PHILOSOPHICAL TRANSACTIONS.

I. *Observations of the Second Comet of* 1822, *made at Rio de Janeiro. By Lieutenant (now Captain)* WILLIAM ROBERTSON, *R.N. Communicated in a Letter to Captain* BASIL HALL, *F.R.S.*

Read June 17, 1830.

I SHALL feel obliged to you to lay before the Royal Society the following observations, which, with the assistance of Lieut. CHARLES DRINKWATER, R.N., I made upon the "second comet of 1822," as it is called. They were made at Rio de Janeiro, when I was Lieutenant of HIS MAJESTY'S ship Creole, under the orders of Commodore Sir THOMAS HARDY; but as the means I had in my possession for making such nice observations were not great, I did not imagine the results could be of much value, till I accidentally gained information of the following remarks in Baron ZACH's Journal, vol. vi. page 596.

"Cette comète, comme nous l'avons dit dans notre V^me^ cahier, page 481, n'a été que très peu observée, à cause de son mouvement fort-rapide en déclinaison australe; elle s'est par conséquent bientôt soustraite à nos regards, pour se montrer peut-être avec plus d'éclat aux antipodes. Nous n'avons reçu d'autres observations que celles que nous avons déjà publiées dans notre cahier précédent. Probablement l'orbite de cet astre passager nous restera inconnue pour toujours, à moins que MM. FALLOW, RUMKER, ou un autre BASIL HALL, ne parviennent à l'observer dans l'hémisphere austral. Mais la correspondence astronomique des deux hémispheres n'est pas encore bien établie *."

The above allusion to your observations on the comet which we observed together at Valparaiso in 1821, and which are published in the Philosophical

* Correspondence Astronomique du Baron ZACH, vol. vi. p. 595.

Transactions, induces me to address this communication to you, to be laid before the Society, if you consider it worthy of that honour.

M. PONS, it appears, (ZACH, vol. vi. p. 385) first discovered this comet on the 31st of May, about two o'clock in the morning. It was then at the distance of $2\frac{1}{2}^\circ$ from the star β Piscium, 5° from η Aquarii, nearly in $340\frac{1}{4}^\circ$ of $\mathcal{R}$, and in $2\frac{1}{2}^\circ$ north declination. As M. PONS had no instruments ready to observe the comet, it does not appear to have been further noticed till the 8th of June, by Professor CATUREGLI at Bologna, and two days afterwards by M. GAMBART at Marseilles. Owing to its extreme feebleness, however, Baron ZACH does not appear to think the observations at Bologna very exact.

The following two Tables of the observations just mentioned are from ZACH'S Correspondence, vol. vi. p. 482.

1822.	Tems vrai à Bologne.	Ascen. droite de la comète.	Declin. de la comète australe.
	h m	° ′	° ′
Juin 8	15 10	347 39	8 49
10	14 45	351 43	13 28
11	14 44	354 32	16 46
12	14 59	358 25	21 5

The following are the only two observations made by M. GAMBART at Marseilles.

1822.	Tems moyen de minuit.	Differ. d'ascen. droite.	N° d'obs.	Differ. de declin.	N° d'obs.	Etoiles companées.
	h m s	° ′ ″		′ ″		
Juin 10	3 3 49	+2 11 9.2	1	−21 38.1	1	ψ^3 du Verseau.
11	2 48 56	−0 20 27.0	4	+30 31.3	4	133 Hor. XXIII. PIAZZI.

From these few observations, M. HULINGENSTEIN has deduced the orbit in SCHUMACHER'S Astronomische Nachrichten, vol. iv. pp. 533, 534, and which I have copied at the end of this letter. But as the above observations comprehend only a very small portion of the orbit, these elements are susceptible of improvement from observations made during a longer interval.

The following are the whole of the observations which were made by Mr. DRINKWATER and myself on this comet.

On the evening of the 18th of June it was first observed, with the naked eye, near the star Canopus, and though it had been in conjunction with the sun on that day, its great southern latitude permitted it to be seen after sunset. Of course we did not know that it had been observed in Europe, and immediately proceeded to determine its position by the only means of which we had command. By means of a reflecting sextant, we took its angular distances from known fixed stars. The faintness of the comet's light, and the uncertainty in estimating its apparent centre, presented considerable difficulties in the employment of this method of observation. It was attempted to diminish the errors which, no doubt, arose from this cause, by taking the angular distances from four stars, and these observations were repeated, as often as the weather permitted, on the succeeding nights. In this manner angular distances were obtained on the evenings of the 18th, 19th, 22nd, 23rd, and 24th of June, 1822; after which the increasing brightness of the moonlight, and the faintness, prevented its being accurately observed with the sextant, and eventually obliterated it altogether.

