weak                 |
| 19 | 4242 | 13.782          | 9109.782 | - 6.4 | 3.1  | 11  | J |                                 |
| 20 | 4252 | 20.649          | 9116.649 | + 7.5 | 5.1  | 7   | J |                                 |
| 21 | 4262 | 21.755          | 9117.755 | - 8.4 | 7.6  | 9   | J |                                 |
| 22 | 4268 | 24.678          | 9120.678 | -32.1 | 4.7  | 8   | J |                                 |
| 23 | 4278 | 28.702          | 9124.702 | -11.7 | 13.5 | 4   | J |                                 |
| 24 | 4280 | 31.624          | 9127.624 | + 1.9 | 2.0  | 16  | J |                                 |

|    |      |                |          |       |      |    |   |               |
|----|------|----------------|----------|-------|------|----|---|---------------|
| 25 | 4287 | Apr 10.601     | 9137.601 | + 0.1 | ±3.1 | 6  | J | overexposed   |
| 26 | 4296 | 17.639         | 9144.639 | - 8.9 | 2.3  | 16 | J |               |
| 27 | 4302 | 21.623         | 9148.623 | -28.9 | 2.8  | 18 | J |               |
| 28 | 4304 | 23.633         | 9150.633 | - 6.3 | 1.7  | 21 | J |               |
| 29 | 4307 | 24.594         | 9151.594 | -12.4 | 3.2  | 17 | J |               |
| 30 | 4315 | 25.641         | 9152.641 | + 9.4 | 6.1  | 7  | J |               |
| 31 | 4321 | 26.589         | 9153.589 | -33.2 | 4.0  | 18 | J | weak plate    |
| 32 | 4332 | May 5.543      | 9162.543 | -10.8 | 5.8  | 7  | J |               |
| 33 | 4351 | 8.547          | 9165.547 | - 0.3 | 5.8  | 4  | J |               |
| 34 | 4357 | 9.544          | 9166.544 | -25.8 | 4.0  | 6  | J |               |
| 35 | 4363 | 10.578         | 9167.578 | - 1.7 | 4.2  | 7  | J |               |
| 36 | 4371 | 11.552         | 9168.552 | -20.7 | 3.8  | 10 | J |               |
| 37 | 4377 | 12.549         | 9169.549 | -15.2 | 2.4  | 14 | J |               |
| 38 | 4384 | 13.558         | 9170.558 | - 9.1 | 3.5  | 4  | J |               |
| 39 | 4398 | 19.569         | 9176.569 | -35.4 | 2.4  | 8  | J |               |
| 40 | 4411 | 24.576         | 9181.576 | -38.0 | 1.7  | 5  | J |               |
| 41 | 4427 | 26.578         | 9183.578 | + 5.9 | 7.3  | 4  | J |               |
| 42 | 5050 | 1912 Feb 8.793 | 9441.793 | -21.7 | 2.2  | 15 | J |               |
| 43 | 5077 | 15.832         | 9448.832 | - 9.4 | 7.0  | 9  | J |               |
| 44 | 5080 | 16.775         | 9449.775 | -19.8 | 2.9  | 10 | J | spectrum weak |
| 45 | 5086 | 17.766         | 9450.766 | - 6.7 | 1.4  | 28 | J |               |
| 46 | 5089 | 22.831         | 9455.831 | + 2.9 | 1.8  | 27 | J |               |
| 47 | 5096 | 23.829         | 9456.829 | -25.5 | 3.0  | 14 | J | mean of 2     |

|    |      |                |          |       |      |      |   |                 |
|----|------|----------------|----------|-------|------|------|---|-----------------|
| 48 | 5103 | Mar 10.777     | 9472.777 | -15.8 | +4.2 | 11   | J |                 |
| 49 | 5111 | 13.787         | 9475.787 | -35.8 | 3.0  | 23   | J |                 |
| 50 | 5117 | 16.783         | 9478.783 | - 5.8 | 2.2  | 26   | J |                 |
| 51 | 5126 | 18.770         | 9480.770 | -11.2 | 3.7  | 16   | J |                 |
| 52 | 5130 | 22.731         | 9484.731 | + 5.0 | 6.2  | 8    | J |                 |
| 53 | 5135 | 25.704         | 9487.704 | + 1.3 | 1.8  | 38   | J |                 |
| 54 | 5145 | 30.667         | 9492.667 | -14.7 | 2.4  | 18   | J |                 |
| 55 | 5153 | 1912 Apr 3.715 | 9496.715 | - 3.3 | 1.2  | 33.5 | J | comparison weak |
| 56 | 5157 | 4.663          | 9497.663 | - 1.9 | 8.0  | 8    | J |                 |
| 57 | 5168 | 10.667         | 9503.667 | -39.2 | 2.3  | 25   | J |                 |
| 58 | 5173 | 11.605         | 9504.605 | + 0.3 | 1.8  | 32   | J |                 |
| 59 | 5181 | 14.642         | 9507.642 | - 3.0 | 1.7  | 5    | J |                 |
| 60 | 5184 | 15.617         | 9508.617 | -45.1 | 3.2  | 20   | J |                 |
| 61 | 5191 | 20.621         | 9513.621 | -42.6 | 2.9  | 22   | J | overexposed     |
| 62 | 5198 | 21.619         | 9514.619 | - 6.1 | 2.1  | 36   | J |                 |
| 63 | 5202 | 23.592         | 9516.592 | -38.9 | 1.6  | 27   | J |                 |
| 64 | 5209 | 24.592         | 9517.592 | + 1.6 | 2.5  | 16   | J |                 |
| 65 | 5216 | 27.589         | 9520.589 | +37.3 | 4.9  | 11   | J | all lines poor  |
| 66 | 5220 | May 1.619      | 9524.619 | - 6.3 | 1.9  | 28   | J |                 |
| 67 | 5222 | 3.638          | 9526.638 | -34.8 | 3.0  | 17   | J |                 |
| 68 | 5225 | 4.620          | 9527.620 | + 5.7 | 3.3  | 24   | J |                 |
| 69 | 5230 | 8.617          | 9531.617 | -33.3 | 3.1  | 19   | J |                 |
| 70 | 5233 | 9.639          | 9532.639 | - 5.1 | 2.0  | 30   | J |                 |

|    |      |                 |             |       |      |      |   |
|----|------|-----------------|-------------|-------|------|------|---|
| 71 | 5240 | 10.626          | 9533.626    | - 7.9 | +2.0 | 23   | J |
| 72 | 5246 | 13.575          | 9536.575    | -26.9 | 3.8  | 14   | J |
| 73 | 5252 | 17.576          | 9540.576    | - 5.6 | 3.7  | 18   | J |
| 74 | 5257 | 18.568          | 9541.568    | -35.2 | 2.8  | 26   | J |
| 75 | 5277 | 30.576          | 9553.576    | - 0.2 | 3.0  | 10   | J |
| 76 | 5283 | 31.578          | 9554.578    | -38.9 | 1.8  | 19   | J |
| 77 | 5286 | Jun 1.597       | 9555.597    | + 6.4 | 2.0  | 33   | J |
| 78 | 5289 | 3.591           | 9557.591    | -27.9 | 1.8  | 25   | J |
| 79 | 5653 | 1913 Feb 12.771 | 9811.771    | - 3.5 | 5.7  | 7    | J |
| 80 | 5656 | 13.713          | 9812.713    | -37.5 | 3.4  | 15   | J |
| 81 | 5682 | Mar 11.660      | 9838.660    | -12.2 | 1.4  | 28   | J |
| 82 | 5689 | 15.682          | 9842.682    | - 3.3 | 2.6  | 17   | J |
| 83 | 5692 | 17.717          | 9844.717    | +15.4 | 6.3  | 8.5  | J |
| 84 | 5697 | 18.742          | 9845.742    | -10.4 | 6.0  | 8.5  | J |
| 85 | 5702 | 19.704          | 9846.704    | + 1.7 | 5.6  | 16   | J |
| 86 | 5717 | Apr 1.695       | 9859.695    | - 3.5 | 3.9  | 13   | J |
| 87 | 5738 | 19.675          | 9877.675    | +25.2 | 3.2  | 8.5  | J |
| 88 | 5753 | 29.557          | 9887.557    | - 9.0 | 2.9  | 25   | J |
| 89 | 5774 | May 3.612       | 9891.612    | -16.2 | 3.5  | 16   | J |
| 90 | 5788 | 10.618          | 9898.618    | + 1.9 | 4.5  | 10.5 | J |
| 91 | 6671 | 1915 Apr 14.674 | 2420602.674 | + 1.6 | 4.3  | 20.5 | J |
| 92 | 6672 | 14.715          | 0602.715    | +10.6 | 4.2  | 18   | J |
| 93 | 6674 | 15.608          | 0603.608    | - 1.0 | 4.2  | 17.5 | J |

|     |      |                 |          |       |      |      |   |               |
|-----|------|-----------------|----------|-------|------|------|---|---------------|
| 94  | 6675 | 15.695          | 0603.695 | - 7.8 | +2.8 | 16   | J | weak          |
| 95  | 6676 | 15.762          | 0603.762 | - 4.0 | 2.1  | 14   | J |               |
| 96  | 6677 | 15.808          | 0603.808 | -29.5 | 4.9  | 8    | J |               |
| 97  | 6679 | 29.581          | 0617.581 | - 2.9 | 2.8  | 21   | J |               |
| 98  | 6680 | 29.674          | 0617.674 | - 7.9 | 4.5  | 20   | J |               |
| 99  | 6681 | 29.748          | 0617.748 | - 1.2 | 3.5  | 11   | J | weak          |
| 100 | 6931 | 1916 Jan 22.815 | 0885.815 | -12.2 | 2.3  | 31   | J |               |
| 101 | 7008 | Apr 28.576      | 0981.576 | -31.1 | 3.0  | 23.5 | J |               |
| 102 | 7009 | 28.611          | 0981.611 | -22.7 | 3.5  | 18.5 | J |               |
| 103 | 7010 | 28.647          | 0981.647 | -34.2 | 2.4  | 19   | J |               |
| 104 | 7011 | 28.684          | 0981.684 | -17.3 | 2.2  | 21   | J |               |
| 105 | 7012 | 28.719          | 0981.719 | -22.8 | 2.6  | 11   | J | spectrum weak |
| 106 | 7015 | May 7.581       | 0990.581 | +24.1 | 4.1  | 10   | J |               |
| 107 | 7016 | 7.660           | 0990.660 | +15.2 | 3.8  | 12   | J |               |
| 108 | 7017 | 7.683           | 0990.683 | + 0.7 | 2.4  | 12   | J |               |
| 109 | 7018 | 7.712           | 0990.712 | - 4.7 | 7.5  | 8    | J | weak          |
| 110 | 7021 | 8.565           | 0991.565 | -32.3 | 3.8  | 19   | J |               |
| 111 | 7026 | 9.554           | 0992.554 | + 4.5 | 3.3  | 25   | J |               |

These velocities are published for what they may be worth. The plates should be remeasured on an oscilloscope measuring engine. There is some evidence of an ultra short period variation (ie. April 15 and May 7, 1915). If this is so then Henroteau's period of 2.5 days may be a beat phenomena.

HD 100889

$\alpha = 11^h 31^m 37^s$

$\delta = -9^\circ 15'$

B9V

|    |      |                 |             |       |       |     |   |                                 |
|----|------|-----------------|-------------|-------|-------|-----|---|---------------------------------|
| 1  | 2441 | 1909 Mar 23.681 | 2418389.681 | +12.4 | *11.3 | 2   | J |                                 |
| 2  | 3501 | 1910 Apr 10.660 | 8772.660    | +23.0 | 12.3  | 2.5 | J |                                 |
| 3  | 3518 | 13.647          | 8775.647    | + 0.5 | 1.9   | 2   | J |                                 |
| 4  | 3538 | May 4.648       | 8796.648    | -16.1 | 5.4   | 2   | J |                                 |
| 5  | 3551 | 6.626           | 8798.626    | +24.2 | 5.4   | 2   | J |                                 |
| 6  | 4189 | 1911 Feb 24.751 | 9092.751    | +17.4 | 8.2   | 3   | J |                                 |
| 7  | 4225 | Mar 6.755       | 9102.755    | +41.8 | 0.6   | 1.5 | J | spectrum and<br>comparison weak |
| 8  | 4234 | 10.775          | 9106.775    | -19.5 | 6.1   | 4   | J |                                 |
| 9  | 4297 | Apr 17.682      | 9144.682    | - 3.4 | 6.7   | 2   | J |                                 |
| 10 | 4308 | 24.631          | 9151.631    | +35.3 | 0.3   | 2   | J |                                 |
| 11 | 4322 | 26.637          | 9153.637    | - 3.0 | 8.6   | 1.5 | J |                                 |
| 12 | 4333 | May 5.572       | 9162.572    | -20.7 | 7.1   | 2   | J |                                 |
| 13 | 4352 | 8.573           | 9165.573    | - 7.8 | 9.2   | 1.5 | J |                                 |
| 14 | 4378 | 12.578          | 9169.578    | -11.1 | 3.7   | 3.5 | J |                                 |
| 15 | 4385 | 13.596          | 9170.596    | -11.9 | 8.5   | 4   | J |                                 |
| 16 | 4389 | 15.566          | 9172.566    | -13.4 | 7.1   | 3.5 | J |                                 |
| 17 | 5139 | 1912 Mar 26.666 | 9488.666    | -15.4 | 3.7   | 4.5 | J | weak                            |
| 18 | 5203 | Apr 23.634      | 9516.634    | +17.9 | 6.9   | 2.5 | J |                                 |
| 19 | 5258 | May 18.612      | 9541.612    | +28.9 | 12.3  | 2   | J |                                 |
| 20 | 5297 | Jun 5.570       | 9559.570    | +11.4 | 5.3   | 4.5 | J |                                 |
| 21 | 5300 | 6.585           | 9560.585    | -17.6 | 0.7   | 2.5 | J |                                 |
| 22 | 5304 | 7.584           | 9561.584    | +15.3 | 8.6   | 3.5 | J |                                 |
| 23 | 5312 | 9.586           | 9563.586    | +53.7 | 20.1  | 2.5 | J | spectrum weak                   |

|    |      |                 |          |       |      |     |   |               |
|----|------|-----------------|----------|-------|------|-----|---|---------------|
| 24 | 5696 | 1913 Mar 18.688 | 9845.688 | -15.1 | +9.2 | 3.5 | J | poor spectrum |
| 25 | 5707 | 22.702          | 9849.702 | +29.0 | 4.0  | 3   | J | spectrum weak |
| 26 | 5716 | Apr 1.653       | 9859.653 | -11.5 | 6.6  | 4.5 | J |               |
| 27 | 5726 | 16.612          | 9874.612 | +13.0 | 6.4  | 3.5 | J |               |
| 28 | 5732 | 17.612          | 9875.612 | +12.4 | 10.2 | 3   | J |               |
| 29 | 5737 | 19.627          | 9877.627 | +18.0 | 6.9  | 5.5 | J |               |
| 30 | 5742 | 20.621          | 9878.621 | +28.5 | 4.6  | 2.5 | J |               |
| 31 | 5745 | 21.633          | 9879.633 | -25.0 | 3.0  | 3.5 | J |               |
| 32 | 5749 | 23.623          | 9881.623 | +16.0 | 3.3  | 1.5 | J |               |
| 33 | 5754 | 29.604          | 9887.604 | +1.9  | 7.4  | 5   | J |               |
| 34 | 5759 | 30.564          | 9888.564 | +13.3 | 3.1  | 3   | J |               |
| 35 | 5764 | May 1.560       | 9889.560 | +14.6 | 3.3  | 3.5 | J |               |
| 36 | 5769 | 2.559           | 9890.559 | +20.3 | 8.1  | 2.5 | J |               |
| 37 | 5773 | 3.561           | 9891.561 | -6.0  | 8.3  | 4.5 | J |               |
| 38 | 5781 | 8.566           | 9896.566 | -6.9  | 1.1  | 2.5 | J |               |
| 39 | 5785 | 9.566           | 9897.566 | -16.6 | 12.3 | 3.5 | J |               |
| 40 | 5787 | 10.570          | 9898.571 | +1.0  | 10.6 | 2.5 | J |               |
| 41 | 5792 | 11.564          | 9899.564 | -5.0  | 10.3 | 5.5 | J |               |
| 42 | 5802 | 19.568          | 9907.568 | -5.4  | 1.8  | 5   | J |               |
| 43 | 5804 | 20.568          | 9908.568 | -6.0  | 4.2  | 7   | J |               |
| 44 | 5806 | 24.561          | 9912.561 | -26.4 | 7.1  | 3   | J |               |
| 45 | 5811 | 25.613          | 9913.613 | +17.2 | 11.1 | 5.5 | J |               |
| 46 | 5813 | 28.592          | 9916.592 | -6.4  | 5.3  | 6   | J |               |

|    |      |                 |             |       |      |     |   |                 |
|----|------|-----------------|-------------|-------|------|-----|---|-----------------|
| 47 | 6161 | 1914 Jan 13.811 | 2420146.811 | - 5.4 | ±2.8 | 4   | J | spectrum weak   |
| 48 | 6191 | Feb 24.813      | 0188.813    | + 7.8 | 9.2  | 4   | J |                 |
| 49 | 6202 | 27.763          | 0191.763    | +18.9 | 9.3  | 5   | J |                 |
| 50 | 6208 | Mar 11.767      | 0203.767    | -44.7 | 25.3 | 3   | J | spectrum weak   |
| 51 | 6223 | 20.729          | 0212.729    | -22.3 | 1.1  | 3   | J | spectrum weak   |
| 52 | 6225 | 23.712          | 0215.712    | + 9.7 | 6.9  | 3.5 | J |                 |
| 53 | 6246 | Apr 13.669      | 0236.669    | -23.8 | 15.1 | 3   | J |                 |
| 54 | 6262 | May 1.625       | 0254.625    | -16.7 | 3.6  | 6   | J |                 |
| 55 | 6266 | 2.561           | 0255.561    | - 2.4 | 8.2  | 6   | J |                 |
| 56 | 6277 | 9.561           | 0262.561    | -26.7 | 3.0  | 6.5 | J |                 |
| 57 | 6283 | 14.588          | 0267.588    | -22.8 | 5.8  | 3.5 | J | spectrum weak   |
| 58 | 6286 | 15.582          | 0268.582    | +10.8 | 12.4 | 6.5 | J |                 |
| 59 | 6656 | 1915 Mar 9.811  | 0566.811    | - 0.2 | 9.5  | 3   | J | weak            |
| 60 | 6664 | 13.762          | 0570.762    | -23.5 |      | 2   | J | weak (one line) |
| 61 | 6668 | Apr 8.603       | 0596.603    | +26.4 | 2.7  | 2   | J | weak            |

This star appears to be a definite spectroscopic binary. These observations suggest a period of the order of 150 days. Further observations are needed.

| HD 103287 |      | δ Ursae Majoris | α = 11 <sup>h</sup> 48 <sup>m</sup> 34 <sup>s</sup> | δ = +54° 15'           | AOV             |
|-----------|------|-----------------|-----------------------------------------------------|------------------------|-----------------|
| 1         | 2324 | 1909 Jan 24.889 | 2418331.889 - 9.3                                   | ±2.2 11                | B               |
| 2         | 2421 | Mar 21.664      | 8387.664 -63.2                                      | 3.3 2.5 + 72.0 9.2 2.5 | B Double Lines? |

Four more spectra taken in 1909 remain unmeasured. This star is definitely a spectroscopic binary according

to the observations of Mellor (Publ. Up. Mich. 3, 71, 1917). Plate 2421 was measured both as single and as double by Baker. Inspection of the plate on both the null projection engine and the Grant oscilloscopic engine reveals the spectrum to be double and therefore the double measures are quoted.

HD 103578      95 Leonis       $\alpha = 11^h 50^m 32^s$        $\delta = +16^\circ 12'$       A3V

A total of 102 velocities exist for the epoch 1912 to 1916. When plotted on the period of Struve and Morgan (Ap. J. 66, 135, 1927) they show evidence for a possible third body in the system as well as a need for a slight adjustment of the period. These velocities will be published separately in connection with a more extensive investigation incorporating recent observations.

HD 104321       $\pi$  Virginis       $\alpha = 11^h 55^m 45^s$        $\delta = +7^\circ 10'$       A4V

1 1315 1908 Apr 16.689 2418048.689 + 9.66  $\pm 4.4$  5 S

HD 105625       $\gamma$  Corvi       $\alpha = 12^h 10^m 40^s$        $\delta = -16^\circ 59'$       B8III

1 4269 1911 Mar 24.707 2419120.707 - 0.9  $\pm 4.8$  6 D

2 6678 1915 Apr 23.734 2420611.734 - 8.4 1.9 8 D

3 6688 May 8.564 0626.564 + 1.8 2.8 10 D

4 6690 10.698 0628.698 +10.9 1.8 5.5 D

5 6693 13.567 0631.567 +20.1 3.0 2.5 D

6 6694 15.572 0633.572 -12.3 3.2 8.5 D

7 6696 19.703 0637.703 - 6.2 3.8 4 D Double

8 6698 21.574 0639.574 + 2.4 3.0 7 D

9 6701 24.590 0642.590 - 9.9 6.5 8 D

10 7001 1916 Apr 18.654 0972.654 - 7.4 1.7 10 D

Mean - 3.0

These velocities together with the published velocities show a range of +20 to -20. In view of the early spectral type we consider it unlikely that this star is a spectroscopic binary.

| HD 107750 |      | 12 Comae Berenices $\alpha = 12^h 17^m 29^s$ |             | $\delta = +26^\circ 24'$ |           | G0III-IV+A3V |                                |
|-----------|------|----------------------------------------------|-------------|--------------------------|-----------|--------------|--------------------------------|
| 1         | 2240 | 1908 Nov 30.929                              | 2418276.929 | +24.7                    | $\pm 2.2$ | 10           | J                              |
| 2         | 2271 | Dec 28.902                                   | 8304.902    | +15.6                    | 1.8       | 5            | J                              |
| 3         | 2371 | 1909 Feb 20.868                              | 8358.868    | -30.8                    | 2.8       | 12           | J                              |
| 4         | 2415 | Mar 20.766                                   | 8386.766    | -26.0                    | 2.8       | 12           | J                              |
| 5         | 2434 | 22.765                                       | 8388.765    | -31.8                    | 2.6       | 14           | J                              |
| 6         | 2443 | 23.733                                       | 8389.733    | -23.1                    | 2.6       | 10           | J                              |
| 7         | 2454 | 26.756                                       | 8392.756    | -14.3                    | 4.1       | 9            | J                              |
| 8         | 2459 | 31.686                                       | 8397.686    | -19.6                    | 2.7       | 23           | J                              |
| 9         | 2466 | Apr 10.658                                   | 8407.658    | -12.5                    | 2.8       | 12           | J                              |
| 10        | 2485 | May 11.658                                   | 8438.658    | -21.1                    | 4.0       | 12           | J                              |
| 11        | 3443 | 1910 Mar 10.795                              | 8741.795    | -20.5                    | 4.0       | 15           | J weak                         |
| 12        | 3456 | 18.705                                       | 8749.705    | -21.8                    | 12.0      | 5            | J comparison weak              |
| 13        | 3460 | 20.692                                       | 8751.692    | -16.5                    | 10.5      | 2            | J very weak                    |
| 14        | 3464 | 21.738                                       | 8752.738    | -30.3                    | 5.5       | 7            | J                              |
| 15        | 3475 | 26.719                                       | 8757.719    | -40.8                    | 11.1      | 2            | J weak                         |
| 16        | 3481 | Apr 1.684                                    | 8763.684    | -16.3                    | 5.5       | 9            | J weak spectrum and comparison |
| 17        | 3488 | 8.622                                        | 8770.622    | -23.8                    | 9.8       | 8            | J                              |
| 18        | 3492 | 9.635                                        | 8771.635    | -27.8                    | 3.7       | 12           | J                              |

|    |      |                 |          |       |      |    |                   |
|----|------|-----------------|----------|-------|------|----|-------------------|
| 19 | 3509 | 12.635          | 8774.635 | -28.4 | ±2.7 | 17 | J                 |
| 20 | 3527 | 21.589          | 8783.589 | -20.7 | 4.6  | 15 | J                 |
| 21 | 3528 | 21.618          | 8783.618 | -26.0 | 2.7  | 22 | J Lumiere X plate |
| 22 | 4190 | 1911 Feb 24.776 | 9092.776 | -19.3 | 2.3  | 24 | D mean of 2       |
| 23 | 4200 | 27.747          | 9095.747 | +14.5 | 2.5  | 16 | D                 |
| 24 | 4235 | Mar 10.804      | 9106.804 | +11.1 | 2.5  | 17 | D                 |
| 25 | 4243 | 13.812          | 9109.812 | + 3.1 | 3.5  | 21 | D                 |
| 26 | 4253 | 20.681          | 9116.681 | + 5.8 | 2.9  | 23 | D                 |
| 27 | 4263 | 21.797          | 9117.797 | -     | -    | -  | D plate missing   |
| 28 | 4283 | Apr 9.730       | 9136.730 | -14.6 | 3.1  | 13 | D                 |
| 29 | 4288 | 10.642          | 9137.642 | -20.3 | 3.7  | 15 | D                 |
| 30 | 4298 | 17.715          | 9144.715 | -17.8 | 2.0  | 16 | D                 |
| 31 | 4305 | 23.674          | 9150.674 | -18.3 | ± 8  | 12 | D                 |
| 32 | 4309 | 24.662          | 9151.662 | -26.  | j    | 7  | D                 |
| 33 | 4316 | 25.680          | 9152.680 | -26.0 | 2.8  | 17 | D                 |
| 34 | 4323 | 26.676          | 9153.676 | -24.7 | 5.8  | 6  | D                 |
| 35 | 4328 | May 4.667       | 9161.667 | -20.1 | 2.2  | 17 | D                 |
| 36 | 4334 | 5.599           | 9162.599 | -26.8 | 3.2  | 16 | D                 |
| 37 | 4343 | 6.638           | 9163.638 | -30.2 | 1.7  | 15 | D                 |
| 38 | 4353 | 8.606           | 9165.606 | -27.1 | 1.5  | 18 | D                 |
| 39 | 4358 | 9.575           | 9166.575 | -34.4 | 1.6  | 15 | D                 |
| 40 | 4364 | 10.608          | 9167.608 | -29.0 | 2.9  | 17 | D                 |
| 41 | 4373 | 11.615          | 9168.615 | -27.2 | 4.4  | 12 | D                 |

|    |      |                 |          |       |      |    |           |
|----|------|-----------------|----------|-------|------|----|-----------|
| 42 | 4379 | 12.608          | 9169.608 | -29.4 | +2.2 | 17 | D         |
| 43 | 4386 | 13.635          | 9170.635 | -29.0 | 2.7  | 14 | D         |
| 44 | 4390 | 16.605          | 9172.605 | - 0.1 | 3.2  | 7  | D         |
| 45 | 4400 | 20.651          | 9177.651 | -17.9 | 2.4  | 15 | D         |
| 46 | 4407 | 21.635          | 9178.635 | -28.2 | 1.6  | 14 | D         |
| 47 | 4412 | 24.617          | 9181.617 | -24.2 | 3.9  | 12 | D         |
| 48 | 4419 | 25.564          | 9182.564 | -21.0 | 1.6  | 14 | D         |
| 49 | 4428 | 26.619          | 9183.619 | -30.8 | 3.0  | 8  | D         |
| 50 | 4434 | 27.568          | 9184.568 | -20.6 | 2.6  | 15 | D         |
| 51 | 4442 | 28.613          | 9185.613 | -26.6 | 3.3  | 11 | D         |
| 52 | 5118 | 1912 Mar 16.822 | 9478.822 | - 6.0 | 5.1  | 12 | D         |
| 53 | 5127 | 18.834          | 9480.834 | + 6.4 | 2.4  | 16 | D         |
| 54 | 5131 | 22.801          | 9484.801 | +14.0 | 1.4  | 29 | D seed 23 |
| 55 | 5136 | 25.756          | 9487.756 | +15.4 | 1.6  | 20 | D         |
| 56 | 5140 | 26.713          | 9488.713 | +19.9 | 1.5  | 23 | D         |
| 57 | 5146 | 30.713          | 9492.713 | +12.8 | 1.6  | 24 | D         |
| 58 | 5154 | Apr 3.772       | 9496.772 | +15.9 | 1.5  | 27 | D seed 23 |
| 59 | 5158 | 4.710           | 9497.710 | +13.8 | 1.8  | 19 | D         |
| 60 | 5169 | 10.723          | 9503.723 | + 6.8 | 6.8  | 23 | D         |
| 61 | 5127 | 11.695          | 9504.695 | +11.7 | 3.1  | 14 | D         |
| 62 | 5182 | 14.694          | 9507.694 | + 3.8 | 3.7  | 12 | D         |
| 63 | 5185 | 15.694          | 9508.694 | + 0.2 | 2.8  | 14 | D         |
| 64 | 5192 | 20.663          | 9513.663 | + 2.0 | 2.4  | 22 | D         |

|    |      |           |          |       |      |    |                |
|----|------|-----------|----------|-------|------|----|----------------|
| 65 | 5199 | 21.667    | 9514.667 | + 4.2 | *1.7 | 18 | D              |
| 66 | 5205 | 23.700    | 9516.700 | + 5.7 | 1.7  | 19 | D              |
| 67 | 5210 | 24.631    | 9517.631 | + 7.4 | 1.5  | 18 | D              |
| 68 | 5217 | 27.634    | 9520.634 | - 5.2 | 2.5  | 17 | D              |
| 69 | 5223 | May 3.703 | 9526.703 | - 0.2 | 2.2  | 8  | D              |
| 70 | 5226 | 4.667     | 9527.667 | -15.8 | 3.1  | 17 | D              |
| 71 | 5231 | 8.678     | 9531.678 | -22.6 | 2.9  | 14 | D              |
| 72 | 5234 | 9.684     | 9532.684 | -27.6 | 2.3  | 20 | D              |
| 73 | 5247 | 13.640    | 9536.640 | -35.6 | 3.7  | 16 | D              |
| 74 | 5251 | 16.665    | 9539.665 | -32.1 | 3.4  | 14 | D              |
| 75 | 5253 | 17.649    | 9540.649 | -26.5 | 0.8  | 24 | D seed 23      |
| 76 | 5260 | 20.569    | 9543.569 | -30.3 | 1.8  | 16 | D              |
| 77 | 5273 | 27.601    | 9550.601 | -30.1 | 2.0  | 15 | D              |
| 78 | 5278 | 30.620    | 9553.620 | -32.1 | 1.9  | 14 | D              |
| 79 | 5284 | 31.627    | 9554.627 | -28.7 | 1.6  | 23 | D              |
| 80 | 5290 | Jun 3.635 | 9557.635 | -27.4 | 2.3  | 17 | D              |
| 81 | 5298 | 5.615     | 9559.615 | -30.1 | 1.6  | 12 | D              |
| 82 | 5308 | 8.592     | 9562.592 | -29.3 | 1.8  | 26 | D              |
| 83 | 5320 | 11.572    | 9565.572 | -21.8 | 1.3  | 20 | D              |
| 84 | 5326 | 20.592    | 9574.592 | -27.5 | 1.8  | 16 | D              |
| 85 | 5332 | 28.605    | 9582.605 | -17.7 | 2.1  | 11 | D              |
| 86 | 5336 | 30.606    | 9584.606 | -17.6 | 2.9  | 8  | D underexposed |
| 87 | 5338 | Jul 2.576 | 9586.576 | -15.6 | 2.5  | 12 | D              |

|     |      |                |          |       |      |      |                |
|-----|------|----------------|----------|-------|------|------|----------------|
| 88  | 5341 | 6.581          | 9590.581 | -20.4 | ±3.6 | 13   | D              |
| 89  | 5352 | 12.610         | 9596.610 | -20.4 | 2.9  | 8    | D              |
| 90  | 5354 | 14.590         | 9598.590 | -20.0 | 2.6  | 15   | D              |
| 91  | 5548 | Nov 3.942      | 9710.942 | -21.4 | 6.0  | 4    | D underexposed |
| 92  | 5678 | 1913 Mar 6.807 | 9833.807 | +13.1 | 1.9  | 22   | D              |
| 93  | 5684 | 11.751         | 9838.751 | +10.7 | 1.5  | 20   | D              |
| 94  | 5693 | 17.783         | 9844.783 | + 3.9 | 2.0  | 23   | D              |
| 95  | 5698 | 18.789         | 9845.789 | + 5.6 | 2.2  | 16   | D              |
| 96  | 5712 | 28.803         | 9855.803 | +14.9 | 2.1  | 23   | D              |
| 97  | 5719 | Apr 1.788      | 9859.788 | -13.8 | 4.2  | 6.5  | D underexposed |
| 98  | 5723 | 7.774          | 9865.774 | +11.4 | 2.3  | 23   | D dust lines   |
| 99  | 5728 | 16.725         | 9874.725 | +17.8 | 2.2  | 22   | D              |
| 100 | 5734 | 17.754         | 9875.754 | +13.8 | 1.6  | 19   | D              |
| 101 | 5742 | 20.746         | 9878.746 | +22.3 | 2.0  | 22.5 | D              |
| 102 | 5746 | 21.701         | 9879.701 | +16.2 | 2.7  | 18.5 | D              |
| 103 | 5751 | 23.765         | 9881.765 | +13.3 | 3.9  | 9    | D underexposed |
| 104 | 5756 | 29.724         | 9887.724 | +12.1 | 3.0  | 22   | D              |
| 105 | 5261 | 30.687         | 9888.687 | +11.5 | 2.7  | 22   | D              |
| 106 | 5766 | 1913 May 1.681 | 9889.681 | +17.4 | 2.4  | 23   | D              |
| 107 | 5771 | 2.692          | 9890.692 | + 9.2 | 2.0  | 17.5 | D              |
| 108 | 5778 | 7.712          | 9895.712 | +13.6 | 3.6  | 14   | D              |
| 109 | 5783 | 8.696          | 9896.696 | +13.8 | 3.5  | 13   | D              |
| 110 | 5789 | 10.665         | 9898.665 | + 6.3 | 3.4  | 10.5 | D              |

|     |      |                 |             |       |      |      |   |
|-----|------|-----------------|-------------|-------|------|------|---|
| 111 | 5794 | 11.678          | 9899.678    | +11.8 | +2.6 | 14   | D |
| 112 | 6230 | 1914 Mar 24.815 | 2420216.815 | -26.3 |      | 2    | D |
| 113 | 6237 | Apr 5.806       | 0228.806    | + 8.2 | 1.6  | 15   | D |
| 114 | 6243 |                 | 0235.794    | +14.8 | 2.3  | 14   | D |
| 115 | 6259 |                 | 0253.669    | +17.9 | 2.5  | 16   | D |
| 116 | 6268 | May 2.663       | 0255.663    | +13.5 | 3.1  | 18.5 | D |
| 117 | 6273 |                 | 0261.705    | + 7.0 | 2.8  | 18.5 | D |
| 118 | 6300 |                 | 0270.664    | +13.5 | 2.6  | 11   | D |
| 119 | 6334 |                 | 0280.612    | +14.6 | 1.8  | 15.5 | D |

underexposed  
one line only

The observations about periastron in 1912 agree well with the Lick observations about periastron in 1935 (Vinterhansen, LOB 19, 101, 1940).

