

Physical Science.

Notice of Prof. STRUVE'S Micrometric Measures of double and multiple stars, with the great Dorpat Refractor, in the years from 1824 to 1835. By SEARS C. WALKER.

On the occasion of the recent visit of Mr. Holcomb to Philadelphia to place in the Exhibition of the Franklin Institute, one of his seven feet Herschelian reflectors, I was informed by that meritorious artist that γ Virginis, from having been perfectly single with the highest powers in his fourteen feet reflectors from 1833 to 1836, has since undergone such a change as to be readily divided with a ten feet reflector. Mr. Holcomb also remarked that η Coronæ is now closer and more difficult to be divided than β Andromedæ. He has, on two occasions, separated η Coronæ; not, however, so completely as to make the discs tangent to each other. This was effected with a fourteen feet reflector under highly favourable atmospheric circumstances. β Andromedæ he has, with a ten feet reflector, recognised to be a double star. Both η Coronæ and β Andromedæ, were in 1850 pronounced, by Sir John F. W. Herschel, to be exceedingly close and difficult to divide (the former of them more so) even with his twenty feet reflector. That Mr. Holcomb, in the interior of New England, almost without assistance, should have carried the art of polishing specula to such a degree of perfection as to detect a variation in the distance of two pairs of stars so close as η Coronæ and γ Virginis, is somewhat surprising, and certainly without a parallel in this country. To test the correctness of Mr. Holcomb's remarks, I examined the British publications on this subject. The opening of γ Virginis is quite in conformity with Sir John F. W. Herschel's predictions previous to his departure for the Cape of Good Hope. Their nearest approach appears, by his elements of their orbit, to have taken place in 1835.5; their distance at that time should have been 0."79, and their present distance 1."6 which would confirm Mr. Holcomb's observations. As I could not find any recent English measurements of η Coronæ, recourse was had to Prof. Struve's measurements published in Schumacher's *Astronomische Nachrichten*. These show that the two stars of η Coronæ which were 1."0 distant in 1836, were only 0."7 in 1835.4, and were still approaching each other. Their distance at this time is 0."5, and again the observation of Mr. Holcomb is confirmed. As there are several reflectors of 7, 10, and 14 feet focal length by Holcomb and Son now in the possession of individuals and colleges, I have thought that it would be useful to give in an English dress some of the most remarkable facts concerning double revolving stars, contained in Struve's announcement of the work of which the title translated from Latin to English is placed at the head of this notice. Previous to this it is proposed to give a short notice of the best telescopes now in use.

The great reflector mounted at the Dorpat observatory in 1825, is a lasting monument of the genius of Joseph Fraunhofer. Its focal length is 13.3 feet, and its clear aperture 9.6 English inches, being one-third larger than that of any achromatic reflector that had hitherto been made. The testimony of its proprietor, as well as of every astronomer who has visited Dorpat, shows that this instrument surpasses all other equatorial refractors previously erected, as much in the mechanical skill displayed in its mounting,

as in its optical capacity. The early death of the great optician who constructed it cannot be too much lamented. The loss to science has fortunately not been irreparable. His surviving partner, J. Von Utschneider, whose wealth enabled Fraunhofer to prosecute his optical discoveries, still retains the art in its greatest perfection. Another instrument, the fellow of the Dorpat refractor, has, since the death of Fraunhofer, been completed by Utschneider for Prof. Encke, at the Berlin Observatory. With it that celebrated astronomer has recently proved the existence of a second division of the ring of Saturn, which had been stated before, but without sufficient confirmation, by Capt. Kater and others. An improvement in the mounting of Encke's Equatorial over even that of the Dorpat, has been introduced through the mechanical contrivance of Mr. Mahler. This enabled Encke, on the first re-appearance of the comet, which bears his name, in September last, to determine its place by simply bringing the comet to the centre of the field, and reading the graduation on the hour and declination circles. Two other refractors of 15 feet focal length, and 11.2 English inches aperture, have been made at the same establishment, the optical part of which is under the direction of Mr. George Merz.