During the whole of the above period, the comet presented the same appearance as it seems to have done in Europe,—namely, that of a nebulous mass, without either tail or nucleus. I was of course inclined to believe, at first, that these observations would be of little value, as I did not doubt that the comet must have been observed from other places in the southern hemisphere, with more efficient instruments than mine. I hope it may still prove so; but, after repeated inquiries, I have not been able to learn that the comet was seen in any other quarter of that portion of the globe. Nor, indeed, was it until its orbit had been computed from my observations by Mr. Thomas Henderson of Edinburgh, that the comet was suspected to have been one previously observed in Europe. This discovery, it will perhaps be thought, gives a new value to the observations which we made; for though the means used were deficient in that precision which is desirable, the observations, taken in conjunction with those made in Europe, embrace a far greater extent of the comet's orbit than either series do alone. And in the present state of cometary astronomy it is impossible to foretell the value which may one day be assigned to observations which at present appear to have little interest.

The following is a faithful transcript of the original observations as they

were actually written down at the time; without the alteration of a letter or a figure.

Rio de Janeiro, June 18th, 1822, at $6^h\ 30^m$ P.M. Observed a bright orbicular nebula near Canopus. On directing the telescope to it, we find it to have the appearance of a comet. At $6^h\ 40^m$ mean time, the following distances were taken with sextants:

From Canopus . . .	3°	6′	20″
—— Sirius	34	27	10
—— α Hydræ . . .	58	9	20
—— α Crucis . . .	47	58	50

June 19th. The comet appeared fainter than last night. There was a thin haze in the sky. The following observations were taken at $6^h\ 40^m$ P.M.:

From Canopus . . .	11°	33′	30″
—— Sirius	30	3	37
—— α Hydræ . . .	46	2	47
—— α Crucis . . .	44	15	30

June 20th. Thick, rainy weather; comet not seen.

June 21st. Thick, cloudy weather.

June 22nd. Fine, clear moonlight. Observed the comet without a telescope. It is still of a round shape, no tail or nucleus observed when looked at with a telescope. The following angular distances were taken at $7^h\ 0^m$ P.M.:

From Canopus . . .	33°	35′	00″
—— Sirius	33	12	00
—— α Hydræ . . .	25	9	45
—— α Crucis . . .	44	36	25

June 23rd. Clear weather. The following angular distances were taken at $6^h\ 34^m$ P.M.:

From Canopus . . .	37°	29′	20″
—— Sirius	35	15	45
—— α Hydræ . . .	21	38	50
—— α Crucis . . .	45	13	10

June 24th. Clear weather; moonlight. The following distances were taken at $6^h\ 30^m$ P.M.:

From α Hydræ	. . . . .	18	57 25
—— α Crucis	. . . . .	46	37 30

June 25th. Saw the comet; but owing to the clear moonlight, it was too faint to be observed with the sextant.

June 26th. Dark cloudy weather, with rain and thunder.

June 27th. Rainy weather. In the evening, fine weather; comet not seen.

June 28th. Cloudy evening.

June 29th. Fine clear moonlight; could not discover the comet.

On my attention being called to this comet during the last year, more than seven years after I had observed it, I placed the above observations in the hands of Mr. THOMAS HENDERSON, of Edinburgh, who has furnished me with the following remarks, which I transcribe verbatim, and request you will communicate to the Royal Society in the same manner.

"From the observations," says Mr. HENDERSON, "made at Rio de Janeiro, by Captain ROBERTSON and Lieutenant DRINKWATER, on the second comet of 1822, I have obtained the following position of that comet referred to the ecliptic, and cleared of the effect of refraction, but not of parallax, aberration, nutation, or precession. Those positions have been adopted which represent the observed angular distances with the minimum of error, as found by the method of least squares.

Mean solar time at Rio de Janeiro. June 1822.	Apparent longitude.	Apparent latitude.
d h m	° ′ ″	° ′ ″
18 6 40	93 39 26	73 51 6 South
19 6 40	125 15 42	66 42 19
22 7 0	147 5 5	47 30 47
23 6 34	149 31 36	43 49 20
24 6 30	150 48 47	40 39 58

"The errors of observation, on the differences between the observed and computed angular distances, do not exceed five minutes of space, except on the

23rd, when, in one observation, the error amounts to eleven minutes; for which reason the position of that day is not employed in computing the orbit.

"The following elements of the comet's parabolic orbit have been obtained by OLBERS' method of computation, founded upon the observations of June 19th, 22nd, and 24th.