1 74

| HD 109485 |      | 23 Comae Berenices $\alpha = 12^h 29^m 52^s$ |             | $\delta = +23^\circ 11'$ |      | AO1V. |           |
|-----------|------|----------------------------------------------|-------------|--------------------------|------|-------|-----------|
|           |      |                                              |             |                          |      | B, J  | mean of 2 |
| 1         | 1251 | 1908 Mar 12.767                              | 2418013.767 | -19.0                    | +3.6 | 9     |           |
| 2         | 1337 | Apr 12.646                                   | 8044.646    | -14.1                    | 6.4  | 5     | J         |
| 3         | 1374 | May 20.594                                   | 8082.594    | -25.7                    | 3.7  | 7     | J         |
| 4         | 1400 | 25.576                                       | 8087.576    | - 1.2                    | 5.1  | 7     | J         |
| 5         | 2372 | 1909 Feb 20.914                              | 8358.914    | -22.7                    | 3.3  | 6     | J         |
| 6         | 2403 | Mar 7.846                                    | 8373.846    | -25.0                    | 2.7  | 6     | J         |
| 7         | 4201 | 1911 Feb 27.774                              | 9095.774    | -19.9                    | 4.3  | 5     | J         |
| 8         | 4254 | Mar 20.710                                   | 9116.710    | -27.0                    | 6.0  | 6     | J         |
| 9         | 5170 | 1912 Apr 10.760                              | 9503.760    | -20.8                    | 3.2  | 13    | J         |
|           |      |                                              |             | Mean -19.5               |      |       |           |

A great many published velocities exist for this star. From a long series obtained at Ottawa, Harper (Publ. D.O. 4, 289, 1919) concludes that this star is an unresolved spectroscopic binary. Our mean is therefore provisional.

HD 110411       $\rho$  Virginis       $\alpha = 12^h 36^m 49^s$        $\delta = +10^\circ 47'$       AOV

1 1266 1908 Mar 21.765 2418022.765 -31.11  $\pm 12.2$  3 J

HD 114330       $\theta$  Virginis       $\alpha = 13^h 4^m 46^s$        $\delta = -5^\circ 00'$       A1V

1 4226 1911 Mar 6.788 2419102.788 - 0.6  $\pm 2.0$  13 J

2 4255 20.747 9116.747 -12.5 4.1 6 J

3 4270 24.642 9120.642 - 7.2 1.2 10 J

4 4299 Apr 17.751 9144.751 - 6.4 1.1 21 J

5 4310 24.694 9151.694 - 8.6 2.6 10 J

6 4317 25.714 9152.714 + 2.2 5.3 7 J

This star is a spectroscopic binary with a period of 13.6 years (Wagman, Bull. A.A.S. 1, 2, 1969). Observations are continuing and will be discussed in a combined astrometric-spectroscopic analysis.

HD 116842      80 Ursae Majoris       $\alpha = 13^h 21^m 13^s$        $\delta = +55^\circ 31'$       A5V

1 1582 1908 Jul 4.592 2418127.592 -16.6  $\pm 6.1$  6 J

2 1583 4.615 8127.615 -55.6 8.1 4 J

3 1588 5.575 8128.575 -10.7 3.8 6 J

4 1589 5.594 8128.594 -19.5 3.6 4 J

5 1603 8.567 8131.567 -10.7 4.7 3 J

6 1604 8.595 8131.595 -47.3 2 J 1 line only

Abt (Ap. J. suppl. 11, 429, 1965) tentatively concludes that this star is not a spectroscopic binary.

| i5 | HD 118232 | 24 Canum Venaticorum | $\alpha = 13^h 30^m 22^s$ | $\delta = +49^\circ 32'$ | A4V  |
|----|-----------|----------------------|---------------------------|--------------------------|------|
| 7  | 1659      | 19.585               | 8142.585                  | -46.0 $\pm$ 12.8         | 4    |
| 8  | 1660      | 19.614               | 8142.614                  | -34.8                    | 4    |
| 9  | 1671      | 22.570               | 8145.570                  | -14.9                    | 4    |
| 10 | 1672      | 22.594               | 8145.594                  | -10.0                    | 5    |
| 11 | 2436      | 1909 Mar 22.818      | 8388.818                  | -13.3                    | 3    |
|    |           |                      | Mean                      | -23.6                    |      |
| 1  | 6251      | 1914 Apr 17.815      | 2420240.815               | + 2.4 $\pm$ 6.2          | 3    |
| 2  | 6256      | 27.769               | 0250.769                  | -41.0                    | 8.0  |
| 3  | 6260      | 30.756               | 0253.756                  | -21.1                    | 6.7  |
| 4  | 6269      | May 2.711            | 0255.711                  | -17.5                    | 9.3  |
| 5  | 6279      | 9.690                | 0262.690                  | -21.4                    | 5.2  |
| 6  | 6285      | 14.756               | 0267.756                  | +10.6                    | 7.3  |
| 7  | 6288      | 15.711               | 0268.711                  | - 7.0                    | 10.5 |
| 8  | 6293      | 16.617               | 0269.617                  | -42.3                    | 4.7  |
| 9  | 6301      | 17.733               | 0270.733                  | -17.5                    | 5.2  |
| 10 | 6304      | 18.647               | 0271.647                  | -14.9                    | 4.6  |
| 11 | 6309      | 19.622               | 0272.622                  | -29.9                    | 3.6  |
| 12 | 6314      | 20.674               | 0273.674                  | -21.5                    | 2.8  |
| 13 | 6319      | 21.713               | 0274.713                  | -19.9                    | 5.8  |

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|    |      |           |          |       |       |     |                                   |
|----|------|-----------|----------|-------|-------|-----|-----------------------------------|
| 14 | 6322 | 22.674    | 0275.674 | - 7.9 | ±6.1  | 3.5 | D                                 |
| 15 | 6323 | 24.693    | 0277.693 | +33.2 | 2.2   | 3   | D                                 |
| 16 | 6327 | 25.701    | 0278.701 | - 4.8 | 3.2   | 6   | D                                 |
| 17 | 6331 | 26.658    | 0279.658 | -12.0 | 6.5   | 6.5 | D                                 |
| 18 | 6335 | 27.612    | 0280.612 | -11.6 | 10.8  | 3   | D                                 |
| 19 | 6337 | 28.709    | 0281.709 | -12.5 | 4.0   | 2   | D                                 |
| 20 | 6339 | 30.651    | 0283.651 | -28.2 | 4.0   | 8   | D                                 |
| 21 | 6349 | Jun 2.663 | 0286.663 | -10.6 | 4.9   | 5   | D                                 |
| 22 | 6369 | 15.592    | 0299.592 | -26.1 | 5.8   | 4   | D                                 |
| 23 | 6370 | 16.585    | 0300.585 | - 2.8 | 7.5   | 9   | D                                 |
| 24 | 6378 | 23.588    | 0307.588 | -13.1 | 4.6   | 4   | D                                 |
| 25 | 6383 | Jul 2.610 | 0316.610 | - 5.0 | 5.7   | 4   | D                                 |
| 26 | 6387 | 3.597     | 0317.597 | Mean  | -15.3 |     | comparison lacking<br>on one side |

Even though there is a range of +33 km/sec. to -42 km/sec., efforts to find a period have failed and we conclude that this star is probably not a spectroscopic binary.

| HD 120315 |      |          |        | n Ursae Majoris | $\alpha = 13^h 43^m 36^s$ | $\delta = +49^0 49'$ | B3V |             |
|-----------|------|----------|--------|-----------------|---------------------------|----------------------|-----|-------------|
| 1         | 2423 | 1909 Mar | 21.700 | 2418387.700     | -21.2                     | $\pm 3.7$            | 5   | B           |
| 2         | 2446 |          | 23.809 | 8389.809        | -26.1                     | 2.2                  | 12  | B mean of 2 |
| 3         | 2544 | May      | 31.649 | 8458.649        | -30.0                     | 3.9                  | 5   | D           |
| 4         | 2562 | Jun      | 11.578 | 8469.578        | -17.4                     | 2.2                  | 10  | D           |
| 5         | 2564 |          | 11.628 | 8469.628        | -19.3                     | 5.7                  | 7   | D           |



|    |      |           |          |       |      |     |   |
|----|------|-----------|----------|-------|------|-----|---|
| 20 | 4289 | 10.686    | 9137.686 | + 1.4 | ±5.2 | 6   | D |
| 21 | 4300 | 17.801    | 9144.801 | -23.4 | 2.8  | 4   | D |
| 22 | 4311 | 24.737    | 9151.737 | - 6.1 | 5.1  | 3   | D |
| 23 | 4318 | 25.767    | 9152.767 | + 4.0 | 3.1  | 5   | D |
| 24 | 4324 | 26.734    | 9153.734 | -16.8 | 5.7  | 5   | D |
| 25 | 4329 | May 4.734 | 9161.734 | + 3.9 | 3.4  | 5   | D |
| 26 | 4335 | 5.627     | 9162.627 | - 9.1 | 1.9  | 5   | D |
| 27 | 4344 | 6.672     | 9163.672 | - 9.8 | 4.1  | 3   | D |
| 28 | 4354 | 8.641     | 9165.641 | + 2.8 | 7.2  | 3   | D |
| 29 | 4359 | 9.606     | 9166.606 | -11.9 | 8.5  | 5   | D |
| 30 | 4365 | 10.641    | 9167.641 | - 3.6 | 9.7  | 3   | D |
| 31 | 4372 | 11.580    | 9168.580 | -24.8 | 5.7  | 3   | D |
| 32 | 4380 | 12.638    | 9169.638 | +25.9 | 2.5  | 3   | D |
| 33 | 4387 | 13.678    | 9170.678 | +19.5 | 5.7  | 5   | D |
| 34 | 4391 | 15.649    | 9172.649 | - 2.5 | 0.3  | 3   | D |
| 35 | 4392 | 17.640    | 9174.640 | -17.4 | 6.3  | 3   | D |
| 36 | 4395 | 18.715    | 9175.715 | -25.9 | 7.1  | 4   | D |
| 37 | 4399 | 19.615    | 9176.615 | +25.9 | 5.1  | 3   | D |
| 38 | 4401 | 20.685    | 9177.685 | -14.2 | 6.2  | 5   | D |
| 39 | 4408 | 23.657    | 9180.657 | -18.2 | 10.0 | 5   | D |
| 40 | 4413 | 24.653    | 9181.653 | - 7.7 | 8.8  | 4   | D |
| 41 | 4420 | 25.594    | 9182.594 | + 7.4 | 6.1  | 5   | D |
| 42 | 4429 | 26.659    | 9183.659 | +11.4 | 16.8 | 1.5 | D |

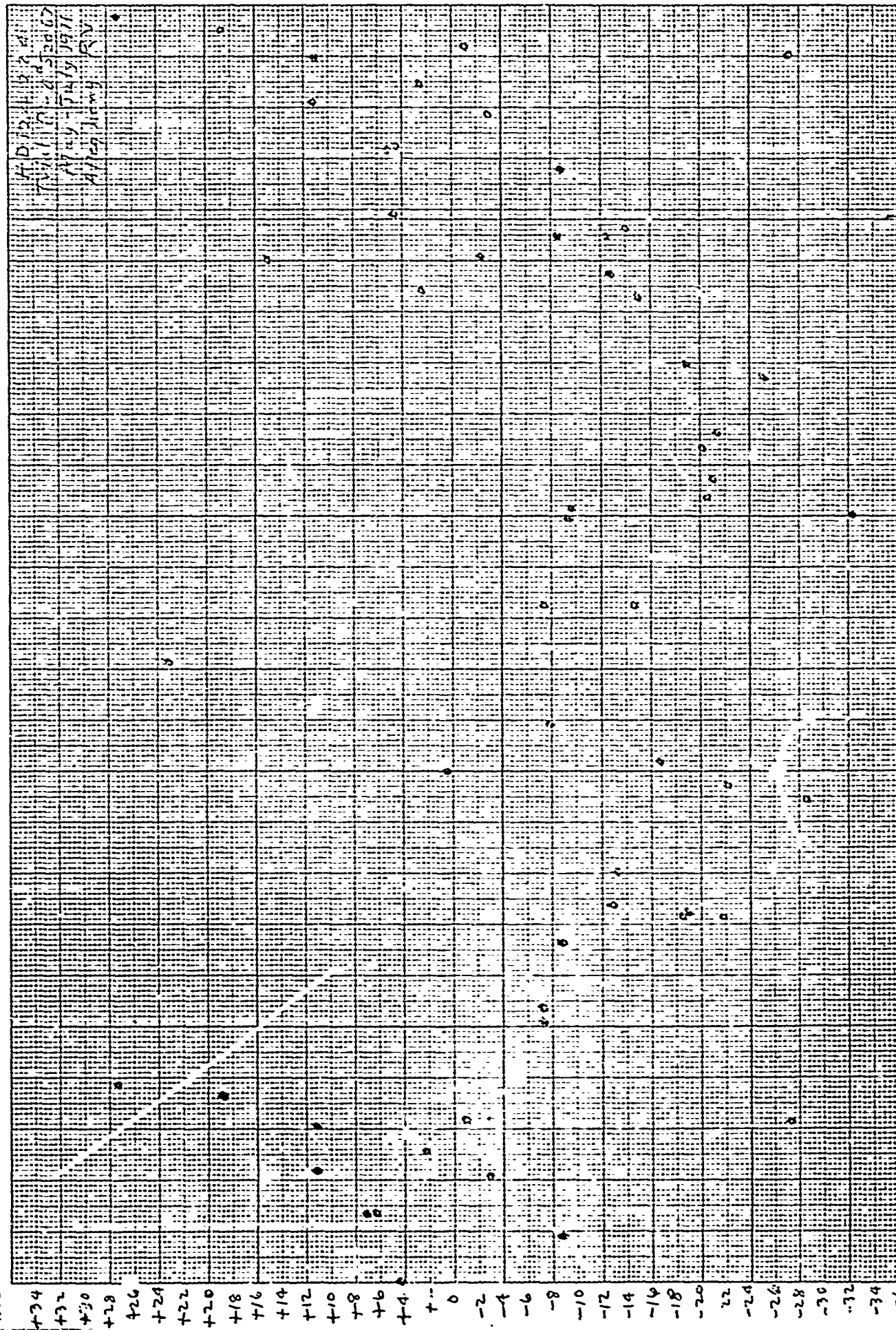
plate very weak

mean of 2

|    |      |                 |          |       |     |   |   |
|----|------|-----------------|----------|-------|-----|---|---|
| 43 | 4435 | 27.608          | 9184.608 | + 3.2 | 6.5 | 5 | D |
| 44 | 4443 | 28.658          | 9185.658 | -11.8 | 5.6 | 4 | D |
| 45 | 4445 | 29.580          | 9186.580 | -32.0 | 2.9 | 5 | D |
| 46 | 4453 | Jun 1.570       | 9189.570 | -21.7 | 3.4 | 5 | D |
| 47 | 4460 | 3.581           | 9191.581 | - 7.6 | 1.3 | 4 | D |
| 48 | 4465 | 8.598           | 9196.598 | +14.9 | 2.7 | 4 | D |
| 49 | 4472 | 10.574          | 9198.574 | -21.5 | 6.1 | 4 | D |
| 50 | 4479 | 12.506          | 9200.596 | - 9.2 | 2.5 | 9 | D |
| 51 | 4485 | 14.602          | 9202.602 | -15.8 | 3.5 | 5 | D |
| 52 | 4489 | 15.588          | 9203.588 | -14.5 | 6.0 | 5 | D |
| 53 | 4494 | 1911 Jun 18.591 | 9206.591 | - 1.7 | 2.9 | 4 | D |
| 54 | 4499 | 19.576          | 9207.576 | - 9.1 | 2.0 | 5 | D |
| 55 | 4504 | 20.585          | 9208.585 | - 8.5 | 3.6 | 9 | D |
| 56 | 4509 | 21.599          | 9209.599 | -15.3 | 4.8 | 6 | D |
| 57 | 4515 | 22.568          | 9210.568 | -21.4 | 5.4 | 5 | D |
| 58 | 4522 | 23.581          | 9211.581 | -20.1 | 2.0 | 5 | D |
| 59 | 4532 | 27.602          | 9215.602 | -29.8 | 4.7 | 4 | D |
| 60 | 4534 | 28.588          | 9216.588 | -21.1 | 3.6 | 5 | D |
| 61 | 4539 | 29.572          | 9217.572 | - 7.4 | 7.0 | 3 | D |
| 62 | 4545 | 30.563          | 9218.563 | -11.9 | 4.3 | 4 | D |
| 63 | 4553 | Jul 1.580       | 9219.580 | - 2.7 | 2.2 | 3 | D |
| 64 | 4560 | 2.566           | 9220.566 | -13.6 | 1.5 | 5 | D |
| 65 | 4566 | 3.602           | 9221.602 | -12.0 | 0.6 | 5 | D |

Fig. 1

V  
Phase



0.5 P=0.52067

0.4

0.3

0.2

0.1

81

Phase (days)

|    |      |        |          |       |      |   |   |
|----|------|--------|----------|-------|------|---|---|
| 66 | 4573 | 4.581  | 9222.581 | -18.0 | ±2.4 | 2 | D |
| 67 | 4592 | 9.588  | 9227.588 | + 0.8 | 10.2 | 4 | D |
| 68 | 4604 | 14.577 | 9232.577 | + 5.7 | 4.0  | 4 | D |
| 69 | 4630 | 26.583 | 9244.583 | + 1.6 | 2.8  | 4 | D |

This star was announced as a spectroscopic binary by Schlesinger (Publ. A.O. 1, 121, 1909) who stated that a range of 134 km/sec. had been observed. Subsequent work at other observatories have shown that this star is a spectrum and light variable with a period of 0.52067 day. The question of variability in radial velocity has never been adequately settled. Daniel measured these plates in 1911 and of course knew nothing of the 1/2-day cycle. A plot of his measures for the May-June 1911 observations ( $T_0 = 2419161.734$ ) against the 1/2-day cycle is shown in Figure 1. A variation is indeed present despite the large scatter and appears to somewhat resemble a pulsation. No attempt has been made to correlate this with the light curve. Since a recent series at Allegheny has been measured from an entirely different interpretation, these results are hereby presented "as is" with no attempt at an explanation.

| HD 126129 |                      | $\alpha = 14^h 18^m 28^s$ |       | $\delta = +8^{\circ} 54'$ |   | A1 |
|-----------|----------------------|---------------------------|-------|---------------------------|---|----|
| 1         | 2460 1909 Mar 31.715 | 2418397.715               | -12.4 | ±4.3                      | 6 | B  |
| 2         | 2487 May 11.721      | 8438.721                  | -21.9 | 14.1                      | 5 | B  |
| 3         | 2545 31.672          | 8458.672                  | -18.8 | 7.2.                      | 5 | B  |
| 4         | 2573 Jun 13.642      | 8471.642                  | -36.1 | 9.1                       | 7 | B  |
| 5         | 2596 19.624          | 8477.624                  | -32.1 | 7.3                       | 5 | B  |
| 6         | 2654 Jul 7.608       | 8495.608                  | - 8.7 | 6.5                       | 4 | B  |
| 7         | 3493 1910 Apr 9.682  | 8771.682                  | -32.0 | 6.9                       | 7 | D  |
| 8         | 3503 10.725          | 8772.725                  | -35.1 | 5.5                       | 6 | D  |
| 9         | 4360 1911 May 9.640  | 9166.640                  | + 3.9 | 2.3                       | 4 | D  |
| 10        | 4375 11.701          | 9168.701                  | - 6.4 | 3.7                       | 4 | D  |
| 11        | 5211 1912 Apr 24.671 | 9517.671                  | -22.6 | 5.8                       | 7 | D  |

Visual binary with HD 126128 (ADS9247), P= 40%0, T= 1918.45.

HD 126248

$\alpha = 14^h 19^m 13^s$

$\delta = +6^\circ 16'$

A3

|    |      |          |        |             |       |      |   |   |                 |
|----|------|----------|--------|-------------|-------|------|---|---|-----------------|
| 1  | 2461 | 1909 Mar | 31.739 | 2418397.739 | -16.3 | 10.1 | 4 | J |                 |
| 2  | 2472 | Apr      | 15.731 | 8412.731    | +45.4 | 8.0  | 4 | J | comparison weak |
| 3  | 2506 | May      | 17.719 | 8444.719    | -33.9 | 3.6  | 4 | J | pier side       |
| 4  | 2536 |          | 29.620 | 8456.620    | + 6.1 | 10.1 | 4 | J |                 |
| 5  | 2584 | Jun      | 16.643 | 8474.643    | + 8.9 | 3.9  | 8 | J |                 |
| 6  | 2590 |          | 18.633 | 8476.633    | -33.4 | 11.1 | 4 | J |                 |
| 7  | 2601 |          | 20.578 | 8478.578    | -26.8 | 2.6  | 3 | J |                 |
| 8  | 2610 |          | 22.610 | 8480.610    | -23.3 | 6.7  | 4 | J |                 |
| 9  | 2615 |          | 29.599 | 8487.599    | - 3.6 | 6.2  | 4 | J | mean of 2       |
| 10 | 2621 |          | 30.576 | 8488.576    | - 4.5 | 4.7  | 6 | J | weak spectrum   |
| 11 | 2629 | Jul      | 1.633  | 8489.633    | - 1.7 | 5.7  | 3 | J |                 |
| 12 | 2633 |          | 3.590  | 8491.590    | -19.0 | 4.7  | 7 | J |                 |
| 13 | 2650 |          | 6.626  | 8494.626    | -29.3 | 6.8  | 3 | J |                 |
| 14 | 2653 |          | 7.577  | 8495.577    | -30.3 | 2.3  | 4 | J |                 |
| 15 | 2663 |          | 8.575  | 8496.575    | -18.1 | 4.5  | 4 | J |                 |
| 16 | 2671 |          | 9.597  | 8497.597    | -33.6 | 2.9  | 3 | J | spectrum weak   |
| 17 | 3465 | 1910 Mar | 21.783 | 8752.783    | -44.2 | 7.8  | 3 | J | very weak       |
| 18 | 3494 | Apr      | 9.715  | 8771.715    | - 3.4 | 5.8  | 3 | J |                 |
| 19 | 3504 |          | 10.749 | 8772.749    | + 5.6 | 9.1  | 2 | J |                 |
| 20 | 3511 |          | 12.722 | 8774.722    | + 1.6 | 3.0  | 2 | J |                 |

|    |      |                 |          |       |      |   |   |                                        |
|----|------|-----------------|----------|-------|------|---|---|----------------------------------------|
| 21 | 3520 | 13.721          | 8775.721 | -10.2 | +1.3 | 3 | J |                                        |
| 22 | 3529 | 21.688          | 8783.688 | -27.1 | 3.4  | 4 | J |                                        |
| 23 | 3546 | May 5.664       | 8797.664 | -26.0 | 5.4  | 3 | J |                                        |
| 24 | 3553 | 6.717           | 8798.717 | -27.0 | 3.6  | 4 | J |                                        |
| 25 | 3558 | 12.685          | 8804.685 | - 9.8 | 1.5  | 5 | J |                                        |
| 26 | 3563 | 15.660          | 8807.660 | -29.0 | 2.7  | 4 | J |                                        |
| 27 | 3570 | 18.681          | 8810.681 | +33.4 |      | 1 | J | one line, diffuse                      |
| 28 | 3574 | 27.638          | 8819.638 | -13.5 | 11.6 | 3 | J |                                        |
| 29 | 3583 | Jun 7.590       | 8830.590 | - 8.9 | 5.0  | 7 | J |                                        |
| 30 | 3591 | 8.583           | 8831.583 | + 1.5 | 6.3  | 6 | J | mean of 2                              |
| 31 | 3596 | 14.635          | 8837.635 | -10.8 | 4.5  | 5 | J | 82.7 apparently double                 |
| 32 | 3599 | 20.600          | 8843.600 | -21.4 | 28.0 | 2 | J |                                        |
| 33 | 3606 | 22.588          | 8845.588 | -15.8 | 18.5 | 2 | J | spectrum weak                          |
| 34 | 3609 | 24.589          | 8847.589 | -16.8 |      | 2 | J | one line only                          |
| 35 | 3614 | 25.613          | 8848.613 | +24.9 | 19.6 | 2 | J | spectrum weak                          |
| 36 | 3646 | Jul 14.588      | 8867.588 | - 5.2 | 3.0  | 5 | J |                                        |
| 37 | 4202 | 1911 Feb 27.806 | 9095.806 | +14.4 |      | 2 | J | one line only spectrum weak            |
| 38 | 4257 | Mar 20.810      | 9116.810 | - 4.0 | 0.6  | 3 | J |                                        |
| 39 | 4290 | Apr 10.730      | 9137.730 | -23.4 | 3.9  | 3 | J |                                        |
| 40 | 4312 | 24.778          | 9151.778 | -20.7 | 1.3  | 2 | J |                                        |
| 41 | 4337 | May 5.684       | 9162.684 | -24.0 | 3.3  | 3 | J | comparison fuzzy slightly out of focus |
| 42 | 4345 | 6.703           | 9163.703 | -33.2 | 2.1  | 3 | J |                                        |
| 43 | 4355 | 8.674           | 9165.674 | +22.0 | 7.8  | 3 | J |                                        |

|    |      |                 |          |        |      |    |              |   |                                |
|----|------|-----------------|----------|--------|------|----|--------------|---|--------------------------------|
| 44 | 4361 | 9.669           | 9166.669 | +17.8  | ±0.2 | 4  |              | J |                                |
| 45 | 4366 | 10.674          | 9167.674 | -87.1  | 8.9  | 6  | + 73.9 ±11.3 | J |                                |
| 46 | 4374 | 11.657          | 9168.657 | -40.7  | 2.5  | 3  |              | J |                                |
| 47 | 4381 | 12.667          | 9169.667 | -27.8  |      | 1  |              | J | one line only                  |
| 48 | 4393 | 17.685          | 9174.685 | -34.1  |      | 1  |              | J | spectrum weak<br>one line only |
| 49 | 4402 | 20.720          | 9177.720 | - 3.7  | 2.7  | 4  |              | J |                                |
| 50 | 4414 | 24.688          | 9181.688 | +17.5  | 11.6 | 4  |              | J |                                |
| 51 | 4421 | 25.626          | 9182.626 | - 1.9  | 7.8  | 6  |              | J |                                |
| 52 | 4436 | 27.648          | 9184.648 | - 0.1  | 17.6 | 3  |              | J |                                |
| 53 | 4446 | 29.622          | 9186.622 | -54.6  | 10.9 | 5  |              | J |                                |
| 54 | 4454 | Jun 1.608       | 9189.608 | -24.1  | 0.9  | 5  |              | J | .                              |
| 55 | 4473 | 1911 Jun 10.608 | 9198.608 | -10.1  | 2.0  | 7  |              | J |                                |
| 56 | 4578 | Jul 5.574       | 9223.574 | -32.4  | 3.4  | 6  |              | J |                                |
| 57 | 4584 | 6.578           | 9224.578 | +10.6  | 4.6  | 3  |              | J |                                |
| 58 | 5104 | 1912 Mar 10.826 | 9472.826 | +44.8: |      | 2  |              | J | spectrum weak<br>one line only |
| 59 | 5141 | 26.755          | 9488.755 | -32.2  |      | 1  |              | J | spectrum weak<br>one line only |
| 60 | 5147 | 30.756          | 9492.756 | -16.6  | 9.9  | 3  |              | J | spectrum weak<br>one line only |
| 61 | 5159 | Apr 4.754       | 9497.754 | - 4.3  | 16.2 | 3  |              | J | spectrum weak                  |
| 62 | 5178 | 11.749          | 9504.749 | +57.4  | 2.9  | 3  |              | J |                                |
| 63 | 5183 | 14.772          | 9507.772 | +30.8  |      | 1  |              | J | one very diffuse<br>line only  |
| 64 | 5200 | 21.725          | 9514.725 | -29.7  | 3.2  | 4  |              | J |                                |
| 65 | 5206 | 23.742          | 9516.742 | -28.1  | 3.3  | 5  |              | J |                                |
| 66 | 5235 | May 9.742       | 9532.742 | -13.3  | 3.8  | 12 |              | J |                                |

|    |      |                 |             |       |      |   |                 |
|----|------|-----------------|-------------|-------|------|---|-----------------|
| 67 | 5248 | 13.715          | 9536.715    | + 8.6 | ±3.5 | 3 | J               |
| 68 | 5261 | 20.640          | 9543.640    | +34.5 | 16.2 | 2 | J diffuse lines |
| 69 | 5287 | Jun 1.655       | 9555.655    | -21.5 | 3.8  | 6 | J               |
| 70 | 5309 | 8.648           | 9562.648    | -11.4 | 6.4  | 8 | J               |
| 71 | 5757 | 1913 Apr 29.768 | 9887.768    | + 2.7 | 8.2  | 4 | J               |
| 72 | 5790 | May 10.712      | 9898.712    | + 8.4 | 9.2  | 4 | J spectrum weak |
| 73 | 5799 | 18.688          | 9906.688    | +32.3 | 7.5  | 5 | J spectrum weak |
| 74 | 6371 | 1914 Jun 16.636 | 2420300.636 | -33.4 | 6.6  | 3 | J               |

This star is a probable spectroscopic binary. Efforts to find a period have been unsuccessful.

|    | HD 135742 | ♐ Librae        |             | α = 15 <sup>h</sup> 11 <sup>m</sup> 37 <sup>s</sup> | δ = -9° 01' | B8V<br>mean of 2<br>measured twice |   |
|----|-----------|-----------------|-------------|-----------------------------------------------------|-------------|------------------------------------|---|
| 1  | 2684      | 1909 Jul 17.608 | 2418505.608 | -50.0 ±1.4                                          | 4           | B                                  |   |
| 2  | 2685      | 17.628          | 8505.628    | -39.8                                               | 1.5         | 4                                  | B |
| 3  | 2700      | 19.606          | 8507.606    | -37.1                                               | 4.3         | 5                                  | B |
| 4  | 2701      | 19.619          | 8507.619    | -49.3                                               | 2.7         | 4                                  | B |
| 5  | 2709      | 20.580          | 8508.580    | -46.9                                               | 0.9         | 5                                  | B |
| 6  | 2712      | 24.566          | 8512.566    | -47.9                                               | 2.0         | 6                                  | B |
| 7  | 2711      | 24.578          | 8512.578    | -43.5                                               | 3.5         | 4                                  | B |
| 8  | 2790      | Aug 10.569      | 8529.569    | -53.8                                               | 3.8         | 4                                  | B |
| 9  | 6261      | 1914 Apr 30.821 | 2420253.821 | -32.7                                               | 10.5        | 3                                  | D |
| 10 | 6264      | May 1.783       | 0254.783    | -30.8                                               | 5.4         | 3                                  | D |
| 11 | 6271      | 2.790           | 0255.790    | -44.1                                               | 1.3         | 3                                  | D |

|    |      |           |          |       |      |   |                |
|----|------|-----------|----------|-------|------|---|----------------|
| 12 | 6274 | 8.757     | 0261.757 | -52.0 | ±3.3 | 3 | D              |
| 13 | 6275 | 8.787     | 0261.787 | -56.3 | 3.0  | 3 | D              |
| 14 | 6281 | 9.776     | 0262.776 | -48.4 | 3.3  | 3 | D              |
| 15 | 6289 | 15.760    | 0268.760 | -50.5 | 3.8  | 3 | D              |
| 16 | 6290 | 15.783    | 0268.783 | -52.6 | 7.6  | 3 | D              |
| 17 | 6295 | 16.689    | 0269.689 | -51.6 | 4.8  | 3 | D              |
| 18 | 6296 | 16.702    | 0259.702 | -37.2 | 2.5  | 3 | D              |
| 19 | 6302 | 17.784    | 0270.784 | -34.4 | 5.7  | 3 | D              |
| 20 | 6305 | 18.714    | 0271.714 | -55.7 | 9.5  | 3 | D              |
| 21 | 6306 | 18.740    | 0271.740 | -49.8 | 4.8  | 3 | D              |
| 22 | 6310 | 19.662    | 0272.662 | -61.4 | 2.2  | 3 | D              |
| 23 | 6311 | 19.684    | 0272.684 | -49.7 | 1.3  | 3 | D              |
| 24 | 6315 | 20.735    | 0273.735 | -38.8 | 3.3  | 3 | D              |
| 25 | 6316 | 20.767    | 0273.767 | -45.2 | 0.3  | 3 | D              |
| 26 | 6320 | 21.785    | 0274.785 | -26.3 |      | 2 | D 1 line only  |
| 27 | 6324 | 24.755    | 0277.755 | -32.4 | 6.4  | 2 | D              |
| 28 | 6325 | 24.781    | 0277.781 | -52.9 | 4.5  | 3 | D underexposed |
| 29 | 6328 | 25.773    | 0278.773 | -36.0 | 3.5  | 3 | D              |
| 30 | 6332 | 26.722    | 0279.722 | -44.0 | 0.6  | 3 | D              |
| 31 | 6340 | 30.696    | 0283.696 | -51.9 | 3.2  | 3 | D              |
| 32 | 6345 | Jun 1.719 | 0285.719 | -39.5 | 4.8  | 3 | D              |
| 33 | 6346 | 1.756     | 0285.756 | -36.7 | 14.3 | 3 | D              |
| 34 | 6350 | 2.707     | 0286.707 | -24.6 | 3.5  | 3 | D              |

|    |      |                 |          |       |      |   |   |
|----|------|-----------------|----------|-------|------|---|---|
| 35 | 6351 | 2.731           | 0286.731 | -23.3 | ±1.9 | 3 | D |
| 36 | 6354 | 6.683           | 0290.683 | -46.0 | 5.4  | 3 | D |
| 37 | 6359 | 8.706           | 0292.706 | -50.1 | 3.5  | 3 | D |
| 38 | 6361 | 9.689           | 0293.689 | -42.5 | 7.8  | 3 | D |
| 39 | 6364 | 10.700          | 0294.700 | -36.8 | 2.5  | 3 | D |
| 40 | 6366 | 12.696          | 0296.696 | -30.3 | 2.9  | 3 | D |
| 41 | 6372 | 16.672          | 0300.672 | -27.9 | 2.9  | 3 | D |
| 42 | 6376 | 17.651          | 0301.651 | -40.2 | 0.9  | 3 | D |
| 43 | 6381 | 28.612          | 0312.612 | -37.6 | 2.5  | 3 | D |
| 44 | 6382 | 29.636          | 0313.636 | -57.4 | 4.8  | 3 | D |
| 45 | 6384 | Jul 2.663       | 0316.663 | -67.8 | 5.4  | 3 | D |
| 46 | 6388 | 3.647           | 0317.647 | -50.3 | 7.0  | 3 | D |
| 47 | 6392 | 5.612           | 0319.612 | -57.2 | 1.0  | 3 | D |
| 48 | 6400 | 15.590          | 0329.590 | -53.6 | 1.9  | 3 | D |
| 49 | 6406 | 20.572          | 0334.572 | -70.5 | 9.5  | 3 | D |
| 50 | 6411 | 21.575          | 0335.575 | -69.7 | 5.4  | 2 | D |
| 51 | 6673 | 1915 Apr 14.833 | 0602.833 | -40.4 | 0.6  | 3 | D |

Mellor (Publ. Mich. O. 3, 73, 1917) states that 79 radial velocities obtained at Michigan in 1914 show an 80-day period. Here we present 42 radial velocities obtained in 1914 also. These when plotted as 10-day means also clearly show the 80-day period. Oddly, however, the indicated  $\alpha$ -velocity for the Allegheny observations seems to be closer to -55 km/sec whereas Mellor claims -37 km/sec for the Michigan observations. This star is a spectroscopic binary.

