On the Great Comet.

By *B. A. Gould.*

The Cordoba observations of the comet extend from the 5th to the 19th of February, during which period the weather was exceptionally favorable. The head was not visible in the mists of the horizon until Febr. 4, on which evening I saw it for a few moments in the twilight, but could not compare it with any star. On the 19th it could only be recognized as a scarcely perceptible whiteness in the field of the large equatoreal of 28½ centimeters aperture; and although I made a series of comparisons, the result is not entitled to much confidence. On the 20th it could not be detected notwithstanding the ephemeris was good and the comet must have been in the field. No nucleus was at any time to be seen.

In my letter of Febr. 17 I mentioned the remarkable characteristics of the tail, which was about 40° long, comparatively faint, and of nearly the same brightness throughout its whole length. Careful drawings of its position were independently made by two observers on every night while it remained visible. It faded gradually, beeing seen through some 35° of length, up to Febr. 14, only five days before the head was lost to sight in the equatorial.

The observations are as follows; those of Febr. 9 and 17 having been made by Mr. Thome, and the others by myself.

Date	Cordoba M. T.	No. Comp.	Star	Comparison − * Δα	Comparison − * Δδ	Comet's apparent α	Comet's apparent δ		
1880 Febr. 5	8h30m26s8	3	z	− 0m11s67	+ 7′ 36″6				
6	8 37 56.3	7	x	+ 2 15.07	− 1 29.0	22h58m32s9	−32°55′ 55″0	− 0s7	+42′ 2
7	8 51 27.1	6	a	+ 2 18.25	− 7 48.5				
8	8 28 9.7	11	b	− 0 36.81	− 1 25.2				
	29 32.3	8	y	− 0 8.45	−12 11 3				
9	8 47 37.8	17	d	− 1 6.09	+ 2 25.8	23 50 51.4	33 45 41.7	− 0.4	−20.8
	8 56 0.2	10	c	− 0 29.36	+ 5 48.2	50 57.2	45 43.3	− 0.5	−20.1
11	8 45 9.7	10	e	+ 1 30.75	− 1 53.0				
	9 4 14.9	18	f	+ 0 1.06	− 4 11.1				
12	8 23 40.8	10	g	− 0 50.17	− 0 48.7				
	23 40.8	10	h	− 2 0.15	+ 0 36.4	0 39 51.0	33 6 15.3	− 0.8	− 7.2
	9 0 26.5	5	i	− 1 55.10	− 6 10.2	40 14.9	5 12.8	− 1.0	−30.2
14	8 24 49.3	14	j	+ 0 29.56	− 4 1.0	1 9 21.8	32 2 48.0	− 0.4	− 3.4
	9 2 22.8	5	k	− 0 49.10	− 0 11.3	44.5	1 48.3	− 1.3	− 4.6
	9 2 22.8	5	l	− 1 26.00	+ 0 42.0	44.2	1 49.1	− 1.0	− 3.8
15	8 27 38.9	5	m	+ 3 28.90	− 5 42.3	1 22 58.1	31 23 19.1	− 1.2	− 6.3
	9 8 37.5	6	n	− 3 20.00	+ 8 33.9	23 20.5	22 4.5	− 1.1	−10.2
17	8 37 51.8	11	O.A1107	+ 3 36.74	− 1 46.1	1 47 43.9	29 54 32.5	+ 1.2	− 2.4
18	8 34 4.5	12	O.A1291	− 0 58.00	+ 0 48.9	1 58 55.2	29 7 12.8	− 0.2	− 6.5
19	9 0 26.8	10	O.A1416	+ 0 36.90	+10 14.7	2 9 34.4	−28 17 44.8	− 1.7	−19.1

Adopted Mean Places of Comparison-Stars. Mean Equinox of 1880.0.

Star	Mag.	α	δ
z	9	22h41m(40)s	−38°27′
x	9	23 0 47s7	−32 54 24″1
a	10	23 13 (49)	33 18
y	9½	23 33 (28)	33 28
b	9½	23 34 (4)	33 34
c	7½	23 51 26.2	33 51 27.7
d	9½	23 51 57.1	33 48 3.8
e		0 22 (52)	33 26
f		0h24m(33)s	−33°23′
g	9	0 40 (42)	33 8
h	8¾	0 41 50 7	33 6 48″1
i	8½	0 42 9.5	32 59 24.8
j	9	1 8 51.8	31 58 43.4
k	8½	1 10 33.0	32 1 33.2
l	8½	1 11 9.6	32 2 27.5
m	9½	1h19m28s6	−31 17 32.7
n	9	1 26 39.9	31 30 34.4
O.A1107	9	1 44 6.5	29 52 42.0
O.A1291	7½	1 59 52.5	29 7 54.7
O.A1416	8	2 8 56.7	28 27 56.3

From the positions observed Febr. 6, 12 and 18. I have deduced the following parabolic elements:

T = 1880 Jan. 27.4048 Wash. m. t.
Ω = 6°10′ 29″6 M. Eq. 1880.0
ω = 86 18 19.0
i = 144 39 38.8
$\log q$ = 7.739364.

