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978-1-108-03977-2 - A Handbook of Double Stars: For the Use of Amateurs

Edward Crossley, Joseph Gledhill and James M. Wilson

Excerpt

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# DOUBLE STARS.

## PART I.

### CHAPTER I.

#### HISTORICAL INTRODUCTION.

THE history of double-star astronomy begins with the year 1779, a year for ever memorable as that in which the greatest of observers began the investigations which created a new department of observational astronomy.

The results of the occasional attention of astronomers to this class of observation prior to the time of Herschel were small indeed. Riccioli, about the middle of the seventeenth century, saw that  $\zeta$  Ursæ Majoris was double, and Kirsch also noted the same fact in 1700. Huyghens saw  $\theta$  Orionis as a quadruple star in 1656; in 1664 Hooke first saw  $\gamma$  Arietis as a double star and  $\alpha$  Centauri appears to have been the fourth double star which yielded to the power of the telescope, as Feuillée is said to have discovered it in 1709 at Lima. Bradley separated  $\gamma$  Virginis in 1718, and both Messier and Cassini watched the occultation of the components by the moon.\* Castor was found to be a double star in 1719,  $\delta$  Cygni in 1753,  $\beta$  Cygni in 1755; then followed  $\gamma$  Andromedæ,  $\epsilon$  Lyræ,  $\gamma$  Ophiuchi,  $\zeta$  Cancræ,  $\beta$  Scorpii,  $\xi$  Ursæ Majoris, etc. Pigott discovered three in 1779.† Nor must

\* See the *Histoire de l'Académie Royale des Sciences*, for the years 1678, 1720, 1774.

† Phil. Trans., vol. lxxi.

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the numerous wide pairs detected by Christian Mayer pass unnoticed. This industrious observer, working at Mannheim with an eight-foot mural quadrant by Bird and a power of about 60 to 80, observed and catalogued a considerable number of stars with Comites.\* A short extract from his book † will give a good idea of the character of the objects and his mode of observation:—

1777.	Stella cum comite.	Gradus lucis.	Differentia Ascensionis rectæ.	Differentia Declinationis.
Jan. 1	Comes Aldebaran	8·9	0° 2' 14"·2	0° 12' 29"
„ 6	Comes Electra	Teles.	0 0 8	0 0 32·5
„ 13	Comes Algol	8	0 2 49·5	0 9 9·5

At the end of the volume a table of the new pairs discovered by him (72 in number) is given; among them are the following:—

	Mag.	Differentia in R.A.	Differentia Declinationis.	Dist.
		sec.	"	"
γ Andromedæ.....	2, 6	0·95	5·8	15·2
Castor .....	1, 6	0·7	3·8	11·0
ζ Cancri .....	7, 8	0·0	7·7	7·7
γ Virginis.....	5, 5	0·5	6·3	9·9
α Herculis.....	3, 7	0·53	4·0	8·9
ε Lyræ.....	6, 8	0·2	3·0	4·2
β Cygni .....	3, 7	2·06	19·9	36·6

In 1777, Maskelyne, in a letter to Mayer, says that he saw *a* Herculis double in August 1777, magnitudes 3 and 6, the preceding star being the fainter, and that the distance of the centres was 7". Mayer also wrote two other papers on this subject.‡

To return. It was in 1779 that Sir William Herschel began to direct his wonderful energy to the observation of double

\* Mayer says that Flamsteed first used the word *comes* for the smaller star of a pair.

† See his work, *De novis in cælo sidereo Phænomenis*, etc., 1779.

‡ “*De centum stellarum fixarum comitibus, eorumque insigni usu ad determinandum motum proprium fixarum;*” and “*De miris fixarum comitumque mutationibus a me observatis a tempore cel. Flamsteedii.*”

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stars; and his famous paper is so interesting, and so fully exhibits the state of this department at the time he wrote, that a short account of it may here with propriety be given.