B9V

$\delta = +33^{\circ} 17'$

$\alpha = 15^h 17^m 48^s$

50 Bootis

HD 136849

71

|    |      |          |        |             |       |           |   |  |   |               |
|----|------|----------|--------|-------------|-------|-----------|---|--|---|---------------|
| 1  | 5254 | 1912 May | 17.738 | 2419540.738 | - 5.2 | $\pm 3.0$ | 2 |  | D | underexposed  |
| 2  | 5263 |          | 22.651 | 9545.651    | + 9.1 |           | 1 |  | D | underexposed  |
| 3  | 5285 |          | 31.691 | 9554.691    | -24.3 | 1.4       | 4 |  | D | one line only |
| 4  | 5305 | Jun      | 7.658  | 9561.658    | -17.0 | 10.2      | 3 |  | D |               |
| 5  | 5313 |          | 9.661  | 9563.661    | -13.7 | 1.9       | 3 |  | D |               |
| 6  | 5316 |          | 10.603 | 9564.603    | -18.6 | 8.9       | 3 |  | D |               |
| 7  | 5321 |          | 11.646 | 9565.646    | -18.7 | 1.7       | 2 |  | D |               |
| 8  | 5323 |          | 13.610 | 9567.610    | -18.2 | 7.3       | 3 |  | D |               |
| 9  | 5795 | 1913 May | 11.736 | 9899.736    | -20.0 | 3.6       | 3 |  | D |               |
| 10 | 5823 | Jun      | 2.702  | 9921.702    | -16.6 | 6.4       | 2 |  | D | diffuse lines |
| 11 | 5837 |          | 9.701  | 9928.701    | -26.8 | 4.1       | 5 |  | D | seed 23       |

Frost, Barrett, and Struve (Ap. J. 64, 1, 1926) list for Yerkes Observatory, three radial velocities of +53, +2 and +71 and two radial velocities in 1915 of +94 and -3 which are only 40 days apart. We consider this star to be a spectroscopic binary. Further observations will be necessary.

|   |           |                           |                                                    |                            |       |           |   |   |
|---|-----------|---------------------------|----------------------------------------------------|----------------------------|-------|-----------|---|---|
| 2 | HD 139006 | $\alpha$ Coronae Borealis | $\alpha = 15^{\text{h}}30^{\text{m}}27^{\text{s}}$ | $\delta = +27^{\circ} 3'$  | AOV   |           |   |   |
| 1 | 6758      | 1915 Jul                  | 11.561                                             | 2420690.561                | -20.6 | $\pm 5.1$ | 5 | J |
| 3 | HD143275  | $\delta$ Scorpius         | $\alpha = 15^{\text{h}}54^{\text{m}}25^{\text{s}}$ | $\delta = -22^{\circ} 20'$ | BOV   |           |   |   |
| 1 | 5236      | 1912 May                  | 9.785                                              | 2419532.785                | -12.3 | $\pm 5.3$ | 9 | D |
| 2 | 5243      |                           | 10.747                                             | 9533.747                   | - 5.9 | 1.3       | 7 | D |
| 3 | 5249      |                           | 13.762                                             | 9536.762                   | -13.2 | 2.4       | 7 | D |
| 4 | 5255      |                           | 17.788                                             | 9540.788                   | - 2.5 | 5.0       | 6 | D |

|    |      |                |                 |       |      |    |       |                |
|----|------|----------------|-----------------|-------|------|----|-------|----------------|
| 5  | 5265 | 22.725         | 9545.725        | -18.2 | +5.2 | 5  |       | D              |
| 6  | 5270 | 24.720         | 9547.720        | -9.4  | 0.9  | 8  |       | D              |
| 7  | 5274 | 27.584         | 9550.684        | -2.7  | 5.8  | 8  |       | D              |
| 8  | 5280 | 30.732         | 9553.732        | -13.5 | 2.6  | 6  | -14.2 | 2 D            |
| 9  | 5293 | Jun 4.684      | 9558.684        | -12.2 | 2.0  | 8  | +10.4 | 1 D            |
| 10 | 5302 | 6.709          | 9560.709        | -10.0 | 2.4  | 8  | -19.6 | 2 D            |
| 11 | 5314 | 9.722          | 9563.722        | -16.9 | 2.4  | 8  | -5.1  | 1 D            |
| 12 | 5324 | 13.664         | 9567.664        | -16.2 | 3.3  | 8  | -15.8 | 1 D            |
| 13 | 5327 | 20.631         | 9574.631        | -14.8 | 1.7  | 8  | -7.0  | 1 D            |
| 14 | 5355 | 14.648         | 9598.648        | -21.3 | 3.3  | 5  |       | D              |
| 15 | 5378 | Aug 2.572      | 9617.572        | -11.4 | 2.3  | 8  | +8.2  | 1 D            |
| 16 | 5724 | 1913 Apr 7.822 | 9865.822        | -22.5 | 3.7  | 8  | -8.6  | 1 D I.S. faint |
| 17 | 5779 | May 7.767      | 9895.767        | -20.9 | 8.6  | 9  |       | D              |
| 18 | 5873 | Jun. 29.625    | 9948.625        | -21.9 | 3.0  | 7  | -0.6  | 1 D            |
| 19 | 5911 | Jul 21.599     | 9970.599        | -11.9 | 4.1  | 8  | -18.1 | 1 D            |
| 20 | 5952 | Aug 24.552     | 2420004.552     | -16.8 | 6.5  | 8  |       | D              |
| 21 | 6265 | 1914 May 1.817 | 0254.817        | -17.9 | 3.2  | 10 | +33.1 | 1 D I.S. faint |
| 22 | 6272 | 2.812          | 0255.812        | -18.8 | 2.5  | 7  |       | D              |
|    |      |                | Mean            | -14.2 |      |    |       |                |
|    |      |                | Mean I.S. - 3.3 |       |      |    |       |                |

This star does not appear to be variable in velocity.

HD 143807

Coronae Borealis  $\alpha = 15^h 57^m 26^s$

$\delta = +30^\circ 8'$

A0 II-III

1 2530 1909 May 27.727 2418454.727 -21.6  $\pm 3.4$  8

B

|    |      |           |          |       |      |     |   |
|----|------|-----------|----------|-------|------|-----|---|
| 2  | 2534 | 28.685    | 8455.685 | -33.5 | ±5.1 | 6.5 | B |
| 3  | 2546 | 31.703    | 8458.703 | -13.5 | 3.2  | 6   | B |
| 4  | 2551 | Jun 5.723 | 8463.723 | + 6.4 | 5.7  | 9   | B |
| 5  | 2566 | 11.688    | 8469.688 | -26.8 | 4.9  | 8   | B |
| 6  | 2574 | 13.672    | 8471.672 | -24.0 | 4.7  | 8   | B |
| 7  | 2577 | 15.672    | 8473.672 | -28.2 | 7.7  | 8   | B |
| 8  | 2597 | 19.652    | 8477.652 | - 4.9 | 4.4  | 8   | B |
| 9  | 2609 | 21.597    | 8479.597 | -16.2 | 4.4  | 5   | B |
| 10 | 2611 | 22.681    | 8480.681 | -19.1 | 7.1  | 7   | B |
| 11 | 2616 | 29.639    | 8487.639 | -16.3 | 2.3  | 9   | B |
| 12 | 2623 | 30.644    | 8488.644 | -11.2 | 3.6  | 8   | B |
| 13 | 2630 | Jul 1.692 | 8489.692 | - 8.9 | 2.9  | 6   | B |
| 14 | 2635 | 3.655     | 8491.655 | -20.2 | 5.2  | 8   | B |
| 15 | 2638 | 4.615     | 8492.615 | -15.7 | 2.9  | 6   | B |
| 16 | 2645 | 5.628     | 8493.628 | +10.4 | 5.5  | 6   | B |
| 17 | 2651 | 6.668     | 8494.668 | -13.0 | 3.4  | 10  | B |
| 18 | 2656 | 7.647     | 8495.647 | -16.5 | 2.0  | 7   | B |
| 19 | 2664 | 8.608     | 8496.608 | -19.6 | 6.4  | 6   | B |
| 20 | 2672 | 9.641     | 8497.641 | -20.8 | 6.9  | 11  | B |
| 21 | 2683 | 17.583    | 8505.533 | -18.0 | 3.9  | 10  | B |
| 22 | 2686 | 17.647    | 8505.647 | -18.3 | 2.3  | 10  | B |
| 23 | 2688 | 17.719    | 8505.719 | -14.2 | 1.7  | 7   | B |
| 24 | 2699 | 19.586    | 8507.586 | -15.2 | 2.1  | 10  | B |

|    |      |                 |          |       |     |    |   |
|----|------|-----------------|----------|-------|-----|----|---|
| 25 | 2704 | 19.713          | 8507.713 | -25.2 | 3.4 | 9  | B |
| 26 | 2710 | 20.612          | 8508.612 | -23.9 | 5.7 | 7  | B |
| 27 | 2714 | 24.599          | 8512.599 | -12.5 | 6.1 | 8  | B |
| 28 | 2719 | 25.594          | 8513.594 | -12.6 | 2.9 | 8  | B |
| 29 | 2721 | 25.704          | 8513.704 | -35.7 | 8.4 | 5  | B |
| 30 | 2734 | 28.573          | 8516.573 | -26.1 | 1.3 | 12 | B |
| 31 | 2739 | Aug 1.563       | 8520.563 | -20.1 | 3.2 | 5  | B |
| 32 | 2741 | 1.664           | 8520.664 | -34.4 | 1.3 | 2  | B |
| 33 | 2747 | 2.568           | 8521.568 | -14.7 | 2.4 | 7  | B |
| 34 | 2749 | 2.665           | 8521.665 | -21.5 | 0.8 | 2  | B |
| 35 | 2756 | 3.592           | 8522.592 | -15.7 | 4.3 | 6  | B |
| 36 | 2758 | 3.670           | 8522.670 | -20.7 | 1.5 | 11 | B |
| 37 | 2764 | 4.611           | 8523.611 | -12.6 | 2.1 | 7  | B |
| 38 | 2765 | 4.640           | 8523.640 | -27.2 | 1.2 | 4  | B |
| 39 | 2768 | 6.561           | 8525.561 | -26.6 | 1.5 | 8  | B |
| 40 | 2770 | 6.644           | 8525.644 | -25.2 | 5.1 | 3  | B |
| 41 | 2778 | 7.622           | 8526.622 | -15.4 | 1.0 | 4  | B |
| 42 | 2777 | 7.659           | 8526.659 | -23.1 | 2.4 | 2  | B |
| 43 | 2783 | 8.574           | 8527.574 | -9.5  | 4.8 | 3  | B |
| 44 | 2784 | 8.626           | 8527.626 | -30.6 | 4.7 | 2  | B |
| 45 | 3506 | 1910 Apr 10.811 | 8772.811 | -20.1 | 1.5 | 8  | D |
| 46 | 3557 | May 12.656      | 8804.656 | -22.7 | 3.8 | 4  | B |
| 47 | 3559 | 12.727          | 8804.727 | -20.6 | 4.2 | 4  | B |

mean of 2

underexposed

underexposed

weak

fogged by development

weak

|    |      |                 |          |       |      |     |                              |
|----|------|-----------------|----------|-------|------|-----|------------------------------|
| 48 | 3562 | 15.638          | 8807.638 | -14.1 | +1.6 | 5   | B                            |
| 49 | 3564 | 15.692          | 8807.692 | -16.2 | 2.3  | 4   | B                            |
| 50 | 3566 | 15.756          | 8807.756 | -15.1 | 4.5  | 5   | B                            |
| 51 | 3571 | 18.723          | 8810.723 | -19.5 | 5.4  | 9   | D                            |
| 52 | 3576 | 27.728          | 8819.728 | -16.7 | 4.3  | 7   | D                            |
| 53 | 4291 | 1911 Apr 10.761 | 9137.761 | -21.5 | 2.2  | 8   | D                            |
| 54 | 5148 | 1912 Mar 30.794 | 9492.794 | -14.7 | 5.4  | 8   | D                            |
| 55 | 5193 | Apr 20.699      | 9513.699 | -15.2 | 1.0  | 10  | D                            |
| 56 | 5213 | 24.769          | 9517.769 | -16.7 | 1.3  | 8   | D                            |
| 57 | 5218 | 27.675          | 9520.675 | -26.0 | 2.8  | 5   | D                            |
| 58 | 5227 | May 4.710       | 9527.710 | -21.3 | 1.9  | 8   | D                            |
| 59 | 5237 | 9.815           | 9532.815 | -15.7 | 1.9  | 11  | D                            |
| 60 | 5241 | 10.666          | 9533.666 | -38.1 | 9.7  | 3.5 | D                            |
| 61 | 5259 | 19.649          | 9542.649 | -1.7  | 2.3  | 4   | D underexposed               |
| 62 | 5264 | 22.695          | 9545.695 | -24.8 |      | 2   | D underexposed one line only |
| 63 | 5269 | 24.647          | 9547.647 | -3.0  | 0.5  | 3.5 | D underexposed               |
| 64 | 5272 | 26.635          | 9549.635 | -17.3 | 1.1  | 4   | D                            |
| 65 | 5281 | 30.763          | 9553.763 | -26.1 | 1.1  | 7   | D                            |
| 66 | 5292 | Jun 4.653       | 9558.653 | -25.3 | 5.9  | 8   | D                            |
| 67 | 5328 | 20.662          | 9574.662 | -12.1 | 2.0  | 9   | D                            |
| 68 | 5389 | Aug 10.542      | 9525.542 | -20.6 | 4.6  | 10  | D                            |
| 69 | 5404 | 17.547          | 9632.547 | -13.5 | 3.9  | 9   | D                            |
| 70 | 5409 | 24.531          | 9639.531 | -22.7 | 5.2  | 7   | D                            |
| 71 | 5685 | 1913 Mar 11.797 | 9838.797 | -19.3 | 1.7  | 9   | D                            |

This star was announced as a spectroscopic binary by Schlesinger (Publ. A.O. I, 121, 1909). Subsequent observations left the issue somewhat in doubt. The first page of an unpublished manuscript by Schlesinger on Cr B still exists and in it Schlesinger states "The plates subsequently secured have not shown a much greater range in velocity than the first ones; it is accordingly desirable to examine the material in detail and to see whether observations should be continued." This star is a sharp-lined A0 star and the possibility that it is a binary is of considerable interest. Observations have been continued at Allegheny to investigate the question of long-term variability, since two stars with similar spectra,  $\alpha$  Gem and  $\epsilon$  Vir A, have periods of 12.4 and 13.6 years respectively. Also if the velocities of 1909 are plotted as 10-day means then a variation with a period of about 55 days is apparent. Further observations will be necessary to confirm this.

| 75         | HD 144206 | $\nu$ Herculis  | $\alpha = 15^h 59^m 41^s$ | $\delta = +46^\circ 19'$ | Ap |
|------------|-----------|-----------------|---------------------------|--------------------------|----|
| 1          | 3597      | 1910 Jun 19.594 | 2418842.594 + 4.6         | $\pm 3.0$ 9.5            | D  |
| 2          | 5830      | 1913 Jun 5.708  | 19924.708 + 7.0           | 1.2 12                   | D  |
| 3          | 5851      | 13.639          | 19932.639 + 1.6           | 1.5 14                   | D  |
| 4          | 6291      | 1914 May 15.816 | 20268.816 + 1.4           | 7.5 7                    | D  |
| 5          | 6317      | 20.814          | 20273.814 + 7.4           | 2.5 5                    | D  |
| Mean + 4.1 |           |                 |                           |                          |    |

| 76                          | HD 148112 | $\omega$ Herculis | $\alpha = 16^h 20^m 48^s$ | $\delta = +14^\circ 16'$ | Ap |
|-----------------------------|-----------|-------------------|---------------------------|--------------------------|----|
| 1                           | 2474      | 1909 Apr 15.799   | 2418412.799 +14.2         | $\pm 4.1$ 10             |    |
| 2                           | 2548      | May 31.745        | 8458.745 - 5.0            | 1.3 8.5                  |    |
| 3                           | 2586      | Jun 16.710        | 8474.710 +12.8            | 3.4 10                   |    |
| 4                           | 2636      | Jul 3.692         | 8491.692 - 9.8            | 4.0 12                   |    |
| 5                           | 3496      | 1910 Apr 9.789    | 8771.789 -14.5            | 2.7 6                    |    |
| 6                           | 3513      | 12.787            | 8774.787 -19.8            | 0.5 4                    |    |
| 7                           | 3548      | May 5.749         | 8797.749 - 4.8            | 1.8 10                   |    |
| 8                           | 3580      | 28.698            | 8820.698 -10.1            | 3.0 6                    |    |
| comparison weak on one side |           |                   |                           |                          |    |



|    |      |                 |          |       |      |    |   |
|----|------|-----------------|----------|-------|------|----|---|
| 2  | 4370 | 10.806          | 9167.806 | -18.8 | ±2.2 | 7  | J |
| 3  | 4417 | 24.781          | 9181.781 | -18.2 | 2.5  | 7  | J |
| 4  | 4424 | 25.725          | 9182.725 | -49.8 | 3.7  | 8  | J |
| 5  | 4448 | 29.701          | 9186.701 | -23.7 | 2.5  | 6  | J |
| 6  | 4457 | Jun 1.726       | 9189.726 | -19.7 | 1.4  | 11 | J |
| 7  | 4483 | 3.714           | 9199.714 | -14.1 | 3.4  | 9  | J |
| 8  | 4468 | 8.730           | 9196.730 | -10.2 | 0.6  | 5  | J |
| 9  | 4476 | 10.704          | 9198.704 | -22.1 | 1.7  | 9  | J |
| 10 | 4488 | 14.710          | 9202.710 | -22.8 | 3.8  | 6  | J |
| 11 | 4492 | 15.725          | 9203.725 | -13.5 | 3.1  | 16 | J |
| 12 | 4518 | 22.670          | 9210.670 | - 7.7 | 2.3  | 5  | J |
| 13 | 4548 | 30.652          | 9218.652 | -31.0 | 9.5  | 4  | J |
| 14 | 5195 | 1912 Apr 20.768 | 9513.768 | -28.6 | 8.0  | 5  | J |
| 15 | 5244 | May 10.775      | 9533.775 | -24.2 | 1.9  | 13 | J |
| 16 | 5250 | 13.801          | 9536.801 | -18.2 | 2.8  | 21 | J |
| 17 | 5271 | 24.766          | 9547.766 | - 6.3 | 2.5  | 14 | J |
| 18 | 5288 | Jun 1.725       | 9555.725 | -53.8 | 3.9  | 8  | J |
| 19 | 5299 | 5.691           | 9559.691 | -26.5 | 3.3  | 13 | J |
| 20 | 5310 | 8.702           | 9562.702 | -10.6 | 1.9  | 15 | J |
| 21 | 5317 | 10.662          | 9564.662 | -21.1 | 2.7  | 12 | J |
| 22 | 5333 | 28.673          | 9582.673 | -14.0 | 4.3  | 8  | J |
| 23 | 5340 | Jul 5.674       | 9589.674 | -19.7 | 3.4  | 16 | J |
| 24 | 5349 | 8.642           | 9592.642 | -22.5 | 4.0  | 10 | J |

|    |      |                 |          |       |      |    |                 |
|----|------|-----------------|----------|-------|------|----|-----------------|
| 25 | 5377 | Aug 1.585       | 9616.585 | -21.8 | ±2.6 | 9  | J               |
| 26 | 5394 | 12.577          | 9627.577 | -30.3 | 1.9  | 8  | J               |
| 27 | 5730 | 1913 Apr 16.837 | 9874.837 | -23.3 | 2.4  | 14 | J               |
| 28 | 5763 | 30.804          | 9888.804 | - 8.0 | 4.5  | 11 | J               |
| 29 | 5768 | May 1.795       | 9889.795 | -30.7 | 6.1  | 7  | J               |
| 30 | 5780 | 7.802           | 9895.802 | -11.3 | 3.4  | 9  | J               |
| 31 | 5784 | 8.772           | 9896.772 | -20.2 | 3.9  | 16 | J               |
| 32 | 5791 | 10.755          | 9898.755 | -32.8 | 4.8  | 12 | J               |
| 33 | 5796 | 11.786          | 9899.786 | -21.0 | 4.0  | 18 | J               |
| 34 | 5800 | 18.743          | 9906.743 | - 9.5 | 3.9  | 9  | J               |
| 35 | 5847 | Jun 12.609      | 9931.609 | -42.4 | 2.7  | 5  | J               |
| 36 | 5864 | 18.591          | 9937.591 | -15.1 | 7.2  | 5  | J spectrum weak |
| 37 | 5865 | 19.614          | 9938.614 | -25.7 | 5.7  | 6  | J               |

The range observed here (-6 to -54) is comparable to the published range of +8 to -40. This star can be considered to be a probable spectroscopic binary.

| 79 | HD 153808 | $\epsilon$ Herculis | $\alpha = 16^h 56^m 28^s$ | $\delta = +31^\circ 4'$ | A0V         |
|----|-----------|---------------------|---------------------------|-------------------------|-------------|
| 1  | 6776      | 1915 Jul 30.595     | 2420709.595               | -99.4                   | ±2.6 8      |
| 2  | 6780      | Aug 12.597          | 0722.597                  | -41.6                   | 1.6 9       |
| 3  | 6786      | 16.565              | 0726.565                  | -35.5                   | 4.5 11      |
| 4  | 6791      | 31.572              | 0741.572                  | -81.9                   | 5.6 6       |
| 5  | 6798      | Sep 7.553           | 0748.553                  | -12.7                   | 2.3 8       |
| 6  | 6805      | 10.535              | 0751.535                  | - 5.2                   | 7.2 7       |
|    |           |                     |                           |                         | D mean of 2 |
|    |           |                     |                           |                         | D           |
|    |           |                     |                           |                         | D           |
|    |           |                     |                           |                         | D           |
|    |           |                     |                           |                         | D           |
|    |           |                     |                           |                         | D           |

|    |      |          |        |             |       |      |     |   |                                                      |
|----|------|----------|--------|-------------|-------|------|-----|---|------------------------------------------------------|
| 7  | 5415 | Sep      | 4.663  | 9650.663    | -29.6 | *2.3 | 2.5 | J |                                                      |
| 8  | 5424 |          | 7.684  | 9653.684    | -67.1 | 2.9  | 6.5 | J |                                                      |
| 9  | 5434 |          | 9.658  | 9655.658    | -50.1 | 5.4  | 7   | J |                                                      |
| 10 | 5439 |          | 11.674 | 9657.674    | -59.0 | 8.2  | 3.5 | J |                                                      |
| 11 | 5462 |          | 27.589 | 9673.589    | -22.8 | 3.9  | 7.5 | J |                                                      |
| 12 | 5474 |          | 30.624 | 9676.624    | +20.8 | 5.3  | 7.5 | J |                                                      |
| 13 | 5488 | Oct      | 4.580  | 9680.580    | +31.1 | 5.3  | 4.5 | J | poor                                                 |
| 14 | 5494 |          | 5.605  | 9681.605    | +26.5 | 4.9  | 4   | J |                                                      |
| 15 | 5501 |          | 11.549 | 9687.549    | - 5.7 | 2.5  | 8.5 | J |                                                      |
| 16 | 5512 |          | 16.547 | 9692.547    | +23.2 | 10.0 | 4   | J |                                                      |
| 17 | 5525 |          | 26.529 | 9702.529    | -11.5 | 4.4  | 5   | J | comparison weak                                      |
| 18 | 5529 |          | 27.489 | 9703.489    | + 0.3 | 4.6  | 4   | J |                                                      |
| 19 | 5538 |          | 30.573 | 9706.573    | - 2.3 | 5.7  | 3   | J | weak                                                 |
| 20 | 5550 | Nov      | 8.511  | 9715.511    | -18.5 | 13.7 | 5   | J |                                                      |
| 21 | 5863 | 1913 Jun | 17.791 | 9936.791    | -36.6 | 7.4  | 3   | J |                                                      |
| 22 | 5872 |          | 28.778 | 9947.778    | -39.3 | 5.0  | 6   | J |                                                      |
| 23 | 5897 | Ju1      | 15.726 | 9964.726    | +24.0 | 7.5  | 2.5 | J |                                                      |
| 24 | 5928 | Aug      | 2.690  | 9982.690    | -11.7 | 4.6  | 9.5 | J |                                                      |
| 25 | 5934 |          | 5.691  | 9985.691    | -55.6 | 5.7  | 8   | J |                                                      |
| 26 | 5980 | Sep      | 3.593  | 2420014.593 | -45.9 | 6.2  | 4.5 | J |                                                      |
| 27 | 5983 |          | 5.588  | 0016.588    | -44.5 | 2.6  | 4   | J |                                                      |
| 28 | 6408 | 1914 Ju1 | 20.667 | 0334.667    | -34.0 | 4.2  | 5.5 | J |                                                      |
| 29 | 6454 | Aug      | 18.635 | 0363.635    | -54.9 | 6.2  | 5   | J | mean of 2, measure<br>comparison weak on<br>one side |

|   |      |        |          |       |      |   |  |  |   |
|---|------|--------|----------|-------|------|---|--|--|---|
| 7 | 6809 | 13.580 | 0754.580 | -65.0 | ±4.5 | 8 |  |  | D |
| 8 | 6810 | 15.535 | 0756.535 | -9.0  | 1.4  | 8 |  |  | D |

These velocities fit the orbit of Baker (Publ. A.O. 2, 17, 1910). Blending with the secondary is evident for plate 6805.

| 0 | HD 154494     | 60 Herculis       | $\alpha = 17^h 0^m 44^s$ | $\delta = +12^\circ 53'$ | A3IV |
|---|---------------|-------------------|--------------------------|--------------------------|------|
| 1 | 3593 1910 Jun | 8.656 2418831.656 | + 2.6                    | ±3.5                     | 7 J  |
| 2 | 3601          | 20.697 8843.697   | -11.2                    | 4.5                      | 13 J |
| 3 | 5362 1912 Jul | 22.649 9606.649   | - 6.9                    | 2.6                      | 10 J |
| 4 | 5801 1913 May | 18.809 9906.809   | +13.2                    | 2.6                      | 15 J |
| 5 | 5887 1913 Jul | 10.663 9959.663   | - 3.2                    | 4.5                      | 15 J |
|   |               | Mean              | - 0.8                    |                          |      |

| 1 | HD 156247     | $\alpha = 17^h 11^m 27^s$ | $\delta = +1^\circ 19'$ | B5V                                  |
|---|---------------|---------------------------|-------------------------|--------------------------------------|
| 1 | 2437 1909 Mar | 22.858 2418388.858        | +44.1                   | mean c.f. 2<br>one line only-blended |

| 2 | HD 156633     | 68 Herculis        | $\alpha = 17^h 13^m 38^s$ | $\delta = +33^\circ 12'$ | B3 III            |
|---|---------------|--------------------|---------------------------|--------------------------|-------------------|
| 1 | 3641 1910 Jul | 13.664 2418866.664 | -90.8                     | ±6.4                     | 5 B               |
| 2 | 6705 1915 Jun | 4.778 2420653.778  | -45.9                     | 4.0                      | 12 H,D mean of 2  |
| 3 | 6710          | 5.777 0654.777     | - 0.8                     | 4.3                      | 10 H.D 3          |
| 4 | 6713          | 9.639 0658.639     | +56.6                     | 4.4                      | 13 1 -7.5 2 H,D 2 |
| 5 | 6718          | 11.689 0660.689    | +52.9                     | 3.2                      | 12 D              |
| 6 | 6725          | 17.643 0666.643    | +76.2                     | 3.4                      | 13 + 3.2 2 H,D 2  |

|    |      |           |          |        |      |    |                 |           |
|----|------|-----------|----------|--------|------|----|-----------------|-----------|
| 7  | 6728 | 19.639    | 0668.639 | +77.7  | ±3.4 | 13 | H,D             | mean of 2 |
| 8  | 6732 | 20.606    | 0669.606 | -105.1 | 4.4  | 15 | H,D             | 2         |
| 9  | 6737 | 23.612    | 0672.612 | +64.0  | 3.5  | 11 | H,D             | 2         |
| 10 | 6753 | Jul 3.625 | 0682.625 | +20.3  | 24.2 | 3  | D               |           |
| 11 | 6755 | 8.600     | 0687.600 | - 1.0  | 3.9  | 8  | H,D             | 2         |
| 12 | 6761 | 13.640    | 0692.640 | -67.0  | 5.0  | 12 | H,D             | 2         |
| 13 | 6766 | 19.592    | 0698.592 | -112.1 | 4.6  | 11 | H,D             | 2         |
| 14 | 6767 | 21.603    | 0700.603 | -108.7 | 2.8  | 11 | H,D             | 2         |
|    |      |           |          |        |      |    | 1               |           |
|    |      |           |          |        |      |    | Mean I.S. = 8.4 |           |

These points fit the orbit of Baker (Publ. A.O. 1, 77, 1909),  $T = 2418125.80$ ,  $P = 2.051027$ .

| 83 | HD 157193            | 70 Herculis | $\alpha = 17^{\text{h}}16^{\text{m}}47^{\text{s}}$ | $\delta = +24^{\circ}36'$ | A1V             |
|----|----------------------|-------------|----------------------------------------------------|---------------------------|-----------------|
| 1  | 2605 1909 Jun 20.693 | 2418478.693 | -10.1                                              | $\pm 4.6$ 5               | J               |
| 2  | 3587 1910 Jun 7.706  | 3830.706    | -10.4                                              | 4.7 4                     | J               |
| 3  | 3692 Aug 1.564       | 3885.564    | -44.2                                              | 2                         | J spectrum weak |
| 4  | 4728 1911 Aug 22.585 | 9271.585    | -23.1                                              | 5.6 7                     | J 1 line only   |
| 5  | 5891 1913 Jul 11.682 | 9960.682    | -34.2                                              | 6.0 5                     | J               |
| 6  | 6385 1914 Jul 2.711  | 2420316.711 | -17.1                                              | 1.3 10                    | J               |

The range of these velocities together with the published velocities is +16 km/sec. to -44 km/sec. This star is a possible spectroscopic binary.

|    |           |                   |                           |                          |        |
|----|-----------|-------------------|---------------------------|--------------------------|--------|
| 84 | HD 162579 | $\alpha$ Ophiuchi | $\alpha = 17^h 30^m 18^s$ | $\delta = +12^\circ 38'$ | A5 III |
|----|-----------|-------------------|---------------------------|--------------------------|--------|

|   |      |          |        |             |       |      |   |   |
|---|------|----------|--------|-------------|-------|------|---|---|
| 1 | 2547 | 1909 May | 31.724 | 2418458.724 | +17.6 | ±6.2 | 5 | B |
| 2 | 2552 | Jun      | 5.742  | 8463.742    | +21.2 | 3.6  | 7 | B |
| 3 | 2673 | Jul      | 9.667  | 8497.667    | +31.7 | 3.7  | 8 | B |
| 4 | 2702 |          | 19.628 | 8507.628    | +12.5 | 2.9  | 7 | B |
| 5 | 2728 |          | 27.692 | 8515.692    | +21.8 | 4.8  | 7 | B |
| 6 | 2729 |          | 27.706 | 8515.706    | +9.1  | 3.0  | 6 | B |

Astrometric binary, period 8  $\frac{1}{2}$  5 (Lippencott and Wagman, A.J. 71, 122, 1966.)

| 5 | HD 162579 | 30 Draco        | $\alpha = 17^h 46^m 41^s$ | $\delta = +50^\circ 48'$ | A2            |                |
|---|-----------|-----------------|---------------------------|--------------------------|---------------|----------------|
| 1 | 3623      | 1910 Jun 28.641 | 2418851.641               | -59.2                    | $\pm 2.6$ 7.5 | D              |
| 2 | 5833      | 1913 Jun 6.705  | 9925.705                  | -72.6                    | 1.3 6         | D underexposed |
| 3 | 5855      | 14.634          | 9933.634                  | -45.9                    | 3.3 6         | D              |
| 4 | 6297      | 1914 May 16.752 | 2420269.752               | -58.7                    | 3.6 6         | D              |

The range of these velocities together with the published velocities is -33 km/sec. to -73 km/sec. This star is therefore a possible spectroscopic binary.

| 6 | HD 164284     | 66 Ophiuchi       | $\alpha = 17^h 55^m 19^s$ | $\delta = +4^{\circ} 22'$ | B2 Ve             |
|---|---------------|-------------------|---------------------------|---------------------------|-------------------|
| 1 | 2540 1909 May | 2418456.760 + 0.4 | $\pm 3.9$                 | 4                         | J                 |
| 2 | 2606 Jun      | 8478.721 - 8.1    | 10.3                      | 2                         | J                 |
| 3 | 2997 Sep      | 8570.582 - 3.4    | 8.5                       | 3                         | J                 |
| 4 | 4721 1911 Aug | 9270.565 -19.8    | 16.1                      | 3                         | J                 |
| 5 | 5960 1913 Aug | 2420007.564 -16.8 | 4.4                       | 4                         | J I.S. is 2 lines |

The published range is +10 km/sec. to -66 km/sec. This star is a possible spectrographic binary.

| 87 | HD 166014 |          | o Hercules  | $\alpha = 18^h 3^m 38^s$ | $\delta = -28^\circ 45'$ | B9V |
|----|-----------|----------|-------------|--------------------------|--------------------------|-----|
| 1  | 5214      | 1912 Apr | 2419517.807 | -10.6                    | $\pm 4.1$                | 4   |
| 2  | 5238      | May      | 9532.847    | -43.6                    | 6.1                      | 5   |
| 3  | 5256      |          | 17.822      | -17.9                    | 5.6                      | 3   |
| 4  | 5266      |          | 22.759      | -53.1                    | 10.2                     | 4   |
| 5  | 5294      | Jun      | 4.716       | -24.7                    | 6.4                      | 3   |
| 6  | 5307      |          | 7.812       | -19.3                    | 6.4                      | 4   |
| 7  | 5334      |          | 28.741      | -18.1                    | 2.2                      | 6   |
| 8  | 5379      | Aug      | 2.610       | -23.0                    | 6.2                      | 6   |
| 9  | 5412      |          | 26.566      | -40.7                    | 1.8                      | 5   |
| 10 | 5797      | 1913 May | 11.821      | -28.1                    | 1.2                      | 3   |
| 11 | 5824      | Jun      | 2.792       | -8.2                     | 12.1                     | 2   |
| 12 | 5846      |          | 11.819      | -39.7                    | 2.1                      | 5   |
| 13 | 6368      | 1914 Jun | 12.818      | -16.4                    | 3.7                      | 2.5 |

broken & out of focus  
2 lines only

The extreme velocities have large probable error hence it is unlikely that this star has variable velocity.

