

that some ready means may be found for trying the diminution of light by tarnish. I think, if the image of a lucid disk were formed beside it at the centre of curvature, the two could be photometrically compared rapidly and without moving the speculum from the tube.

As to the ultimate possible size of a speculum of metal, an accident that occurred in casting a 6-feet, at which I was present, satisfied us that one of 7-feet could be made; nor is this the limit. But if the 4-feet "Foucault" just erected at Paris prove, as I hope it will, a great success, it is probably in that direction that the improvement of very large specula will tend. It will probably be difficult to form large glass disks with sufficient uniformity of strength in every direction, to resist distortion; but on the other hand, silver is so much more reflective than speculum metal,\* that its equiluminous aperture will be only  $\frac{2}{3}$  rds of the other.

I look to this telescope with great interest; for, from it in conjunction with the great Refractor which is now in construction for the Observatoire, can alone be expected a really accurate comparison of the Achromatic and Reflector. As I have elsewhere stated, such comparison can only be fairly made when the conditions are identical; when the locality, the night, the object, the observer are the same; and I may add, when there is no personal or party bias in the judge. An observer becomes in some cases so much attached to his instrument as almost to identify himself with its character; and it may even happen that national feeling is interested in favour of a particular artist. All will be favourable at the Observatoire, and I trust that M. Le Verrier and his accomplished assistants will profit by so auspicious an opportunity.

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*On the Transit across the Sun's Disk of the Second or Great Comet of 1819.* By J. R. Hind, Esq.

The second or great Comet of 1819 made its appearance in these latitudes under circumstances very similar to those attending the early visibility of the great Comet of 1861. It ascended above the north-west horizon as a conspicuous naked-eye object, and was very generally detected in Europe in the first days of July. The earliest observation for position appears to have been made by Professor Tralles at Berlin on the evening of the 1st of the month, and the latest observations were made by Struve at Dorpat and by Olbers at Bremen in the middle of October.

\* The mean of Jamin's co-efficients for silver at perpendicular incidence is 0.90, which gives for the Newtonian 0.81, greater than that of most Achromatics. It is, however, doubted whether a film reflects as much as solid silver. A Committee has been appointed by the British Association to examine this, and some other cases of reflection.

The comet passed its perihelion on the morning of June 28, and consequently was already receding from the Sun, when it first attracted attention in Europe.

Olbers calculated parabolic elements from observations between July 2 and 9, which he communicated to Bode in a letter dated July 27; and it was in this letter that he announced his discovery from his own orbit of the notable fact, that a transit of the comet across the Sun's disk must have taken place at the passage of the ascending node early on the morning of June 26, or two days before arrival at perihelion, and therefore while astronomers were ignorant of its presence. His first calculation gave for the time of ingress June 25,  $17^{\text{h}} 39^{\text{m}}$  Berlin mean time, and for that of egress  $21^{\text{h}} 18^{\text{m}}$ : at  $19^{\text{h}} 30^{\text{m}}$  the comet according to this computation would have been only  $1' 27''$  west of the Sun's centre. Olbers also remarked on the interest that would attach to any examination of the spots upon the Sun's disk, that might have happened to be made during the time of the transit.

General von Lindener of Glatz, in consequence of this notice from Olbers, reported to Bode that he had looked at the Sun at  $5^{\text{h}}$ ,  $6^{\text{h}}$ , and  $7^{\text{h}}$ , on the morning of June 26, and found it without any spots. He states that he had been in the habit of examining the Sun's disk since the year 1800, and that in 1819, although in his seventy-seventh year, he observed it two or three times daily with an achromatic by Ramsden of  $2\frac{1}{2}$ -feet, and powers 25 and 75.

This statement of the invisibility of spots on the morning in question was contradicted by the evidence of Professor Schumacher, who at 8 A.M. at Altona, had viewed the Sun's disk, as on several preceding mornings, though only with the telescope of a 7-inch Troughton sextant, but on no occasion had found it free from spots. Professor Brandes, of Breslau, had remarked one spot shortly before noon, "in its proper place near exit." Gruithuisen, at Munich, at 8 A.M. found two spots near the western limb and one in the middle of the disk, and he gave his reasons for supposing that the latter was either "a new opening" or the nucleus of the comet. Wildt, of Hanover, has also put upon record that *about June 26*, at 7 A.M., "at most one or two days earlier or later," he saw an ill-defined confused spot, which he considered to have been the comet.