With one of them lately mounted at the Bogenhausen Observatory in Munich, the Director, Mr. Lamont, has observed the sixth Satellite of Saturn and the third Satellite of Herschel, neither of which had been observed by any other astronomer living, the 20 feet reflector of Sir John Herschel having proved inadequate to the task. Another refractor of 23 feet focal length and 15.3 English inches aperture was ordered in 1834, by Struve, for the Central Observatory of Pulkova, near Petersburg, at an expense of 76,000 roubles, [\$16,000.] This instrument was partly finished when Pres. A. D. Bache visited Munich in the spring of 1838. A letter just received from George Merz, by Mr. Geo. M. Justice, states, in excuse for the delay in completing the instruments ordered for the Philadelphia Observatory, that this great refractor, and a smaller one of 9.7 feet length and 7 inches aperture mounted as a heliometer, have just been completed after four year's labour. The Pulkova refractor, though inferior perhaps in optical capacity to Sir William Herschel's 40 feet reflector, will far surpass it in precision of measurements.

Two refractors of 19 feet focal length, and 11.8 inches aperture, in the possession of Sir James South, and of the Cambridge Observatory, are the workmanship of M. Cauchoix of Paris. An imperfection in the mounting of the former by Troughton and Simms, and a protracted law suit consequent thereon, has deprived the world of the valuable labours of Sir James South. The Cambridge refractor is not yet mounted. There is however a refractor by Cauchoix second only in power to the great Pulkova refractor, in the possession of Mr. Cooper of Ireland. This equatorial mounted at that gentleman's observatory is twenty-five English feet in length, and 13.3 inches aperture. Though superior in dimensions to the Bogenhausen refractor, there are few published observations with Cauchoix's refractors that indicate a superiority in optical capacity. On the contrary the two observations of Lamont already alluded to are almost without a rival in the nineteenth century. I should have stated that they are wholly without example, but for the recent observations said to have been made by P. De Vico, at the Roman College, Rome, with a telescope which its maker, Cauchoix, states, *Astr. Nachr.* 305, to be of the same size as that of the Transit instrument made by him for the Paris Observatory. P. De Vico is said by Dumouchel, *Astr. Nachr.* 357, to have seen six rings of Saturn on several evenings, and in the course of

the summer of 1838, all of the seven satellites of Saturn. As the seventh or innermost satellite has not been seen this century by the most powerful telescopes in use, this discovery, if authentic, while it affords the most remarkable testimony in favour of Cauchoix's telescopes, shows also that the serenity of the sky of Italy is such as to set aside the distinctions of optical capacity of telescopes that prevail in more northern climates.

It is worthy of remark, that the star or rather the stellar system γ Coronæ, already mentioned, furnishes a singular test of the comparative excellence of telescopes. Mr. Holcomb speaks of the two stars of γ Coronæ the principal and its companion. It is evident that the telescopes he has yet made are not adequate to the exhibition of a second companion or satellite. Sir John F. W. Herschel has, with his twenty feet reflector, seen this second companion, with a power of 300. As no mention is made of it in Struve's notice of his *mensuræ micrometricæ*, where repeated measures of distance and position of the first are given, it is clear that the Dorpat refractor is too small to exhibit this second companion. It has however been observed by Lamont, and its distance and position carefully measured—another instance of the wonderful power and precision of measurement afforded by the Bogenhausen refractor, as Sir John F. W. Herschel had only determined these quantities by conjecture. Mr. Lamont has also determined the distance and position of the small companion of α Cancri of the twentieth magnitude. Sir John F. W. Herschel remarks that this small star is nearly equal in lustre to the largest of the satellites of Herschel, and that no telescope is adequate to show the latter which does not also exhibit the former.

To return to the subject of Struve's micrometric measurements—these contain the result of the arduous labours of that indefatigable astronomer since 1824. Some idea of their magnitude may be formed when we are told that they amount to 10,500 observations, counting for a single one the entire set of observations of a double star made in a single day even when often repeated. These have been portioned out among 2707 pairs of stars, of which none have been observed less than twice. In making them, Struve used a spider line micrometer visible in an illuminated field. For very faint stars he used an invention peculiar to Fraunhofer, by which the lines are made luminous in a dark field, without concealing the faintest objects from view. It does not appear that any British artists have succeeded in imitating this illuminated line micrometer. Hence many observations of comets, nebulae and faint double stars have been omitted, or their place supplied by conjecture, which this invention would have furnished. I am informed by Pres. A. D. Bache that an inconvenience occurs in the present mode of arranging these micrometers, viz: that the spider lines are only illuminated on one side, requiring a correction to be applied for the observed transit over the line.