| 88 | HD 169986 |          | 59 Serpentis | $\alpha = 18^h 22^m 06^s$ | $\delta = +00^\circ 08'$ | G0+A0                      |
|----|-----------|----------|--------------|---------------------------|--------------------------|----------------------------|
| 1  | 3588      | 1910 Jun | 7.738        | 2418830.738               | -15.5                    | $\pm 2.2$ 19 J             |
| 2  | 3595      |          | 8.742        | 8831.742                  | -22.7                    | 3.8 9 J                    |
| 3  | 3602      |          | 20.746       | 8843.746                  | +14.2                    | 5.4 2 J spectrum very weak |

|    |      |                |          |       |      |    |   |                    |
|----|------|----------------|----------|-------|------|----|---|--------------------|
| 4  | 3610 | 24.710         | 8847.710 | -23.9 | +5.3 | 11 | J |                    |
| 5  | 3616 | 25.689         | 8848.689 | -37.4 | 3.9  | 5  | J |                    |
| 6  | 3625 | 28.720         | 8851.720 | -39.5 | 7.6  | 4  | J | spectrum weak      |
| 7  | 3653 | Jul 20.665     | 8873.665 | -34.5 | 4.4  | 8  | J | spectrum weak      |
| 8  | 3659 | 24.621         | 8877.621 | -29.5 | 2.1  | 15 | J |                    |
| 9  | 3664 | 26.576         | 8879.576 | -31.8 | 4.3  | 13 | J |                    |
| 10 | 3670 | 28.576         | 8881.576 | -25.4 | 3.4  | 18 | J | numerous lines     |
| 11 | 3697 | Aug 5.603      | 8889.603 | -12.3 | 7.0  | 4  | J |                    |
| 12 | 3710 | 8.569          | 8892.569 | -36.0 | 2.6  | 14 | J |                    |
| 13 | 3722 | 12.582         | 8896.582 | - 4.1 | 3.5  | 5  | J | spectrum weak      |
| 14 | 4341 | 1911 May 5.810 | 9162.810 | -11.1 | 2.5  | 20 | J |                    |
| 15 | 4406 | 20.842         | 9177.842 | - 8.3 | 2.9  | 17 | J |                    |
| 16 | 4418 | 24.819         | 9181.819 | +14.8 | 4.9  | 12 | J | spectrum weak      |
| 17 | 4425 | 25.769         | 9182.769 | - 5.9 | 3.7  | 10 | J |                    |
| 18 | 4440 | 27.790         | 9184.790 | -28.2 | 7.7  | 8  | J | spectrum very weak |
| 19 | 4449 | 29. -          | -        | -     | -    | -  |   | plate missing      |
| 20 | 4451 | 30.802         | 9187.802 | - 8.7 | 9.5  | 5  | J | spectrum very weak |
| 21 | 4458 | Jun 1.775      | 9189.775 | - 5.3 | 3.1  | 23 | J |                    |
| 22 | 4463 | 3.759          | 9191.759 | -19.5 | 5.4  | 13 | J | spectrum weak      |
| 23 | 4477 | 10.746         | 9198.746 | -21.1 | 5.6  | 16 | J |                    |
| 24 | 4481 | 12.714         | 9200.714 | + 3.2 | 4.5  | 9  | J |                    |
| 25 | 4502 | 19.722         | 9207.722 | -14.4 | 2.9  | 14 | J |                    |
| 26 | 4507 | 20.731         | 9208.731 | -28.2 | 5.2  | 8  | J |                    |

|    |      |           |          |       |      |    |   |                    |
|----|------|-----------|----------|-------|------|----|---|--------------------|
| 27 | 4512 | 21.706    | 9209.706 | -13.4 | *3.4 | 17 | J |                    |
| 28 | 4519 | 22.718    | 9210.718 | -15.1 | 3.0  | 10 | J |                    |
| 29 | 4526 | 23.758    | 9211.758 | -13.1 | 6.8  | 11 | J | spectrum poor      |
| 30 | 4537 | 28.740    | 9216.740 | -25.1 | 2.7  | 14 | J |                    |
| 31 | 4542 | 29.735    | 9217.735 | -21.0 | 1.4  | 15 | J |                    |
| 32 | 4556 | Jul 1.680 | 9219.680 | -18.4 | 3.8  | 12 | J |                    |
| 33 | 4563 | 2.678     | 9220.678 | - 0.5 | 5.1  | 9  | J | lines ragged       |
| 34 | 4570 | 3.742     | 9221.742 | -29.1 | 5.1  | 12 | J |                    |
| 35 | 4575 | 4.657     | 9222.657 | -23.6 | 8.5  | 6  | J | spectrum weak      |
| 36 | 4580 | 5.665     | 9223.665 | -31.3 | 3.6  | 10 | J | spectrum weak      |
| 37 | 4589 | 8.707     | 9226.707 | -34.3 | 5.0  | 20 | J |                    |
| 38 | 4594 | 9.686     | 9227.686 | -13.5 | 2.9  | 18 | J |                    |
| 39 | 4607 | 14.698    | 9232.698 | -11.8 | 4.5  | 13 | J |                    |
| 40 | 4611 | 15.633    | 9233.633 | -19.1 | 2.8  | 14 | J |                    |
| 41 | 4617 | 17.666    | 9235.666 | - 6.6 | 6.3  | 6  | J | spectrum very weak |
| 42 | 4623 | 22.631    | 9240.631 | -11.5 | 3.2  | 20 | J |                    |
| 43 | 4632 | 26.664    | 9244.664 | -20.7 | 2.8  | 17 | J |                    |
| 44 | 4642 | 28.658    | 9246.658 | -18.7 | 5.3  | 8  | J |                    |
| 45 | 4649 | 30.624    | 9248.624 | -17.2 | 4.9  | 8  | J |                    |
| 46 | 4656 | Aug 6.649 | 9255.649 | -10.6 | 9.4  | 6  | J |                    |
| 47 | 4666 | 9.633     | 9258.633 | -14.5 | 3.7  | 12 | J |                    |
| 48 | 4673 | 10.603    | 9259.603 | -26.5 | 4.9  | 13 | J |                    |
| 49 | 4679 | 11.613    | 9260.613 | -23.2 | 4.4  | 12 | J |                    |

|    |      |          |          |             |      |     |                    |
|----|------|----------|----------|-------------|------|-----|--------------------|
| 50 | 4697 | 16.619   | 9265.619 | -36.9       | +3.3 | 10  | J                  |
| 51 | 4714 | 20.562   | 9269.562 | -35.0       | 3.3  | 12  | J                  |
| 52 | 6282 | 1914 May | 9.808    | 2420262.808 | -4.0 | 8.6 | 13 J spectrum weak |

This star is a spectroscopic triple system, orbit by Tilley (Ap. J. 98, 347, 1943). The short period of 1.85 days represents a double line A0 A0 binary which Jordan apparently measured blended. These velocities, therefore, have significance only in terms of the 386 day period.

|    | HD 170000 | $\phi$ Draconis  | $\alpha = 18^h 22^m 12^s$ | $\delta = +71^\circ 17'$ | A0si                |
|----|-----------|------------------|---------------------------|--------------------------|---------------------|
| 1  | 4471      | 1911 Jun 9.719   | 2419197.719               | -21.7                    | $\pm 2.4$ 9 J       |
| 2  | 4482      | 12.765           | 9200.765                  | -41.0                    | 3.1 10 J            |
| 3  | 4497      | 18.760           | 9206.760                  | -59.2                    | 6.2 6 J             |
| 4  | 4559      | Jul 1.783        | 9219.783                  | -46.7                    | 8.0 5 J             |
| 5  | 5335      | 1912 Jun 28.804  | 9582.804                  | -33.4                    | 2.3 12 J            |
| 6  | 5840      | 1913 Jun 10.6''2 | 9929.672                  | -14.5                    | 3.7 12 J            |
| 7  | 5852      | 13.703           | 9932.703                  | -13.7                    | 3.2 8 J             |
| 8  | 5856      | 14.678           | 9933.678                  | -15.0                    | 4.1 7 J             |
| 9  | 5860      | 15.860           | 9934.860                  | - 9.2                    | 1.7 7.5 J           |
| 10 | 5866      | 21.674           | 9940.674                  | - 6.0                    | 2.8 7.5 J           |
| 11 | 5892      | Jul 12.622       | 9961.622                  | -26.2                    | 5.4 5 J             |
| 12 | 5933      | Aug 5.627        | 9985.627                  | -31.8                    | 5.4 10 J            |
| 13 | 5937      | 9.567            | 9989.567                  | -26.5                    | 3.8 7 J overexposed |
| 14 | 5942      | 19.566           | 9999.566                  | -11.3                    | 2.9 8 J             |
| 15 | 5967      | 30.565           | 2420010.565               | -30.2                    | 2.9 8 J             |

|    |      |                 |          |       |      |     |                   |
|----|------|-----------------|----------|-------|------|-----|-------------------|
| 16 | 5987 | Sep 6.537       | 0017.537 | -18.5 | ±2.1 | 5   | J                 |
| 17 | 5992 | 8.576           | 0019.576 | -27.1 | 3.1  | 14  | J                 |
| 18 | 6007 | 23.533          | 0034.533 | -18.7 | 1.9  | 8   | J                 |
| 19 | 6298 | 1914 May 16.806 | 0269.806 | -31.0 | 4.3  | 8   | J                 |
| 20 | 6307 | 18.795          | 0271.795 | -31.4 | 2.8  | 13  | J                 |
| 21 | 6312 | 19.729          | 0272.729 | - 9.0 | 2.5  | 7   | J                 |
| 22 | 6329 | 25.830          | 0278.830 | -24.3 | 2.5  | 7.5 | J                 |
| 23 | 6355 | Jun 6.735       | 0290.735 | -15.4 | 4.9  | 10  | J                 |
| 24 | 6373 | 16.708          | 0300.708 | - 8.6 | 2.4  | 11  | J strong exposure |
| 25 | 6379 | 23.651          | 0307.651 | -20.5 | 3.1  | 6.5 | J                 |
| 26 | 6396 | Jul 11.632      | 0325.632 | -15.9 | 3.2  | 12  | J                 |
| 27 | 6401 | 15.732          | 0329.732 | - 0.9 | 2.6  | 12  | J                 |
| 28 | 6438 | Aug 12.583      | 0357.582 | -70.2 | 5.8  | 10  | J                 |
| 29 | 6441 | 13.598          | 0358.598 | -53.9 | 3.4  | 7   | J                 |
| 30 | 6462 | 23.604          | 0368.604 | -37.7 | 4.9  | 11  | J                 |
| 31 | 6463 | 26.567          | 0371.567 | -38.3 | 6.1  | 11  | J                 |
| 32 | 6469 | 31.578          | 0376.578 | -31.0 | 2.3  | 12  | J                 |
| 33 | 6477 | Sep 13.521      | 0389.521 | -30.2 | 2.7  | 9   | J                 |
| 34 | 6485 | 15.554          | 0391.554 | -14.6 | 4.4  | 9   | J                 |
| 35 | 6490 | 18.536          | 0394.536 | -10.8 | 2.3  | 8   | J                 |
| 36 | 6492 | 20.537          | 0396.537 | -28.5 | 3.4  | 11  | J                 |
| 37 | 6496 | 21.533          | 0397.533 | -27.0 | 2.0  | 14  | J                 |
| 38 | 6501 | 22.548          | 0398.548 | -23.4 | 3.8  | 5.5 | J                 |

39 6515' 29.503 '0405.503 -18.5 ± 4.8 '9

All published velocities as well as these fit a period of 127.8 days. Preliminary elements are

$$\begin{aligned} P &= 127^d.85 \\ T_0 &= 2413823.7 \\ \phi &= \text{periastron } 61.0^\circ \\ k &= 30 \text{ km/sec.} \\ e &= 0.60 \\ \omega &= 120^\circ \\ \gamma &= -25.5 \text{ km/sec.} \end{aligned}$$

An interesting feature is the large scatter about this curve which implies a short period. Several persons have noted doubling of lines in the spectrum (see Hnatek, A.N. 197, 185, 1913). There is a suggestion also, of a much longer period. The star is a visual binary (ADS 11311) and is presently closing in to periastron. It is unlikely that this can account for the apparent long period variation.

| 90 | HD 172167 | $\alpha$ Lyrae  | $\alpha = 18^h 33^m 33^s$ | $\delta = +38^\circ 41'$ | A0V    |
|----|-----------|-----------------|---------------------------|--------------------------|--------|
| 1  | 2620      | 1909 Jun 29.833 | 2418487.833               | -13.8 ± 1.4              | 4      |
| 2  | 2639      | Ju1 4.646       | 8492.646                  | -14.6                    | 1.3 12 |
| 3  | 2640      | 4.661           | 8492.661                  | -15.3                    | 1.2 14 |
| 4  | 2675      | 9.764           | 8497.764                  | -17.3                    | 1.5 12 |
| 5  | 2715      | 24.721          | 8512.721                  | -22.1                    | 1.0 13 |
| 6  | 2716      | 24.728          | 8512.728                  | -18.2                    | 1.5 13 |
| 7  | 2776      | Aug 7.560       | 8526.560                  | -10.1                    | 1.4 11 |
| 8  | 2779      | 7.686           | 8526.686                  | -12.5                    | 0.9 16 |
| 9  | 2781      | 7.781           | 8526.781                  | -7.6                     | 2.0 8  |
| 10 | 2792      | 10.622          | 8529.622                  | -16.6                    | 1.5 11 |
| 11 | 2793      | 10.631          | 8529.631                  | -14.5                    | 1.3 13 |
| 12 | 2803      | 18.561          | 8537.561                  | -15.7                    | 0.8 14 |
| 13 | 2804      | 18.571          | 8537.571                  | -13.9                    | 1.2 15 |
| 14 | 2822      | 21.732          | 8540.732                  | -20.0                    | 1.2 19 |
| 15 | 2823      | 21.746          | 8540.746                  | -18.4                    | 0.9 17 |

mean of 2

mean of 2

mean of 2

underexposed -  
reject

mean of 2

mean of 2

mean of 2

overexposed

|    |      |           |          |       |      |    |
|----|------|-----------|----------|-------|------|----|
| 16 | 2826 | 22.543    | 8541.543 | -15.5 | ±0.9 | 10 |
| 17 | 2827 | 22.547    | 8541.547 | -15.7 | 0.9  | 12 |
| 18 | 2838 | 24.542    | 8543.542 | -14.7 | 1.3  | 13 |
| 19 | 2839 | 24.551    | 8543.551 | -16.5 | 1.2  | 9  |
| 20 | 2863 | 28.567    | 8547.567 | -16.6 | 0.9  | 14 |
| 21 | 2864 | 28.574    | 8547.574 | -17.3 | 1.4  | 11 |
| 22 | 2874 | 30.555    | 8549.555 | -15.9 | 0.8  | 13 |
| 23 | 2875 | 30.565    | 8549.565 | -14.4 | 0.9  | 12 |
| 24 | 2879 | 31.640    | 8550.640 | -18.3 | 1.9  | 10 |
| 25 | 2880 | 31.643    | 8550.643 | -18.2 | 0.7  | 9  |
| 26 | 2884 | Sep 1.658 | 8551.658 | -9.6  | 1.7  | 11 |
| 27 | 2885 | 1.666     | 8551.666 | -13.8 | 1.8  | 14 |
| 28 | 2896 | 5.516     | 8555.516 | -17.0 | 0.8  | 14 |
| 29 | 2897 | 5.522     | 8555.522 | -12.1 | 0.6  | 14 |
| 30 | 2906 | 7.519     | 8557.519 | -13.4 | 1.3  | 7  |
| 31 | 2907 | 7.524     | 8557.524 | -15.9 | 2.0  | 7  |
| 32 | 2918 | 8.581     | 8558.581 | -16.6 | 1.8  | 6  |
| 33 | 2919 | 8.596     | 8558.596 | -12.4 | 2.5  | 8  |

mean of 2

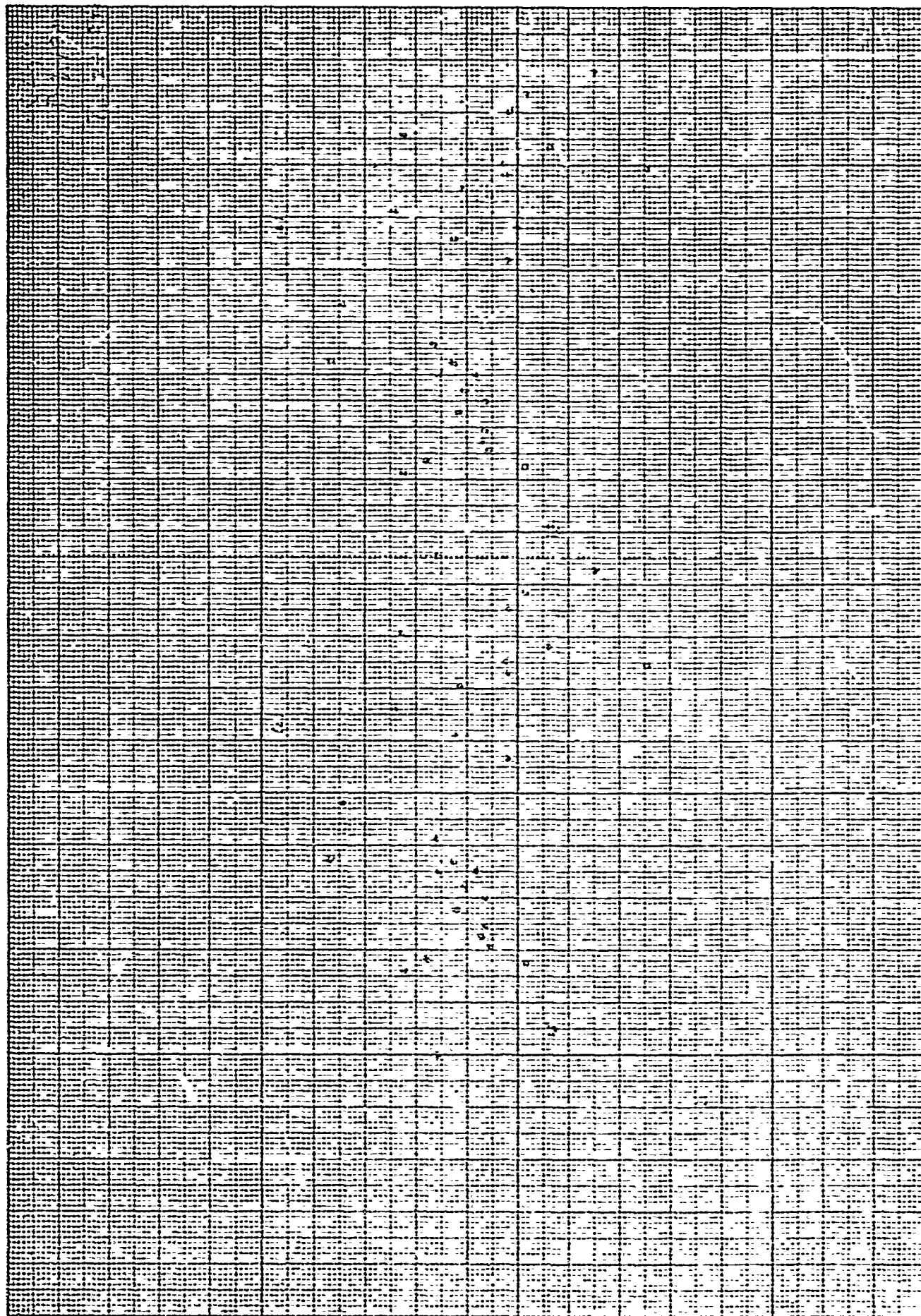
2

overexposed; poor  
guiding  
overexposed

A periodic variation in radial velocity of 0.19 days was found by Belopolsky (z.f. Astroph. 2, 245, 1931). This was subsequently emphatically disavowed by Neubauer (L.O.B. 17, 109, 193) who considered no variation existed greater than 0.2 km/sec., even though some of his observations show an apparent variation of the proper parameters. Figure 2 shows a plot of these velocities on a trial period of 0.1903 days. There is considerable scatter, however, a periodic variation appears evident that might well be associated with large scale atmospheric motion. The fact that the variation is still apparent after a total of more than 370 cycles would seem to be of significance. However, almost 50% of the observations lie within p.e. 1.5 km/sec., which is close to the mean p.e. per plate. We feel that a careful series of observations should be obtained to resolve this issue.

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| HD 173648 |      | $\epsilon$ Lyrae |        | $\alpha = 18^h 41^m 20^s$ | $\delta = +37^\circ 30'$ | Am           |
|-----------|------|------------------|--------|---------------------------|--------------------------|--------------|
| 1         | 6706 | 1915 Jun         | 4.853  | 2420653.853               | -54.2                    | $\pm 1.3$ 41 |
| 2         | 6722 |                  | 12.694 | 0661.694                  | -79.0                    | 1.8 14       |
| 3         | 6727 |                  | 17.839 | 0666.839                  | -50.5                    | 1.2 37       |
| 4         | 6729 |                  | 19.724 | 0668.724                  | +14.4                    | 0.9 47       |
| 5         | 6733 |                  | 20.666 | 0669.666                  | -45.5                    | 1.3 45       |
| 6         | 6738 |                  | 23.672 | 0672.672                  | +26.4                    | 0.8 45       |
| 7         | 6741 |                  | 24.578 | 0673.578                  | -24.2                    | 2.0 25       |
| 8         | 6742 |                  | 25.659 | 0674.659                  | -70.8                    | 2.7 24       |
| 9         | 6744 |                  | 26.631 | 0675.631                  | -32.4                    | 0.7 47       |
| 10        | 6750 | Jul              | 2.634  | 0681.634                  | +10.9                    | 1.1 43       |
| 11        | 6759 |                  | 11.590 | 0690.590                  | - 5.5                    | 1.1 40       |
| 12        | 6768 |                  | 21.658 | 0700.658                  | -72.7                    | 1.3 47       |
| 13        | 6771 |                  | 22.588 | 0701.588                  | -20.5                    | 1.5 37       |

weak

comparison weak

weak

out of focus

comparison very weak

These velocities agree with the orbit of Jordan (Publ. A.O. 1, 115, 1909).

| HD 173880 |      | 111 Herculis |        | $\alpha = 18^h 42^m 36^s$ | $\delta = +18^\circ 4'$ | A3V          |
|-----------|------|--------------|--------|---------------------------|-------------------------|--------------|
| 1         | 2625 | 1909 Jun     | 30.703 | 2418488.703               | -44.6                   | $\pm 1.9$ 17 |
| 2         | 2996 | Sep          | 20.533 | 8570.533                  | -58.3                   | 1.0 24       |
| 3         | 3024 |              | 27.544 | 8577.544                  | -55.5                   | 1.4 14       |
| 4         | 3033 |              | 28.517 | 8578.517                  | -41.3                   | 2.4 17       |
| 5         | 3043 | Oct          | 3.581  | 8583.581                  | -54.3                   | 1.1 18       |

D mean of 2

D mean of 2

D mean of 2

D

D

|    |       |                 |          |       |      |      |          |
|----|-------|-----------------|----------|-------|------|------|----------|
| 6  | 3045  | 4.509           | 8584.509 | -49.7 | *1.8 | 17.5 | D        |
| 7  | 3057  | 5.552           | 8535.552 | -54.2 | 1.1  | 13.5 | D        |
| 8  | 3110  | 12.516          | 8592.516 | -29.3 | 4.5  | 14.5 | D        |
| 9  | 3611  | 1910 Jun 24.775 | 8847.775 | -49.7 | 2.4  | 15.5 | D        |
| 10 | 3617  | 25.731          | 8848.731 | -48.8 | 1.5  | 23   | D        |
| 11 | 3621B | -               | -        | -     | -    | -    | - reject |
| 12 | 3624  | 28.676          | 8851.676 | -53.3 | 1.9  | 18   | D        |
| 13 | 3630  | Jul 4.682       | 8857.682 | -49.9 | 2.8  | 16.5 | D        |
| 14 | 3634  | 7.643           | 8860.643 | -40.5 | 2.1  | 12   | D        |
| 15 | 3638  | 8.717           | 8861.717 | -47.8 | 2.3  | 9.5  | D        |
| 16 | 3648  | 19.753          | 8872.753 | -45.8 | 2.5  | 18   | D        |
| 17 | 3654  | 23.597          | 8876.597 | -49.9 | 3.1  | 12.5 | D        |
| 18 | 3665  | 26.633          | 8879.633 | -50.2 | 1.6  | 22   | D        |
| 19 | 3669A | 27. -           | -        | -     | -    | -    | - reject |
| 20 | 3671  | 28.618          | 8881.618 | -47.2 | 1.1  | 15.5 | D        |
| 21 | 3686  | 31.580          | 8884.580 | -41.2 | 1.7  | 15.5 | D        |
| 22 | 3693  | Aug 4.718       | 8888.718 | -47.4 | 2.1  | 8    | D        |
| 23 | 3705  | 6.604           | 8890.604 | -46.7 | 1.9  | 20.5 | D        |
| 24 | 3711  | 8.617           | 8892.617 | -49.4 | 1.8  | 19   | D        |
| 25 | 3715  | 11.606          | 8895.606 | -48.7 | 2.0  | 18.5 | D        |
| 26 | 3729  | 13.565          | 8897.565 | -48.5 | 1.4  | 15.5 | D        |
| 27 | 3735  | 15.603          | 8899.603 | -51.6 | 2.6  | 16   | D        |
| 28 | 3736  | 17.569          | 8901.569 | -46.8 | 2.7  | 16.5 | D        |

|    |       |                |          |       |     |      |              |
|----|-------|----------------|----------|-------|-----|------|--------------|
| 29 | 3738  | 19.552         | 8903.552 | -47.7 | 1.0 | 26.5 | D            |
| 30 | 3744  | 20.563         | 8904.563 | -49.0 | 2.0 | 11.5 | D            |
| 31 | 3749  | 26.542         | 8910.542 | -50.6 | 1.9 | 17   | D            |
| 32 | 3758  | 27.547         | 8911.547 | -47.3 | 3.3 | 15   | D            |
| 33 | 3765  | 28.568         | 8912.568 | -50.7 | 3.5 | 8    | D            |
| 34 | 3772  | 29.558         | 8913.558 | -33.5 | 3.6 | 14   | D            |
| 35 | 3777  | 30.602         | 8914.602 | -38.8 | 3.6 | 12.5 | D            |
| 36 | 3779C | -              | -        | -     | -   | -    | - reject     |
| 37 | 3779  | Sep 6.567      | 8921.567 | -50.9 | 3.2 | 12   | D            |
| 38 | 3786  | 7.542          | 8922.542 | -52.1 | 2.0 | 8.5  | D            |
| 39 | 3792  | 9.587          | 8924.587 | -53.7 | 3.5 | 8.5  | D            |
| 40 | 3793  | 10.572         | 8925.572 | -36.7 | 5.1 | 5    | D            |
| 41 | 3795  | 11.582         | 8926.582 | -55.2 | 2.5 | 10.5 | D            |
| 42 | 3806  | 15.587         | 8930.587 | -42.5 | 1.5 | 17   | D focus poor |
| 43 | 3813  | 16.566         | 8931.566 | -53.0 | 1.6 | 15.5 | D            |
| 44 | 3818  | 21.556         | 8936.556 | -47.9 | 4.2 | 7.5  | D            |
| 45 | 3826  | 22.545         | 8937.545 | -54.8 | 3.3 | 13   | D            |
| 46 | 3832  | 26.527         | 8941.527 | -56.8 | 1.6 | 19.5 | D            |
| 47 | 3839  | 28.548         | 8943.548 | -56.2 | 2.3 | 14.5 | D            |
| 48 | 3848  | 29.558         | 8944.558 | -53.1 | 2.4 | 12.5 | D            |
| 49 | 4018  | Nov 8.473      | 8984.473 | -52.6 | 1.6 | 14   | D            |
| 50 | 4331  | 1911 May 4.821 | 9161.821 | -52.0 | 1.8 | 17   | D            |
| 51 | 4469  | Jun 8.792      | 9196.792 | -47.2 | 1.2 | 29   | D seed 23    |

|    |      |            |          |       |      |    |   |         |
|----|------|------------|----------|-------|------|----|---|---------|
| 52 | 4699 | Aug 18.590 | 9267.590 | -47.4 | ±1.3 | 34 | D | seed 23 |
| 53 | 4852 | Oct 13.510 | 9323.510 | -45.2 | 1.5  | 33 | D |         |
| 54 | 4939 | Nov 16.465 | 9357.465 | -45.8 | 1.6  | 27 | D |         |

This is a spectroscopic binary of low amplitude. A period of 130 days appears to satisfy these observations. Further observations will be necessary to confirm this.

93 HD 180163 n Lyrae  $\alpha = 19^h 10^m 21^s$   $\delta = +38^\circ 58'$  B21V

|   |      |                 |             |              |      |    |  |  |
|---|------|-----------------|-------------|--------------|------|----|--|--|
| 1 | 5267 | 1912 May 22.807 | 2419545.807 | -13.7        | ±2.2 | 17 |  |  |
| 2 | 5295 | Jun 4.754       | 9558.754    | -10.6        | 1.5  | 19 |  |  |
| 3 | 5319 | 10.799          | 9564.799    | -1.9         | 1.2  | 19 |  |  |
| 4 | 5381 | Aug 2.760       | 9617.760    | -12.0        | 1.2  | 25 |  |  |
| 5 | 5446 | Sep 16.599      | 9662.599    | -14.8        | 1.3  | 20 |  |  |
| 6 | 6806 | 1915 Sep 10.590 | 2420751.590 | <u>-11.0</u> | 1.5  | 16 |  |  |

Mean -10.7

| 94 | HD 180554 | 1 Vulpeculae    | $\alpha = 19^h 11^m 55^s$ | $\delta = +21^\circ 13'$ | B31V                 |
|----|-----------|-----------------|---------------------------|--------------------------|----------------------|
| 1  | 2608      | 1909 Jun 20.822 | 2418478.822               | -28.9                    | ±3.6 12 + 73.7 2     |
| 2  | 2627      | 30.763          | 8488.763                  | -30.9                    | 2.2 12 J mean of 2 2 |
| 3  | 2742      | Aug 1.704       | 8520.704                  | -36.3                    | 2.6 8 J 2            |
| 4  | 2750      | 2.706           | 8521.706                  | -28.7                    | 5.0 13 J 2           |
| 5  | 3589      | 1910 Jun 7.769  | 8830.769                  | -14.9                    | 4.6 6 J 2            |
| 6  | 3991      | Oct 30.517      | 8975.517                  | -39.0                    | 11.6 3 J             |
| 7  | 4001      | 31.483          | 8976.483                  | -50.5                    | 5.2 10 J             |

|    |      |          |        |          |       |      |    |   |
|----|------|----------|--------|----------|-------|------|----|---|
| 8  | 4019 | Nov      | 8.510  | 8984.510 | -17.9 | +3.5 | 6  | J |
| 9  | 4037 |          | 20.481 | 8996.481 | -30.2 | 3.1  | 7  | J |
| 10 | 4426 | 1911 May | 25.806 | 9182.806 | -33.8 | 3.4  | 7  | J |
| 11 | 4433 |          | 26.842 | 9183.842 | -36.5 | 3.3  | 3  | J |
| 12 | 4452 |          | 30.856 | 9187.856 | -12.4 | 9.3  | 6  | J |
| 13 | 4470 | Jun      | 8.845  | 9196.845 | + 6.0 | 2.5  | 7  | J |
| 14 | 4484 |          | 12.843 | 9200.843 | -27.6 | 2.7  | 10 | J |
| 15 | 4498 |          | 18.807 | 9206.807 | -31.1 | 5.8  | 8  | J |
| 16 | 4513 |          | 21.744 | 9209.744 | -10.8 | 8.7  | 4  | J |
| 17 | 4521 |          | 22.786 | 9210.786 | -27.9 | 2.6  | 10 | J |
| 18 | 4527 |          | 23.812 | 9211.812 | -36.3 | 8.5  | 6  | J |
| 19 | 4544 |          | 29.816 | 9217.816 | -31.8 | 3.6  | 10 | J |
| 20 | 4558 | Ju1      | 1.755  | 9219.755 | -29.4 | 3.3  | 7  | J |
| 21 | 4572 |          | 3.824  | 9221.824 | -52.8 | 5.1  | 5  | J |
| 22 | 4600 |          | 12.712 | 9230.712 | -24.4 | 2.1  | 9  | J |
| 23 | 4766 | Sep      | 6.574  | 9286.574 | - 4.4 | 7.0  | 9  | J |
| 24 | 4771 |          | 11.554 | 9291.554 | -19.6 | 3.3  | 11 | J |
| 25 | 4831 |          | 30.499 | 9310.499 | -17.7 | 5.7  | 9  | J |
| 26 | 4872 | Oct      | 19.496 | 9329.496 | -12.8 | 8.1  | 11 | J |
| 27 | 4893 |          | 26.503 | 9336.503 | - 7.7 | 2.9  | 7  | J |
| 28 | 5296 | 1912 Jun | 4.794  | 9558.794 | -25.0 | 3.3  | 10 | J |
| 29 | 5325 |          | 13.811 | 9567.811 | +10.2 | 2.2  | 4  | J |
| 30 | 5351 | Ju1      | 8.827  | 9592.827 | -11.6 | 4.5  | 10 | J |

|    |      |                 |             |       |      |     |                 |
|----|------|-----------------|-------------|-------|------|-----|-----------------|
| 31 | 5360 | 16.803          | 9600.803    | -11.5 | *6.6 | 4   | J               |
| 32 | 5384 | Aug 4.781       | 9619.781    | -60.3 | 3.7  | 6   | J               |
| 33 | 5391 | 11.690          | 9626.690    | -29.6 | 5.4  | 7   | J               |
| 34 | 5396 | 13.648          | 9628.648    | -33.7 | 3.9  | 7   | J               |
| 35 | 5429 | Sep 8.631       | 9654.631    | -27.8 | 3.8  | 5   | J               |
| 36 | 5437 | 10.636          | 9656.636    | -44.8 | 3.3  | 4   | J               |
| 37 | 5467 | 28.574          | 9674.574    | -36.3 | 4.4  | 4   | J               |
| 38 | 5493 | Oct 5.556       | 9681.556    | -16.9 | 2.9  | 11  | J               |
| 39 | 5511 | 16.496          | 9692.496    | -47.0 | 5.7  | 7   | J               |
| 40 | 5524 | 26.478          | 9702.478    | -18.4 | 4.8  | 13  | J               |
| 41 | 5537 | 30.492          | 9706.492    | -16.3 | 5.7  | 9   | J               |
| 42 | 5810 | 1913 May 24.790 | 9912.790    | -16.0 | 2.6  | 10  | J               |
| 43 | 5828 | Jun 4.841       | 9923.841    | -12.1 | 2.3  | 8   | J               |
| 44 | 5842 | 10.808          | 9929.808    | -25.9 | 1.9  | 7   | J               |
| 45 | 5858 | 14.806          | 9933.806    | -24.8 | 5.5  | 4.5 | J               |
| 46 | 5862 | 17.785          | 9936.785    | -30.0 | 12.8 | 5   | J               |
| 47 | 5889 | Ju1 10.812      | 9959.812    | -29.1 | 4.3  | 12  | J               |
| 48 | 5896 | 15.670          | 9964.670    | -24.3 | 3.1  | 8   | J               |
| 49 | 5919 | 29.599          | 9978.599    | -18.1 | 4.6  | 9   | J               |
| 50 | 5943 | Aug 19.616      | 9999.616    | +11.4 | 4.5  | 7   | J               |
| 51 | 5979 | Sep 3.544       | 2420014.544 | -20.1 | 5.1  | 4.5 | J               |
| 52 | 6021 | 30.521          | 0041.521    | - 7.0 | 3.7  | 13  | J               |
| 53 | 6333 | 1914 May 26.767 | 0279.767    | +11.0 | 6.1  | 4.5 | J spectrum weak |

|    |      |            |          |       |      |      |   |
|----|------|------------|----------|-------|------|------|---|
| 54 | 6341 | 30.737     | 0283.737 | -10.4 | ±6.4 | 4    | J |
| 55 | 6347 | Jun 1.806  | 0285.806 | -23.2 | 3.4  | 13   | J |
| 56 | 6356 | 6.798      | 0290.798 | -19.1 | 6.5  | 8    | J |
| 57 | 6367 | 12.760     | 0296.760 | -22.2 | 5.2  | 6    | J |
| 58 | 6374 | 16.752     | 0300.752 | -44.3 | 4.2  | 10   | J |
| 59 | 6389 | Jul 3.698  | 0317.698 | -22.9 | 2.6  | 11   | J |
| 60 | 6395 | 10.746     | 0324.746 | -32.0 | 7.2  | 5    | J |
| 61 | 6397 | 11.681     | 0325.681 | -43.0 | 4.3  | 9    | J |
| 62 | 6402 | 15.783     | 0329.783 | -49.3 | 4.1  | 8    | J |
| 63 | 6403 | 18.596     | 0332.596 | -52.9 | 7.3  | 8    | J |
| 64 | 6407 | 20.612     | 0334.612 | -43.6 | 4.3  | 10   | J |
| 65 | 6418 | 25.631     | 0339.631 | -9.5  | 4.9  | 7    | J |
| 66 | 6422 | 26.614     | 0340.614 | -40.9 | 1.5  | 6    | J |
| 67 | 6429 | 29.671     | 0343.671 | -47.3 | 5.2  | 10.5 | J |
| 68 | 6433 | 30.670     | 0344.670 | -33.0 | 4.6  | 11.5 | J |
| 69 | 6439 | Aug 12.636 | 0357.636 | -24.5 | 3.6  | 14   | J |
| 70 | 6442 | 13.628     | 0358.628 | -24.2 | 4.3  | 13   | J |
| 71 | 6446 | 15.561     | 0360.561 | -28.7 | 5.0  | 12   | J |
| 72 | 6452 | 17.590     | 0362.590 | -18.6 | 3.7  | 13.5 | J |
| 73 | 6453 | 18.581     | 0363.581 | -24.8 | 3.9  | 15   | J |
| 74 | 6455 | 19.658     | 0364.658 | -29.7 | 0.9  | 8.5  | J |
| 75 | 6504 | Sep 25.542 | 0401.542 | -22.2 | 4.2  | 10   | J |
| 76 | 6509 | 28.535     | 0404.535 | -42.4 | 3.9  | 13   | J |

comparison weak  
on pier side

|    |      |            |          |       |      |     |   |                    |
|----|------|------------|----------|-------|------|-----|---|--------------------|
| 77 | 6523 | Oct 2.533  | 0408.533 | -24.7 | ±4.9 | 12  | J |                    |
| 78 | 6692 | 1915 May   | 0628.859 | -17.1 | 2.3  | 5.5 | J |                    |
| 79 | 6697 | 19.809     | 0637.809 | -7.2  | 5.6  | 5   | J | spectrum weak      |
| 80 | 6700 | 21.776     | 0639.776 | -22.4 | 2.7  | 12  | J |                    |
| 81 | 6719 | Jun 11.751 | 0660.751 | -6.3  | 12.9 | 8.5 | J |                    |
| 82 | 6730 | 19.761     | 0668.761 | -12.7 | 4.2  | 2   | J | spectrum very weak |
| 83 | 6734 | 20.727     | 0669.727 | -35.8 | 6.8  | 13  | J |                    |
| 84 | 6743 | 25.736     | 0674.736 | -29.6 | 5.1  | 12  | J | comparison weak    |

Period about 240 days?