But the most definite observations, and those which I propose more particularly to examine here, are that of Privy Councillor Pastorff, of Buchholtz, near Frankfort-on-the-Oder, whose Sun-spot drawings and manuscripts were some years since presented, by Sir John Herschel, into whose possession they had come, to the Library of the Royal Astronomical Society; and the observation of Canon Stark of Augsburg.

Pastorff communicated the details of his observations to the Baron de Zach in a letter dated 1824, November 25, which is published in the *Correspondance Astronomique* &c. t. xi. p. 550.

He writes:—"Permit me to communicate to you yet another very curious observation which I found by accident in filing my old papers: it is not an observation made à la D'Angos; it is quite certain and made with the greatest precision. On the 26th of June, 1819, on looking at the Sun, I saw very distinctly upon its disk a nebulous spot and three black ones. The nebulous spot was perfectly round and slightly luminous. I am persuaded it was the comet, which, according to the calculations of M. Olbers, ought to pass over the Sun's disk June 26, 1819, at 5<sup>h</sup> 47<sup>m</sup> A.M. The roundness, the nebulosity, the luminous point in the centre appeared to me so remarkable, that I made a sketch as correctly as possible. At 8<sup>h</sup> 26<sup>m</sup> A.M. this nebulous spot was 84''·5 in diameter, and its distance from the south-east limb of the Sun was 6' 10''. On the 27th of June, on looking at the Sun about 9 A.M., the nebulous spot, as well as one of the black spots, had disappeared. The other two black spots which on June 26 at 8<sup>h</sup> 26<sup>m</sup> A.M. were distant 36'' and 34'' respectively from the limb of the Sun, were already at a distance of 6' therefrom." Pastorff gives, for the position of Buchholtz: longitude 0<sup>h</sup> 49<sup>m</sup> 45<sup>s</sup>·5 E. of Paris; latitude 52° 26' 50''.

Canon Stark's observation at Augsburg is found in his *Meteorologisches Jahrbuch* which contains regular observations of solar spots. He states that at 7<sup>1</sup>/<sub>4</sub> A.M. on June 26, he saw a remarkable spot which "was neither like an opening nor shallow," and in which there was no black depth (*schwarze Vertiefung*); the spot was small and not well defined. It was 15' 25'' from the west limb and 14' 30'' from the north limb of the Sun; hence not far from the centre of his disk. Stark adds that, at noon, his second hour of observation, the spot was no longer visible.

Some years since I calculated the circumstances of the transit of the comet across the Sun's disk, making use of the Parabolic Orbits of Dirksen and Nicolai, with Carlini's Tables for the Sun. The comet's positions from the two sets of elements were not found very accordant, and though confirming in general Olber's computation,\* it appeared worth while to attempt a closer determination of the orbit, and this I have lately made. From observations between 1819, July 3 and October 12, by Gauss, Nicolai, Olbers, and Struve, I obtained the following parabola:—

T	1819, June 27·71547, Greenwich Mean Time.			
	°	'	"	
π	287	8	10·8	} Mean Equinox, 1819, July 0.
Ω	273	41	56·8	
i	80	44	38·1	
log q	9·5332327			

Motion direct.

\* Bode's figure in *Berliner Jahrbuch*, 1823, is not drawn correctly.

This orbit is by no means to be regarded as a definite one. Indeed, I found reason to infer that the comet's motion was not closely parabolic, and I will take this opportunity of suggesting that it deserves a thorough investigation. My only object was to secure elements which may be relied upon as giving the comet's geocentric place during the transit within a very few seconds of arc.