Many of Struve's measurements of the brighter double stars were made in the day time. The powers used were from 320 to 1000. The value of a turn of the micrometer screw, was 15."315. The screw was sub-divided into 100 parts, thus reading to 0."153; or (since the tenth part of a division could be easily distinguished) to 0."0153. The position circle had two verniers each reading to a single minute.

In 1827 Prof. Struve published his *Catalogus novus*, or new Catalogue of double and multiple stars. In 1836 he announced his *Mensuræ Micrometricæ*, a work of which the title is placed at the head of this notice. It is published by the Imperial Russian Academy, and contains a complete re-

view of the double stars visible at Dorpat to the number of 2622, whose distance asunder is less than $16''$. The angles of position reckoned from the north in the declination circle eastward round the circle, are given for different dates, and their distances, magnitudes, right ascensions and declinations are also stated. These singular pairs and multiples of stars thus given for a particular epoch in position, bearing, apparent distance and magnitude, with an accuracy hitherto unattained by any other astronomer, will remain for ages the subject of observation, and comparison.

It has not been the object of Prof. Struve to compute the orbits of double stars; but to furnish a general review of the heavens so that others may be guided in their selection of the proper objects of research.

The number of stars known to revolve round each other was stated by Sir John F. W. Herschel 1831 to amount to about 40, of which the elliptical elements of nine pairs, computed chiefly by himself, are given in his astronomy. His observations at the Cape have added to the number, and there can be no doubt that the *Mensuræ Micrometricæ* of Struve will serve to increase it. The attention of astronomers is particularly called to twenty-eight of the most remarkable pairs, and triplets of these stars in his paper, published in the *Astronomical Notices* No. 304; of these it is proposed to furnish a list, with occasional references to the more recent results obtained by Dr. Mädler, of the Berlin Observatory.

423 Atlas Pleiadum R. A.; 3h. 38.9m., Dec. + $23^{\circ} 30'$.

These difficult double stars were measured once in 1827. They were seen elongated in 1830. Since then there has been no trace of the companion.

*1356 α Leonis H. 1.26. R. A., 9h. 19.0m., Dec. + $9^{\circ} 50'$ mag. 6.2 and 7.0.

Epoch.	Distance.	Direction.	Days of Observation.
1782.87		$110^{\circ} .90$	
1804.09		$130 .88$	
1825.21	$0''.970$	$153 .94$	5
1832.25	$0 .515$	$163 .40$	2
1833.29	$0 .447$	$172 .80$	3
1835.33	$0 .3$	$177 .40$	3

From these it appears that the motion is direct. Probably these stars passed their aphelion between 1804 and 1825. In 1804, they were four times as distant as in 1782, and twice as distant as in 1795. In 1836 and 1837 the two stars should have ceased to appear double in any telescope. Shortly afterwards the companion was expected to emerge on the other side.

* On examining this very close pair of stars, with the 7 feet Herschelian by Holcomb on the 8th of January, 1839, an evening remarkable for its serenity, I was induced to believe that the companion has already emerged, as was anticipated.

1670 γ Virginis, H. 3.18, R. A., 12h. 32.8m. Dec. — $0^{\circ} 29'$, both of 3d mag.

1825.32	2".373	277°.92	6	Struve.
1828.38	2 .070	271 .50	1	"
1829.39	1 .782	268 .28	5	"
1831.36	1 .492	260 .92	5	"
1832.52	1 .262	253 .50	4	"
1833.37	1 .056	245 .53	7	"
1834.38	0 .912	231 .66	5	"
1834.84		214 .60	1	"
1835.38	0 .514	195 .48	9	"
1836.41	0 .257	151 .57		"
1837.20		100 .42		Encke.
1837.41	0 .595	78 .12		Struve.
1837.48	0 .626	76 .40		Encke, Galle, Mädler.
1838.41	0 .867	52 .03		Struve.
1838.42	0 .768	50 .65		Otto, Struve.
1838.43	0 .830	49 .20		Galle, Mädler.

These two stars are variable in brightness, sometimes one, sometimes the other, appearing the brighter. The direction of these stars was noted by Bradley in 1718, and by Mayer in 1756. During this century they have revolved through more than half their orbit, and have diminished their distance from $6''.5$ to $0''.3$, and are again receding. Herschell II's period of revolution, 660 years, appears no longer tenable. Mädler, in the *Astr. Nachr.* 363, finds the period to be nearly 160 years.