95 HD 182568 2 Cygni  $\alpha = 19^h 20^m 11^s$   $\delta = +29^\circ 26'$  B3IV

|   |      |                 |             |       |      |    |   |  |
|---|------|-----------------|-------------|-------|------|----|---|--|
| 1 | 3603 | 1910 Jun 20.789 | 2418843.789 | -9.9  | ±2.0 | 10 | D |  |
| 2 | 4878 | 1911 Oct 20.521 | 9330.521    | -22.0 | 2.0  | 7  | D |  |

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96 HD 182640  $\delta$  Aquilae  $\alpha = 19^h 20^m 27^s$   $\delta = +02^\circ 55'$  F01V

|   |     |                 |             |       |      |    |   |  |
|---|-----|-----------------|-------------|-------|------|----|---|--|
| 1 | 515 | 1907 May 28.864 | 2417724.864 | -21.8 | ±2.8 | 14 | B |  |
| 2 | 516 | 28.889          | 7724.889    | -20.5 | 2.3  | 8  | B |  |
| 3 | 531 | 29.810          | 7725.810    | -32.6 | 2.1  | 15 | B |  |
| 4 | 532 | 29.846          | 7725.846    | -29.7 | 2.9  | 15 | B |  |
| 5 | 684 | Jul 23.713      | 7780.713    | -30.2 | 4.4  | 12 | B |  |
| 6 | 753 | Aug 13.719      | 7801.719    | -29.4 | 2.6  | 18 | B |  |

|    |      |                 |          |       |      |    |                     |
|----|------|-----------------|----------|-------|------|----|---------------------|
| 7  | 785  | 26.572          | 7814.572 | -29.0 | ±1.8 | 13 | B                   |
| 8  | 786  | 26.601          | 7814.601 | -27.5 | 3.2  | 19 | B                   |
| 9  | 789  | 28.717          | 7816.717 | -25.0 | 4.2  | 19 | B                   |
| 10 | 796  | 30.719          | 7818.719 | -26.1 | 3.1  | 8  | B                   |
| 11 | 803  | 31.756          | 7819.756 | -29.5 | 3.4  | 13 | B                   |
| 12 | 804  | 31.785          | 7819.785 | -31.3 | 2.9  | 17 | B                   |
| 13 | 808  | Sep 1.577       | 7820.577 |       |      |    | plate missing       |
| 14 | 810  | 5.599           | 7824.599 |       |      |    | plate missing       |
| 15 | 819  | 6.653           | 7825.653 | -28.2 | 2.6  | 16 | comp. one side only |
| 16 | 820  | 6.700           | 7825.700 | -39.1 | 1.7  | 18 | B                   |
| 17 | 837  | 12.632          | 7831.632 | -33.3 | 2.3  | 18 | B                   |
| 18 | 838  | 12.686          | 7831.686 | -40.9 | 4.1  | 14 | B                   |
| 19 | 868  | 16.622          | 7835.622 | -35.4 | 2.3  | 18 | B                   |
| 20 | 878  | 23.544          | 7842.544 | -26.2 | 2.3  | 17 | B                   |
| 21 | 879  | 23.580          | 7842.580 | -45.1 | 3.9  | 8  | U                   |
| 22 | 880  | 23.593          | 7842.593 | -44.7 | 1.6  | 5  | F                   |
| 23 | 881  | 23.604          | 7842.604 | -45.1 | 3.7  | 4  | F                   |
| 24 | 901  | Oct 5.560       | 7854.560 | -33.0 | 2.3  | 20 | B                   |
| 25 | 902  | 5.603           | 7854.603 | -34.3 | 1.5  | 17 | B                   |
| 26 | 916  | 8.572           | 7857.573 | -31.2 | 2.3  | 21 | B                   |
| 27 | 917  | 8.618           | 7857.618 | -29.6 | 1.7  | 18 | B                   |
| 28 | 920  | 14.567          | 7863.567 | -19.4 | 2.4  | 16 | B                   |
| 29 | 1334 | 1908 Apr 25.834 | 8057.834 | -31.1 | 2.9  | 16 | B                   |

|    |      |          |        |          |       |      |    |                  |
|----|------|----------|--------|----------|-------|------|----|------------------|
| 30 | 1349 | May      | 9.822  | 8071.822 | -28.6 | +1.9 | 23 | B                |
| 31 | 1360 |          | 10.816 | 8072.816 | -25.9 | 1.3  | 25 | B,F<br>mean of 2 |
| 32 | 1383 |          | 22.788 | 8084.788 | -28.6 | 1.0  | 23 | B<br>mean of 2   |
| 33 | 1384 |          | 22.826 | 8084.826 | -37.0 | 2.0  | 20 | B                |
| 34 | 1390 |          | 23.847 | 8085.847 | -30.1 | 1.8  | 19 | B                |
| 35 | 1398 |          | 24.833 | 8086.833 | -28.8 | 1.4  | 27 | B<br>mean of 2   |
| 36 | 1439 | Jun      | 4.769  | 8097.769 | -33.0 | 1.5  | 17 | B                |
| 37 | 1448 |          | 5.770  | 8098.770 | -28.2 | 2.3  | 10 | B                |
| 38 | 1455 |          | 6.779  | 8099.779 | -28.6 | 2.0  | 18 | B                |
| 39 | 1473 | 1908 Jun | 8.792  | 8101.792 | -36.4 | 2.4  | 21 | B                |
| 40 | 1511 |          | 18.786 | 8111.786 | -40.3 | 3.1  | 14 | B                |
| 41 | 1516 |          | 20.719 | 8113.719 | -28.7 | 1.4  | 14 | B                |
| 42 | 1523 |          | 21.793 | 8114.793 | -29.2 | 4.8  | 6  | B                |
| 43 | 1549 |          | 26.783 | 8119.783 | -26.6 | 1.5  | 18 | B                |
| 44 | 1566 |          | 28.738 | 8121.738 | -34.2 | 1.9  | 20 | B                |
| 45 | 1571 |          | 30.779 | 8123.779 | -31.0 | 2.3  | 16 | B                |
| 46 | 1602 | Jul      | 6.781  | 8129.781 | -26.5 | 1.7  | 13 | B                |
| 47 | 1610 |          | 8.747  | 8131.747 | -22.4 | 1.3  | 20 | B                |
| 48 | 2085 | Oct      | 18.544 | 8233.544 | -27.1 | 2.6  | 15 | B                |
| 49 | 2094 |          | 22.490 | 8237.490 |       |      |    | plate missing    |
| 50 | 2102 |          | 28.531 | 8243.531 | -38.3 | 4.0  | 10 | F                |
| 51 | 2103 |          | 28.553 | 8243.553 | -29.6 | 5.4  | 8  | F                |
| 52 | 2108 | Nov      | 1.524  | 8247.524 | -36.8 | 3.6  | 8  | F                |

|    |      |          |          |          |       |     |   |
|----|------|----------|----------|----------|-------|-----|---|
| 53 | 2109 | 1.543    | 8247.543 | -26.6    | ±6.2  | 5   | F |
| 54 | 2647 | 1909 Jul | 5.685    | 8493.685 | -34.8 | 3.2 | 7 |
| 55 | 2655 |          | 7.626    | 8495.626 | -37.2 | 5.2 | 3 |
| 56 | 2658 |          | 7.733    | 8495.733 | -46.9 | 4.6 | 6 |
| 57 | 2661 |          | 7.824    | 8495.824 | -32.6 | 7.8 | 4 |

Astrometric Binary, period 1250 days (Alden, A.J. 51, 59, 1944).

| HD 187362 | α Sagittae      | α = 19 <sup>h</sup> 44 <sup>m</sup> 32 <sup>s</sup> | δ = +18° 53' | A3V      |
|-----------|-----------------|-----------------------------------------------------|--------------|----------|
| 1 3740    | 1910 Aug 19.615 | 2418903.615                                         | -16.5        | ±4.0 3.5 |
| 2 3745    |                 | 20.604                                              | 8904.604     | -23.5    |
| 3 3759    |                 | 27.585                                              | 8911.585     | -23.3    |
| 4 3766    |                 | 28.621                                              | 8912.621     | -11.7    |
| 5 3773    |                 | 29.597                                              | 8913.597     | -58.0    |
| 6 4644    | 1911 Jul 28.722 |                                                     | 9246.722     | -49.0    |
| 7 4706    | Aug 19.688      |                                                     | 9268.688     | -30.1    |

1 line only  
1 line only

seed 23

In contrast to these velocities the Yerkes velocities are primarily positive. This star is a probable spectroscopic binary.

| HD 187842 | α Aquilae       | α = 19 <sup>h</sup> 4 <sup>m</sup> 54 <sup>s</sup> | δ = +8° 35' | A7V    |
|-----------|-----------------|----------------------------------------------------|-------------|--------|
| 1 1551    | 1908 Jun 26.811 | 2418119.811                                        | -9.0        | ±6.9 7 |
| 2 1829    | Aug 24.673      |                                                    | 8178.673    | -13.7  |

B  
B

|    |      |          |        |          |              |           |   |   |
|----|------|----------|--------|----------|--------------|-----------|---|---|
| 3  | 2641 | 1909 Jun | 4.675  | 8492.675 | -21.0        | $\pm 1.0$ | 7 | B |
| 4  | 2642 |          | 4.704  | 8492.704 | -27.3        | 7.6       | 6 | B |
| 5  | 2726 |          | 27.672 | 8515.672 | -26.0        | 2.7       | 9 | B |
| 6  | 2727 |          | 27.682 | 8515.682 | -24.4        | 5.2       | 8 | B |
| 7  | 2738 |          | 30./59 | 8518.759 | -13.9        | 8.7       | 7 | B |
| 8  | 2807 | Aug      | 18.699 | 8537.699 | -19.2        | 3.1       | 6 | B |
| 9  | 2808 |          | 18.711 | 8537.711 | -24.5        | 3.8       | 7 | B |
| 10 | 2853 |          | 25.668 | 8544.668 | -22.2        | 4.8       | 7 | B |
| 11 | 2854 |          | 25.676 | 8544.676 | <u>-34.9</u> | 6.7       | 7 | B |
|    |      |          |        | Mean     | -21.8        |           |   |   |

|    |           |               |                           |                          |              |           |     |   |
|----|-----------|---------------|---------------------------|--------------------------|--------------|-----------|-----|---|
| 99 | HD 188260 | 13 Vulpeculae | $\alpha = 19^h 49^m 13^s$ | $\delta = +23^\circ 49'$ | AO III       |           |     |   |
| 1  | 3144      | 1909 Oct      | 26.524                    | 2418606.524              | -36.8        | $\pm 1.4$ | 7.5 | D |
| 2  | 3712      | 1910 Aug      | 8.655                     | 8892.655                 | <u>-21.5</u> | 1.8       | 6.5 | D |
|    |           |               |                           | Mean                     | -29.7        |           |     |   |

| 100 | HD 189178 | $\alpha = 19^h 53^m 46^s$ |        |             | $\delta = +40^{\circ} 6'$ |            | B5Vp?              |                                            |
|-----|-----------|---------------------------|--------|-------------|---------------------------|------------|--------------------|--------------------------------------------|
| 1   | 5330      | 1912 Jun                  | 20.764 | 2419574.764 | -52.4                     | $\pm 10.0$ | 7.5                | J                                          |
| 2   | 5344      | Jul                       | 6.747  | 9590.747    | +40.9                     | 1.4        | 3                  | J weak                                     |
| 3   | 5364      |                           | 22.796 | 9606.796    | -10.6                     | 8.9        | 2 + 99.2 $\pm 8.9$ | J secondary probably<br>blend with primary |
| 4   | 5388      | Aug                       | 6.749  | 9621.749    | + 5.6                     | 6.8        | 5                  | J                                          |
| 5   | 5397      |                           | 13.708 | 9628.708    | -49.8                     | 3.1        | 4                  | J                                          |
| 6   | 5402      |                           | 16.733 | 9631.733    | -18.2                     | 6.8        | 5.5                | J poor                                     |

|    |      |                |          |       |      |     |       |    |        |
|----|------|----------------|----------|-------|------|-----|-------|----|--------|
| 30 | 6539 | Oct 20.537     | 0426.537 | -53.8 | ±4.2 | 7   | -36.0 | 2' | J      |
| 31 | 6751 | 1915 Jul 2.694 | 0681.694 | -18.5 | 1.0  | 4   |       |    | J weak |
| 32 | 6763 | 13.802         | 0692.802 | -31.1 | 4.8  | 9   |       |    | j      |
| 33 | 6795 | Sep 1.592      | 0742.692 | +14.0 | 6.8  | 7.5 |       |    | J      |

Mean I.S. = -4.0

K line is probably a  
blend with stellar

| HS 192685 |      |                 |             |       |                          |   |                          |   |     |              |
|-----------|------|-----------------|-------------|-------|--------------------------|---|--------------------------|---|-----|--------------|
|           |      |                 |             |       | $\alpha = 20^h 11^m 2^s$ |   | $\delta = +25^\circ 17'$ |   | B3V |              |
| 1         | 3707 | 1910 Aug 6.678  | 2418890.678 | - 0.3 | ±9.1                     | 2 |                          |   | D   | underexposed |
| 2         | 4581 | 1911 Aug 11.699 | 9260.699    | - 7.9 | 3.8                      | 5 |                          |   | D   |              |
| 3         | 4873 | Oct 19.544      | 9329.544    | -12.0 | 4.8                      | 9 | -14.0                    | 1 | D   |              |
| 4         | 5357 | 1912 Jul 14.809 | 9598.809    | -15.0 | 5.2                      | 5 |                          |   | D   |              |
| 5         | 5452 | Sep 19.636      | 9665.636    | -25.0 | 5.6                      | 5 |                          |   | D   |              |
| 6         | 6375 | 1914 Jun 16.804 | 2420300.804 | + 2.8 | 2.7                      | 6 |                          |   | D   |              |
| 7         | 6398 | Jul 11.746      | 0325.746    | -34.6 | 5.7                      | 7 | -12.8                    | 2 | D   |              |
| 8         | 6405 | 19.749          | 0333.749    | - 2.7 | 2.4                      | 6 |                          |   | D   |              |
| 9         | 6413 | 21.729          | 0335.729    | + 1.1 | 2.1                      | 8 | -17.1                    | 1 | D   |              |
| 10        | 6448 | Aug 15.679      | 0360.679    | -41.3 | 5.3                      | 8 |                          |   | D   |              |
| 11        | 6456 | 19.720          | 0364.720    | - 5.1 | 5.0                      | 8 |                          |   | D   |              |

|    |      |            |          |       |      |   |   |
|----|------|------------|----------|-------|------|---|---|
| 12 | 6465 | 26.740     | 0371.740 | + 2.6 | ±1.9 | 7 | D |
| 13 | 6479 | Sep 13.681 | 0389.681 | -23.9 | 2.3  | 6 | D |
| 14 | 6482 | 14.652     | 0390.652 | -22.3 | 6.2  | 8 | D |
| 15 | 6505 | 25.595     | 0401.595 | -17.5 | 3.6  | 7 | D |
| 16 | 6516 | 29.594     | 0405.594 | -19.6 | 5.2  | 6 | D |
| 17 | 6519 | Oct 1.622  | 0407.622 | -18.2 | 4.2  | 8 | D |
| 18 | 6524 | 2.591      | 0408.591 | -19.1 | 2.9  | 7 | D |
| 19 | 6528 | 5.613      | 0411.613 | + 5.4 | 3.0  | 6 | D |

Mean I.S. - -12.2

A spectroscopic binary. Efforts to find a period have so far been unsuccessful.

| 102 | HD 192696 | 33 Cygn i       | $\alpha = 20^h 11^m 4^s$ | $\delta = +56^\circ 16'$ | A3 IV-V  |
|-----|-----------|-----------------|--------------------------|--------------------------|----------|
| 1   | 3922      | 1910 Oct 13.602 | 2418958.602              | -56.3                    | 1        |
| 2   | 3930      | 14.543          | 8959.543                 | -33.1                    | ±8.1 2   |
| 3   | 3937      | 15.587          | 8960.587                 | -15.4                    | 11.4 2.5 |
| 4   | 3949      | 18.539          | 8963.539                 | -45.5                    | 4.6 2.5  |
| 5   | 3981      | 25.567          | 8970.567                 | -32.3                    | 3.9 3.5  |
| 6   | 3992      | 30.554          | 8975.554                 | -19.5                    | 4.4 4    |
| 7   | 4038      | Nov 20.517      | 8996.517                 | -14.7                    | 1.6 3    |
| 8   | 4045      | 22.472          | 8998.472                 | -32.4                    | 5.6 3    |
| 9   | 4051      | 26.501          | 9002.501                 | -19.1                    | 1.9 2.5  |

J spectrum weak  
one line only

This star is classified as a possible spectroscopic binary with a long period on the basis of a 1961 Allegheny

series in which all velocities are close to 0 km/sec.

| 1103 | HD 196724 | 1910 Jul | 19.822 | 2418872.822 | 29 Vulpeculae | $\alpha = 20^h 34^m$ | $\delta = +20^\circ 51'$ | A0V         |
|------|-----------|----------|--------|-------------|---------------|----------------------|--------------------------|-------------|
| 1    | 3651      |          |        |             | -27.6         | $\pm 4.2$            | 10                       | D           |
| 2    | 3656      |          | 23.701 | 8876.701    | -26.9         | 1.7                  | 4                        | D           |
| 3    | 3660      |          | 25.715 | 8878.715    | -9.8          | 2.0                  | 9                        | D           |
| 4    | 3667      |          | 26.697 | 8879.697    | -9.5          | 6.2                  | 7                        | D           |
| 5    | 3674      |          | 28.714 | 8881.714    | -27.6         | 4.5                  | 5.5                      | D           |
| 6    | 3688      |          | 31.682 | 8884.682    | -35.9         | 3.0                  | 4                        | D           |
| 7    | 3694      | Aug      | 4.762  | 8889.762    | -27.2         | 6.6                  | 5                        | D           |
| 8    | 3699      |          | 5.677  | 8889.677    | -10.7         | 2.7                  | 8                        | D           |
| 9    | 3706      |          | 6.643  | 8890.643    | -22.0         | 1.3                  | 5                        | D           |
| 10   | 3717      |          | 11.686 | 8895.686    | -27.7         | 3.6                  | 9                        | D           |
| 11   | 3723      |          | 12.651 | 8896.651    | -14.1         | 3.3                  | 7                        | D           |
| 12   | 3731      |          | 13.681 | 8897.681    | -23.3         | 24.5                 | 3                        | D very weak |
| 13   | 3741      |          | 19.644 | 8903.644    | -21.8         | 1.9                  | 5                        | D           |
| 14   | 3746      |          | 20.640 | 8904.640    | -28.0         | 4.4                  | 6                        | D           |
| 15   | 3752      |          | 26.641 | 8910.641    | -25.5         | 2.1                  | 5.5                      | D           |
| 16   | 3760      |          | 27.626 | 8911.626    | -26.7         | 3.0                  | 6                        | D           |
| 17   | 3767      |          | 28.661 | 8912.661    | -21.4         | 5.7                  | 3                        | D           |
| 18   | 3774      |          | 29.631 | 8913.631    | -21.7         | 2.5                  | 8                        | D           |
| 19   | 3778      |          | 30.653 | 8914.653    | -24.3         | 1.8                  | 6                        | D           |
| 20   | 3780      | Sep      | 6.618  | 8921.618    | -5.6          | 3.5                  | 5                        | D           |

|    |      |           |          |       |      |     |                            |
|----|------|-----------|----------|-------|------|-----|----------------------------|
| 21 | 3787 | 7.588     | 9922.588 | -23.3 | ±4.3 | 7   | D                          |
| 22 | 3796 | 11.631    | 9926.631 | -35.7 | 1.8  | 4   | D                          |
| 23 | 3801 | 14.654    | 9929.654 | -30.7 | 3.2  | 7   | D                          |
| 24 | 3807 | 15.630    | 9930.630 | -18.8 | 4.6  | 7   | D                          |
| 25 | 3820 | 21.650    | 9936.650 | -18.6 | 2.0  | 4   | D                          |
| 26 | 3828 | 22.629    | 9937.629 | -30.1 |      | 3   | D underexposed<br>one side |
| 27 | 3834 | 26.619    | 9941.619 | -31.7 | 6.2  | 5   | D                          |
| 28 | 3841 | 28.626    | 9943.626 | -20.3 | 3.8  | 4.5 | D                          |
| 29 | 3862 | Oct 1.578 | 9946.578 | -37.5 | 4.0  | 4   | D                          |
| 30 | 3875 | 7.563     | 9952.563 | -28.4 | 2.6  | 8   | D                          |
| 31 | 3882 | 8.585     | 9953.585 | -29.3 | 3.2  | 5   | D                          |
| 32 | 3891 | 10.598    | 9955.598 | -28.5 | 0.7  | 8   | D                          |
| 33 | 3913 | 12.572    | 9957.572 | -39.3 | 2.7  | 6   | D                          |
| 34 | 3931 | 14.583    | 9959.583 | -36.5 | 8.8  | 5   | D                          |

This star is a spectroscopic binary. These velocities show a strong progression to more negative values.  
The mean velocity for October is more negative than any previously published velocity.

| 104 | HD 196740     | 28 Vulpeculae | $\alpha = 20^h 34^m 10^s$ | $\delta = +23^\circ 45'$ | B5V      |
|-----|---------------|---------------|---------------------------|--------------------------|----------|
| 1   | 3661 1910 Jul | 2418878.746   | -29.1                     | $\pm 7.8$                | 4        |
| 2   | 4661 1911 Aug | 9257.747      | -41.5                     | 7.1                      | 2        |
| 3   | 4690          | 15.681        | 9264.681                  | -58.6                    | 12.3 3.5 |
| 4   | 4854          | Oct 13.579    | 9323.579                  | <u>-31.9</u>             | 4.5 4    |
|     |               |               | Mean                      | -39.4                    |          |

| 105 | HD 197345 | $\alpha$ Cygni | $\alpha = 20^h 38^m 1^s$ | $\delta = +44^\circ 55'$ | A2Ia |
|-----|-----------|----------------|--------------------------|--------------------------|------|
| 1   | 2643      | 1909 Jul       | 4.724                    | 2418492.724 - 7.7        | B    |
| 2   | 2644      |                | 4.745                    | 8492.745 - 5.6           | B    |
| 3   | 2707      |                | 19.869                   | 8507.869 - 3.9           | B    |
| 4   | 2708      |                | 19.878                   | 8507.878 - <u>5.1</u>    | B    |
|     |           |                | Mean - 5.6               |                          |      |

| 106 | HD 201601 | $\delta$ Equulei | $\alpha = 21^h 5^m 29^s$ | $\delta = +9^\circ 44'$ | Fp |
|-----|-----------|------------------|--------------------------|-------------------------|----|
| 1   | 4894      | 1911 Oct         | 26.542                   | 2419336.542 - 27.4      | D  |
| 2   | 4976      | Dec              | 6.460                    | 9337.460 - 17.0         | D  |
| 3   | 5392      | 1912 Aug         | 11.751                   | 9625.751 - 18.1         | D  |
| 4   | 5418      | Sep              | 5.724                    | 9650.724 - 19.2         | n  |

A recent series at Allegheny in the 1960's suggests a variation in the range of -6 to -26 km/sec. Consequently we still must consider this star as a possible spectroscopic binary.

| 107 | HD 202447 | $\alpha$ Equulei | $\alpha = 21^h 10^m 50^s$ | $\delta = +4^\circ 50'$ | F8+A3 |
|-----|-----------|------------------|---------------------------|-------------------------|-------|
| 1   | 4601      | 1911 Jul         | 12.758                    | 2419230.758 - 8.6       | D     |
| 2   | 4628      |                  | 24.786                    | 9242.786 - 17.7         | D     |
| 3   | 4635      |                  | 26.821                    | 9244.821 - 13.5         | D     |
| 4   | 4638      |                  | 27.828                    | 9245.828 - 10.8         | D     |
| 5   | 4645      |                  | 28.778                    | 9246.778 - 16.5         | D     |
| 6   | 4652      |                  | 30.783                    | 9248.783 - 13.3         | D     |

|    |      |     |        |          |       |     |    |   |
|----|------|-----|--------|----------|-------|-----|----|---|
| 7  | 4659 | Aug | 6.828  | 9255.828 | -14.1 | 4.9 | 18 | D |
| 8  | 4668 |     | 9.767  | 9258.767 | -13.2 | 1.6 | 33 | D |
| 9  | 4676 |     | 10.763 | 9259.763 | -10.3 | 3.5 | 29 | D |
| 10 | 4682 |     | 11.727 | 9260.727 | -16.8 | 2.3 | 30 | D |
| 11 | 4691 |     | 15.709 | 9264.709 | -20.6 | 2.0 | 26 | D |
| 12 | 4701 |     | 18.733 | 9267.733 | -16.6 | 1.9 | 24 | D |
| 13 | 4707 |     | 19.742 | 9268.742 | -18.1 | 2.1 | 21 | D |
| 14 | 4717 |     | 20.753 | 9269.753 | -14.4 | 1.0 | 42 | D |
| 15 | 4724 |     | 21.720 | 9270.720 | -22.1 | 1.6 | 19 | D |
| 16 | 4730 |     | 22.706 | 9271.706 | -13.5 | 1.0 | 31 | D |
| 17 | 4744 | Sep | 1.683  | 9281.683 | -13.7 | 1.3 | 28 | D |
| 18 | 4754 |     | 3.692  | 9283.692 | -21.5 | 1.1 | 26 | D |
| 19 | 4761 |     | 4.647  | 9284.647 | -20.2 | 1.3 | 31 | D |
| 20 | 4767 |     | 6.600  | 9286.600 | -15.9 | 1.7 | 19 | D |
| 21 | 4772 |     | 11.588 | 9291.588 | -21.1 | 1.6 | 26 | D |
| 22 | 4779 |     | 12.641 | 9292.641 | -25.7 | 2.1 | 31 | D |
| 23 | 4786 |     | 13.631 | 9293.631 | -24.9 | 2.6 | 23 | D |
| 24 | 4792 |     | 17.669 | 9297.669 | -20.4 | 1.7 | 28 | D |
| 25 | 4799 |     | 18.670 | 9298.670 | -28.7 | 3.1 | 13 | D |
| 26 | 4803 |     | 19.635 | 9299.635 | -18.2 | 1.0 | 25 | D |
| 27 | 4809 |     | 20.665 | 9300.665 | -17.0 | 1.5 | 30 | D |
| 28 | 4815 |     | 22.665 | 9302.665 | -19.3 | 1.4 | 27 | D |
| 29 | 4825 |     | 26.655 | 9306.655 | -22.0 | 1.7 | 21 | D |

|    |      |           |          |       |      |    |   |              |
|----|------|-----------|----------|-------|------|----|---|--------------|
| 30 | 4833 | 30.598    | 9310.598 | - 8.9 | *3.8 | 5  | D | underexposed |
| 31 | 4843 | Oct 8.601 | 9318.601 | -20.6 | 1.6  | 26 | D |              |
| 32 | 4853 | 13.549    | 9323.549 | -18.3 | 1.5  | 27 | D |              |
| 33 | 4866 | 18.577    | 9328.577 | -17.0 | 1.2  | 31 | D |              |
| 34 | 4880 | 21.554    | 9331.554 | -20.8 | 1.4  | 9  | D | underexposed |
| 35 | 4887 | 25.574    | 9335.574 | -19.5 | 2.8  | 21 | D |              |
| 36 | 4901 | 28.517    | 9338.517 | -17.2 | 1.3  | 28 | D |              |
| 37 | 4916 | Nov 2.526 | 9343.526 | -21.6 | 1.1  | 27 | D |              |
| 38 | 4922 | 5.516     | 9346.516 | -19.9 | 1.6  | 30 | D |              |
| 39 | 4928 | 10.502    | 9351.502 | -21.3 | 1.4  | 33 | D |              |
| 40 | 4935 | 13.506    | 9354.506 | -22.8 | 1.1  | 24 | D |              |
| 41 | 4940 | 16.506    | 9357.506 | -17.8 | 1.3  | 28 | D |              |
| 42 | 4945 | 19.516    | 9360.516 | -20.5 | 2.0  | 26 | D |              |
| 43 | 4949 | 21.483    | 9362.483 | -17.8 | 1.4  | 27 | D |              |
| 44 | 4958 | 26.494    | 9367.494 | -15.8 | 1.7  | 26 | D |              |
| 45 | 4969 | Dec 5.456 | 9376.456 | -16.7 | 1.6  | 25 | D |              |
| 46 | 4984 | 7.452     | 9378.452 | -16.0 | 1.3  | 29 | D |              |
| 47 | 4997 | 28.464    | 9399.464 | -15.5 | 1.1  | 27 | D |              |
| 48 | 5005 | 31.466    | 9402.466 | -19.8 | 1.7  | 26 | D |              |

These observations do not satisfy the 97.56 day period of Deutsch (P.A.S.P. 66, 58, 1954) and suggest the period may be longer. Deutsch, however, points out the distinct advantage of condensed spectra for determining radial velocities of this star. Twice the period is a possibility. Observations of this star at Allegheny are continuing.

| HD 203064 |      | 68 Cygni |        | $\alpha = 21^h 14^m 43^s$ | $\delta = +43^\circ 31'$ | 08     |                   |
|-----------|------|----------|--------|---------------------------|--------------------------|--------|-------------------|
| 1         | 2869 | 1909 Aug | 29.761 | 2418548.761               | -20.6                    | 4.7 2  | J                 |
| 2         | 3120 | Oct      | 13.562 | 593.562                   | -29.2                    | 17.9 2 | J                 |
| 3         | 3178 | Nov      | 4.556  | 615.556                   | -27.7                    | 12.5 2 | J                 |
| 4         | 3233 |          | 15.501 | 626.501                   | - 9.0                    | 17.9 2 | J                 |
| 5         | 4602 | 1911 Jul | 12.796 | 9230.796                  | + 3.7                    | 9.2 3  | J                 |
|           |      |          |        | Mean                      | -14.8                    |        | Mean I.S. = -17.0 |

This star does not appear to be variable in velocity.

| 109 | HD 207650 | 14 Pegasus      | $\alpha = 21^h 45^m 25^s$ | $\delta = +29^{\circ} 43'$ | A0V    |   |
|-----|-----------|-----------------|---------------------------|----------------------------|--------|---|
| 1   | 2868      | 1909 Aug 29.728 | 2418548.728               | -32.8                      | 2.9 6  | J |
| 2   | 3700      | 1910 Aug 5.715  | 8889.715                  | -20.5                      | 2.8 12 | J |
| 3   | 4662      | 1911 Aug 8.781  | 9257.781                  | -30.2                      | 3.3 9  | J |
| 4   | 4883      | Oct 23.580      | 9333.580                  | -20.6                      | 2.7 7  | J |

129

Orbit by Petrie (Publ. D.A.O. Z, 245, 1940). These velocities fall on the flat portion of the curve and are blended velocities of little significance.

| 110 | HD 208057            | 16 Pegasi   | $\alpha = 21^h48^m31^s$ | $\delta = +25^{\circ} 27'$ | B3V |
|-----|----------------------|-------------|-------------------------|----------------------------|-----|
| 1   | 3725 1910 Aug 12.742 | 2418896.742 | +3.3 7                  | + 0.3 1                    | D   |
| 2   | 4692 1911 Aug 15.740 | 9264.740    | 5.4 4                   | -12.9 1                    | D   |
| 3   | 4820 Sep 24.672      | 9304.672    | 1.7 14                  | - 9.5 1                    | D   |

