Lisbon Magnetic Observations

MR. DE BRITO CAPELLO, Director of the Lisbon Magnetic Observatory, having addressed to me several interesting results having reference to the notice of his observations which appeared in NATURE, vol. xiii. p. 301, I am anxious to communicate them to your readers.

With reference to the movement of the declination magnet from 8 A.M. to 2 P.M. Mr. Capello gives me the following mean values for each year from 1858 to 1875:—

1858	...	...	8° 74'	1867	...	...	6° 15'
1859	...	...	10° 54'	1868	...	...	7° 17'
1860	...	...	10° 11'	1869	...	...	8° 42'
1861	...	...	9° 00'	1870	...	...	10° 83'
1862	...	...	7° 84'	1871	...	...	10° 60'
1863	...	...	7° 65'	1872	...	...	9° 45'
1864	...	...	6° 94'	1873	...	...	8° 22'
1865	...	...	6° 61'	1874	...	...	7° 23'
1866	...	...	6° 19'	1875	...	...	6° 09'

These quantities, Mr. Capello remarks, show the maxima 1859·8 and 1870·9, and the minimum 1867·1, agreeing very nearly with the epochs of maximum and minimum sun-spots.

It also appears as if the minimum had been reached again last year, the mean oscillation (6° 09') being less than in 1867. This agrees with the conclusion derived by me from the Trevandrum observations, and communicated to the French Academy of Sciences last year. Dr. R. Wolf had previously (as I now find¹) concluded from his sun-spot observations that the minimum would probably appear in 1875-6; and he considers we have now one of the short periods, which his tables of sun-spots show may be expected every 80-90 years. My own conclusion to the same effect (that we have now a short period) was founded on a consideration of the magnetic observations. The last short period was that from the maximum 1829·7 (shown by Arago's observations) to that of 1837·5 (shown by Gauss's observations), an interval of rather less than eight years. If we may take 1875·5 as the epoch of the present minimum, then the interval from the last is nearly nine years. As the interval from the minimum of Arago (1824·2) to the next was nearly 9·2 years, we find a space of nearly forty-two years from the last short period to this one. Should this hold for the next maximum it will occur about 1879·0.

Mr. Capello has obtained the interesting result that the curve showing the mean diurnal disturbance of the vertical magnetic force is the exact inverse of that for the mean diurnal disturbance of declination at Lisbon; a movement of the north pole of the declination magnet towards the west corresponding to one downwards of the south pole of the balance needle. It appears also that the difference of sign in the temperature coefficient for the balance magnet due to changes of the compensation bar from brass to zinc and zinc to brass, on which a remark was made in NATURE, vol. xiii. p. 302, does not affect the results for the diurnal variation, each year giving the same mean law of a minimum vertical force between 11 A.M. and noon, and a maximum near 5 P.M. whatever the sign of the temperature coefficient. It appears also that the results at Lisbon are confirmed by those obtained at Coimbra, ninety miles to the north.

JOHN ALLAN BROWN

The Early History of Continued Fractions

THE reviewer in NATURE, (vol. xiii., p. 304), very properly points out that the first mathematician who used continued fractions was Cataldi, and not Lord Brounker, as is still often stated.

To this fact I drew attention in a pamphlet, published in 1874, not then knowing that De Morgan had done the same many years ago. There is, however, in connection with the same subject, another historical fact almost equally interesting, which few in this country seem to be aware of, and which therefore it may be desirable to bring before your readers.