1728 42 Comæ Berenices R. A., 13h. 1.6m., Dec. + $18^{\circ} 28'$, both 6th mag. One is however smaller than the other and is somewhat yellow.

1829.40	$0''.640$	$11^{\circ}.6$
1833.37	single	
1834.45	elongated	228 .3
1835.39	0 .3	191 .2

From which it appears that one has retrograded upon the other, through $90^{\circ}.4$ of its apparent orbit, in 5.99 years. Between 1829 and 1835 a central occultation of the two stars has taken place. They were readily divisible in 1827, 28, 29, with a power of 600. In 1833 they remained single and perfectly round with a power of 1000.

1937 η Coronæ H. 1.16, R. A. 15h. 16.1m., Dec. + $30^{\circ} 36'$.

1826.77	1".075	$35^{\circ}.28$	4 days.
1829.55	0 .960	43 .25	2
1831.63	0 .883	50 .63	3
1832.76	0 .790	56 .87	3
1835.42	0 .732	74 .75	7
1836.52	0 .563	88 .77	

Period of their orbit 43 years, in 1835, still approaching each other. In 1835, distance $0''.507$, according to Mädler's *Ephemeris Astr. Nachr.* 354.

1967 γ Coronæ, R. A. 15h. 35.5m. Dec. + 26° 52'.

These two stars of the 4th and 7th magnitude, present an example of a complete central occultation.

1826.75	0".725	111°.05	2 days.
1828.98	0.540	110.7	3
1832.21	0.4	102.7	3
1833.34	0.4	105.8	2
1835.44			

Three trials on different days with a power of 1000, under favourable circumstances, showed them single without the slightest variation from the circular form.

2055 λ Ophiuchi H. 1.83. R. A. 16h. 22.1m., Dec. + 2° 22'. 4.0 and 6.1. mag.

The measures of the elder Herschel and of Struve give

1783.18		75.°4	
1802.39		69. 32	
1825.51	0."837	331. 80	3 days.
1828.51	0. 813	342. 10	3 "
1831.90	1. 043	349. 47	3 "
1834.42	0. 987	350. 60	2 "
1835.55	0. 996	352. 48	5 "

As the first observations do not conform with each other, if we change the direction of the first by adding 180° it will appear probable that these two stars revolve round each other in a period of less than 40 years.

2084 ζ Herculis — H. I. 36. R. A. 16h 34.8', Dec. + 31° 55', 3.0 and 6.5 mag.

This wonderful pair of stars has, in a period of not more than 6 years, exhibited the phenomenon of the disappearance of the companion and its re-appearance on the other side of the principal star.

The measures of the elder Herschel and of Struve are,

1782.55	D	69.°3	
1795.	smaller than D	between 0° and 90°	
1802.	the star is single.		
1826.63	0."910	23.°40	5 days.
1828.	} The star is single under the most favourable circumstances, with the greatest magnifying powers.		
1829.			
1831.			
1832.75	0."81	220.°5	1 day. Struve.
1834.45	0. 910	203. 5	2 " "
1835.55	1. 094	197. 1	5 " "
1836.58		188. 02	Madler.
1836.60	1. 090	186. 30	Struve.
1838.70	1. 350	168. 50	Galle.

The only hypothesis that will reconcile all these observations is that of an orbit of about 14 years duration. Whether this is correct or not must be decided by future observations. Such was the opinion of Struve in 1836. Dr. Mädler, in *Astr. Nachr.* 363, finds a period of 36.3375 years as the result of the more recent observations.

2262. τ Ophiuchi = H. I. 88. R. A. 17h 53.4m. Dec.—8° 10'

This pair which, in 1783, Herschel pronounces to be the closest of all the double stars, exhibited, ten years ago, the opposite phenomenon of that which γ Coronæ, and α Leonis have presented. In 1825 Struve could see no trace of the companion. In 1827 the star appeared elongated. In 1835 on six different days they appeared as two small stars of 5th and 5.5 magnitude in contact with each other. Their centres were 0."35 asunder, the mean angle 256.°7:

3062 = H. I. 39. R. A. 23h 57.1m, Dec. + 57° 28'. Mag. 6.9 and 8.0.