Time of perihelion passage, mean solar time at Greenwich, 1822, July 15.651.

Longitude of the perihelion	220° 19′ 49″
Inclination of the orbit	35 36 0
Longitude of the ascending node . . .	98 14 47
Logarithm of perihelion distance . . .	9.92879

Motion retrograde.

"The following are the errors of the places computed from these elements, or the corrections to be applied to the computed places, in order to obtain those which were observed.

	Longitude.	Latitude.
June 18	− 7′	+ 1′
19	+ 5	+ 1
22	0	· · 1
23	+ 15	· · 5
24	0	+ 1

"The greatest error is on the 23rd; the observations of which day, for the reasons already stated, are supposed not to be so exact as those of the other days. The other errors, it may be remarked, are not greater than what might have been expected from the uncertainty of the observations, and great latitude of the comet, when the errors in longitude are apparently much increased, from being reckoned upon a small circle.

"On comparing the foregoing elements, computed from Captain ROBERTSON and Lieutenant DRINKWATER's observations, with those deduced by M. HULINGENSTEIN from the observations made in Europe, referred to at page 2, it will be seen that the differences between them are wonderfully small, considering the different instruments used by the observers in the two hemispheres.

"The elements, placed side by side, stand thus:

	By M. Hulingenstein's computation from observations in Europe.	By the computations from Captain Robertson's observations at Rio de Janeiro.
Time of perihelion passage,	July 16.03925	July 15.651
	Mean Solar Time at Marseilles.	Mean Solar Time at Greenwich.
Longitude of the perihelion	219° 53′ 48″	220° 19′ 49″
Inclination of the orbit	37 43 4	35 36 0
Longitude of the ascending node	97 51 23	98 14 47
Logarithm of perihelion distance	9.92743	9.92879

" Perhaps more correct elements might be obtained from a comparison of all the observations, European as well as South American, were it deemed of sufficient importance to undergo the requisite labour. But without entering into such an investigation, enough has been already stated to show that the instruments and other means in the possession of every naval officer, are sufficient to enable him to determine, with considerable accuracy, the orbit of any comet which is not too faint for being observed with the usual reflecting instruments used at sea."

Before concluding this communication, it may not be improper to mention that about the same time that we were making the observations above detailed, on the "second comet of 1822," we were fortunate enough to see the celebrated comet of Encke, but it had not sufficient light to enable us to observe it in the same manner that we did the other. We were therefore obliged to content ourselves with observing it through an ordinary telescope. But, as it does not appear that on this return of Encke's comet to the neighbourhood of the earth, it was seen in any other part of the world, except at Paramatta, the following notes of what we saw of it at Rio de Janeiro, may not be altogether uninteresting, though probably of little or no value to astronomers.

Memorandum of Encke's comet seen at Rio de Janeiro in 1822.

June 7th. At $6^h\ 30^m$ P.M. Observed the comet calculated by Professor Encke, in the constellation Gemini. It was only seen through a telescope, and appeared like a faint nebula of a round form. There were two stars of the 5th

or 6th magnitude near it, with which it formed a right-angled triangle; the right angle at the northernmost of the two stars, and the comet to the westward.

June 10th. Observed ENCKE's comet after sunset. It has increased its $\mathcal{R}$. The stars seen along with it on the 7th are not now in the field of view of the telescope at the same time with the comet.

June 12th. Observed ENCKE's comet after sunset. It was very faint. No stars that we have in our catalogues (which are very limited) in the field of the telescope.

June 13th. Observed ENCKE's comet forming an angle of about 100° at β Canis Minoris, with Procyon; at about once and a quarter the distance from β Canis Minoris, that β is from Procyon. It is not brighter than when it was first seen.

June 17th. ENCKE's comet again seen. A line drawn from Sirius to β Canis Minoris cuts a star of the 3rd or 4th magnitude: about $\frac{1}{5}$th of the distance from that star to Procyon, was the comet, in a triangle formed by three stars of the 5th or 6th magnitude, seen by the telescope thus,  , the $\mathcal{R}$ being about 103°, and declination 5° north, and it has still the same nebulous, orbicular appearance as when first seen.

June 18th. Saw ENCKE's comet after sunset—very faint. It had increased its $\mathcal{R}$ considerably since last night, from the small stars seen last night in the field of the telescope.

June 19th. Hazy, and the direction of the comet not seen.

June 20th and 21st. Thick weather; comet not seen.

June 22nd. Fine clear moonlight; ENCKE's comet could not be made out, nor was it again seen.

If you think any of these observations likely to interest the Royal Society, I request you will do me the honour to present them.