The similarity of this orbit to that of the Great Comet of 1843 is palpable. The elaborate and exhaustive discussion of the observations of that comet, published by Hubbard in vols I and II of the Astron. Journal, resulted in an ellipse corresponding to a period of 532.66 years; but although the sum of the squares of the differences between the calculated and the observed positions was thus reduced to a minimum, Hubbard called especial attention to the large changes in the major axis, which might be made without doing violence to the observations. He also gave, with the final values for each of the elements and each residual, the coefficient of its variation for a given change in the eccentricity. Applying these to the case of a period of 175 years, upon the hypothesis of its identity with the comet of 1668, he found that this only implied an increase of the probable error of a single observation from $\pm$ 8″44 to $\pm$ 11″32.

If the same coefficients be used with the variation of the eccentricity corresponding to a period of 37 years, the probable error of a single observation is increased to $\pm$ 39″05; and furthermore the distribution of the residuals becomes unsatisfactory and the discordances clearly systematic. Yet this does not appear to me a fatal objection; for it is far from certain that the point observed was the comet's center of gravity; and if it was not, systematic discordances ought to be expected.

A very remarkable result is obtained by introducing, in Hubbard's expressions for the variation of the elements, that value of $\triangle e$ which represents a 37-year period. Assuming for the semi-axis major $a = 11.0867$, we have $\log \triangle e = 6.697639$, $\triangle e$ being of course negative. The employment of this value renders the elements in every instance less similar to those deduced for the present comet. But if we reverse the signs of Hubbard's coefficients for all the terms except q, and refer the node to the mean equinox of 1880.0, his elements become as follows:

T = 1843 Febr. 27.52452 Berlin m. t.
Ω = 6° 9′ 10″5
ω = 86 9 39.4
i = 145 4 32.7
$\log q$ = 7.810286
e = 0.999417248

or almost the same as those deduced from 12 days' observations of the present comet. I have not been able to undertake the solution of Hubbard's final equations, from which the coefficients are deduced. They are given in the Astr. Journal, II 57. A superficial examination has not disclosed any error in the signs.

The suggestions made, in 1843, by many astronomers, relative to the identity of the great comet of that year with those which appeared in 1668 and 1702, now acquire new force. As for the former, Petersen's ephemeris (Astr. Nachr. XX, 404), calculated with Argelander's elements of the Comet of 1843 upon the assumption of a perihelion-passage 1668 Febr. 29, shows that very small changes would be requisite to satisfy the places marked upon Gottignies's chart, within the limits of their probable errors. As for the latter, it would seem that at the time of its apparition Cassini held it to be identical with that of 1668, which he himself had observed; an opinion repeated in 1843 by Cooper, with his own indorsement. Schumacher considered that the orbit determined in 1843 was incompatible with Maraldi's description of the position of the tail on 1702 March 2, as also with the observation by Marten Brouwer, cited by Struyck. But, while the interval between the perihelia of 1668 and 1702 was a few days less than 34 years, the average time of revolution between 1702 and 1843 would be 35¼ years, and the period has now increased to 36 years 11 months. Influences which could so largely modify the major axis, and which I suppose chiefly referable to actual friction of one side of the comet against the sun itself, or the dense portion of its atmosphere, cannot but manifest themselves to some extent in the other elements.