Daniel Schwenter, a professor at Altdorf, in the first quarter of the seventeenth century, made use of the present well-known process for expressing the ratio of two integers as a continued fraction, and calculated the convergent, exactly in the mode at present followed. He does not indeed seem to have written as we now do the actual continued fraction obtained in any case,

¹ "Astronomische Mittheilungen," 38, p. 378, July 1875.

but the process of repeated division, and the mode of finding the convergents were most fully described and exemplified by him.¹

The following, therefore, seems to be, in few words, the early history of continued fractions:—

1. Cataldi published, in 1613, his discovery that the square root of an integer can be expressed as an interminate continued fraction, e.g.,

$$\sqrt{18} = 4 + \frac{2}{8 + \frac{2}{8 + \frac{2}{8 + \dots}}}$$

2. Schwenter, almost certainly without knowledge of what Cataldi had done, published in 1636 the mode of changing an ordinary fraction into a continued fraction with unit-numerators, and of calculating therefrom convergents to the given fraction, e.g.,

$$\frac{117}{233} = \frac{1}{3 + \frac{1}{6 + \frac{1}{4 + \frac{1}{2}}}}$$

3. Brounker, very probably in ignorance of what had been done by Cataldi and Schwenter, made the discovery that

$$\frac{\pi}{2} = \frac{1}{1 + \frac{1}{2 + \frac{4}{2 + \frac{9}{2 + \dots}}}}$$

which was published by Wallis in 1655 ("Arithmetica Infinitorum" p. 181), along with a tolerably complete theory of continued fractions in general.

The necessary details bearing on these three main facts will be found in a painstaking work by Prof. Favaro, "Notizie Storiche sulle Frazioni Continue," Roma, 1875, or in shorter form, in a school "programme" by Dr. Günther, "Beiträge zur Entwicklungsgeschichte der Kettenbrüche," 1872.

That Cataldi, Schwenter, and Brounker, starting from totally different points should all light on the continued fraction form, and that it should be twice (perhaps nearly thrice) lost, are certainly strange facts, forming a curious chapter in the history of scientific discovery.

THOMAS MUIR

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The Dry River-beds of the Riviera

MR. R. E. BARTLETT (NATURE, vol. xiii. p. 406) asks for some theory to account for the existence of the broad stony river-beds of Piedmont. He instances the Paglione at Nice, which is indeed the merest rudiment of a river for the greater part of the year. But if Mr. Bartlett will wait, not so much for the snows on the Maritime Alps to be melted, as for the rainy weeks of autumn to come again,

Quam fera diluvies quietos
Irritat amnes,

he will see that that now despicable river annually flows with a vehemence and a volume worthy of its size. Many a dry and insignificant torrent-bed in the neighbourhood of Nice swells during the rainy season to a torrent indeed; the thoroughness with which they then drain the adjacent slopes is amply sufficient to explain their existence and their appearance when their "occupation's gone."

HENRY T. WHARTON

London, April 2

The Flame of Common Salt

HAVING been much interested in the progress of the investigations concerning the blue flame of common salt when thrown into a coal fire, I made the following experiments, by which I came to the conclusion that the origin of the blue flame is due to the presence of copper, which occurs in nearly every coal as an ingredient of the pyrites.

According to "Bercelius," by agency of the blow-pipe, small
¹ See "Daniel Schwenter, Deliciae physico-mathematicae," Nürnberg, 1696, p. 111. "M. Daniel Schwenter's Geometriae practicae novae et auctae, Libri IV." durch Georgium Andream Böcklern, Nürnberg, 1657, p. 431.

traces of chlorine can be discovered by dissolving at first a larger quantity of oxide of copper in a bead of microcosmic salt; if, then, any substance containing chlorine be brought in contact with the bead on the point of the blue jet, the blue flame of the blow-pipe is coloured azure blue; the same colour is even exhibited when chloride of sodium and oxide of copper are heated in the bead; the yellow flame of the sodium is scarcely visible, and does not conceal the azure blue flame.

In making the above experiment, I immediately suspected that the blue light imparted to the coal corresponds with the light of the microcosmic bead, the chlorine of the salt combines with the copper, which burns with the azure blue flame.

To convince myself that the blue colour is not due to any other cause, I took a charcoal fire free of copper, and threw salt into it; the salt gave a slightly yellow flame of sodium, and not the minutest trace of a blue flame could be discovered, though large quantities of salt were used, but on throwing the slightest quantity of oxide of copper on to the charcoal, the azure blue colour occurred instantly.