A21a

 $\delta = +60^{\circ} 40'$  $\alpha = 21^h 42^m 34^s$ 

v Cephei

HD 207260

|   |      |          |        |             |              |           |    |   |
|---|------|----------|--------|-------------|--------------|-----------|----|---|
| 1 | 4954 | 1911 Nov | 22.520 | 2419363.520 | - 9.8        | $\pm 2.3$ | 19 | D |
| 2 | 5430 | 1912 Sep | 8.695  | 9654.695    | - 9.9        | 0.7       | 22 | D |
| 3 | 5910 | 1913 Jul | 20.811 | 9969.811    | -23.3        | 1.6       | 19 | D |
| 4 | 5958 | Aug      | 25.726 | 2420005.726 | <u>-18.8</u> | 1.6       | 20 | D |

Mean -15.3



|    |      |                 |          |       |      |     |   |
|----|------|-----------------|----------|-------|------|-----|---|
| 20 | 6548 | 25.590          | 0431.590 | -17.1 | +6.0 | 2.5 | D |
| 21 | 6573 | Nov 17.536      | 0454.536 | +0.7  | 4.0  | 5   | D |
| 22 | 6582 | 27.503          | 0464.503 | -45.5 | 2.8  | 4   | D |
| 23 | 6770 | 1915 Jul 21.808 | 0700.808 | +10.0 | 2.2  | 4   | D |
| 24 | 6784 | Aug 13.774      | 0723.774 | -13.5 | 7.9  | 3   | D |
| 25 | 6854 | Oct 29.588      | 0800.588 | -14.9 | 5.4  | 4   | D |

The spectrum of this star has been described as having double lines (Lee, Ap. J. 39, 42, 1914). Inspection of these plates does indeed show a suggestion of duplicity although not convincingly. These velocities are presented "as is" pending a solution to the question. If the lines are regarded as single then a steady progression to more negative values occurs from the middle of August to the middle of October. We regard this star to be a probable spectroscopic binary.

| 112 | HD 210418 | $\theta$ Pegasi | $\alpha = 22^{\text{h}}5^{\text{m}}9^{\text{s}}$ | $\delta = +5^{\circ}42'$ | A2V    |                   |
|-----|-----------|-----------------|--------------------------------------------------|--------------------------|--------|-------------------|
| 1   | 3668      | 1910 Jul 26.735 | 2418879.735                                      | - 8.8                    | 5.8 6  | D                 |
| 2   | 3675      | 28.743          | 8881.743                                         | -18.7                    | 5.3 6  | D                 |
| 3   | 3689      | 31.729          | 8884.729                                         | -21.6                    | 3.1 6  | D                 |
| 4   | 3695      | Aug 4.810       | 8888.810                                         | -18.8                    | 7.0 4  | D possibly double |
| 5   | 3701      | 5.748           | 8889.748                                         | -15.9                    | 3.0 6  | D                 |
| 6   | 3708      | 6.721           | 8890.721                                         | -50.5                    | 14.0 2 | D                 |
| 7   | 3713      | 8.693           | 8892.693                                         | -25.4                    | 4.7 5  | D                 |
| 8   | 3718      | 11.725          | 8895.725                                         | -26.0                    | 4.6 6  | D                 |
| 9   | 3724      | 12.708          | 8896.708                                         | -12.7                    | 6.9 5  | D                 |
| 10  | 3732      | 13.732          | 8897.732                                         | -18.3                    | 16.9 3 | D                 |
| 11  | 3742      | 19.672          | 8903.672                                         | - 8.3                    | 4.5 7  | D                 |

|    |      |           |          |       |      |   |                                   |
|----|------|-----------|----------|-------|------|---|-----------------------------------|
| 12 | 3747 | 20.685    | 8904.685 | - 8.2 | ±1.0 | 2 | D                                 |
| 13 | 3753 | 26.675    | 8910.675 | -36.6 | 6.0  | 4 | D                                 |
| 14 | 3761 | 27.663    | 8911.663 | -24.9 | 2.8  | 4 | D                                 |
| 15 | 3768 | 28.706    | 8912.706 | + 1.2 | 0.8  | 4 | D                                 |
| 16 | 3775 | 29.664    | 8913.664 | -19.0 | 5.1  | 4 | D                                 |
| 17 | 3781 | Sep 6.667 | 8921.667 | -18.5 | 5.6  | 2 | D                                 |
| 18 | 3788 | 7.632     | 8922.632 | -70.6 | 0.3  | 2 | D                                 |
| 19 | 3797 | 11.681    | 8926.681 | -12.0 | 4.5  | 3 | D possibly double                 |
| 20 | 3802 | 14.696    | 8929.696 | -32.0 | 4.6  | 5 | D                                 |
| 21 | 3808 | 15.670    | 8930.670 | - 6.0 | 3.4  | 6 | D                                 |
| 22 | 3814 | 16.604    | 8931.604 | - 9.4 | 2.9  | 6 | D                                 |
| 23 | 3816 | 17.651    | 8932.651 | -20.1 | 3.0  | 5 | D                                 |
| 24 | 3817 | 20.735    | 8935.735 | + 0.5 | 5.1  | 3 | D                                 |
| 25 | 3821 | 21.692    | 8936.692 | + 3.2 | 4.8  | 3 | D                                 |
| 26 | 3829 | 22.735    | 8937.735 | -20.6 | 4.2  | 1 | D                                 |
| 27 | 3835 | 26.668    | 8941.668 | -24.8 | 2.2  | 3 | D                                 |
| 28 | 3842 | 28.662    | 8943.662 | -24.1 | 6.4  | 4 | D narrow spectrum possibly double |
| 29 | 3850 | 29.649    | 8944.649 | -15.6 | 6.7  | 5 | D                                 |
| 30 | 3859 | 30.675    | 8945.675 | - 9.3 | 4.4  | 5 | D                                 |
| 31 | 3863 | Oct 1.622 | 8946.622 | - 5.4 | 2.8  | 4 | D possibly double                 |
| 32 | 3869 | 2.653     | 8947.653 | -14.1 | 4.3  | 4 | D                                 |
| 33 | 3877 | 7.657     | 8952.657 | + 0.2 | 1.2  | 6 | D                                 |
| 34 | 3883 | 8.615     | 8953.615 | -19.2 | 1.5  | 7 | D                                 |

|    |      |                |          |       |      |   |                   |
|----|------|----------------|----------|-------|------|---|-------------------|
| 35 | 3892 | 10.619         | 8955.619 | -19.7 | +3.8 | 8 | D                 |
| 36 | 3905 | 11.682         | 8956.682 | -20.3 | 4.3  | 6 | D                 |
| 37 | 3914 | 12.608         | 8957.608 | - 9.1 | 2.4  | 5 | D                 |
| 38 | 3923 | 13.638         | 8958.638 | -17.6 | 4.6  | 6 | D                 |
| 39 | 3938 | 15.617         | 8960.617 | -29.7 | 6.9  | 7 | D                 |
| 40 | 3944 | 17.562         | 8962.562 | - 8.8 | 4.4  | 6 | D                 |
| 41 | 3950 | 18.585         | 8963.585 | -16.2 | 4.0  | 5 | D                 |
| 42 | 3955 | 19.621         | 8964.621 | -24.9 | 3.4  | 6 | D                 |
| 43 | 3964 | 20.575         | 8965.575 | - 7.9 | 2.4  | 5 | D                 |
| 44 | 3974 | 23.621         | 8968.621 | - 2.5 | 4.8  | 6 | D                 |
| 45 | 3982 | 25.611         | 8970.611 | -26.5 | 3.2  | 5 | D                 |
| 46 | 3986 | 26.606         | 8971.606 | -34.0 | 3.4  | 1 | D                 |
| 47 | 3987 | 29.549         | 8974.549 | -37.0 | 2.8  | 7 | D                 |
| 48 | 4002 | 31.518         | 8976.518 | -24.3 | 2.2  | 8 | D                 |
| 49 | 4010 | Nov 4.622      | 8980.622 | - 6.5 | 4.9  | 6 | D                 |
| 50 | 4020 | 8.544          | 8984.544 | - 8.7 | 3.9  | 7 | D                 |
| 51 | 4039 | 20.551         | 8996.551 | - 5.2 | 5.5  | 7 | D                 |
| 52 | 4046 | 22.503         | 8998.503 | -38.1 | 2.1  | 4 | D possibly double |
| 53 | 4052 | 26.541         | 9002.541 | -12.0 | 2.3  | 6 | D                 |
| 54 | 4066 | 1910 Dec 4.511 | 9010.511 | -16.9 | 2.4  | 4 | D possibly double |
| 55 | 4067 | 8.478          | 9014.478 | -27.9 | 5.5  | 5 | D                 |
| 56 | 4073 | 9.488          | 9015.488 | - 5.6 | 4.3  | 6 | D                 |
| 57 | 4078 | 13.543         | 9019.543 | -10.4 | 2.3  | 4 | D                 |

|    |      |                 |          |       |      |   |                                               |
|----|------|-----------------|----------|-------|------|---|-----------------------------------------------|
| 58 | 4085 | 14.469          | 9020.469 | - 8.3 | ±2.7 | 5 | D                                             |
| 59 | 4103 | 17.451          | 9023.451 | -12.3 | 4.4  | 7 | D                                             |
| 60 | 4113 | 21.515          | 9027.515 | -26.3 | 5.3  | 6 | D                                             |
| 61 | 4120 | 25.453          | 9031.453 | -14.9 | 8.1  | 6 | D                                             |
| 62 | 4123 | 27.458          | 9033.458 | -13.3 | 5.1  | 7 | D                                             |
| 63 | 4614 | 1911 Jul 15.809 | 9233.809 | -17.5 | 6.3  | 7 | D                                             |
| 64 | 4629 | 24.824          | 9242.824 | -10.8 | 4.1  | 7 | D                                             |
| 65 | 4639 | 27.858          | 9245.858 | -17.9 | 6.6  | 7 | D                                             |
| 66 | 4653 | 30.815          | 9248.815 | -11.9 | 5.0  | 7 | D                                             |
| 67 | 4669 | Aug 9.799       | 9258.799 | - 9.5 | 3.5  | 6 | D                                             |
| 68 | 4677 | 10.801          | 9259.801 | -10.5 | 1.0  | 7 | D                                             |
| 69 | 4683 | 11.767          | 9260.767 | -15.3 | 2.5  | 7 | possibly double<br>wide spectrum<br>mean of 2 |
| 70 | 4702 | 18.762          | 9267.762 | - 6.7 | 1.3  | 7 | D                                             |
| 71 | 4708 | 19.769          | 9268.769 | - 9.6 | 3.3  | 6 | D                                             |
| 72 | 4718 | 20.812          | 9269.812 | -12.8 | 3.1  | 6 | D                                             |
| 73 | 4725 | 21.749          | 9270.749 | - 3.9 | 2.6  | 7 | D                                             |
| 74 | 4731 | 22.756          | 9271.756 | - 7.5 | 3.2  | 6 | D                                             |
| 75 | 4738 | 31.728          | 9280.728 | - 9.3 | 2.2  | 6 | D                                             |
| 76 | 4745 | Sep 1.715       | 9281.715 | -13.0 | 0.7  | 6 | D                                             |
| 77 | 4755 | 3.721           | 9283.721 | -16.0 | 1.7  | 6 | D                                             |
| 78 | 4762 | 4.678           | 9284.678 | -21.3 | 5.5  | 7 | D                                             |
| 79 | 4773 | 11.622          | 9291.622 | - 9.6 | 3.8  | 7 | D                                             |
| 80 | 4780 | 12.684          | 9292.684 | + 8.0 | 2.6  | 7 | D                                             |

| 81 | 4787 | 13.662 | 9293.662 | - 8.9 | +2.1 | 7 | D |
|----|------|--------|----------|-------|------|---|---|
| 82 | 4793 | 17.708 | 9297.708 | -20.9 | 3.5  | 4 | D |
| 83 | 4800 | 18.717 | 9298.717 | -17.0 | 10.3 | 6 | D |
| 84 | 4804 | 19.669 | 9299.669 | -31.4 | 4.9  | 6 | D |
| 85 | 4810 | 20.694 | 9300.694 | -14.8 | 1.1  | 5 | D |
| 86 | 4816 | 22.694 | 9302.694 | - 8.4 | 2.4  | 6 | D |
| 87 | 4826 | 26.692 | 9306.692 | -14.6 | 1.9  | 4 | D |

Mean - 0.7

The published range is small for a star this early in spectral type. We do not consider this star to be a spectroscopic binary.

| 114 | HD 212076 | 31 Pegasi      | $\alpha = 22^h 16^m 36^s$ | $\delta = +11^\circ 42'$ | B2Ve                |
|-----|-----------|----------------|---------------------------|--------------------------|---------------------|
| 1   | 4844      | 1911 Oct 8.641 | 2419318.641               | 0.0 $\pm$ 3.0            | 10                  |
| 2   | 4855      | 13.631         | 9323.631                  | +16.4                    | 3.6                 |
| 3   | 4874      | 19.623         | 9329.623                  | -7.8                     | 1.1                 |
|     |           |                |                           |                          | 13.5                |
|     |           |                |                           |                          | Mean + 3.3          |
|     |           |                |                           |                          | Mean I. S. -11.0    |
|     |           |                |                           |                          | em. +16.0 $\pm$ 4.7 |
|     |           |                |                           |                          | em. +31.0 $\pm$ 1.7 |
|     |           |                |                           |                          | Mean em. +23.5      |

| 115 | HD 212097            | 32 Pegasi         | $\alpha = 22^h 16^m 42^s$ | $\delta = +27^\circ 50'$ | B8V       |
|-----|----------------------|-------------------|---------------------------|--------------------------|-----------|
| 1   | 3658 1910 Jul 23.793 | 2418876.793 - 1.3 | $\pm 2.7$ 9               |                          | D         |
| 2   | 3662                 | 8878.781 - 3.7    | 3.8 8.5                   |                          | D         |
| 3   | 3714 Aug 8.749       | 8892.749 +13.5    | 1.4 7                     |                          | D         |
| 4   | 4583 1911 Jul 5.850  | 9223.850 + 6.7    | 4.5 9                     |                          | D         |
| 5   | 4603                 | 12.836            | 9230.836 +13.0            |                          | D         |
| 6   | 4646                 | 28.823            | 9246.823 + <u>5.3</u>     |                          | D seed 23 |

Mean + 5.2

| 116              | HD 212120           | 2 Lacertae        | $\alpha = 22^h 16^m 54^s$ | $\delta = +46^\circ 2'$ | B6IV |
|------------------|---------------------|-------------------|---------------------------|-------------------------|------|
| 1                | 6779 1915 Aug 8.823 | 2420718.823 -12.7 | $\pm 6.1$ 10              | -28.5 2                 | D    |
| 2                | 6785                | 13.830            | 0723.830 -48.9            |                         | D    |
| 3                | 6792                | 31.671            | 0741.671 -84.3            |                         | D    |
| 4                | 6799 Sep 7.625      | 0748.625 +12.4    | 2.0 10                    |                         | D    |
| 5                | 6807                | 10.708            | 0751.708 -28.4            |                         | D    |
| 6                | 6812                | 15.699            | 0756.699 -15.0            | - 6.9 3                 | D    |
| 7                | 6827 Oct 8.633      | 0779.633 +70.8    | 3.2 14                    |                         | D    |
| 8                | 6867 Nov 11.544     | 0813.544 +61.4    | 1.7 14                    |                         | D    |
| Mean I. S. -15.5 |                     |                   |                           |                         |      |

The velocities fit satisfactorily onto the orbit of Baker (Publ. A.O., 1, 93, 1910) with  $P = 2^d 616394$  and  $T_0 = 2413193.30$ . Some blending is evident.

| 117 | HD 213420 | 6 Lacertae | $\alpha = 22^h 26^m 10^s$ | $\delta = +42^\circ 37'$ | B2IV |
|-----|-----------|------------|---------------------------|--------------------------|------|
|-----|-----------|------------|---------------------------|--------------------------|------|

|    |      |          |        |             |       |      |      |       |   |     |                                             |
|----|------|----------|--------|-------------|-------|------|------|-------|---|-----|---------------------------------------------|
| 1  | 821  | 1907 Sep | 6.755  | 2417825.755 | -18.2 | +1.8 | 19   | - 0.4 | 2 | J   | mean of 2                                   |
| 2  | 822  |          | 6.788  | 7825.788    | -25.6 | 1.8  | 18   | + 3.2 | 3 | J   | mean of 2                                   |
| 3  | 829  |          | 11.684 | 7830.684    | -18.5 | 2.0  | 25   | -13.8 | 4 | J   | mean of 2                                   |
| 4  | 830  |          | 11.715 | 7830.715    | -21.1 | 2.0  | 13   | -16.3 | 3 | J   |                                             |
| 5  | 831  |          | 11.737 | 7830.737    | -20.7 | 1.2  | 18   | -11.9 | 4 | J   | mean of 2                                   |
| 6  | 877  |          | 20.649 | 7839.649    | -20.2 | 1.7  | 17   | -21.3 | 1 | J   | spectrum weak<br>mean of 2                  |
| 7  | 885  |          | 26.708 | 7845.708    | -22.4 | 1.5  | 16   | -13.0 | 3 | J   | mean of 2                                   |
| 8  | 893  | Oct      | 2.662  | 7851.662    | -18.0 | 2.3  | 16   | -25.0 | 3 | J   | mean of 2                                   |
| 9  | 894  |          | 2.689  | 7851.689    | -12.6 | 2.2  | 18   | - 4.6 | 3 | J   | mean of 2                                   |
| 10 | 909  |          | 6.662  | 7855.662    | -22.0 | 1.3  | 18   | -17.2 | 5 | J   | mean of 2                                   |
| 11 | 910  |          | 6.700  | 7855.700    | -23.8 | 1.7  | 16   | -17.0 | 1 | J   | mean of 2                                   |
| 12 | 918  |          | 8.653  | 7857.653    | -23.1 | 1.1  | 17   | -14.6 | 4 | J   | mean of 2                                   |
| 13 | 919  |          | 8.687  | 7857.687    | -34.9 | 2.7  | 11   | -22.5 | 2 | J   | mean of 2                                   |
| 14 | 958  | Nov      | 10.521 | 7890.521    | -24.7 | 1.9  | 24   | -12.5 | 4 | J   | IS mean of 2, 2nd.<br>meas. by J-8.3 reject |
| 15 | 959  |          | 10.562 | 7890.562    | -21.4 | 2.0  | 26   | -15.4 | 3 | J   | mean of 2                                   |
| 16 | 972  |          | 13.549 | 7893.549    | -20.7 | 1.7  | 27   | -15.0 | 5 | J,B | 2 meas. by J<br>mean of 2                   |
| 17 | 973  |          | 13.581 | 7893.581    | -22.0 | 2.1  | 11   | -11.6 | 4 | J   | mean of 2                                   |
| 18 | 983  |          | 15.535 | 7895.535    | -16.1 | 1.1  | 19   | -19.3 | 6 | J,B | 2 meas. by J<br>mean of 2                   |
| 19 | 984  |          | 15.559 | 7895.559    | -19.8 | 0.9  | 23   | -17.3 | 6 | J,B | 2 meas. by J<br>mean of 2                   |
| 20 | 999  |          | 16.515 | 7896.515    | -14.4 | 2.2  | 22   | - 9.8 | 4 | J   | mean of 2                                   |
| 21 | 1391 | 1908 May | 23.873 | 8085.873    | + 9.6 | 4.1  | 18   | - 1.7 | 4 | J   | mean of 2                                   |
| 22 | 1399 |          | 24.869 | 8086.869    | - 8.6 | 3.6  | 12.5 | + 2.4 | 2 | J   |                                             |
| 23 | 1407 |          | 25.865 | 8087.865    | - 4.3 | 2.0  | 5.5  |       |   | J   |                                             |

|    |      |          |        |       |       |      |       |   |   |
|----|------|----------|--------|-------|-------|------|-------|---|---|
| 47 | 4768 | Sep      | 7.575  | - 1.4 | ± 3.3 | · 7  | - 6.9 | 2 | J |
| 48 | 4902 | Oct      | 28.549 | - 9.7 | 1.8   | 17   | - 8.0 | 2 | J |
| 49 | 5345 | 1912 Jul | 6.790  | -18.0 | 3.2   | 12.5 | - 3.0 | 2 | J |
| 50 | 5425 | Sep      | 7.735  | -27.3 | 4.2   | 11.5 | -26.8 | 2 | J |
| 51 | 5513 | Oct      | 16.592 | -22.7 | 2.6   | 11   | -25.3 | 2 | J |

Mean I.S. -14.4

These observations show evidence of a long period variation. Yearly means formed from these and from all published observations are listed below.

| Observatory  | Year | Mean J.D.<br>2410000+ | Mean RV | #Obs's | Observatory | Year | Mean J.D.<br>2410000+ | Mean RV | #Obs's |
|--------------|------|-----------------------|---------|--------|-------------|------|-----------------------|---------|--------|
| Yerkes       | 1903 | 6335.1                | -13.4   | 3      | Yerkes      | 1905 | 7118.6                | -11.5   | 1      |
| A.O. Yerkes  | 1907 | 7859.9                | -21.1   | 21     | A.O.        | 1908 | 8117.3                | - 9.2   | 16     |
| A.O.         | 1910 | 8927.0                | -12.7   | 7      | A.O. Yerkes | 1911 | 9291.8                | - 7.7   | 6      |
| A.O.         | 1912 | 9644.0                | -23.6   | 3      | Lick        | 1924 | 14105.8               | -14     | 1      |
| Lick, D.A.O. | 1925 | 14371.9               | - 5.6   | 3      | D.A.O.      | 1926 | 14763.3               | -10.3   | 4      |
| H-P          | 1942 | 20615.0               | - 4.6   | 12     |             |      |                       |         |        |

These means appear to fit a period of 880 days with the following preliminary elements -  $P = 880^d$ ,  $T_0 = 2416300.0$ ,  $\phi$  periastron  $700^\circ$ ,  $e = 0.30$ ,  $\omega = 190^\circ$ ,  $\gamma = -11.9$  km/sec.,  $k = 9$  km/sec.

| 118 | HD 214734 | 30 Cephe | $\alpha = 22^{\text{h}}35^{\text{m}}6^{\text{s}}$ | $\delta = + 63^{\circ} 4'$ | A2    |           |     |                              |
|-----|-----------|----------|---------------------------------------------------|----------------------------|-------|-----------|-----|------------------------------|
| 1   | 5929      | 1913 Aug | 2.761                                             | 2419982.761                | - 3.5 | $\pm 5.0$ | 3   | J                            |
| 2   | 6004      | Sep      | 13.626                                            | 2420024.626                | -13.8 | 2.7       | 5.5 | J                            |
| 3   | 6036      | Oct      | 8.586                                             | 0049.586                   | +11.0 | 9.0       | 4.5 | J                            |
| 4   | 6417      | 1914 Jul | 22.829                                            | 0336.829                   | -20.8 | 12.6      | 3   | J                            |
| 5   | 6437      | Aug      | 6.812                                             | 0351.812                   | - 5.8 |           | 2   | J                            |
| 6   | 6445      |          | 13.819                                            | 0358.819                   | - 3.9 | 0.6       | 5   | 1 line only<br>spectrum weak |
| 7   | 6461      |          | 21.809                                            | 0366.809                   | +43.2 |           | 2   | J                            |
| 8   | 6489      | Sep      | 17.703                                            | 0393.703                   | -12.6 | 11.3      | 6   | spectrum weak<br>1 line only |
| 9   | 6494      |          | 20.684                                            | 0396.684                   | - 3.9 | 3.3       | 11  | J                            |
| 10  | 6498      |          | 21.675                                            | 0397.675                   | + 1.5 | 3.0       | 4.5 | J                            |
| 11  | 6526      | Oct      | 2.719                                             | 0408.719                   | +20.9 |           | 2   | J                            |

1 line only  
spectrum weak

spectrum weak  
1 line only

1 line only  
spectrum weak

|    |      |          |        |          |       |      |     |       |   |                                |
|----|------|----------|--------|----------|-------|------|-----|-------|---|--------------------------------|
| 24 | 1424 | Jun      | 1.826  | 8094.826 | + 3.5 | ±3.1 | 11  |       | J |                                |
| 25 | 1441 |          | 4.865  | 8097.865 | -14.5 | 1.7  |     | -23.2 | 4 | J mean of 2                    |
| 26 | 1449 |          | 5.809  | 8098.809 | - 5.7 | 2.4  | 16  | - 9.0 | 3 | J                              |
| 27 | 1456 |          | 6.832  | 8099.832 | -34.7 | 6.8  | 4   |       |   | J                              |
| 28 | 1466 |          | 7.825  | 8100.825 | - 5.2 | 3.2  | 16  | -14.1 | 4 | J                              |
| 29 | 1474 |          | 8.830  | 8101.830 | -16.8 | 4.0  | 18  |       |   | J I.S. rejected                |
| 30 | 1485 |          | 11.826 | 8104.826 | -10.2 | 2.4  | 12  |       |   | J I.S. rejected                |
| 31 | 1498 |          | 15.831 | 8108.831 | - 2.3 | 2.4  | 13  |       |   | J I.S. rejected                |
| 32 | 1506 |          | 17.802 | 8110.802 | -16.8 | 5.4  | 19  | -21.4 | 1 | J                              |
| 33 | 1553 |          | 26.863 | 8119.863 | -21.3 | 3.4  | 17  | -39.8 | 3 | J                              |
| 34 | 1580 | Jul      | 1.816  | 8124.816 | -11.3 | 4.0  | 14  |       |   | J                              |
| 35 | 1612 |          | 8.809  | 8131.809 | -14.3 | 0.8  | 14  | - 9.4 | 3 | J                              |
| 36 | 1666 |          | 19.739 | 8142.739 | - 5.8 | 2.9  | 14  | -14.7 | 4 | J                              |
| 37 | 2241 | Dec      | 2.561  | 8278.561 | -22.6 | 1.3  | 18  | -14.3 | 3 | J                              |
| 38 | 3644 | 1910 Jul | 13.504 | 8866.804 | -17.7 | 3.3  | 16  | -21.7 | 3 | J                              |
| 39 | 3676 |          | 28.771 | 8881.771 | -27.9 | 4.7  | 14  | -15.0 | 3 | J                              |
| 40 | 3782 | Sep      | 6.717  | 8921.717 | -12.8 | 6.4  | 12  | - 9.8 | 1 | J comparison weak on pier side |
| 41 | 3836 |          | 27.748 | 8942.748 | -13.0 | 4.5  | 8   |       |   | J comparison and spectrum weak |
| 42 | 3851 |          | 29.688 | 8944.688 | - 4.0 | 6.7  | 8.5 |       |   | J comparison and spectrum weak |
| 43 | 3893 | Oct      | 10.642 | 8955.642 | 0.0   | 2.1  | 5   | -19.3 | 3 | J                              |
| 44 | 3993 |          | 30.584 | 8975.584 | -10.0 | 4.2  | 10  |       |   | J plate fogged                 |
| 45 | 4551 | 1911 Jun | 30.802 | 9218.802 | -14.4 | 5.4  | 8   | -29.6 | 1 | J                              |
| 46 | 4693 | Aug      | 15.768 | 9264.768 | - 7.3 | 5.4  | 6.5 | - 7.1 | 2 | J                              |

i2 6541 20.661 0426.661 +13.3 +6.8 8 J

An examination of these as well as 10 recent Allegheny plates of 30 Cep fails to confirm doubling of  $\lambda 4481$  reported by Harper (Publ. D.A.O. Z, 92, 1937). The velocity range observed here, +43 to -20, matches the published range of velocities. The lines are very broad and the star should be remeasured on an oscilloscope contour comparator. This star is probably a spectroscopic binary.

| 119 | HD 214993            | 12 Lacertae | $\alpha = 22^h 37^m 0^s$ | $\delta = +39^\circ 42'$ | B2 III                     |
|-----|----------------------|-------------|--------------------------|--------------------------|----------------------------|
| 1   | 4911 1911 Oct 29.607 | 2419339.607 | -26.6                    | +1.8 13                  | -10.1 3 D                  |
| 2   | 4985 Dec 7.489       | 9378.411    | +1.3                     | 1.8 13                   | -2.6 1 D                   |
| 3   | 5331 1912 Jun 20.815 | 9574.815    | -24.9                    | 4.3 -9.5                 | -13.0 1 D I.S. is weak     |
| 4   | 5368 Jul 26.818      | 9610.818    | -12.4                    | 2.9 10.5                 | +4.2 0.5 D I.S. is crooked |
| 5   | 5385 Aug 4.845       | 9619.845    | +12.8                    | 2.7 12                   | +25.2 1 D I.S. is weak     |
| 6   | 5393 11.823          | 9626.823    | +9.0                     | 2.6 10                   | +34.4 1 D                  |
| 7   | 5399 14.747          | 9629.747    | -6.2                     | 2.7 14.5                 | -15.3 0.5 D I.S. is faint  |
| 8   | 5422 Sep 6.721       | 9652.721    | -33.6                    | 2.6 10.5                 | +22.4 0.5 D I.S. is faint  |
| 9   | 5426 7.776           | 9653.776    | -18.9                    | 2.0 13                   | +2.9 0.5 D                 |
| 10  | 5435 9.749           | 9655.749    | -16.0                    | 3.8 9                    | +5.2 1 D I.S. is weak      |
| 11  | 5443 12.685          | 9658.685    | -11.8                    | 2.8 12                   | -3.7 1 D                   |
| 12  | 5453 19.710          | 9665.710    | -32.1                    | 3.6 13                   | D                          |
| 13  | 5469 29.595          | 9675.595    | -24.6                    | 1.3 15.5                 | -15.8 3 D                  |
| 14  | 5483 Oct 2.595       | 9678.595    | -41.3                    | 3.3 9                    | D                          |
| 15  | 5498 6.615           | 9682.615    | -7.7                     | 3.0 14                   | -20.4 1 D                  |
| 16  | 5517 17.540          | 9693.540    | -24.1                    | 2.3 16                   | -27.2 2 D                  |
| 17  | 5532 28.534          | 9704.534    | -20.6                    | 3.0 8                    | D                          |

|    |      |                 |             |       |      |      |   |
|----|------|-----------------|-------------|-------|------|------|---|
| 18 | 5535 | 29.503          | 9705.503    | -27.2 | +2.2 | 12   | D |
| 19 | 5551 | Nov 8.605       | 9715.605    | -11.7 | 3.0  | 13   | D |
| 20 | 5559 | 16.542          | 9723.542    | + 7.7 | 3.2  | 11.5 | D |
| 21 | 5585 | 29.494          | 9736.494    | - 4.3 | 4.5  | 11   | D |
| 22 | 5592 | Dec 3.520       | 9740.520    | - 9.7 | 2.8  | 15   | D |
| 23 | 5593 | 7.470           | 9744.470    | -25.2 | 2.2  | 10   | D |
| 24 | 5599 | 12.481          | 9749.481    | -43.0 | 3.3  | 14   | D |
| 25 | 5869 | 1913 Jun 27.817 | 9946.817    | -29.3 | 2.9  | 14   | D |
| 26 | 5876 | 29.848          | 9948.848    | + 0.5 | 2.6  | 16   | D |
| 27 | 5879 | Jul 2.791       | 9951.791    | - 8.7 | 3.6  | 14   | D |
| 28 | 5898 | 15.795          | 9964.795    | -45.2 | 3.5  | 14   | D |
| 29 | 5901 | 17.819          | 9966.819    | - 6.1 | 3.5  | 12   | D |
| 30 | 5907 | 19.800          | 9968.800    | -14.6 | 4.8  | 14   | D |
| 31 | 5917 | 26.774          | 9975.774    | -19.5 | 2.8  | 11   | D |
| 32 | 5923 | 30.829          | 9979.829    | - 3.5 | 3.6  | 11   | D |
| 33 | 5932 | Aug 4.786       | 9984.786    | - 6.0 | 3.1  | 12   | D |
| 34 | 5939 | 9.714           | 9989.714    | -28.1 | 2.9  | 10.5 | D |
| 35 | 5948 | 22.786          | 2420002.786 | - 7.6 | 3.1  | 13.5 | D |
| 36 | 5950 | 23.677          | 0003.677    | - 5.1 | 1.9  | 13   | D |
| 37 | 5955 | 24.785          | 0004.785    | -19.2 | 2.8  | 15   | D |
| 38 | 5965 | 29.707          | 0009.707    | +11.1 | 2.7  | 13.5 | D |
| 39 | 5972 | 31.678          | 0011.678    | + 6.7 | 1.7  | 14   | D |
| 40 | 5984 | Sep 5.664       | 0016.664    | - 9.0 | 3.7  | 13   | D |

I.S. is weak



|    |      |                 |          |       |      |      |       |   |                |
|----|------|-----------------|----------|-------|------|------|-------|---|----------------|
| 64 | 6499 | 21.728          | 0397.728 | -20.6 | +3.0 | 12   | -21.9 | 1 | D              |
| 65 | 6512 | 28.707          | 0404.707 | -23.7 | 3.2  | 11.5 | -1.5  | 2 | D              |
| 66 | 6532 | Oct 11.687      | 0417.687 | +10.3 | 3.6  | 13   | +1.7  | 2 | D              |
| 67 | 6536 | 19.664          | 0425.664 | -30.8 | 2.3  | 10.5 | -23.9 | 3 | D              |
| 68 | 6545 | 22.652          | 0428.652 | -11.4 | 1.1  | 16   | -22.0 | 3 | D              |
| 69 | 6554 | Nov 2.610       | 0439.610 | -27.7 | 3.1  | 14   | -31.4 | 2 | D              |
| 70 | 6562 | 6.592           | 0443.592 | +6.7  | 2.8  | 14   | -4.5  | 2 | D              |
| 71 | 6566 | 9.592           | 0446.592 | -34.8 | 1.9  | 14   | -36.3 | 1 | D              |
| 72 | 6571 | 13.570          | 0450.570 | -25.1 | 2.6  | 15   | -18.4 | 2 | D              |
| 73 | 6583 | 27.569          | 0464.569 | -19.9 | 2.8  | 16   | -6.3  | 2 | D              |
| 74 | 6746 | 1915 Jun 26.826 | 0675.826 | -1.5  | 3.0  | 14   | +5.6  | 1 | D              |
| 75 | 6757 | Jul 8.765       | 0687.765 | -25.6 | 1.8  | 17   | -13.9 | 2 | D              |
| 76 | 6765 | 17.834          | 0696.834 | -23.0 | 1.4  | 14   | -7.2  | 1 | D              |
| 77 | 6773 | 22.803          | 0701.803 | -37.4 | 2.5  | 14   | +2.0  | 2 | D              |
| 78 | 6788 | Aug 16.725      | 0726.725 | -42.1 | 4.4  | 7    |       |   | D underexposed |
| 79 | 6796 | - Sep 1.776     | 0742.776 | -28.6 | 1.7  | 14   | -5.7  | 1 | D              |
| 80 | 6803 | 8.764           | 0749.764 | -13.5 | 1.8  | 14   | +11.7 | 2 | D              |
| 81 | 6808 | 10.765          | 0751.765 | -5.6  | 5.9  | 8    |       |   | D              |
| 82 | 6813 | 15.782          | 0756.782 | -7.5  | 8.2  | 5    |       |   | D              |
| 83 | 6818 | 28.719          | 0769.719 | -22.4 | 2.2  | 13   | +2.4  | 2 | D              |
| 84 | 6823 | Oct 7.700       | 0778.700 | -27.9 | 2.3  | 16   | -5.9  | 1 | D              |
| 85 | 6828 | 8.689           | 0779.689 | -8.5  | 1.9  | 14   | -10.2 | 2 | D              |
| 86 | 6838 | 21.634          | 0792.634 | -20.5 | 0.7  | 16   | -26.5 | 2 | D              |

|    |      |                 |          |       |      |      |       |   |                 |
|----|------|-----------------|----------|-------|------|------|-------|---|-----------------|
| 87 | 6844 | 22.617          | 0793.617 | -17.6 | ±2.5 | 19   | - 7.9 | 3 | D               |
| 88 | 6849 | 26.628          | 0797.628 | -25.9 | 1.6  | 17   | -10.3 | 2 | D               |
| 89 | 6855 | 29.665          | 0800.665 | -30.9 | 3.2  | 12.5 | -16.4 | 2 | D               |
| 90 | 6861 | Nov 5.630       | 0807.630 | -40.4 | 3.2  | 9    |       |   | D               |
| 91 | 6863 | 9.583           | 0811.583 | - 0.9 | 2.6  | 18   | - 9.4 | 3 | D               |
| 92 | 6868 | 11.600          | 0813.600 | -26.3 | 4.0  | 11   | + 5.1 | 1 | D               |
| 93 | 7078 | 1916 Aug 28.768 | 1104.768 | -13.4 | 2.9  | 13   | -18.8 | 2 | D               |
| 94 | 7080 | 31.656          | 1107.656 | -30.7 | 1.6  | 15   | -10.6 | 1 | D I.S. is faint |
| 95 | 7081 | 31.740          | 1107.740 | - 9.1 | 2.1  | 15   | - 2.7 | 2 | D               |
| 96 | 7083 | Sep 2.684       | 1109.684 | - 6.3 | 2.1  | 15   | -18.1 | 1 | D               |

