

Reihe nach die Plattennummer, das Datum, die der Mitte der Belichtung entsprechende Mitteleuropäische Zeit, den Beobachter am Fernrohr (E = *Eberhard*, L = *Ludendorff*), die auf die Sonne reduzierte Radialgeschwindigkeit v und die Anzahl n der gemessenen Linien. Die letzte Kolumne enthält etwaige Bemerkungen.

ζ Ursae majoris, schwächere Komponente.

Platte Nr.	Datum	M. E. Z.	Beob.	v km	n	Bemerkungen
1808	1905 April 20	10 ^h 5	E, L	— 13.0	7	
1828	Mai 16	10.0	E, L	— 12.0	5	etwas unterbelichtet
1921	1906 April 10	10.6	E, L	— 14.0	5	etwas unterbelichtet
1947	Mai 4	10.1	L	— 9.6	6	
1949	» 5	10.0	E	— 7.3	11	
1951	» 6	9.8	L	— 13.0	12	
1953	» 7	10.3	E	— 14.0	6	unterbelichtet
1959	» 14	9.7	L	— 7.9	6	
2108	1907 April 20	9.2	L	— 10.0	11	
2110	» 25	9.9	L	— 16.4	8	
2111	» 26	9.2	L	— 11.7	10	
2112	» 28	9.2	E	— 15.1	10	etwas unterbelichtet
2119	Mai 12	9.7	E, L	— 17.7	10	
2120	» 14	9.3	L	— 13.4	17	

Die Übereinstimmung der einzelnen Werte von v ist recht mangelhaft, und man könnte versucht sein, daraus auf eine Veränderlichkeit der Radialbewegung zu schließen. Die Messungen sind aber, wie schon oben hervorgehoben wurde, ziemlich unsicher, und es ist wohl möglich, daß infolge dieses Umstandes und der den Aufnahmen mit dem Spektrographen IV überhaupt anhaftenden Unsicherheiten Fehler bis zu 5 km in den Werten der Radialgeschwindigkeit entstehen, die genügen würden, um die Abweichungen der Einzelwerte von v von ihrem Mittelwert zu erklären. Dieser Mittelwert aus den 14 beobachteten Werten der Radialgeschwindigkeit ist

$$v = -12.5 \text{ km.}$$

Als mittlerer Fehler dieses Mittelwertes ergibt sich der Betrag ± 0.81 km, der m. F. des Einzelwertes von v ist dagegen ± 3.0 km.

Für die Radialgeschwindigkeit des Schwerpunkts des spektroskopischen Doppelsternsystems, welches die hellere Komponente von Mizar bildet, hat Vogel den Wert -14.2 km gefunden, dessen m. Fehler ± 0.61 km beträgt. Dieser Wert stimmt also nahe mit dem der Radialgeschwindigkeit der schwächeren Komponente überein, und die Differenz von -1.7 km kann infolge ihres beträchtlichen mittleren Fehlers (± 1.01 km) nicht verbürgt werden.

Es war von vornherein zu erwarten, daß die Radialgeschwindigkeiten der beiden Komponenten nahezu gleich sein würden, da ihre relative Bewegung sehr gering ist. Nach Lewis¹⁾ ändert sich nämlich der Positionswinkel nur um $0^{\circ}025$ im Jahr, während die Änderungen der ungefähr $14''.4$ betragenden Distanz überhaupt unmerklich sind.

Nicht ohne Interesse ist der Umstand, daß das Spektrum der schwächeren Komponente von Mizar nahezu identisch ist mit dem der helleren zu der Zeit, wenn die Absorptionslinien dieses spektroskopischen Doppelsterns einfach erscheinen. Nur sind die Linien im Spektrum der schwächeren Komponente eine Spur kräftiger als die im Spektrum der helleren. Die drei Komponenten von ζ Ursae majoris stehen also nahezu auf derselben Entwicklungsstufe.

Von dem Spektrum von Alkor, der bekanntlich dieselbe Eigenbewegung wie Mizar hat und daher jedenfalls in physischem Konnex mit ihm steht, haben wir nur eine Aufnahme erhalten (1905 April 30). In dem ganzen hier in Betracht kommenden Spektralbezirk ist aber nur eine Absorptionslinie, nämlich $H\gamma$, sichtbar, und diese ist so breit und verwaschen, daß eine Ausmessung der Platte nicht angängig war. Wir haben daher keine weiteren Aufnahmen von dem Spektrum dieses Sterns hergestellt.

Potsdam, Astrophysikalisches Observatorium, 1907 November.

H. Ludendorff.

¹⁾ Memoirs of the Royal Astronomical Society, 56, p. 359.

A new form of meridian mark.

By G. W. Hough.

About three years ago, I made some experiments to ascertain whether a practicable meridian mark could be established which would not require a collimator object glass for bringing the mark in focus.