The elder Herschel's and Struve's observations give;

1782.65		320.°7	
1823.81	1."25	36. 7	
1831.71	0. 820	87. 5	2 days.
1833.71	0. 557	108. 57	3 "
1835.66	0. 420	132. 62	5 "
1836.61	0. 466	146. 38	

The motion of the companion is direct and amounts to 65° in the last 3.95 years. The period cannot yet be determined. Future observations will be necessary to show whether the companion, between 1783 and 1823, revolved through 76° or 436° of its orbit. This was Struve's opinion in 1835. Dr. Mädler, *Astr. Nachr.* 344, finds a period of 84.5140 years.

1196. ζ Cancræ = H. I. 24 et 111. 19. R. A. 8h 2.1m, Dec. + 18° 10'
A. 5.0, B. 5.7, C. 5.5 mag.

A. and B.					A. and C.				
1826.22	1."140	57.°63	3 days.		1826.22	5."300	154.°67	3 days.	
1828.80	1. 040	38. 45	2 "		1828.99	5. 313	151. 38	3 "	
1831.28	1. 048	29. 80	6 "		1831.28	5. 402	148. 57	6 "	
1832.28	1. 150	27. 52	4 "		1832.28	5. 520	148. 60	4 "	
1833.27	1. 147	22. 10	3 "		1833.27	5. 470	147. 60	3 "	
1835.31	1. 136	20. 12	5 "		1835.31	5. 318	145. 44	5 "	

1523. ξ Ursæ majoris. = H. 1.2 R. A. 11h 8.8m, Dec. 32° 30.

1826.20	1."748	238.°75	3 days.
1827.27	1. 715	228. 27	4 "
1829.35	1. 671	213. 59	7 "
1831.44	1. 706	203. 82	5 "
1832.41	1. 750	195. 94	5 "
1833.38	1. 695	188. 24	5 "
1834.44	1. 875	184. 10	2 "
1835.42	1. 764	180. 18	5 "

1938. P. XV 74 prope μ Bootis = H. 1.17. R. A. 15h 18.0m, Dec. + 37° 56'.

1826.77	1.''385	327.°00	2 days.
1829.73	1. 243	324. 05	2 "
1833.85	1. 190	319. 17	3 "
1835.55	1. 103	318. 63	3 "

The stars are still approaching each other.

1998. ξ Libræ = H. 1. 33. et II. 20. R. A. 15h 54.7m Dec. — 10° 53'.

The observations of the elder Herschel and Struve, give

A. and B.				$\frac{A. + B.}{2}$ and C.			
1782.36		187.°94		1782.36		88.°62	
1825.47	1.''147	355. 97	5 days	1825.48	6.''750	78. 60	4 days.
1832.00	1. 225	4. 15	2 "	1832.00	6. 670	76. 75	2 "
1833.91	1. 240	5. 85	2 "	1833.91	6. 965	75. 20	2 "
1835.00	1. 235	7. 30	2 "	1835.00	7. 020	75. 40	2 "

2032. σ Coronæ = H. 1.3. R. A. 16h 7.9m, Dec. + 34° 20'.

1827.02	1.''312	89.°35	4 days.
1830.11	1. 220	104. 90	3 "
1832.99	1. 297	118. 80	3 "
1835.50	1. 308	130. 46	5 "

1757. P. XIII. 127. R. A. 13h 25.4m, Dec. + 0° 35'. 7.8 and 8.9 mag.

1831.78	1.''544	20.°97	7 days.
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The angle in 1825 was 10°, and in 1835, 25.°6. Hence a change of the angle is rendered certain.

1424. τ Leonis = H. 1. 28. R. A. 10h 10.4m, Dec. + 20° 44'.

1828.14	2.''458	102.°03	6 days.
1831.34	2. 484	103. 26	5 "
1832.75	2. 504	103. 46	5 "
1835.16	2. 562	104. 94	5 "

1536. ι Leonis. R. A. 11h 14.8m, Dec. + 11° 29', 3.9 and 7.1st mag.

1832.01	2.''193	92.°38	12 days.
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The angle is regularly diminishing, so that for the epoch t it may be denoted by

$$92^{\circ}38 - 0.^{\circ}834 (t - 1832.01)$$

1909. 44 Bootis = H. 1.15. R. A. 14h 58.0m, Dec. + 48° 22', 5.2 and 6.1 mag.