The great historical problem of finding stellar parallax had presented itself to him, and with his usual ardour he set himself the task of grappling with all its difficulties. After noticing Galileo's method, and the previous attempts to carry it out by Hooke, Flamsteed, Molineux, and Bradley, and pointing out the cause of their failure, he proceeds to describe his own method, viz., *to measure the position angle of two stars of unequal magnitudes at two opposite points of the earth's orbit*. He states the essential conditions to be, (1) that the stars be near each other; (2) that their magnitudes be very unequal. He then criticises the attempt made by Dr. Long, and points out the causes of his want of success, viz., unsuitable double stars, and want of adequate optical power. (Dr. Long had chosen  $\gamma$  Arietis, Castor,  $\gamma$  Virginis, etc., and his magnifying power did not exceed 70.) His own method is then shown to be independent of refraction, nutation, precession, change of obliquity of the ecliptic, and aberration. The highest possible power is to be used; and a figure showing  $\alpha$  Lyræ under powers from 460 to 6450 is given. Having fully satisfied himself that the method was sound and practicable, the next step was the selection of suitable pairs of stars. And here his own noble words may fitly be quoted:—

“I resolved to examine every star in the heavens with the utmost attention, and a very high power, that I might collect such materials for this research as would enable me to fix my observations on those that would best answer my end. The subject has already proved so extensive, and still promises so rich a harvest to those who are inclined to be diligent in the pursuit, that I cannot help inviting every lover of astronomy to join with me in observations that must inevitably lead to new discoveries.”—*Phil. Trans.*, vol. lxxii.

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It was in this spirit, and with this glowing enthusiasm, that Herschel began those sweeps and measures which have added so much to our knowledge of the sidereal universe.

A full description of his method of finding the position angle and distance apart of the components of a double star, statements respecting the accuracy of his estimations and micrometric measures, etc., are then given. Then comes the catalogue of his discoveries. The pairs given number 269, and they are arranged in six classes, according to distance: Class I., close pairs requiring "indeed a very superior telescope, the utmost clearness of air," etc. II., those suitable for "very delicate measures of the micrometer." III., from 5" to 15". IV., from 15" to 30". V., from 30" to 1'. VI., from 1' to 2'.\*

Of these 269 objects, 227 were new, 9 were known before Mayer's time, and 33 were known to Mayer and other observers. A single extract will show the form and character of the information given respecting these stars:—

"16.  $\eta$  Coronæ borealis, Fl. 2.

"Sept. 9.—Double. A little unequal. They are whitish stars. They seem in contact with 227, and though I can see them with this power, I should certainly not have discovered them with it; with 400, less than  $\frac{1}{4}$  diameter; with 932, fairly separated, and the interval a little larger than with 460. I saw them also with 2010, but they are so close that this power is too much for them, at least when the altitude of the stars is not very considerable; with 460 they are as fine a miniature of  $\epsilon$  Bootis as that is of  $\alpha$  Geminorum. Position  $59^{\circ} 19' N$  following."†

In 1803 appeared Herschel's celebrated paper announcing the discovery of *binary* stars, and this was followed in 1822 by a list of 145 new double stars.

\* Herschel's first measure of a double star is said to have been that of the trapezium in Orion.

† Phil. Trans., 1782.

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During the first twenty years of this century, notwithstanding the splendour of the discoveries above described, double stars were but little observed. No doubt the principal cause was the want of instruments of suitable power and construction. In 1816 Sir John Herschel began to review the double stars discovered by his father, and was soon joined by Sir James South. For a list of his papers containing measures, etc., see List A, Part IV. For this distinguished observer, double-star measurement ever possessed a charm; and from time to time, all through his long life, catalogues, measures, etc., were contributed by him to the Memoirs of the Royal Astronomical Society. Valuable results were also obtained during Sir John's stay at the Cape of Good Hope; and just before his lamented death he was busy at work on a general catalogue of double stars.

Two years before the reviews began at Slough, Friedrich Georg Wilhelm Struve, in the distant and ill-furnished observatory of Dorpat, was turning his attention in the same direction. Although an 8 feet transit by Dollond, and a 5 feet telescope by Troughton (power 126), were the only instruments at his command, he began to observe the positions, and occasionally to measure the position-angles and distances, of double stars. These results are to be found in the early volumes of the Dorpat observations. And in order to facilitate the study of this subject, he published in 1820 the places of double stars. In 1821 the fine Ertel Circle was received, and in 1824 the famous Fraunhofer refractor was added. Then began the great survey of the heavens between the pole and  $15^\circ$  of south declination, for the purpose of discovering new double stars, and the formation of a general catalogue of them. From 1824 to 1835 Struve and his assistants devoted themselves almost entirely to the execution of this noble scheme, and in 1837 appeared the results in the magnificent work entitled *Mensuræ Micrometricæ Stellarum duplicium et multiplicium*. Nor did double stars

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lose their attractiveness at the observatory of Dorpat after the conclusion of this vast undertaking. In 1839 the splendid observatory at Poulkova was established, and in 1861, on the resignation of his father, the directorship was placed in the hands of Otto Struve. From year to year careful and systematic measures have been made up to the present time, and the latest publication of the distinguished son of the great Struve is a noble series in two volumes of measures of the most important double stars.