From Le Verrier's Solar Tables, I found for June 25 at 19<sup>h</sup> 15<sup>m</sup> mean time at Augsburg=18<sup>h</sup> 40<sup>m</sup> 44<sup>s</sup> Paris mean time :

Sun's Apparent Right Ascension	°	'	"
	94	5	46.9
" " Declination	+23	24	42.0
Hourly Motion in R.A.	+	2	35.7
" " in Decl.	-	0	4.0
Earth's log Radius-vector	0.0071930+0.0000008.t <sup>h</sup>		

And from the above elements

	h	m	s	Paris M.T.	h	m	s
	16	40	44		20	40	44
Comet's True Right Ascension	°	'	"		°	'	"
	94	3	9.0		94	13	49.6
" " Declination	+23	6	49.1		+23	41	11.6
The aberration in R.A. = -14".8; in Decl. = -47".7.							
The sidereal time at Greenwich mean noon, June 25 = 6 <sup>h</sup> 11 <sup>m</sup> 9 <sup>s</sup> .0.							

Calculating from these data, as we should for *Mercury* or *Venus*, the following times for ingress or egress of the comet, referred to the centre of the Earth, and expressions for reduction to the surface, are obtained :—

	Greenwich M.T.		
	h	m	s
Ingress	16	52	54 + [1.4605].p.sin l - [1.1369].p.cos l.cos.(λ - 125 45)
Egress	20	29	56 + [1.4595].p.sin l - [1.1412].p.cos l.cos.(λ - 147 21)

The ingress would take place at 172°.2 from the Sun's north point, counted as in double-star measures, and the egress at 8°.7, so that the comet crossed his disk, from south to north, very nearly in the direction of the circle of declination passing through his centre.

For the present purpose, however, the following figures are more available :—

Greenwich Mean Time.	Apparent Right Ascension. (Comet-Sun.)	Apparent Declination. (Comet-Sun.)
h m s	' "	' "
16 31 23	+2 18.7	-18 48.7
18 31 23	+2 27.6	-1 29.4
20 31 23	+2 36.5	+15 49.8

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Assuming for the semi-diameter of the Sun the Greenwich value at the Earth's mean distance, the apparent semi-diameter during the comet's transit would be  $15' 46''.0$ , hence at the time of Stark's observation the comet's calculated position is  $13' 18''$  from the Sun's eastern limb, and  $14' 17''$  from his southern limb; which position, compared with the observation, shows a difference of  $2' 49''$  in R.A., and  $2' 45''$  in Decl. For the time of Pastorff's observation, corresponding to  $19^h 26^m 54^s$  Greenwich mean time, we have from the above numbers—

	'	"
Comet East of Sun's Centre	2	32
Comet North     ,,     ,,	6	31

which differs widely from the position assigned by Pastorff— $6' 10''$  from the Sun's south-eastern limb.

The small effect of parallax is neglected in both cases. I have been favoured by Mr. Ranyard with a copy of Pastorff's drawing, the original of which, as already stated, is in the Society's archives. The object represented as having been observed upon the Sun's disk is certainly a very remarkable one, bearing every resemblance to the ordinary figure of a telescopic comet, and quite different from the forms of sun-spots. If, however, Pastorff really saw the comet upon the solar disk, his account of its position must be very erroneous.

Stark's position also is open to some doubt, though much nearer to that which the comet must have occupied at the time of his observation; it may perhaps be granted that he possibly saw the comet upon the Sun. Nevertheless, it is impossible not to remark the great difference between his description of its appearance and that given by Pastorff. It appears very improbable that a comet seen in projection upon the Sun's disk would present the cometary aspect which Pastorff describes; it is far more likely that the nucleus only would be discerned. If Pastorff's observation is a *bonâ-fide* one, what he really did see must remain an enigma. I will merely add in conclusion, that there are other observations of his which are exceedingly difficult of comprehension.

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*Note on the Displacement of Lines in the Spectra of Stars.*  
By W. H. M. Christie, Esq.

In recent Numbers of the *Comptes Rendus*, P. Secchi has called attention to some apparent discordances between the Greenwich results for the motions of stars in the line of sight, as given in the *Monthly Notices* for November 1875, and those obtained by Dr. Huggins, and has with justice pointed out that there are many difficulties attending all such observations. On these

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