The observations of this pair shew a remarkable increase in distance between 1826 and 1835, while the angle has undergone but little change. The comparison of the early observations with the more recent, leads to a very interesting result.

1781.62	less than 2.''	60.°1	
1802.25		62. 9	
1819.43	1.''5	228. 0	
1821.33		229. 1	
1826.79	2. 230	231. 0	1 day.
1829.20	2. 555	233. 65	2 "
1832.95	2. 963	234. 47	3 "
1835.51	3. 173	235. 23	6 "

These data indicate that the plane of the orbit of the companion passes nearly through the solar system. As the distance has been continually increasing since 1819, and as the elder Herschel saw the companion on the other side of the principal, it appears that a central occultation must have taken place between 1802 and 1819. Probably the companion was between 1781 and 1802 at its greatest elongation on the one side. It is now approaching its greatest elongation on the other side.

2909. ζ Aquarii = H. 11. 7. R. A. 22h 19.8m, Dec. — $0^{\circ} 55'$

1825.73	3."600	359.°80	2 days.
1832.81	3. 458	355. 29	3 "
1835.66	3. 356	353. 20	5 "

The well known increase of the angle of position of these stars, appears now to be accompanied with a variation of their distance.

2120. Herculis 210. R. A. 16h 57.6m, Dec. + $28^{\circ} 20'$, 6.4 and 9.2 mag.

The mean of 11 measures from 1829 to 1835 gives

1833.25 3."445 $3^{\circ} 08$

The distance and angle are rapidly diminishing.

1110. Castor = H. 11.1. α = 7h 23.5m Dec. + $32^{\circ} 15'$.

1826-22	4."404	262.°54	5 days.
1827.28	4. 417	262. 32	4 "
1828.89	4. 358	261. 10	5 "
1831.31	4. 464	259. 58	5 "
1832.86	4. 525	257. 72	4 "
1835.33	4. 734	255. 48	5 "
*1836.26	4. 647	255. 62	

It is remarkable that Struve's measures shew the distance to be increasing, while *Herschel II*, from his researches concerning the orbit of Castor, has arrived at the opposite conclusion, viz: that these two stars should still approach each other, till in 1856 they are to be only 0."68 apart. The observation of Dr. Mädler confirms the remark of Struve. The angular motion of the companion is so slow, and the change of distance so small, that perhaps half a century of nice observations will be required to determine the elements of its orbit.

1263. Anonyma. R. A. 8h 33.7m, Dec. + $42^{\circ} 19'$, 7.6 and 8.2 mag.

This pair of stars offer a remarkable change of distance and angle, as appears from the following mean yearly results.

1828.36	4."86	359.°0	1 day.
1829.36	5. 43	4. 12	2 "
1831.31	7. 08	4. 95	2 "
1832.33	7. 455	7. 27	2 "
1833.29	7. 973	8. 00	3 "
1834.36	8. 935	8. 40	3 "
1835.35	9. 595	9. 29	4 "

1888 ξ Bootis = H. 11. 18. R. A. 14h 43.3m, Dec. + $19^{\circ} 49'$.

1829.46	7."217	334.°17	4 days.
1832.40	7. 140	331. 10	2 "
1835.43	7. 070	328. 98	5 "

* Mädler's observation.

2272 70 *p* Ophiuchi = H. 11.4. R. A. 17h 56.6m, Dec. + 2° 33'.

Struve's measures give:

1819.64		168.°48	5 days.
1820.77		160. 25	2 "
1821.74		157. 65	5 "
1822.64		153. 87	3 "
1825.57	3.''984	148. 22	14 "
1827.02	4. 375	145. 15	2 "
1828.71	4. 782	140. 22	4 "
1829.59	5. 087	138. 08	6 "
1830.84	5. 310	135. 75	2 "
1831.68	5. 410	134. 70	5 "
1832.75	5. 553	133. 97	3 "
1834.47	5. 852	131. 15	4 "
1835.60	6. 108	130. 76	5 "

60. " Cassiopæia = H. 111. 3. R. A. 0h 38.5m, Dec. + 56° 53'.

