PUBLICATIONS OF THE WASHBURN OBSERVATORY OF THE UNIVERSITY OF WISCONSIN. VOL. XIII, PART I; MEREDIAN OBSERVATIONS FOR STELLAR PARALLAX. SECOND SERIES, 1898-1905

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Meredian Observations for Stellar Parallax. Second Series, 1898-1905 by Albert S. Flint

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ALBERT S. FLINT

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VOL. XIII, PART I

MERIDIAN OBSERVATIONS FOR STELLAR PARALLAX

Second Series, 1898-1905

BY ALBERT S. FLINT
ASTRONOMER

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The Washburn Observatory

FOUNDED BY

Cadwallader C. Washburn

Born 1818; Died 1882.

CONTENTS.

LIST OF TABLES

1. INTRODUCTION.

The observations whose constants and results for stellar parallax are presented in the present volume were conducted by the method of meridian transits, and are similar to those which were published in Vol. XI of the Publications of the Washburn Observatory except for a few changes in the conditions, the most important of which was the introduction of the registering transit micrometer. They were undertaken primarily to determine the annual parallax of stars of the second magnitude; but other stars were added to the list where the time intervals allowed.

The data of the individual observations are omitted here as a measure of economy. But they are given for the first star of the list, as an example, and for α Ursae Minoris because of its high declination and because its reduction differs somewhat from that of the remaining stars of the list.

The complete list of stars and the series of parallax results, together with a comparison of the latter *inter se* were published in the *Astronomical Journal*, Nos. 631 and 636. An extensive comparison of the present results for stellar parallax with the several larger series of similar results that have appeared from different observatories of the world was published in the same journal, No. 696.

The making of all the observations, the reading of most of the chronograph sheets, and the recording of the readings from the remainder, the inspection of all data in the observing books, the entering of these data on the reduction sheets, and all the solutions after the normal equations were formed, were done by myself.

Twelve assistants were employed in the course of the computations, undergraduate and graduate students of the university or clerical assistants in the observatory. Special mention for continued and intelligent service should be made of Messrs. A. G. Worthing, Joel Stebbins, Willibald Weniger, Samuel R. Hatch, and of Miss Winifred Hatch, and my daughter, Miss Helen Flint.

2. SELECTION OF STARS FOR OBSERVATION.

The list of stars observed extends from —35° in declination to the pole and was made, with regard to these limits, as follows:

1. All stars from 1.5 to 2.5 in magnitude, except β Cassiopeiae, $0^h\ 3^m$, which was in the previous list, Vol. XI, and was omitted from the present list in favor of α Andromedae. These stars are thirty-nine in number, while the number of stars in the entire heavens between these limits of magnitude is sixty-two.

2. Over twenty stars between magnitudes 2.5 and 3, from the list of standard stars of the British Nautical Almanac for 1900, which list includes all stars of magnitude 3.5 or brighter.
3. Certain stars of larger proper motion not previously observed.
4. Double stars of considerable proper motion, from a manuscript list sent by Professor S. W. BURNHAM.
5. Certain stars from Professor T. J. J. SEE's list of binaries, for which list orbits had been computed by him.
6. A few miscellaneous stars from the list of Vol. XI which were inadequately observed in that series or which attracted special interest.

The comparison stars were selected from the Bonner Durchmusterung and the Argentine General Catalogue. Each parallax star, in general, was observed with two comparison stars. The selection of the latter was made chiefly with reference to securing stars as near the standard magnitude 7.0 as possible, at least between the limits 6.5 and 8, with due regard to symmetry of position. The list of comparison stars was compared with the Cincinnati Catalogue of Proper Motion Stars, 1900.0, and with catalogues of double stars in order to avoid stars unsuitable in the respects thus indicated.

The entire list of stars observed is given in Table VII, where the parallax stars alone have serial numbers printed in the first column. These numbers are the same as those given in the first publication of results, *Astronomical Journal*, No. 631, and are printed here in heavier type. References in the present text to parallax stars and to comparison stars, are made by means of the serial numbers of the entire list. These numbers are printed in the second column of Tables VII, VIII, and X.

3. METHOD OF OBSERVATION.

The instrument employed was the REPSOLD meridian circle of 12.2 cm. aperture with ocular giving a power of 180 diameters and fitted with the REPSOLD registering transit micrometer. This was the first regular series of observations at this observatory in which this form of micrometer was employed; but a description of it is given in Vol. XII, page 242. The adopted value of one revolution of the screw was $6^s.2923 \pm 0^s.00045$, determined from 19 transits of stars of different declinations from 0° to 78°, observed in March, 1901 and February, 1903. An incidental determination of possible corrections to this value, will be found in the explanations of the observations on α Ursae Minoris. One revolution of the turning heads makes three revolutions of the screw or $18^s.9$ at the equator. There are three movable threads of which two form a pair distant apart by about 11″, while the third is distant about 30″ from the middle of the pair. Five fixed vertical threads serve to define the portions of the field.

The pointing on the star images was made by maintaining the bisection of the space between the close pair of threads. Although this method is presumably more liable to systematic error in series of observations for star positions, it seemed advisable to adopt it in the present work, inasmuch as a large portion of the observations would be made in the twilight and because a fainter star, of 8.0 magnitude or fainter, is completely hidden behind a single thread. Preliminary observations indicated that the probable error of a single chronograph signal, on brighter stars, was the same for either method of maintaining bisection. Certain of the stars observed are pairs of greater or less width. The closer pairs of stars were observed in the middle of the space between the threads; but if the components fell each near one of the pairs of threads, the pointing was made by maintaining the space between one star image and its nearer thread equal to the space between the other star image and the other thread. The former cases are distinguished in the list by the abbreviation *med.*, the latter by the word "pair."

Two methods of reducing the apparent magnitudes of the brighter stars were available. The old brass wire screens which are described in Vol. XI, page 2, and which are entirely separate from the instrument, were still in service; and the new slat screen, designed by Professor COMSTOCK, and first described in the *Astronomical Journal*, No. 470, had been fitted to the object end of the telescope, Oct. 9, 1898.

The purpose of the latter device was to provide something which should be attached to the telescope and so be made equally applicable at all zenith distances and which should allow the observer to make a gradual diminution of apparent magnitude. A rectangular frame of aluminum clamped to the objective end of the telescope holds a series of five parallel slats before the object glass, each 25 mm. wide, and so placed that when they lie in one plane they completely cover the objective. Each slat rotates about its longitudinal axis, and all are made to open at exactly the same angle by means of a connecting rod at each side of the frame joined to the series of axes. Since there is no occasion to turn the slats through an angle of more than 90°, there is always a good leverage for turning the slats and no possibility of a dead point. The middle slat has a pulley attached to its axis, over which a wire cord passes to a second pulley secured to the telescope tube near the eye end. Each branch of the cord contains a coil spring to equalize the tension. The weight of the entire slat apparatus is 27 oz. (0.76 kg.). When the slats are wide open there is no appreciable deterioration of the star images, and with very bright stars the interference pattern appears as a row of minute sharp stellar points 4".5 apart, extending to either side of the stellar image in a line at right angles to the direction of the slats. The diminution of light also is insensible. The thickness of each slat is one millimeter or less and the computed reduction in stellar magnitude is less than 0.005. As the slats are turned the interference images at first become brighter and the line extends rapidly in a series of spectral images, while the central group remain in appearance as stellar points. As employed in the present work the slats were set perpendicular to the meridian so that the line of interference images was in line with the meridian. The attention of the observer while maintaining bisection in right ascension was kept upon the middle group of three or five images. A comparison