Mean I.S. - -11.3

| 120 | HD 214994 |                 | $\alpha = 22^h 37^m 4^s$ | $\delta = +28^\circ 47'$ | A1V |
|-----|-----------|-----------------|--------------------------|--------------------------|-----|
| 1   | 3726      | 1910 Aug 12.769 | 2418896.769 + 3.5        | $\pm 1.8$ 9              | D   |
| 2   | 3754      | 26.707          | 8910.707 + 2.9           | 4.0 7                    | D   |
| 3   | 4703      | 1911 Aug 18.801 | 9267.801 - 1.6           | 1.9 9                    | D   |
| 4   | 4774      | Sep 11.663      | 9291.663 + 8.4           | 1.4 5.5                  | D   |
|     |           |                 | Mean + 2.7               |                          |     |

| 121 | HD 216735 |                 | $\alpha = 22^h 50^m 12^s$ | $\delta = +8^\circ 17'$ | A1V |
|-----|-----------|-----------------|---------------------------|-------------------------|-----|
| 1   | 3690      | 1910 Jul 31.761 | 2418884.761 - 26.6        | $\pm 6.7$ 6             | D   |
| 2   | 4726      | 1911 Aug 21.785 | 9270.785 - 28.2           | 5.8 5                   | D   |
| 3   | 4888      | Oct 25.619      | 9335.619 - 20.1           | 3.9 6                   | D   |
| 4   | 4950      | Nov 21.535      | 9362.535 - 19.9           | 3.0 7                   | D   |

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The range of the published velocities together with these velocities is +16 to -28 km/sec. This is a probable spectroscopic binary.

| 122 | HD 216916 |                 | $\alpha = 22^h 51^m 50^s$ | $\delta = +41^\circ 4'$ | B2IV |
|-----|-----------|-----------------|---------------------------|-------------------------|------|
| 1   | 5403      | 1912 Aug 16.802 | 2419631.802 - 37.8        | $\pm 1.8$ 15            | D    |
| 2   | 5419      | Sep 5.801       | 9651.801 - 9.2            | 3.4 11                  | D    |
| 3   | 5431      | 8.767           | 9654.767 - 38.3           | 1.5 15                  | D    |
| 4   | 5440      | 11.777          | 9657.777 - 13.3           | 3.6 11                  | D    |
| 5   | 5447      | 16.661          | 9662.661 + 3.8            | 1.8 15                  | D    |
| 6   | 5456      | 20.628          | 9666.628 - 47.3           | 1.7 16                  | D    |
| 7   | 5464      | 27.707          | 9673.707 + 1.9            | 2.4 12                  | D    |

|    |      |           |          |       |     |    |       |     |                   |
|----|------|-----------|----------|-------|-----|----|-------|-----|-------------------|
| 8  | 5470 | 29.651    | 9675.651 | -19.0 | 1.8 | 11 | -22.3 | 1   | D                 |
| 9  | 5475 | 30.718    | 9676.718 | -34.0 | 1.8 | 15 | -20.8 | 1   | D                 |
| 10 | 5477 | Oct 1.590 | 9677.590 | -41.7 | 3.3 | 15 | -17.9 | 0.5 | D                 |
| 11 | 5484 | 2.655     | 9678.655 | -43.3 | 2.1 | 17 | -30.8 | 2   | D                 |
| 12 | 5489 | 4.653     | 9680.653 | -32.6 | 2.2 | 11 |       |     | D                 |
| 13 | 5495 | 5.673     | 9681.673 | -17.4 | 3.1 | 14 |       |     | D                 |
| 14 | 5499 | 6.690     | 9682.690 | -15.0 | 1.9 | 12 | - 8.0 | 0.5 | D                 |
| 15 | 5503 | 14.594    | 9690.594 | -32.3 | 1.9 | 15 | -29.0 | 4   | D                 |
| 16 | 5507 | 15.578    | 9691.578 | -18.8 | 2.1 | 18 | -21.1 | 2   | D                 |
| 17 | 5515 | 16.674    | 9692.674 | -38.0 | 2.0 | 16 | -23.6 | 2   | D                 |
| 18 | 5518 | 17.610    | 9693.610 | -11.5 | 2.0 | 15 | -18.6 | 3   | D                 |
| 19 | 5521 | 20.537    | 9696.537 | - 0.5 | 1.7 | 13 | - 4.5 | 2   | D                 |
| 20 | 5526 | 26.587    | 9702.587 | -31.1 | 1.8 | 15 | -19.9 | 2   | D                 |
| 21 | 5530 | 27.572    | 9703.572 | -26.9 | 2.4 | 18 | -12.2 | 1   | D                 |
| 22 | 5533 | 28.643    | 9704.643 | -24.8 | 2.0 | 12 |       |     | D                 |
| 23 | 5536 | 29.573    | 9705.573 | -31.4 | 5.0 | 7  |       |     | D underexposed    |
| 24 | 5539 | 30.679    | 9706.679 | - 2.4 | 2.1 | 13 |       |     | D                 |
| 25 | 5542 | 31.644    | 9707.644 | + 3.3 | 7.1 | 4  |       |     | D underexposed    |
| 26 | 5543 | Nov 3.543 | 9710.543 | - 3.4 | 2.5 | 15 | -22.9 | 4   | D                 |
| 27 | 5549 | 4.620     | 9711.620 | -26.4 | 2.5 | 4  |       |     | D underexposed    |
| 28 | 5555 | 11.530    | 9718.530 | -18.6 | 3.2 | 19 | -28.7 | 2   | D comparison weak |
| 29 | 5560 | 16.595    | 9723.595 | -16.3 | 4.5 | 6  |       |     | D underexposed    |
| 30 | 5561 | 18.517    | 9725.517 | -42.7 | 1.4 | 16 | -29.5 | 3   | D                 |

|    |      |                 |             |       |      |    |       |     |
|----|------|-----------------|-------------|-------|------|----|-------|-----|
| 31 | 5566 | 19.507          | 9726.507    | -46.8 | ±1.4 | 13 |       | D   |
| 32 | 5570 | 20.500          | 9727.500    | -36.5 | 1.5  | 14 | -13.0 | 1   |
| 33 | 5574 | 22.496          | 9729.496    | -15.4 | 3.4  | 18 | -10.4 | 1   |
| 34 | 5578 | 26.529          | 9733.529    | +13.5 | 2.5  | 17 | - 0.8 | 4   |
| 35 | 5580 | 28.487          | 9735.487    | -17.8 | 2.2  | 15 | -14.6 | 4   |
| 36 | 5586 | 30.457          | 9737.457    | -30.5 | 1.7  | 15 | -25.6 | 3   |
| 37 | 5594 | Dec 7.515       | 9744.515    | +12.2 | 3.0  | 16 | +10.4 | 4   |
| 38 | 5606 | 13.469          | 9750.469    | -39.1 | 2.9  | 18 | -26.6 | 2   |
| 39 | 5614 | 25.501          | 9762.501    | -34.1 | 1.7  | 16 | -44.6 | 3   |
| 40 | 5904 | 1913 Jul 18.812 | 9967.812    | -27.6 | 2.7  | 11 | -17.5 | 2   |
| 41 | 5921 | 29.754          | 9978.754    | -23.5 | 3.8  | 10 | + 7.8 | 1   |
| 42 | 5926 | Aug 1.809       | 9981.809    | -29.1 | 3.5  | 12 | -14.9 | 1   |
| 43 | 5935 | 5.761           | 9985.761    | -16.9 | 2.3  | 11 |       |     |
| 44 | 5940 | 9.777           | 9989.777    | - 1.4 | 2.2  | 6  |       |     |
| 45 | 5951 | 23.737          | 2420003.737 | -35.3 | 3.7  | 12 | -10.5 | 2   |
| 46 | 5959 | 25.792          | 0005.792    | -37.2 | 1.3  | 15 | -17.2 | 2   |
| 47 | 5962 | 27.742          | 0007.742    | -16.4 | 1.5  | 16 | -11.7 | 2   |
| 48 | 5970 | 30.783          | 0010.783    | +19.0 | 1.8  | 16 | - 1.8 | 1   |
| 49 | 5973 | 31.755          | 0011.755    | - 0.8 | 2.9  | 13 | + 7.0 | 2   |
| 50 | 5976 | Sep 1.701       | 0012.701    | + 6.5 | 2.6  | 15 | + 7.7 | 1   |
| 51 | 5981 | 3.657           | 0014.657    | -17.6 | 1.0  | 14 |       |     |
| 52 | 5985 | 5.726           | 0016.726    | -18.9 | 2.2  | 13 | +13.3 | 0.5 |
| 53 | 5989 | 1913 Sep 6.687  | 0017.687    | -13.7 | 8.2  | 5  |       |     |

underexposed

underexposed

|    |      |           |          |       |      |    |       |     |   |                   |
|----|------|-----------|----------|-------|------|----|-------|-----|---|-------------------|
| 54 | 5994 | 8.728     | 0019.728 | -13.1 | ±4.0 | 17 | -12.7 | 1   | D |                   |
| 55 | 5997 | 9.664     | 0020.664 | -27.7 | 3.4  | 10 | + 0.1 | 0.5 | D |                   |
| 56 | 6002 | 10.792    | 0021.792 | - 3.1 | 5.9  | 3  |       |     | D | much underexposed |
| 57 | 6005 | 13.694    | 0024.694 | + 9.8 | 2.9  | 11 | +11.6 | 1   | D |                   |
| 58 | 6009 | 23.674    | 0034.674 | +18.8 | 1.9  | 14 | + 2.0 | 1   | D |                   |
| 59 | 6014 | 24.712    | 0035.712 | + 5.1 | 3.2  | 12 | -13.5 | 1   | D |                   |
| 60 | 6017 | 25.649    | 0036.649 | + 2.0 | 1.9  | 23 | - 4.8 | 2   | D | seed 23           |
| 61 | 6020 | 27.621    | 0038.671 | -29.6 | 1.5  | 17 | -13.4 | 2   | D |                   |
| 62 | 6023 | 30.683    | 0041.683 | -49.1 | 2.1  | 13 | -35.3 | 1   | D |                   |
| 63 | 6026 | Oct 4.701 | 0045.701 | -12.0 | 1.7  | 15 | -20.2 | 1   | D |                   |
| 64 | 6029 | 6.710     | 0047.710 | + 4.8 | 2.1  | 13 | - 0.9 | 2   | D |                   |
| 65 | 6033 | 7.691     | 0048.691 | +14.7 | 2.0  | 15 | -36.3 | 1   | D |                   |
| 66 | 6037 | 8.638     | 0049.638 | - 1.8 | 1.5  | 17 | -19.5 | 0.5 | D |                   |
| 67 | 6041 | 9.740     | 0050.740 | -17.0 | 2.6  | 15 | -34.1 | 0.5 | D |                   |
| 68 | 6043 | 10.606    | 0051.606 | -23.4 | 2.3  | 19 | - 6.3 | 3   | D | seed 23           |
| 69 | 6046 | 13.685    | 0054.685 | -34.7 | 2.2  | 10 |       |     | D |                   |
| 70 | 6049 | 14.621    | 0055.621 | -13.5 | 3.5  | 13 | -22.7 | 2   | D |                   |
| 71 | 6052 | 15.606    | 0056.606 | - 4.7 | 2.1  | 13 | + 8.9 | 2   | D |                   |
| 72 | 6057 | 31.622    | 0072.622 | - 3.6 | 4.9  | 10 |       |     | D | broad dust band   |
| 73 | 6062 | Nov 2.629 | 0074.629 | -25.2 | 2.0  | 13 | -12.2 | 2   | D |                   |
| 74 | 6067 | 4.537     | 0076.537 | -34.8 | 2.6  | 12 | -47.7 | 2   | D |                   |
| 75 | 6070 | 5.661     | 0077.661 | -29.3 | 4.6  | 12 | -52.2 | 1   | D |                   |
| 76 | 6076 | 6.658     | 0078.658 | -27.6 | 2.2  | 12 | -16.5 | 2   | D |                   |

|    |      |                 |          |       |      |    |       |     |                |
|----|------|-----------------|----------|-------|------|----|-------|-----|----------------|
| 77 | 6079 | 14.487          | 0086.487 | -14.4 | +1.8 | 14 | -0.4  | 1   | D              |
| 78 | 6087 | 17.617          | 0089.617 | -31.8 | 1.3  | 15 | -18.4 | 2   | D              |
| 79 | 6091 | 20.590          | 0092.590 | -32.7 | 2.7  | 12 | -16.0 | 2   | D              |
| 80 | 6098 | 21.588          | 0093.588 | -17.8 | 4.0  | 13 | -17.3 | 1   | D              |
| 81 | 6101 | 22.523          | 0094.523 | +19.3 | 3.1  | 15 | -4.4  | 2   | D              |
| 82 | 6108 | Dec 3.529       | 0105.529 | +1.1  | 2.4  | 13 | +2.5  | 1   | D              |
| 83 | 6110 | 4.527           | 0106.527 | +10.2 | 1.4  | 20 | -3.6  | 3   | D seed 23      |
| 84 | 6112 | 5.540           | 0107.540 | +24.9 | 3.1  | 13 | -3.8  | 2   | D              |
| 85 | 6114 | 9.545           | 0111.545 | -32.1 | 1.1  | 15 |       |     | D              |
| 86 | 6118 | 11.524          | 0113.524 | -44.1 | 1.9  | 14 | -12.5 | 1   | D              |
| 87 | 6124 | 12.561          | 0114.561 | -51.7 | 1.5  | 15 | -25.7 | 2   | D              |
| 88 | 6130 | 13.466          | 0115.466 | -36.4 | 2.1  | 16 | -24.6 | 1   | D              |
| 89 | 6136 | 15.517          | 0117.517 | -5.6  | 1.9  | 13 | -11.9 | 3   | D              |
| 90 | 6143 | 19.530          | 0121.530 | -6.1  | 2.2  | 14 | -11.2 | 3   | D              |
| 91 | 6149 | 22.534          | 0124.534 | -42.9 | 2.9  | 11 |       |     | D              |
| 92 | 6153 | 28.546          | 0130.546 | -8.0  | 4.6  | 6  |       |     | D underexposed |
| 93 | 6410 | 1914 Jul 20.794 | 0334.794 | -18.6 | 2.5  | 15 | -18.7 | 0.5 | D              |
| 94 | 6425 | 26.803          | 0340.803 | +2.5  | 2.6  | 16 | -15.7 | 2   | D              |
| 95 | 6451 | Aug 15.816      | 0360.816 | +12.9 | 3.0  | 16 | -9.4  | 2   | D              |
| 96 | 6474 | Sep 6.785       | 0382.785 | -8.0  | 2.0  | 14 | -5.0  | 2   | D              |
| 97 | 6480 | 13.764          | 0389.764 | -24.8 | 2.2  | 17 | -3.6  | 1   | D              |
| 98 | 6502 | 22.746          | 0389.746 | +2.6  | 4.1  | 12 |       |     | D              |
| 99 | 6517 | 29.697          | 0405.697 | -35.7 | 3.2  | 13 |       |     | D              |

|                   |      |                 |          |       |      |    |              |
|-------------------|------|-----------------|----------|-------|------|----|--------------|
| 100               | 6529 | Oct 5.703       | 0411.703 | + 9.8 | +2.6 | 13 | D            |
| 101               | 6578 | Nov 23.588      | 0460.588 | + 0.4 | 1.6  | 17 | D            |
| 102               | 6588 | Dec 15.535      | 0482.535 | + 7.3 | 2.1  | 15 | D            |
| 103               | 6595 | 22.489          | 0489.489 | -37.7 | 2.5  | 15 | D            |
| 104               | 6886 | 1915 Dec 21.499 | 0853.499 | -33.4 | 2.2  | 16 | D            |
| 105               | 6906 | 1916 Jan 2.503  | 0865.503 | -41.2 | 1.9  | 18 | D            |
| 106               | 6915 | 8.515           | 0871.515 | +14.7 | 1.8  | 18 | D            |
| 107               | 7075 | Aug 21.794      | 1097.794 | + 1.4 | 3.8  | 8  | D            |
| 108               | 7077 | 28.709          | 1104.709 | -44.1 | 2.4  | 15 | D            |
| 109               | 7082 | Sep 2.631       | 1107.631 | - 4.9 | 1.8  | 16 | D            |
| Mean I.S. ~ -14.4 |      |                 |          |       |      |    | D            |
|                   |      |                 |          |       |      |    | underexposed |

Daniel measured these plates in the years 1912-1916 and derived periods of 12.093 days with a good fit though large scatter and 1.09 days with only a fair fit. No solution for orbit was apparently made. The presently accepted period adopted by Struve et.al. (Ap.J. 116, 81, 1952) is 12.097 days. Daniel, of course, was unaware of the 0.17 day periods, but on account of the large scatter in the 12 day period, evidently he did spend considerable time searching for periods close to 1 day. A possibility exists of a very long period also.

| 123 | HD 217675          | o Andromedae | $\alpha = 22^{\text{h}}57^{\text{m}}19^{\text{s}}$ | $\delta = +41^{\circ}47'$ | B6p               |
|-----|--------------------|--------------|----------------------------------------------------|---------------------------|-------------------|
| 1   | 185 1906 Nov 4.543 | 2417519.548  | -20.0                                              | $\pm 3.4$ 12              | J comparison weak |
| 2   | 186 4.572          | 7519.572     | -17.9                                              | 3.3 10                    | J K too faint     |
| 3   | 198 6.596          | 7521.596     | -10.4                                              | 6.0 3                     | J plate weak      |
| 4   | 220 8.534          | 7523.584     | -10.4                                              | 7.3 2                     | J                 |
| 5   | 221 8.605          | 7523.605     | -22.6                                              | 2.9 3.5                   | J                 |
| 6   | 222 8.627          | 7523.627     | -17.6                                              | 6.0 4.5                   | J                 |

|    |     |          |        |          |       |      |      |   |
|----|-----|----------|--------|----------|-------|------|------|---|
| 7  | 722 | 1907 Aug | 4.742  | 7792.792 | -13.5 | *2.5 | 11.5 | J |
| 8  | 738 |          | 10.779 | 7798.779 | - 3.4 | 1.4  | 9.5  | J |
| 9  | 739 |          | 10.809 | 7798.809 | -10.1 | 2.7  | 8    | J |
| 10 | 759 |          | 14.789 | 7802.789 | -18.2 | 2.6  | 15   | J |
| 11 | 760 |          | 14.817 | 7802.817 | -13.9 | 1.2  | 12.5 | J |
| 12 | 761 |          | 14.831 | 7802.831 | - 8.2 | 2.5  | 13.5 | J |
| 13 | 778 |          | 24.760 | 7812.760 | - 6.0 | 0.8  | 6.5  | J |
| 14 | 779 |          | 24.817 | 7812.817 | - 1.1 | 3.5  | 12   | J |
| 15 | 780 |          | 24.838 | 7812.838 | - 9.7 | 3.3  | 11   | J |
| 16 | 790 |          | 28.792 | 7816.792 | -15.8 | 2.2  | 11.5 | J |
| 17 | 791 |          | 28.814 | 7816.814 | -11.0 | 0.3  | 6    | J |
| 18 | 792 |          | 28.834 | 7816.834 | -10.7 | 3.4  | 8    | J |
| 19 | 797 |          | 30.769 | 7818.769 | -14.5 | 2.5  | 11   | J |
| 20 | 798 |          | 30.802 | 7818.802 | -13.1 | 1.9  | 11.5 | J |
| 21 | 799 |          | 30.822 | 7818.822 | -19.1 | 0.9  | 14   | J |
| 22 | 809 | Sep      | 1.712  | 7820.712 | -10.3 | 5.7  | 5.5  | J |
| 23 | 813 |          | 5.739  | 7824.739 | - 7.8 | 4.1  | 14.5 | J |
| 24 | 814 |          | 5.789  | 7824.789 | - 8.4 | 1.8  | 16   | J |
| 25 | 980 | Nov      | 14.510 | 7894.510 | -10.4 | 1.3  | 14   | J |
| 26 | 981 |          | 14.547 | 7894.547 | - 7.4 | 1.7  | 17   | J |
| 27 | 982 |          | 14.571 | 7894.571 | -10.8 | 2.5  | 15.5 | J |
| 28 | 985 |          | 15.578 | 7895.578 | -15.9 | 2.4  | 15   | J |
| 29 | 986 |          | 15.612 | 7895.612 | -16.5 | 1.4  | 12.5 | J |

|    |      |          |          |          |       |     |      |   |
|----|------|----------|----------|----------|-------|-----|------|---|
| 30 | 987  | 15.633   | 7895.633 | -20.7    | +3.6  | 12  | J    |   |
| 31 | 1425 | 1908 Jun | 1.856    | 8094.856 | -22.9 | 3.6 | 13.5 | J |
| 32 | 1450 |          | 5.845    | 8098.845 | - 9.9 | 1.8 | 7.5  | J |
| 33 | 1457 |          | 6.867    | 8099.867 | -21.9 | 2.3 | 8    | J |
| 34 | 1467 |          | 7.865    | 8100.865 | -17.4 | 4.8 | 10   | J |
| 35 | 1475 |          | 8.857    | 8101.857 | - 8.6 | 4.6 | 10   | J |
| 36 | 1486 |          | 11.859   | 8104.859 | - 6.9 | 2.2 | 12   | J |
| 37 | 1507 |          | 17.791   | 8110.791 | - 4.2 | 2.7 | 14.5 | J |
| 38 | 1541 |          | 25.790   | 8118.790 | +21.8 | 2.8 | 3    | J |
| 39 | 1561 |          | 27.816   | 8120.816 | - 9.3 | 1.3 | 6    | J |
| 40 | 1581 | Jul      | 1.846    | 8124.846 | - 9.6 | 1.0 | 7    | J |
| 41 | 1595 |          | 5.808    | 8128.808 | -20.0 | 2.4 | 8    | J |
| 42 | 1620 |          | 9.788    | 8132.788 | -18.2 | 4.2 | 10.5 | J |
| 43 | 1643 |          | 15.767   | 8138.767 | -15.2 | 0.8 | 13   | J |
| 44 | 1667 |          | 19.771   | 8142.771 | -12.7 | 3.4 | 12   | J |
| 45 | 1769 | Aug      | 12.698   | 8166.698 | -18.5 | 1.6 | 8    | J |
| 46 | 1789 |          | 16.776   | 8170.776 | -14.1 | 2.0 | 7    | J |
| 47 | 1804 |          | 20.690   | 8174.690 | -18.8 | 0.4 | 6    | J |
| 48 | 1848 |          | 26.774   | 8180.774 | -11.8 | 1.4 | 11   | J |
| 49 | 2118 | Nov      | 2.586    | 8248.586 | - 6.4 | 2.1 | 17   | J |
| 50 | 2131 |          | 4.684    | 8250.684 | - 7.0 | 1.6 | 7    | J |
| 51 | 2153 |          | 9.531    | 8255.531 | -14.2 | 3.7 | 11   | J |
| 52 | 2172 |          | 13.556   | 8259.556 | - 7.6 | 1.8 | 11   | J |

|      |      |          |        |          |       |      |       |   |
|------|------|----------|--------|----------|-------|------|-------|---|
| 53   | 2882 | 1909 Aug | 31.740 | 8550.740 | - 7.2 | ±4.2 | 10    | J |
| 54   | 2912 | Sep      | 7.752  | 8557.752 | - 6.0 | 3.4  | 9     | J |
| 55   | 2927 |          | 10.743 | 8560.743 | -12.7 | 0.6  | 8     | J |
| 56   | 3645 | 1910 Jun | 13.827 | 8866.827 | - 5.0 | 3.2  | 10    | J |
| 57   | 3677 |          | 28.795 | 8881.795 | -14.4 | 3.4  | 12    | J |
| 58   | 3783 | Sep      | 6.769  | 8921.769 | -16.1 | 2.8  | 9     | J |
| 59   | 3837 |          | 27.784 | 8942.784 | - 7.0 | 1.9  | 3     | J |
| 60   | 3843 |          | 28.696 | 8943.696 | - 1.5 | 3.8  | 6     | J |
| 61   | 3894 | Oct      | 10.660 | 8955.660 | -12.6 | 5.5  | 7     | J |
| 62   | 3994 |          | 30.609 | 8975.609 | - 6.4 | 5.6  | 5     | J |
| 63   | 4552 | 1911 Jun | 30.821 | 9218.821 | -13.2 | 5.6  | 5     | J |
| 64   | 4694 | Aug      | 15.784 | 9264.789 | -11.9 | 7.0  | 4     | J |
| 65   | 4769 | Sep      | 7.701  | 9287.701 | -23.5 | 2.9  | 3     | J |
| 66   | 4788 |          | 13.698 | 9293.698 | -23.0 | 2.9  | 10    | J |
| 67   | 4903 | Oct      | 28.578 | 9338.578 | -12.4 | 2.9  | 10    | J |
| 68   | 5346 | 1912 Jun | 6.816  | 9590.816 | -40.5 | 1.1  | 2     | J |
| 69   | 5427 | Sep      | 7.806  | 9653.806 | -12.7 | 5.0  | 6     | J |
| 70   | 5514 | Oct      | 16.618 | 9692.618 | -17.8 | 3.8  | 7     | J |
| Mean |      |          |        |          |       |      | -12.4 |   |

The HD catalogue lists the spectrum as B5 and A2p composite. It is possible that the A2p component (HD 217676) is variable in velocity. These velocities are based on the H lines, the K line, and 4226 HeI. The 4226 HeI line agrees closely with the mean of the individual line velocities for each plate. See the note by Plaskett and Pearce (Publ. D.A.O., 5, 165, 1930).

|     |           |                  |          |                           |                            |              |   |
|-----|-----------|------------------|----------|---------------------------|----------------------------|--------------|---|
| 124 | HD 218045 | $\alpha$ Pegasi  |          | $\alpha = 22^h 59^m 47^s$ | $\delta = +14^{\circ} 40'$ | B9.5 III     |   |
|     | 1         | 2762             | 1909 Aug | 3.864                     | 2418522.864 + 4.7          | $\pm 3.5$ 7  | B |
|     | 2         | 2763             |          | 3.878                     | 8522.878 + <u>12.1</u>     | 4.5 6        | B |
|     |           |                  |          | Mean + 8.1                |                            |              |   |
| 125 | HD 210080 | 7 Andromedae     |          | $\alpha = 23^h 7^m 58^s$  | $\delta = +48^{\circ} 52'$ | FOV          |   |
|     | 1         | 3121             | 1909 Oct | 13.589                    | 2418593.589 + 14.4         | $\pm 1.5$ 21 | J |
|     | 2         | 3135             |          | 19.603                    | 8599.603 + 5.2             | 21           | J |
|     | 3         | 4709             | 1911 Aug | 19.800                    | 9268.800 + 4.6             | 2.9 9        | J |
|     | 4         | 4775             | Sep      | 11.699                    | 9291.699 + 8.4             | 1.8 20       | J |
| 126 | HD 220825 | $\kappa$ Piscium |          | $\alpha = 23^h 21^m 48^s$ | $\delta = +0^{\circ} 42'$  | Ap           |   |
|     | 1         | 3181             | 1909 Nov | 4.607                     | 2418615.507 - 9.3          | $\pm 1.0$ 16 | D |
|     | 2         | 4670             | 1911 Aug | 9.835                     | 9258.835 - 3.2             | 2.3 15       | D |
|     | 3         | 4732             |          | 22.788                    | 9271.788 - 7.1             | 2.2 13       | D |
|     | 4         | 4946             | Nov      | 19.550                    | <u>-12.1</u>               | 3.1 17       | D |
|     |           |                  |          | Mean - 8.1                |                            |              |   |
| 127 | HD 222304 | 18 Andromedae    |          | $\alpha = 23^h 34^m 18^s$ | $\delta = +49^{\circ} 55'$ | B9           |   |
|     | 1         | 3136             | 1909 Oct | 19.624                    | 2418599.624 - 4.3          | $\pm 1.7$ 2  | J |
|     | 2         | 3145             |          | 30.600                    | 8610.600 + 25.4            | 1.6 2        | J |
|     | 3         | 3190             | Nov      | 6.560                     | 8617.560 + 24.1            | 2.7 2        | J |
|     | 4         | 3234             |          | 15.528                    | 8626.528 + 14.4            | 1.7 2        | J |

comparison weak on  
one side

|    |      |          |        |            |             |      |     |
|----|------|----------|--------|------------|-------------|------|-----|
| 5  | 4047 | 1910 Nov | 22.546 | 8998.546   | -26.5 ±14.0 | 3    | J   |
| 6  | 4068 | Dec      | 8.523  | 9014.523   | + 4.5       | 11.0 | 3   |
| 7  | 4867 | 1911 Oct | 18.608 | 9328.608   | - 1.6       | 13.8 | 2   |
| 8  | 4895 |          | 26.584 | 9336.584   | -20.4       | 7.7  | 5   |
| 9  | 4904 |          | 28.608 | 9338.608   | -11.9       | 4.5  | 2   |
| 10 | 4917 | Nov      | 2.588  | 9343.588   | +11.7       | 2.0  | 2.5 |
| 11 | 4951 |          | 21.618 | 9362.618   | + 2.3       | 4.1  | 3   |
| 12 | 4970 | Dec      | 5.520  | 9376.520   | - 2.2       | 5.6  | 3   |
| 13 | 4998 |          | 28.525 | 9399.525   | +10.7       | 1.1  | 4   |
| 14 | 5015 | 1912 Jan | 7.505  | 9409.505   | -12.3       | 4.2  | 5   |
| 15 | 5478 | Oct      | 1.646  | 9677.646   | - 9.8       | 3.7  | 3   |
| 16 | 5587 | Nov      | 30.507 | 9737.507   | + 0.8       | 6.8  | 3   |
|    |      |          |        | Mean - 2.0 |             |      |     |

The scatter is not unduly large for a star of this spectral type, and with low individual plate weights, hence we consider it unlikely to be a spectroscopic binary.

| HD 224572 |      | $\sigma$ Cassiopeiae |        | $\alpha = 23^h 53^m 56^s$ (1900) |       | $\delta = +55^\circ 12'$ |     | B1V |
|-----------|------|----------------------|--------|----------------------------------|-------|--------------------------|-----|-----|
| 1         | 3182 | 1909 Nov             | 4.637  | 2418615.637                      | -12.4 | ± 1.4                    | 4.5 | D   |
| 2         | 4875 | 1911 Oct             | 19.696 | 19329.696                        | + 1.5 | 3.4                      | 3   | D   |
| 3         | 5982 | 1913 Sep             | 3.733  | 20014.733                        | -16.5 | 1.2                      | 9   | D   |
|           |      |                      |        | Mean -12.1                       |       |                          |     |     |

## MANUAL FOR THE MEASUREMENT AND REDUCTION OF ALLEGHENY RADIAL VELOCITIES

OLD SYSTEM - 1906-1917

This procedure is basically one of first calculating the radial velocities from a table of preliminary wavelengths and screw readings and to then adjust the radial velocities and the screw readings and finally the wavelengths, utilizing the mean deviations of the individual lines from zero residual.

The plates were first measured on the small spectrogram measuring engine which had a half-millimeter pitch screw. The plate was mounted so that the violet end of the spectrum was on the left as seen in the microscope with the emulsion up. The weight was on the left and the screw hand wheel on the right. The engine was tilted toward the measurer. The plate carriage was shifted back and forth and the plate itself rotated and translated until it was horizontal in the eyepiece field. Usually this horizontal orientation could be established by means of a dust particle on the cross hair or a horizontal reticle at the side of the eyepiece field. Once horizontal the plate was set and locked so that  $\lambda 4163$  of the Ti comparison was at the screw reading 98.61. Measure of the lines then commenced from the violet end toward the red, always moving the cross hair onto the line from the violet side so as to be raising the weight while setting and thus remove the backlash from the screw.

Two settings were made on the upper comparison line and two on the lower. The average of these was recorded on the measuring sheet as the "direct" comparison reading. Three settings were made on each measuring sheet as the "direct" star reading. The procedure used in setting on the center of the line was to balance the black on either side of the cross hair for the case of the comparison line and to balance the white on either side of the cross hair for the case of

the star line. Allowance for grain irregularity would have to be made when necessary.

The procedure, so far, was similar to that of all observatories, however, the small measuring engine was unique in regards to reversal of the plate. Rather than reverse the plate and go through the entire setup procedure, the entire machine was reversed without it being necessary to touch the plate.

The measuring engine sat on a wooden base which could be merely turned around. The machine was now tilted again toward the measurer. This placed the weight at the right and the screw wheel at the left. The readings were repeated as before but this time from red to violet and recorded on the measuring sheets as "reverse". The chief difference in this respect was that the reversed readings were made with the weight rather than against the weight. In other words, rather than raising the weight while making the setting, the weight is lowered while making the setting in reverse. This meant that one side of the screw thread received wear during the direct reading while the other side received wear during the reverse reading. Normally, only one side of the screw receives wear when the plate is reversed, since the measure is made against the weight direct and reversed.

The early measures, themselves, are probably all right because the half-millimeter pitch resulted in a minimum of backlash with a tight nut. The later measures (the ones being reduced now) may not be so good since the wear on both sides of the thread resulted in the screw wearing out completely by 1917. The technique for setting on the comparison lines varied somewhat with the measurer. Some measurers set on the tips of the comparison lines; some about one third of the way from the tip and some on the whole line. The correction applied varied from  $-0.2$  km/sec. for a setting on the tip to  $-0.5$  km/sec. for a setting on the whole line.

We turn our attention now from the measuring technique to the arrangement of

the measuring sheet. Two types of measuring sheets were used. The arrangement of the data on these sheets, however, was basically the same for both.



