ANNALS OF THE ROYAL OBSERVATORY, EDINBURGH. VOL. II. NEW REDUCTION OF HENDERSON'S CATALOGUE FOR THE EPOCH, 1840-0

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NEW REDUCTION OF HENDERSON'S CATALOGUE FOR THE EPOCH, 1840·0.

BY

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UNDER THE DIRECTION OF

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[The reduction of the observations was complete and the printing of the Catalogue in hand when I was appointed to succeed Dr. Copeland, and there is nothing for me to add to the following preface prepared a few weeks before his death, which shows the interest he took in the re-reduction, and his appreciation of the value of the observations made by Henderson and Wallace.

F. W. Dyson.

24th July 1906.]

PREFACE.

The present volume of the Annals of the Royal Observatory, Edinburgh, contains a catalogue of stars for the epoch 1840, based on a new and independent reduction of the meridian observations made at the old site of the Observatory on the Calton Hill by Thomas Henderson, the first Astronomer Royal for Scotland, and his assistant, Mr. Alexander Wallace, in the years 1834 to 1845.

It has long been recognised as a most pressing need of modern astronomy to reduce anew the meridian observations made between 1750 and 1850 with the best values of astronomical constants now available and more refined methods of reduction than those formerly adopted. Accordingly, most of the more important star catalogues published during that period have been re-issued in a greatly improved form. In order to form some idea as to whether the observations of Henderson were likely to yield better star places than had already been deduced from them, I took steps in 1891 to have these places compared with the Fundamental Catalogue of the Astronomische Gesellschaft. This comparison, carried out by Mr. Heath, chief assistant, showed the necessity of a complete new reduction of the observations, and this was therefore proceeded with. In August 1893, I had the advantage of a verbal consultation with Professor Auwers in Berlin, whose great experience in matters of this kind made the advice he gave on a number of important points particularly valuable. The observations of Right Ascensions were first taken in hand by Mr. Heath, and from 1896 by Dr. Halm, who joined the staff of the Observatory in September 1895. An important improvement was effected by following a suggestion already made by Henderson, who discovered that the inclination of the axis of the transit instrument was dependent on temperature, which was subsequently found by Prof. Piazzi Smyth also to be the case with the changes in azimuth. But in the course of the new reduction it was found that an additional discordance in the level and azimuth errors had been introduced by the heating effect of the illuminating apparatus giving rise to a systematic difference between night and day observations.

In the reduction of the declinations one of the main features consists in rendering the observations made in the period 1835–1840, when no nadirs were observed, uniform with those made in the subsequent period.

Dr. Halm, who had charge of the final preparation of the Catalogue and the investigation of systematic errors, has given in the Introduction full particulars of the method of reduction, and the results of comparison of the new Edinburgh star places with those of other authorities.

RALPH COPELAND.

ROYAL OBSERVATORY,
EDINBURGH, *2nd October* 1905.

INTRODUCTION.

The Edinburgh Catalogue of Stars for the equinox 1840·0 is based on meridian observations made during the years 1835 to 1845 by Thomas Henderson and his assistant, Alexander Wallace, at the Royal Observatory on the Calton Hill, Edinburgh. The observations were taken with a transit instrument by Repsold & Son, of Hamburg, and a mural circle by Troughton & Simms, of London; Mr. Wallace having charge of the transit instrument, while Professor Henderson simultaneously determined the meridian altitudes of the stars with the mural circle. A few transits were occasionally observed by Henderson himself, but the personal equation between him and his assistant having been repeatedly ascertained, Henderson's observations could be readily adapted to Wallace's mode of observing transits. On the other hand, none of the mural circle observations during this interval were made by Mr. Wallace. A description of the instruments is found in the Introduction to Volume I. of the "Astronomical Observations made at the Royal Observatory, Edinburgh," from which the following abstract is taken.

"The transit instrument is 8·3 feet in focal length; the object-glass, made by Fraunhofer and Utzschneider, of Munich, is 6·4 inches in diameter. The axis is 3·8 feet in length; the pivots are of steel, turning in Y's of brass, which have the usual adjustments for horizontal and vertical motion. Counterpoises placed on the longer arms of levers, the fulcra of which are on the piers, act on the ends of the axis by means of friction wheels, and allow only a small part of the weight of the instrument to press on the Y's. Each pier is a single block of sandstone from Craigleith Quarry, and is founded on the rock of which the Calton Hill is composed. The axis is 7·1 feet above the floor.

The process of reversing the instrument is conveniently and safely performed by means of an apparatus which allows the counterpoises to act before the pivots touch the Y's, so that no additional pressure is exerted upon them, and the instrument is replaced without the least collision.

Five vertical wires and one horizontal wire of spider-thread are placed in the eye-end of the telescope, in addition to which there are two other vertical wires which are fixed to the same frame and move together by means of a micrometer screw.

The telescope has four eyepieces, whose magnifying powers are 100, 136, 200, and 300; but 200 was the power commonly used. For faint objects, the power 136 was applied. The whole aperture of the object-glass was employed, except in observations of the sun, when it was contracted to 2·5 inches, and the instrument screened from the solar rays.

A spirit-level determines the inclination of the axis to the horizon. It is suspended from the pivots, and the divisions are marked on the glass tube. Each division is 0·07 inches, and by fixing the level to the mural circle it was ascertained that each division is equivalent to $1''\cdot14$ of arc. Each value of the inclination of the axis is the mean of two separate determinations, made when the telescope is in the horizontal position; the one when the object-glass is pointed to the north, the other when pointed to the south. The difference between the values of the inclination found in the two positions appears to be insensible. The same may be said with regard to the difference of inclinations before and after reversing the instrument.

The mural circle is similar to those at that time in use at the Greenwich Observatory. It is fixed to a pier composed of seven blocks of Craigleith sandstone, founded on the rock. The diameter of the circle, and focal length of the telescope, is 6 feet, and the aperture of the object-glass 3·7 inches. The conical axis of the circle, which passes through the pier, and moves in a collar, is 4·3 feet in length; and levers with counterpoises support a great part of the weight of the instrument. The centre of the circle is 7·4 feet above the floor. The limb is divided to every five minutes by lines cut upon a belt of gold; and the divisions are read by six microscopes, fixed to the pier at a distance of 60° from each other. The microscopes are distinguished by the numerals I., II., III., IV., V., and VI. Facing the circle, the diameter I.–II. lies in a horizontal direction, I. being north and II. south. Following in the direction north horizon, zenith, south horizon, nadir, the arrangement of these microscopes is I., VI., IV., II., V., III., so that Microscopes I. and II., III. and IV., V. and VI. are diametrically opposite each other. This is also the direction in which the circle readings increase, so that Microscope VI. shows 60° more than Microscope I., Microscope IV. 120° more, etc. During the years 1835 and 1836 all the microscopes have been read at each observation, whereas in all the later observations only I. and II. have been employed. A table of corrections for reducing the observations made with two microscopes to the mean of the six was prepared by Henderson and published in Volume III. and reprinted in all the later volumes.

The telescope of the mural circle has one fixed horizontal wire, one horizontal wire moved by a micrometer screw, five vertical wires, and three eyepieces, magnifying 74, 98, and 154 times. The highest power was generally used. In all cases the whole aperture of the object-glass was employed. In observing the sun, the whole instrument, except the object-glass, was screened from his rays.

Prior to December 3, 1835, the object observed was bisected by the horizontal wire. Since that time, the movable wire was kept at a distance of $7''$ nearly from the fixed wire, and the object was made to bisect the space between the two wires. This mode was found better adapted for faint objects, and stars observed by day, than the former.