1827.21	10.''25	85.°6	1 day.
1832.05	9. 780	87. 60	5 "
1835.26	9. 520	91. 23	3 "

These observations shew a diminution of the distance as well as an increase in the angle of position.

1516. Anonyma. R. A. 11h 3.7m, Dec. + 74° 25', 7.0 and 7.5 mag.

This pair of stars is worthy of special observation.—Struve's measures give:

1831.54	9.''930	298.°70	2 days.
1832.84	9. 560	299. 37	2 "
1833.46	9. 250	299. 75	2 "
1834.43	8. 945	300. 97	2 "
1835.56	8. 425	301. 67	4 "

These show a diminution of distance and an increase in the angle of position. Besides South's and Struve's measures, an observation in the *Histoire Celeste* of Lalande, of the difference of R. A. and Dec., confirms this remark. The old observations give:

1790.21	29.''26 + 6"	298.°58 + 15°
1823.92	14. 22	
1824.28	12. 479	296. 27

From these measures there follows the remarkable result, that these two stars, now distant only 8'', were forty-five years ago 30'' asunder.

2708. Anonyma. R. A. 20h 32.0m, Dec. + 38° 1', 7.0 and 8.7 mag.

Struve's observations give, from 1828 to 1835,

1832.63	11.''252	351.°72
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The distance and angle are both varying, they may be thus expressed :

$$11.''252 + 0.''206 (t - 1832.63) \\ 351.°72 - 0. 823 (t - 1832.63)$$

2758.61 Cygni = H. IV. 18. R. A. 20h 59.0m, Dec. + 37° 54'.

These stars shew an increase in distance and angle of position.

1821.62	15. "02	84.°38	
1828.72	15. 31	89. 4	1 day.
1831.70	15. 632	91. 16	4 "
1832.77	15. 790	92. 35	1 "
1835.65	15. 967	93. 83	6 "

Examination of Col. Reid's work on the Law of Storms; by JAMES P. ESPY.

My friend, President A. D. Bache, on his return from Europe, put into my hands a highly interesting work by Lt. Col. W. Reid, C. B., of the Royal Engineers, being "An attempt to develop the law of storms, by means of facts, arranged according to place and time, and hence to point out a cause for the variable winds, with a view to practical use in navigation."

This work is illustrated by charts showing the direction in which the various storms investigated moved along the surface of the sea, and showing the locality of the ships whose logs are given in the body of the work.

This work furnishes many additional proofs of that beautiful generalization first hinted at by Franklin, afterwards by Dr. Mitchell, of New York, and lately established in the most satisfactory manner, according to the true principle of inductive philosophy, by Wm. Redfield, of New York: namely, "*Great storms which originate in the windward Islands of the West Indies; progress from the place of commencement in a curve towards the N. W., till on reaching the lat. of 30° N., when they are moving nearly towards the N., their motion after this is towards the N. E. as far as traced.**"

From all the facts collected by Mr. Redfield, by the joint Committee of the American Philosophical Society and the Franklin Institute, and by Col. Reid, it would seem that these storms constantly become wider and wider, from their place of commencement, and perhaps elongated in their N. E. and S. W. diameter after they reach a lat. as high as 40° or 45°.

Col. Reid agrees with Col. Capper and Mr. Redfield, that these storms are in the form of great whirlwinds; and Sir John Herschel who is of the same opinion, "does not see how Mr. Espy's theory, though he considers it ingenious, is tenable against the indications of the barometer, for unquestionably if a large body of air, he says, were to set on every side inwards towards a central ascending column, the necessary effect would be an increase of weight of the entire barometric column."

Now this objection is so obvious, that any theory, which has no answer for it, or which does not contain an answer to it in itself, does not deserve the name of ingenious; and it arises from so imperfect or inaccurate a view of the doctrine which I teach, that I am sure as soon as Sir John shall see my papers on the subject, he will see and confess that the objection has already been fully answered. If I am right in this matter, Sir John owes it not merely to me, but to the cause of science, on a point which he acknowledges to be of immense importance, to come out and correct his mistake; for such is the weight of his name, that many will not think it worth while to examine a system which has been condemned by Sir John Herschel.

As to Col. Reid, his whole book is a proof that he is much fonder of truth than of theory. He will therefore do me justice. I was highly delighted

* Perhaps they sometimes turn E. or even S. E.