In 1861 at the Dudley Observatory, Albany, New York, Mr. Edmund Blunt of the United States Coast-Survey established for me a mark at a distance of six miles. The mark consisted of a small square with a diagonal in the plane

of the meridian, and it was used in connection with the 8-inch Pistor and Martins meridian circle. When the definition was good, especially after a rain, observations could be made with great precision. This mark was in use for a number of years, until covered by intervening shrubbery.

Observations on such a mark of course, could only be made during daylight.

A meridian mark to be of the greatest value should be located at such a distance from the telescope, that any probable change in its position, should not appreciably change the direction of the meridian.

The collimator marks of 100 and 300 feet focus, I infer from the meager data already published, are liable to more or less displacement, owing to the short distance and the effect of temperature on the collimator object-glass and the mark.

In 1903, I published in *Astr. Nachr.* No. 3902 a paper "Determination of the cause of variation of level and azimuth in fixed meridian instruments". In this paper, the variation in the level of the Repsold Meridian circle was investigated during a period of two years. The data regarding azimuth were defective so that a definite investigation of this element could not be made.

As systematic meridian observations are not carried on at our observatory, an investigation regarding variation in azimuth would necessitate frequent azimuth determinations from astronomical observations. Hence, an invariable terrestrial mark would require a minimum outlay of labor for such an investigation.

In photographic work, when it is desired to bring objects lying in different planes to a common focus, the aperture of the lens is reduced. It occurred to me that this method might be used to bring objects in focus without changing the focal length of the telescope. Accordingly, I made some experiments and found when the aperture of the object-glass of the Repsold meridian circle of 6 feet focus was reduced to one inch, all objects at 1000 feet and beyond were brought in good focus. This aperture corresponds to $f/72$.

A concrete pier 2 feet square and rising $2\frac{1}{2}$ feet above the surface of the ground was erected at a distance of 1140 feet north. On the top of the pier was bolted a cast-iron box, 15 inches wide, 10 inches high and 10 inches deep. Inside the box is an adjustable brass plate with a hole 0.15 inch in diameter, behind which is placed a 50 volt, 16 candle lamp. The lamp is supplied with electricity over a No. 8 iron wire, grounded at either end. A storage battery, which had been installed at the observatory for rotating the dome and illuminating the instruments, supplies the electricity. Either 55 or 70 volts may be used, usually the latter. During daylight, when the sun is not shining directly on the mark, it appears like a 6th magnitude star; at night, brighter. Of course, the size of the stellar image may be increased or diminished in various ways: viz., by changing the size of the hole in the brass plate; changing the voltage, or the size of the aperture over the object glass. As now arranged, the mark may be observed at any time, with the exception of two or three hours in the middle of the day under strong sun-light.

After the mark had been in use a year or more, the stone pier was surrounded by a wooden box to prevent any possible interference with the apparatus.

In order that an object at a finite distance may suffer no change of direction, the hole in the cap which covers the object-glass must be in the optical axis. Any deviation will cause a displacement proportional to the focal length of the telescope divided by the distance of the object.

At 1000 feet, one inch subtends an angle of $17''1$. A play of one-hundredth of an inch in the fit of the cap over the object-glass would amount to $0''.08$. An ordinary fit of the cap would give rise to an inappreciable error. In the course of my experiments, I used a cap over the object-glass having two holes at 4 inches distance between the centers. In this case, there were two images of the mark, and by measuring the distance between them, the distance of the pier was determined.

In order to know whether the hole in the cap is in the optical axis, the cap may be revolved 180 degrees or the mark may be observed with the full aperture of the object-glass. In the latter case, there is seen a well defined disk of light about $90''$ in diameter.

A terrestrial mark of this form can not ordinarily be observed with the same degree of precision as a star near the zenith, owing to lateral refraction, due to the unequal temperature of the ground and air, as well as the unequal temperature of the observing room and the outside air. At times, the present mark is absolutely steady, but more generally its steadiness is comparable with that of a star observed near the horizon. In general, however, five bisections of the stellar image will determine the azimuth with a probable error not greater than that incident to the observation of a circumpolar star. The full aperture of the object-glass is sometimes used and the micrometer wire placed tangent to the east and west sides of the diffraction disk, but I think no greater accuracy is attained than by the direct bisection of the stellar image.

The form of mark described above has a number of distinct advantages over the collimator marks now in use.

1st. It eliminates the collimator object-glass and any change of direction due to its displacement.

2nd. The azimuth pier may be placed at such a distance from the telescope that any probable displacement of the pier from temperature will be inappreciable in changing the direction of the meridian.

From my experience with the Albany mark, distant 6 miles and the present mark, distant 1140 feet, I infer that for marks placed outside the observing room, there will be little difference in the steadiness, whether the distance is 100 feet or 1000 feet; in other words, steadiness is not a direct function of the distance.

3rd. Any number of independent piers may be used.

I think it advisable to use two piers placed far enough apart to be independent of each other. Then the measure of distance between two such marks would indicate any possible displacement, independently of astronomical observations.