If we suppose the increase of the period to have been regular, and no other serious perturbation to have existed, the corresponding returns to perihelion would have occurred about 1736 July 8, 1771 June 6 and 1806 Dec. 18. But it need cause no surprise that even so brilliant a phenomenon should have passed unrecorded, since the very small portion of the orbit which lies on the northern side of the ecliptic is traversed within a very few hours of the moment of perihelion, and the tail would point southwardly both before and after the perihelion-passage. In 1736 I find no comet recorded, and the comet of 1771 moved in an orbit totally different from this. But the same does not appear certain as regards the second comet of 1806, which passed its perihelion on Dec. 28 of that year. In No. 1374 of the Astr. Nachr. is a determination by Hensel who found

the inclination to be 144°57′. The other elements are totally discordant, the orbit being hyperbolic, and the perihelion-distance 2.175. The series of observations extends through three months, a fact which also seems adverse to the hypothesis of identity; but I have here no means of reference to the observations themselves, since Hensel gives only a table of residuals between the observed positions and those deduced from Bessel's provisional elements. A very slight examination would show whether the observed geocentric path was compatible with such an orbit as the present one. Finally Pingré mentions a comet with a tail 30° long, observed by Apian and Gemma Frisius in January 1538, and there are several records of earlier comets which favor the hypothesis of identity with the recent one and a gradually increasing period.

Cordoba 1880, Febr. 26.

Untersuchungen über den grossen südlichen Cometen von 1880.

Circular der Kaiserlichen Akademie der Wissenschaften in Wien.

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Der Umstand, dass die von Ralph Copeland aus den ersten, allerdings nur genäherten Beobachtungen, welche die Cap-Sternwarte von dem grossen südlichen Cometen mittheilt, abgeleiteten Elemente eine entfernte Aehnlichkeit mit den Elementen des grossen Märzcometen von 1843 aufweisen, wie dies auch der Herr Berechner bemerkt, verbunden mit dem Umstande, dass der jetzige Comet in seiner ganzen Erscheinung eine überraschende Aehnlichkeit mit dem ebengenannten Cometen zeigte, veranlasste mich zu untersuchen, ob der Lauf des neuen Cometen nicht etwa mit den Elementen des damaligen darstellbar sei. Zu diesem Zwecke reducirte ich die letzten Elemente von Hubbard auf das mittlere Aequinoctium 1880.0, vernachlässigte die Excentricität, die bei dieser vorläufigen Untersuchung nicht in Betracht kommen kann, und legte den Periheldurchgang auf Jan. 27.6 mittl. Berliner Zeit, mit anderen Worten, ich ging von den Elementen aus:

T = 1880 Januar 27.600 mittl. Berl. Zeit.
π = 84°20′42″
ϑ = 1 45 59 } mittl. Aeq. 1880.0
i = 144 19 39
$\log q$ = 7.743377.

Damit gestaltet sich der Lauf des Cometen zwischen Februar 10—15:

	9 Uhr mittl. Berl. Zeit	ϑ
	α	
Febr. 10	0h 5m1	— 33°34′
„ 11	0 21.8	33 21
„ 12	0 37.8	33 1
„ 13	0 53.1	32 33
„ 14	1 7.8	31 58
„ 15	1 21.4	— 31 20

während die Beobachtungen vom Cap lauten:

Cap Mean Time		α	ϑ
Febr. 10	9¼	0h 4m	— 33°40′
„ 11	8¾	0 21	33 31
„ 12	9	0 37	33 11
„ 13	8½	0 52	32 44
„ 14	8¾	1 6	32 10
„ 15	8½	1 20	— 31 34

Nach diesen Resultaten kann es wohl kaum einem Zweifel unterliegen, dass die beiden Himmelskörper identisch sind. Geht man übrigens mit einer Umlaufszeit von 36.9 Jahren um 21 Umläufe zurück, so stösst man auf den grossen Cometen von 1106, dessen Identität mit dem Märzcometen von 1843 schon damals von vielen Seiten vermuthet wurde.

Hält man nun an der Identität der beiden Cometen fest, so müsste der Comet jetzt in unseren Gegenden sichtbar sein, falls er nicht bereits zu lichtschwach geworden ist; sein Lauf in den nächsten Wochen wäre nämlich der folgende:

1880 12 Uhr mittl. Berl. Zeit

	α	ϑ	Lichtst.
April 4.5	5h 4m23s	— 7°42′2	0.013
„ 8.5	11 16	6 59.5	
„ 12.5	17 46	6 21.9	
„ 16.5	23 59	5 48.8	
„ 20.5	29 56	5 19.9	
„ 24.5	5 35 41	— 4 54.6	0.006

Der Lichtstärke liegt als Einheit die vom 10. Februar zu Grunde.

Nachtrag.

Seit dem Erscheinen des Circulares habe ich noch die genäherte Beobachtung des Cometen von Gould: Febr. 4. 5h27m55s Cordoba Sternzeit = 11h52m50s mittl. Berl. Zt.: α = 22h24m10s ϑ = — 31°29′1 mit den