Here, too, must be mentioned the labours of Admiral Smyth. With an 8 feet equatorial, this excellent observer measured 680 stars between 1830 and 1843, and the results were published in 1844, under the title *Cycle of Celestial Objects*. In 1860, the *Speculum Hartwellianum*, containing later measures, etc., was published.

Mädler, observing with the Dorpat refractor, measured a large number of double stars between the years 1834 and 1845, and published the results in 1847, in an elaborate work entitled *Untersuchungen über die Fixstern-systeme*. In this fine work are given extensive lists of double stars having probable direct motion, probable retrograde motion, and certain motion; chapters dealing with the orbits of the most important binaries; very complete lists of measures; a chapter on the combinations of double stars to form "higher systems," etc., etc.

Between 1830 and 1868 Dawes communicated many important lists of measures and papers on double stars to the Royal Astronomical Society. His great catalogue was, however, not published till 1867. This work is enriched by the addition of valuable introductions, notes, and lists of measures made by previous observers.

Valuable measures were made at Lord Wrottesley's observatory between the years 1843 and 1860.

Powell and Jacob, at Madras, made many useful measures, the former from 1853 to 1862, and the latter from 1853 to 1857.

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The Baron Dembowski began his fine series of measures in the year 1852 at Naples. He proposed to measure all the Dorpat “*lucidæ*” within the reach of his instrument. This important undertaking he successfully accomplished between the years 1852 and 1858; and a more valuable contribution to this department has rarely been made. In 1862 he resumed the examination of those Dorpat stars which exhibited changes in angle or distance; and the careful measurement of the great binaries has been continued up to the present time. The last review also included the measurement of a large number of the double stars discovered at Poulkova.

Secchi, in the years 1856 to 1859, paid considerable attention to double stars, and in 1860 appeared his *Catalogo di 1321\* stelle Doppie misurate col grande equatoriale di Merz all' osservatorio del Collegio Romano*. Some years later he also published *Serie seconda delle misure micrometriche, fatte all' equatoriale di Merz del Collegio Romano, dal 1863 al 1866 inclusive, stelle doppie e Nebulose dal P. A. Secchi*.

In 1861, the late Rev. R. Main, Radcliffe Observer, began to observe a selected list of double stars. These observations have been published from year to year in the volumes issued by the observatory up to the present time. They have all been made with the Heliometer.

At Mr. Barclay's observatory the measurement of double stars has always held a prominent place in the work of the observers Mr. Romberg and Mr. Talmage.

Dunér, at the Lund Observatory, issued a volume of double star measures in 1876. It contains his results from 1867 to 1875, and is a valuable addition to the works on double-star astronomy.

Mr. O. Stone and his assistants at the Cincinnati Observatory have for some time paid special attention to double stars, and several lists of measures have already been published.

\* The number is really 1221.

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Mr. Burnham, of Chicago, has published no less than nine catalogues of double stars, his own discoveries, since 1871 : all these objects have also had their positions and distances either measured or estimated by this most industrious observer.

Dr. William Doberck, at Markree Observatory, has taken up this branch of astronomy with great spirit and success. For some of the results of his labours see List A.

Professor Pritchard, of the new Oxford University Observatory, assisted by Messrs. Plummer and Jenkins, is making careful measures of the principal binaries, and is also engaged in a re-investigation of their orbits, by a method possessing some new features, and which seems to yield good results.

M. Camille Flammarion has devoted himself with great ardour to double-star investigations : his catalogue of important objects, with lists of measures, will shortly be published.

This subject has always attracted the attention of patrons and wealthy amateurs, and the names of Lord Wrottesley, George Bishop, Esq., J. G. Barclay, Esq., Colonel Cooper, Edward Crossley, Esq., Isaac Fletcher, Esq., M.P., and G. Knott, Esq., must here be mentioned as deserving of special praise for the spirited manner in which they have established and supported observatories for the prosecution of this class of observation.