**ALLEGHENY OBSERVATORY.**

Star Algoe  
Date 1912 Feb 23  
Time 7:00

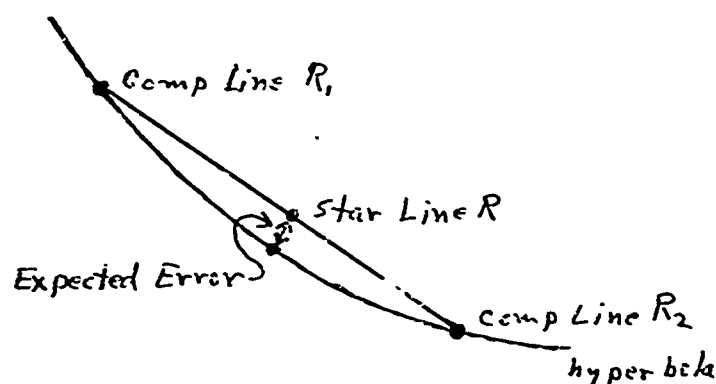
Plate No. 5090  
Measured by Sehl  
1912 Apr. 1

Scale.  $-0.3$  ✓  
 Curv.  $-27.5$  ✓  
 $v$ .  $-0.11$  ✓  
 $v_s$   $-2792$  ✓  
 Sum  $+47.38$  ✓  
 $V$   $+47.6$  ✓  $P_c = \pm 2.4$

[illegible]

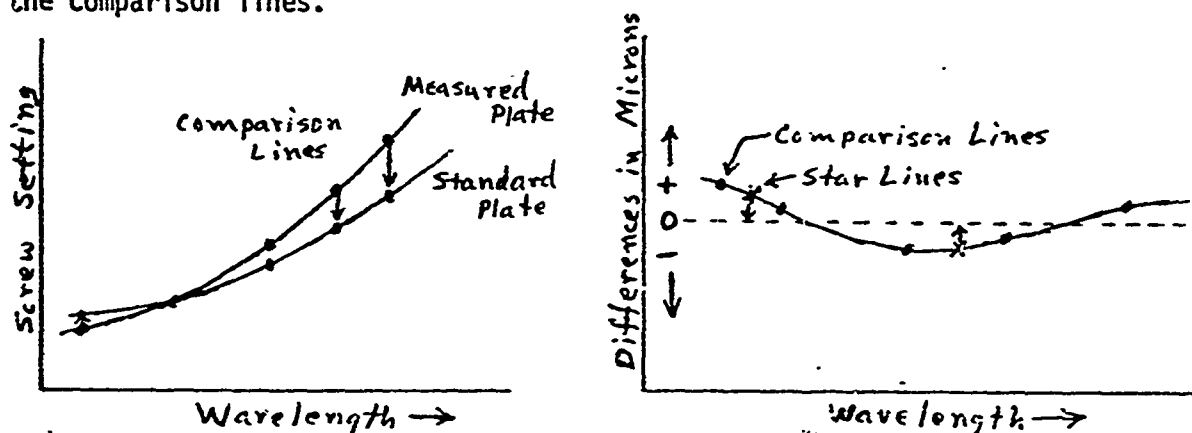
Type I was the original measuring sheet in use. Used in 1907, it was replaced by Type II about April 1908. Type II was in use then for the remainder of the program.

The reduction of the measures to give radial velocity was basically that of converting the deviation of the measures from a standard table of measures into radial velocity. Schlesinger, as is customary with all observatories using the Standard Table reduction method, had to set up his own table for the Mellon Spectrograph. Such a table is dependent on the dispersion of the spectrograph as well as the characteristics of the prisms, lenses, and other components. Thus each spectrograph requires its own table. What Schlesinger did was to take four plates during the winter and four during the summer. The average comparison settings for each of these two series were compared with each other using  $\lambda$  4164 for the common setting. The deviation in scale due to the summer-winter temperature difference, was found to be very nearly linear. Fitting the differences in dispersion to a smooth parabola, he then determined what error would be expected by interpolating a star line between two comparison lines on the parabola, linearly, rather than along the parabola.



The maximum error between two plates was determined from the fact that the temperature difference here was maximum, he chose the greatest distance available between comparison lines, and assumed the star line to be half way between. This led to a maximum error of 0.14 km/sec. Since this error was sufficiently small,

he concluded that no sensible error is involved by assuming that, for short distances, the differences of dispersion may be considered as linear. Schlesinger's linear interpolation method differs from the Standard Table reduction method commonly used today, in that, now one reduces the star lines to the standard table using a plot of the differences between the measures and the table for the comparison lines.



The difference, then between the reduced setting of the star line and the standard setting in microns, is converted directly to radial velocity using  $dV/dR$  values similar to Schlesinger's. In this case, the standard plates were measured and averaged to determine the standard screw setting for each comparison line that was not obviously blended. From these readings, a Hartmann reduction was used to compute the observed wave lengths of the comparison lines. The formula used first was

$$(\lambda_0 - 2304.4) (211.09 - R) = [5.3204664]$$

where  $\lambda_0 = 2304.4$ ,  $R_0 = 211.09$ , and  $\log c = 5.3204664$ . These  $\lambda$ 's were compared to the Rowland  $\lambda$ 's and the differences  $\Delta\lambda$  incorporated into the above formula to reduce the standard settings to the Rowland  $\lambda$  system as so:

$$(\lambda_0 + \Delta\lambda - 2304.4) (211.09 - R) = [5.3204664]$$

The constants here were evidently revised about 1907 since the  $\theta$  Aquilae reduction as well as all subsequent reductions used  $\lambda_0 = 2305.592$ ,  $R_0 = 211.208$ , and  $\log c = 5.3206322$ . Table A and Table B in A.O. Publ. 2, p. 13-14 list the

wavelengths of the comparison lines, the normal screw settings of the comparison lines, and  $dv/dR$ , the radial velocity corresponding to a displacement of one turn of the screw.

For each star now the lines to be measured (star and comparison) were chosen. The choice generally consisted of all good star lines and those comparison lines which bracketed each star line. A master list of preliminary wave lengths of the star lines was adopted on November 7, 1907, mostly from Rowland's solar wave lengths. A few wavelengths came from other sources such as Hartmann, Frost, Runge, and Paschen, etc. Standard screw settings for these star lines were computed from the Hartmann formula. These screw settings along with those for the chosen comparison lines were then used to compute once and for all, a table of four quantities which were entered on a 3" x 5" card. (A card was made up for each star). These quantities were:

| Rough Screw<br>Setting | $(R_2 - R_1)_{Norm.}$ | $(R - R_1)_{Norm.}$ | $k = \frac{R - R_1}{R_2 - R_1}$ | $\frac{dv}{dR}$ |
|------------------------|-----------------------|---------------------|---------------------------------|-----------------|
|                        |                       |                     |                                 |                 |

The plates were measured, top and bottom settings on the comparison lines and star line settings, both direct and reversed. Each star line was weighted on a scale from 1 to 4, depending on how easily and accurately the settings could be made. A few weights of 1- were recorded, which have been assigned the value  $\frac{1}{2}$  in these reductions. A well defined line, which was easily bisected and for which the three settings agreed very well with each other, was given high weight, say 3 or 4. Mean values of the comparison settings and star settings were computed. Those means on either side of the star line being  $R_1$  and  $R_2$  and then mean

star setting being  $R$ . The measured values  $R - R_1$  and  $R_2 - R_1$  were computed for each line and the velocity of each line, then computed from the formula,

$$v_s = \{ (R - R_1) - (R - R_1) - [ (R_2 - R_1) - (R_2 - R_1) ] k \} \frac{dV}{dR}$$

The weighted average of the line velocities  $v_s$  yielded the plate velocity, which when corrected for diurnal and annual motion of the earth gave the star velocity for the plate. This star velocity was considered a preliminary velocity.

Now it so happens that the adopted Rowland wavelengths were for the sun at very high dispersion. There is no reason to believe that for a star of very different temperature and pressure, these wavelengths are the same. Moreover, the blending ratios will probably be very different and of course, low dispersion makes blending much more serious for the case of the Allegheny spectrograms. Hence the adopted Rowland wave lengths should not be the actual wavelengths of the star in question at the dispersion used. Each line, therefore, has a wavelength error, which should yield a systematic error or deviation from the plate velocity. Individual deviations in km/sec. were tabulated for each star line for all plates of a star and each was multiplied by the weight of the line. Then a weighted mean deviation was computed for all plates. This weighted mean was used to correct the star line in question. For instance, if  $\lambda 3933$  or  $R = 82.7$ , we derive a mean residual error of  $-2.7$  km/sec. Then for each plate, the line velocity  $v_s$  of  $\lambda 3933$  is corrected by adding  $+ 2.7$  km/sec. Having done this for each line a new weighted mean of the corrected  $v_s$ 's yielded a corrected plate velocity and a corrected, or final star velocity. These corrected entries were made on the measuring sheets with red ink. The correction for each line was also used to correct the adopted Rowland wavelengths to the "true" wavelengths.

First the screw readings were corrected and then the "true" wave lengths were computed for the corrected screw readings. The screw readings were corrected with the formula,

$$\frac{\Delta v_s}{\frac{dV}{dR}} = \frac{\Delta R}{T}$$

For example for our  $\lambda 3933$   $\Delta v_s = -2.7$  km/sec. and  $\frac{dV}{dR} = 969$

$$\frac{-2.7}{969} = \frac{\Delta R}{1}$$

$$\Delta R = -0.0028$$

$$R_{\text{norm}} = 82.7284$$

$$R_{\text{true}} = 82.7256$$

Using  $R = 82.7256$ , the Hartmann formula was used to compute the "true"  $\lambda$  of 3933.789 ( $\theta$  Aquilae). This procedure was followed for each star line and the results published for each star. The result was that each star had slightly different final  $\lambda$ 's due primarily to differences in blending.

A master table of the adopted wavelengths and screw readings and reduction coefficients follows on the next page.

One complication in these radial velocities, is the matter of interstellar H and K lines. While the different character (ie. the sharpness and non-variability) of these lines were recognized in those days, their true nature was not known. It is now known that they originate from absorption in the ground state of ionized calcium atoms in interstellar space and primarily in gas clouds of the spiral arms. Velocities derived from them are distinct from the velocity of the star and should not be averaged into the plate velocity. In the old measures, these were averaged into the plate velocity in many cases. When so done, they must be removed from the plate velocities and expressed separately. A list of those stars in which H and K is interstellar, follows also.

TABLE OF ADOPTED WAVELENGTHS

| $\lambda$ comp.<br>(Rowland) | R comp.<br>(*Regularly used) | $\lambda$ star | R star  | Ident.   | Spectral Range              | $\frac{dV}{dR}$ |
|------------------------------|------------------------------|----------------|---------|----------|-----------------------------|-----------------|
| 3924.673                     | * 82.0026                    | 3926.678       | 82.1627 | He       | 09.5-B5                     | 962             |
| 3930.022                     | 82.4286                      |                |         |          |                             |                 |
|                              |                              | 3933.825       | 82.7284 | (Cat (K) | (IS09.5-B5), B6-B9.5, A0-A8 | 969             |
|                              |                              | 3936.064       | 82.9047 | He       |                             |                 |
|                              |                              | 3943.919       | 83.5190 |          | B6-B9.5                     | 978             |
|                              |                              | 3956.819       | 84.5154 | Fe       |                             |                 |
| 3958.355                     | * 84.6381                    |                |         |          |                             |                 |
| 3962.995                     | 84.9872                      |                |         |          |                             |                 |
| 3964.416                     | 85.0932                      |                |         |          |                             |                 |
|                              |                              | 3964.875       | 85.1296 | He       | 09.5-B5                     | 998             |
|                              |                              | 3968.625       | 85.4135 | Ca (H)   | (IS09.5-B5)                 | 999             |
|                              |                              | 3970.177       | 85.5307 | He       |                             | 1000            |
|                              |                              | 3984.109       | 86.5722 |          | B6-B9.5                     | 1016            |
| 3989.912                     | 87.0006                      |                |         |          |                             |                 |
|                              |                              | 3995.190       | 87.3885 |          | 09.5-B5                     |                 |
| 3998.790                     | * 87.6524                    |                |         |          |                             |                 |
|                              |                              | 4005.408       | 88.1317 | Fe       |                             | 1036            |
|                              |                              | 4009.417       | 88.4209 | He       | 09.5-B5, B6-B9.5            | 1039            |
| 4012.541                     | 88.6459                      | 4012.541       | 88.6453 | Ti       | A0-A8                       | 1042            |

|          |         |                |                       |      |
|----------|---------|----------------|-----------------------|------|
| 4017.925 | 89.0300 | Ti             |                       | 1073 |
| 4024.136 | 89.4798 | He             |                       | 1074 |
| 4025.043 | 89.5320 |                |                       | 1054 |
| 4026.370 | 89.6284 | He (blend)     | 09.5-B5, B6-B9.5      | 1056 |
| 4028.497 | 89.7785 | Ti             |                       | 1058 |
| 4030.646 | 89.9282 | Fe-Ti          | A0-A8                 | 1060 |
| 4045.975 | 90.9949 | Fe             | A0-A8, F0-F8          | 1075 |
| 4048.930 | 91.1989 | Fe             |                       | 1079 |
| 4053.981 | 91.5461 |                |                       |      |
| 4060.415 | 91.9025 |                |                       |      |
| 4063.759 | 92.2092 | Fe             | A0-A8, F0-F8          | 1093 |
| 4067.284 | 92.4468 | Fe (blend)     |                       | 1096 |
| 4069.946 | 92.6257 |                | 09.5-B5               | 1099 |
| 4072.342 | 92.7863 |                |                       | 1101 |
| 4077.630 | 93.1391 |                | A0-A8, F0-F8          |      |
| 4078.631 | 93.2048 |                |                       |      |
| 4089     | 93.9058 |                | 09.5-B5               | 1117 |
| 4102.000 | 94.7378 | H <sub>2</sub> | B6-B9.5, A0-A8, F0-F8 | 1129 |
| 4121.015 | 95.9557 | He (blend)     | B6-B9.5               | 1147 |
| 4128.204 | 96.4096 | Si             | B6-B9.5, A0-A8        | 1155 |
| 4131.040 | 96.5876 | Si             | B6-B9.5, A0-A8        | 1157 |
| 4137.061 | 96.9641 |                | B6-B9.5               | 1163 |
| 4143.572 | 97.3681 | Fe             | A0-A8, F0-F8          | 1170 |

|          |           |          |          |            |          |                       |      |
|----------|-----------|----------|----------|------------|----------|-----------------------|------|
| 4163.818 | * 98.6079 | 4143.919 | 97.3892  | He         | 09.5-B5, | B6-B9.5               | 1170 |
|          |           | 4154.667 | 98.0500  | Fe         |          | A0-A8                 | 1181 |
|          |           | 4163.818 | 98.2092  | Ti         |          |                       | 1184 |
| 4172.066 | 99.1028   | 4169.131 | 98.9267  | He         | 09.5-B5  |                       | 1195 |
| 4186.280 | 99.9490   | 4179.246 | 99.5319  |            |          | A0-A8                 | 1206 |
|          |           | 4187     | 100.02   |            |          | A0-A8                 | 1214 |
|          |           | 4198.800 | 100.6835 | Fe         |          | A0-A8, F0-F8          | 1226 |
|          |           | 4206.211 | 101.1137 |            | 09.5-B5? | B6-B9.5, A0-A8        | 1233 |
|          |           | 4215.703 | 101.6599 | Srt        |          | A0-A8, F0-F8          | 1242 |
|          |           | 4226.904 | 102.2974 | Ca         |          | A0-A8, F0-F8          | 1253 |
|          |           | 4233.328 | 102.6598 | Mn - Fe    |          | B6-B9.5, A0-A8, F0-F8 | 1260 |
|          |           | 4242.535 | 103.1748 | Cr         |          |                       | 1270 |
| 4263.290 | *104.3178 | 4250.657 | 103.6252 | Fe (blend) |          | A0-A8                 | 1277 |
| 4274.746 | 104.9395  | 4267.301 | 104.5364 | C          | 09.5-B5, | B6-B9.5               | 1294 |
|          |           | 4271.657 | 104.7724 | Fe (blend) |          | A0-A8, F0-F8          | 1299 |
|          |           | 4275.476 | 104.9784 |            |          | A0-A8                 |      |
|          |           | 4290.080 | 105.7586 | Ti         |          | A0-A8, F0-F8          | 1317 |
| 4294.204 | 105.9799  | 4290.377 | 105.7747 | Ti         |          | A0-A8, F0-F8          | 1318 |

|          |           |          |          |                   |                              |
|----------|-----------|----------|----------|-------------------|------------------------------|
| 4295.914 | 106.0660  | 4314     | 107.06   | M                 |                              |
| 4313.034 | 106.9634  | 4321.119 | 107.3804 | Fe                | 1353                         |
|          |           | 4325.938 | 107.6268 | Fe                | A0-A8,F0-F8, M 1355          |
|          |           | 4337     | 108.23   | M                 |                              |
| 4338.084 | *108.2450 | 4340.634 | 108.3744 | H <sub>δ</sub>    | B6-B9.5, A0-A8,F0-F8, M 1370 |
|          |           | 4352.083 | 108.9474 | Mg                | A0-A8,F0-F8, 1382            |
| 4367.839 | 109.7305  | 4375.103 | 110.0827 | Mn                | 1406                         |
|          |           | 4384.477 | 110.5378 |                   | A0-A8,F0-F8, M 1415          |
|          |           | 4388.100 | 110.7149 | He                | B6-B9.5, 1419                |
|          |           | 4391.146 | 110.8506 | Fe-T <sub>1</sub> | A0-A8 1422                   |
| 4399.935 | *111.2818 | 4395.    | 111.07   | M                 |                              |
|          |           | 4400     | 111.32   | M                 |                              |
|          |           | 4404.927 | 111.5165 |                   | A0-A8,F0-F8, M 1436          |
|          |           | 4408     | 111.69   | M                 |                              |
| 4434.168 | 112.8858  | 4437.718 | 113.0501 | He                | 09.5-B5 1470                 |
|          |           | 4443.976 | 113.3369 | Ti                | A0-A8,F0-F8 1477             |
| 4455.485 | 113.8602  |          |          |                   |                              |
| 4457.600 | *113.9556 |          |          |                   |                              |

|          |           |          |                    |            |                          |        |
|----------|-----------|----------|--------------------|------------|--------------------------|--------|
| 4468.7   | 114.4529  | 4462.165 | 114.1570           | Fe-Mn      | A0-A8                    | 1496   |
|          |           | 4468.663 | 114.4523           | Ti         |                          | 1503   |
|          |           | 4471.676 | 114.5867           | He (blend) | 86-89.5                  | 1506   |
|          |           | 4481.397 | 115.0177           | Mg         | B6-B9.5, A0-A8, F0-F8, M | 1516   |
|          |           | 4481.438 | 115.0195<br>(0214) | Ti         | 09.5-B5?                 |        |
|          |           | 4489     | 115.39             |            |                          | M      |
| 4496.318 | 115.6720  | 4496     | 115.70             |            |                          | M      |
| 4501.448 | *115.8942 | 4501.448 | 115.8942           | Ti         |                          | 1536   |
|          |           | 4508.455 | 116.1975           | Fe         |                          | 1543   |
| 4512.906 | 116.3888  | 4515.508 | 116.5002           | Fe         | A0-A8                    | 1550   |
|          |           | 4518     | 116.62             |            |                          | M      |
| 4522.974 | 116.8188  | 4523     | 116.83             |            |                          | M      |
| 4527.490 | 117.0099  | 4534.139 | 117.2908           | Ti         | A0-A8, F0-F8,            | 1572   |
|          |           | 4535     | 117.35             |            |                          | M 1574 |
| 4544.864 | *117.7402 | 4549.808 | 117.9454           | Ti-Co      | B6-B9.5, A0-A8, F0-F8    | 1588   |
| 4552.632 | 118.0580  | 4552.857 | 118.0717           |            | 09.5-B5                  | 1592   |

|          |           |          |          |                |                         |
|----------|-----------|----------|----------|----------------|-------------------------|
| 4555.662 | *118.1840 |          |          |                |                         |
|          |           | 4558.827 | 118.3180 | Cr             | A0-A8                   |
|          |           |          |          |                | 1600                    |
| 4617.452 | 120.6694  | 4572.156 | 118.8634 | T1             | 1616                    |
| 4623.279 | 120.8956  |          | 0.5      |                |                         |
| 4667.768 | 122.5931  |          |          |                |                         |
| 4682.088 | 123.1245  |          |          |                |                         |
| 4742.979 | 125.3178  |          |          |                |                         |
| 4841.074 | *128.6321 |          |          |                |                         |
| 4856.203 | 129.1190  |          |          |                |                         |
|          |           | 4861.527 | 129.2900 | H <sub>B</sub> | 09.5-B5, B6-B9.5, A0-A8 |
|          |           |          |          |                | 1928                    |
| 4885.265 | *130.0420 |          |          |                |                         |

\* These lines were used in the majority of cases.

TABLE OF STARS HAVING INTERSTELLAR H &amp; K

| Star                                    | 1900 $\alpha$                  | Sp. V.     | Star                  | 1900 $\alpha$                   | Sp. V.     | ** Definite           | I.S. Lines                      |
|-----------------------------------------|--------------------------------|------------|-----------------------|---------------------------------|------------|-----------------------|---------------------------------|
| $\delta$ Peg                            | 0 <sup>h</sup> 8 <sup>m</sup>  | B2 0       | $\beta$ Sco           | 15 <sup>h</sup> 60 <sup>m</sup> | B2 -12.1   | 20 Tau                | 3 <sup>h</sup> 40 <sup>m</sup>  |
| $\pi$ And                               | 0 <sup>h</sup> 32 <sup>m</sup> | B4 -1.8    | 38 Oph (U Oph)        | 17 <sup>h</sup> 11 <sup>m</sup> | B5n -17.8  | $\lambda$ Tau         | 3 <sup>h</sup> 55 <sup>m</sup>  |
| $\circ$ Cas                             | 0 <sup>h</sup> 39 <sup>m</sup> | B4ne -6.5  | 66 Oph                | 17 <sup>h</sup> 53 <sup>m</sup> | B5ne -16.6 | $\pi$ 4 Ori           | 4 <sup>h</sup> 46 <sup>m</sup>  |
| 68 Cas                                  | 0 <sup>h</sup> 39 <sup>m</sup> | B5n -3.0   | A Aq1 (4 Aq1)         | 18 <sup>h</sup> 40 <sup>m</sup> | B7n -19    | 9 Cam ( $\alpha$ Cam) | 4 <sup>h</sup> 44 <sup>m</sup>  |
| $\nu$ And                               | 0 <sup>h</sup> 44 <sup>m</sup> | B5 -3.0    | $\beta$ Lyr           | 18 <sup>h</sup> 46 <sup>m</sup> | Bep -18.0  | $\beta$ Ori           | 5 <sup>h</sup> 10 <sup>m</sup>  |
| $\phi$ Per                              | 1 <sup>h</sup> 37 <sup>m</sup> | B0ne -6.6  | $\delta$ Lyr          | 18 <sup>h</sup> 50 <sup>m</sup> | B3 -17     | $\eta$ Ori            | 5 <sup>h</sup> 19 <sup>m</sup>  |
| $\xi$ Ari                               | 2 <sup>h</sup> 19 <sup>m</sup> | B8 +4.3    | $\iota$ Lyr           | 19 <sup>h</sup> 4 <sup>m</sup>  | B6n -14    | $\delta$ Ori          | 5 <sup>h</sup> 20 <sup>m</sup>  |
| 35 Ari                                  | 2 <sup>h</sup> 28 <sup>m</sup> | B3 +4.6    | $\eta$ Lyr            | 19 <sup>h</sup> 11 <sup>m</sup> | B5 -12.6   | $\alpha$ Ori          | 5 <sup>h</sup> 29 <sup>m</sup>  |
| $\circ$ Per                             | 2 <sup>h</sup> 38 <sup>m</sup> | B2 +10.2   | 1 Vul                 | 19 <sup>h</sup> 12 <sup>m</sup> | B5n -16    | $\theta$ Ori          | 5 <sup>h</sup> 30 <sup>m</sup>  |
| 1717 Tau                                | 3 <sup>h</sup> 40 <sup>m</sup> | B5ne +18.2 | 2 Sgr                 | 19 <sup>h</sup> 16 <sup>m</sup> | Aev -8     | $\iota$ Ori           | 5 <sup>h</sup> 30 <sup>m</sup>  |
| 19 Tau                                  | 3 <sup>h</sup> 39 <sup>m</sup> | B7n +14.0  | 2 Cyg                 | 19 <sup>h</sup> 20 <sup>m</sup> | B5 -15     | $\epsilon$ Ori        | 5 <sup>h</sup> 31 <sup>m</sup>  |
| 20 Tau                                  | 3 <sup>h</sup> 40 <sup>m</sup> | B9 +15.0   | $\sigma$ Aq1          | 19 <sup>h</sup> 35 <sup>m</sup> | B3 -14.0   | 125 Tau               | 5 <sup>h</sup> 34 <sup>m</sup>  |
| 21 Tau                                  | 3 <sup>h</sup> 40 <sup>m</sup> | B9n +16.0  | Groom 2950 (V380 Cyg) | 19 <sup>h</sup> 47 <sup>m</sup> | B2 -16.2   | $\zeta$ Ori           | 5 <sup>h</sup> 36 <sup>m</sup>  |
| 23 Tau                                  | 3 <sup>h</sup> 40 <sup>m</sup> | B5ne +16.9 | Groom 2984            | 19 <sup>h</sup> 54 <sup>m</sup> | B5n -14    | $\xi$ Ori             | 6 <sup>h</sup> 6 <sup>m</sup>   |
| 27 Tau                                  | 3 <sup>h</sup> 43 <sup>m</sup> | B9n +14.5  | 25 Cyg                | 19 <sup>h</sup> 56 <sup>m</sup> | B3e -18    | 5 Mon                 | 6 <sup>h</sup> 36 <sup>m</sup>  |
| $\epsilon$ Per                          | 3 <sup>h</sup> 51 <sup>m</sup> | B1n +9.1   | 28 Cyg                | 20 <sup>h</sup> 6 <sup>m</sup>  | B3ne -20   | $\eta$ Lyr            | 19 <sup>h</sup> 11 <sup>m</sup> |
| $\xi$ Per                               | 3 <sup>h</sup> 52 <sup>m</sup> | 07n +11.7  | +25 <sup>o</sup> 4165 | 20 <sup>h</sup> 11 <sup>m</sup> | B3n -14    | 57 Cyg                | 20 <sup>h</sup> 50 <sup>m</sup> |
| $\lambda$ Tau                           | 3 <sup>h</sup> 55 <sup>m</sup> | B3 +20.8   | $\omega$ Cyg          | 20 <sup>h</sup> 27 <sup>m</sup> | B3n -14    | A Cyg                 | 21 <sup>h</sup> 15 <sup>m</sup> |
| $\pi$ 4 Ori                             | 4 <sup>h</sup> 46 <sup>m</sup> | B2 +23.2   | 28 Vul                | 20 <sup>h</sup> 34 <sup>m</sup> | B7n -14    | 2 Lac                 | 22 <sup>h</sup> 17 <sup>m</sup> |
| 9 Cam<br>( $\alpha$ Cam)<br>$\beta$ Ori | 4 <sup>h</sup> 41 <sup>m</sup> | 09e -6.0   | $\alpha$ Cyg          | 20 <sup>h</sup> 38 <sup>m</sup> | cA2e -10.0 | 12 Lac                | 22 <sup>h</sup> 38 <sup>m</sup> |
|                                         | 5 <sup>h</sup> 10 <sup>m</sup> | cB8e -15.7 | 57 Cyg                | 20 <sup>h</sup> 50 <sup>m</sup> | B3 -17     | 16 Lac                | 22 <sup>h</sup> 52 <sup>m</sup> |

|                       |                                  |      |       |                |                                 |     |       |       |                                |
|-----------------------|----------------------------------|------|-------|----------------|---------------------------------|-----|-------|-------|--------------------------------|
| n Ori                 | 5 <sup>h</sup> 19 <sup>m</sup>   | B0   | +10.8 | A Cyg (68 Cyg) | 21 <sup>h</sup> 15 <sup>m</sup> | 08n | -13.3 | 1 Cas | 23 <sup>h</sup> 2 <sup>m</sup> |
| δ Ori                 | 5 <sup>h</sup> 20 <sup>m</sup>   | B2   | +21.6 | 9 Cep          | 21 <sup>h</sup> 35 <sup>m</sup> | cB2 | -22.2 |       |                                |
| ψ Ori                 | 5 <sup>h</sup> 24.2 <sup>m</sup> | B2   | +14.1 | 16 Peg         | 21 <sup>h</sup> 48 <sup>m</sup> | B3e | - 9   |       |                                |
| δ Ori                 | 5 <sup>h</sup> 27 <sup>m</sup>   | B0   | +13.9 | 30 Peg         | 22 <sup>h</sup> 15 <sup>m</sup> | B6  | - 6   |       |                                |
| VV Ori                | 5 <sup>h</sup> 29 <sup>m</sup>   | B2n  | +19.2 | 31 Peg         | 22 <sup>h</sup> 17 <sup>m</sup> | B3e | - 8   |       |                                |
| (-1 <sup>0</sup> 843) | 5 <sup>h</sup> 29 <sup>m</sup>   | B0   | +16.5 | 32 Peg         | 22 <sup>h</sup> 17 <sup>m</sup> | B8n | - 8   |       |                                |
| θ Ori                 | 5 <sup>h</sup> 30 <sup>m</sup>   | 07   | +20   | 2 Lac          | 22 <sup>h</sup> 17 <sup>m</sup> | B5  | -15   |       |                                |
| ι Ori                 | 5 <sup>h</sup> 30 <sup>m</sup>   | 08   | +27.4 | 4 Lac          | 22 <sup>h</sup> 20 <sup>m</sup> | cB8 | -18   |       |                                |
| ε Ori                 | 5 <sup>h</sup> 31 <sup>m</sup>   | B0e  | +18.8 | 6 Lac          | 22 <sup>h</sup> 26 <sup>m</sup> | B3  | -10.6 |       |                                |
| 125 Tau               | 5 <sup>h</sup> 34 <sup>m</sup>   | B3   | +16.6 | 10 Lac         | 22 <sup>h</sup> 35 <sup>m</sup> | 09  | -14.0 |       |                                |
| ζ Ori                 | 5 <sup>h</sup> 36 <sup>m</sup>   | B0ne | +19.6 | 12 Lac         | 22 <sup>h</sup> 38 <sup>m</sup> | B1  | -16.0 |       |                                |
| ξ Ori                 | 6 <sup>h</sup> 6 <sup>m</sup>    | B3n  | +13.0 | 16 Lac         | 22 <sup>h</sup> 52 <sup>m</sup> | B3  | -13.2 |       |                                |
| 5 Mon                 | 6 <sup>h</sup> 36 <sup>m</sup>   | 07   | +15.2 | o And          | 22 <sup>h</sup> 57 <sup>m</sup> | B7n | -11.2 |       |                                |
| η CMa                 | 7 <sup>h</sup> 20 <sup>m</sup>   | cB7  | +22.9 | 1 Cas          | 23 <sup>h</sup> 2 <sup>m</sup>  | cB1 | -11   |       |                                |
| -15 <sup>0</sup> 1810 | 7 <sup>h</sup> 20 <sup>m</sup>   | B3e  | +18.3 | δ Cas          | 23 <sup>h</sup> 54 <sup>m</sup> | B3n | - 9   |       |                                |

# REDUCTION TABLE

Example of reduction for the star  $\alpha$  And

| Ti comp. | R comp.  | $R_2 - R_1$ | $R_2 - R_1$ |
|----------|----------|-------------|-------------|
| 3925     | 82.0026  |             |             |
| 3930     | 82.4286  | 2.6355      |             |
| 3958     | 84.6381  |             | 2.5586      |
| 3963     | 84.9872  |             |             |
| 3964     | 85.0932  | 3.0143      | 2.0134      |
| 3990     | 87.0006  |             |             |
| 3999     | 87.6524  |             |             |
| 4079     | 93.2048  |             |             |
|          |          | 5.4031      |             |
| 4164     | 98.6079  |             |             |
| 4172     | 99.1028  | 5.7099      |             |
|          |          |             | 5.2150      |
| 4263     | 104.3178 |             |             |
|          |          | 3.9272      |             |
| 4338     | 108.2400 |             |             |
|          |          |             | 3.0368      |
| 4400     | 111.2818 | 5.7106      |             |
| 4458     | 113.9556 |             | 4.6124      |
|          |          |             | 1.9386      |
| 4501     | 115.8942 |             |             |

| * Line              | R star   | $(R_2 - R_1)_N$ | $(R - R_1)_N$  | $k = \frac{R - R_1}{R_2 - R_1}$ | $\frac{dV}{dR}$ | (X 1000)     |
|---------------------|----------|-----------------|----------------|---------------------------------|-----------------|--------------|
| 3934 Cu II (k)      | 82.7284  | 2.6355          | 0.7258         | 0.2754                          | 0.969           |              |
|                     | 82.7284  | 2.5586          | 0.2998         | 0.1172                          | 0.969           |              |
| 3944                | 83.5190  | 2.6355 (2.559)  | 1.5164 (1.090) | 0.5754 (0.426)                  | 0.978           |              |
| 3984                | 86.5722  | 3.0143          | 1.9341         | 0.6416                          | 1.016           |              |
|                     | 86.5722  | 2.0134          | 1.5850         | 0.7872                          | 1.016           |              |
|                     | 88.421   | 2.0134          | 1.769          | 0.8615                          | 1.039           | (B) HC       |
|                     | 89.628   | 2.126           | 1.976          | 0.9294                          | 1.056           | B HC         |
| 4102 H <sub>δ</sub> | 94.7378  | 5.4031          | 1.5330         | 0.2837                          | 1.129           |              |
| 4128 SiI            | 96.4096  | 5.4031          | 3.2048         | 0.5931                          | 1.155           |              |
| 4131 SiI            | 96.5876  | 5.4031          | 3.3828         | 0.6261                          | 1.157           |              |
| 4137                | 96.9641  | 5.4031          | 3.7593         | 0.6958                          | 1.163           |              |
|                     | 97.389   | 5.403           | 4.184          | 0.7743                          | 1.170           | B            |
| 4206                | 101.1137 | 5.7099          | 2.5058         | 0.4389                          | 1.233           |              |
|                     | 101.1137 | 5.2150          | 2.0109         | 0.3856                          | 1.233           |              |
| 4267 Cl             | 104.5364 | 3.9272          | 0.2186         | 0.0557                          | 1.294           |              |
| 4341 H <sub>δ</sub> | 108.3744 | 5.7106          | 0.1294         | 0.0227                          | 1.370           |              |
|                     | 108.3744 | 3.0368          | 0.1294         | 0.0426                          | 1.370           |              |
|                     | 114.587  | 1.939           | 0.631          | 0.3254                          | 1.506           | (He blend B) |
| 4481 Mg II (b1)     | 115.0177 | 1.9386          | 1.0621         | 0.5479                          | 1.516           |              |
|                     | 115.0177 | 4.6124          | 3.7359         | 0.8100                          | 1.516           |              |

Replace v column with  $\Delta(R-R_1) = ([R-R_1]_M - [R-R_1]_N)$

Replace p.v. column with  $\Delta (R_2 - R_1) \quad k = ([R - R_1]_M - [R_2 - R_1]_N) k$

$$V = \{ \Delta (R - R_1) - \Delta (R_2 - R_1) \quad k \} \quad \frac{dV}{dR}$$