Lastly, compilers of useful catalogues of binary stars and the writers of handbooks must not be forgotten : among the former, Mr. A. Brothers, F.R.A.S., and among the latter the Rev. W. A. Darby, M.A., and, above all, the Rev. T. W. Webb, M.A., deserve especial mention.

Measures by the following observers and others have also been published : Auwers, Bessel, Bond, Brünnow, Challis, Dunlop, Ellery, Encke, Engelmann, Ferrari, Fletcher, Galle, Gledhill, Hall, Hind, Holden, Jacob, Kaiser, Knott, Lassell, Maclear, Miller, Mitchell, Morton, Newcomb, Nobile, Powell, Schiaparelli, Seabroke, Spörer, Waldo, Wilson.



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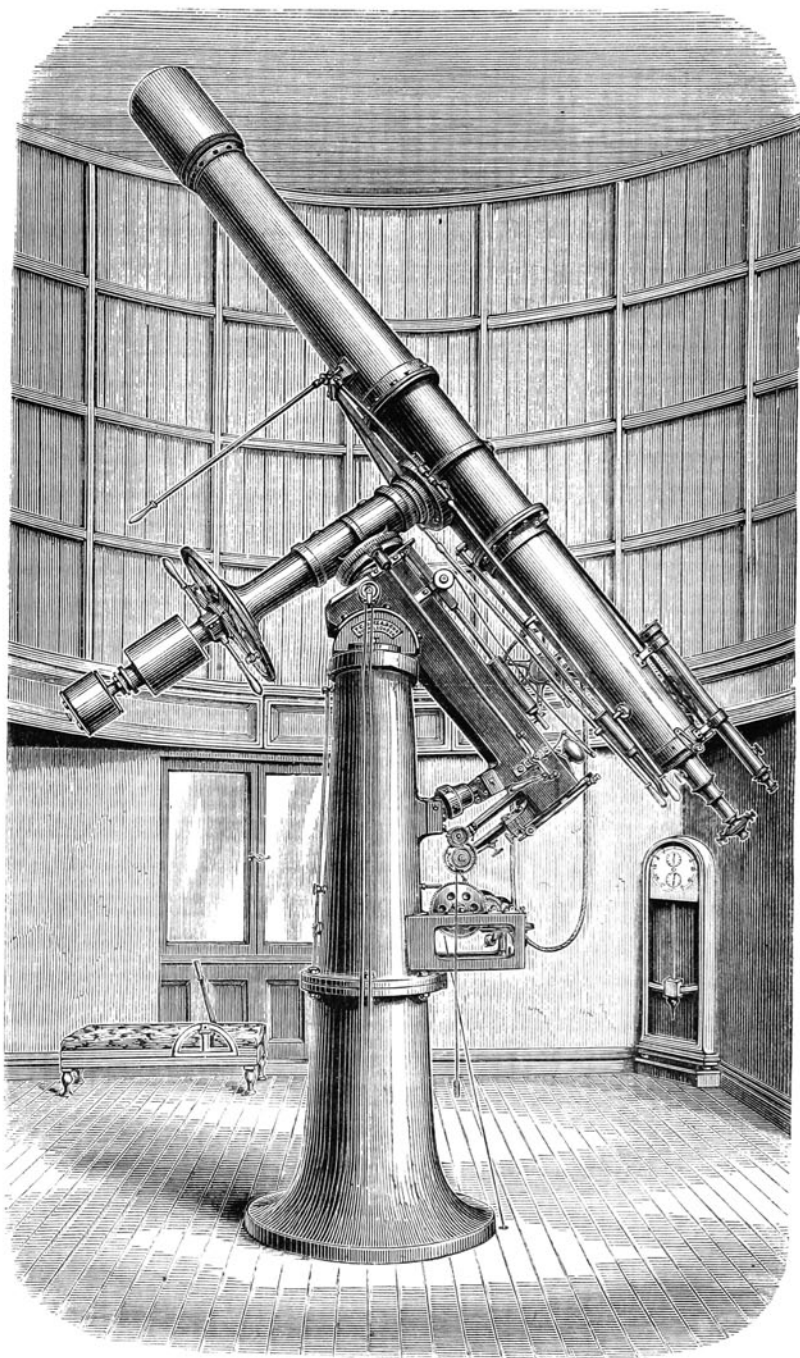
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