The following chlorides, HCl, KCl, NH_4Cl , BaCl_2 , CaCl_2 which I had at my disposal, exhibited more or less a blue colour when cast into a coal fire.

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OUR ASTRONOMICAL COLUMN

DOUBLE STARS.—Baron Dembowski communicates to the *Astronomische Nachrichten*, Nos. 2,076–2081, his later measures of double-stars, amongst which is a considerable number of well known binaries. The measures are given in a slightly modified form from that adopted in most of the Baron's previous important communications, which commenced in vol. 62 of the above periodical.

For the sake of facilitating a comparison with the best-determined orbits of revolving double-stars, we extract a few of the most recent Gallarate epochs or means of the year's measures:—

Name of Star.	Year.	Position.	Distance.	Position (c-o).	Distance (c-o).
Castor	1875'25	235°03	5'54	+ 0°94	+ 0°39
ξ Cancri	1875'14	130°94	0°74	+ 0°88	- 0°05
ξ Ursæ Maj. ...	1875'27	317°56	1°09	+ 6°44	- 0°13
γ Virginis	1874'93	159°35	4'77	+ 0°80	0°00
ξ Bootis	1874'89	286°32	4'54	+ 1°12	+ 1°02
η Coronæ Bor. ...	1875'41	66°69	0°86	- 3°13	- 0°13
ξ Scorpii	1874'96	68°97	7'12	- 1°80	+ 0°06
ξ Herculis	1875'52	149°09	1°41	- 1°20	- 0°09
70 Ophiuchi	1875'52	83°72	3'48	+ 3°11	+ 0°85
δ Cygni	1875'02	335°26	1°60	- 1°13	- 0°14
ε 3062	1875'67	292°17	1°47	- 4°62	+ 0°14

The orbits with which the above comparisons have been made are by the following calculators; the periods of revolution are added.

Castor	Thiele	996'85 years.
ξ Cancri	O. Struve	62'4 "
ξ Ursæ Majoris ...	Hind	60'68 "
γ Virginis	Thiele	185'01 "
ξ Bootis	Hind	168'9 "
η Coronæ Bor. ...	Wijkander	41'58 "
ξ Scorpii	Thiele	49'05 "
ξ Herculis	Dunér	34'22 "
70 Ophiuchi	Schur	94'37 "
δ Cygni	Behrmann	415'1 "
ε 3062	Schur	112'64 "

Comparisons are omitted in the cases of several binaries, the orbits of which have been worked up to about present time, principally by Dr. Doberck, of Markree Observatory. Mr. W. Plummer's orbit of ξ Cancri gives the angle 15° greater than the measures, the distance nearly agreeing. The orbit of ξ Ursæ Majoris by Dr. Ball, of Dunsink Observatory, Dublin, is not available as printed in the "Monthly Notices" of the Royal Astronomical Society, the excentricity being omitted, and the same element has escaped also in Dr. Doberck's orbit of σ Coronæ Borealis.

THE EQUATOR OF MARS.—Sir W. Herschel's determination of the position of the plane of the equator of this planet, from observations made in the autumn of 1783, was communicated to the Royal Society in December of the same year. He found for the inclination of the axis to the orbit, 61° 18', and therefore for the obliquity on the globe of Mars, 28° 42'; the inclination of the axis to the ecliptic, 59° 42', the north pole being directed in 1783 to longitude 347° 47'. From these figures we deduce for the ascending node of the equator of Mars upon that of the earth (N) 48° 9', and its inclination thereto (I) 41° 27'.

Olbers, from the observations of Schroeter and Harding, on the south polar spot upon Mars in October and November, 1798, found for the longitude of this pole 172° 54'·7, and the latitude 60° 33'·2, and hence we have for the ascending node of the equator on the orbit, 84° 54', and for the obliquity on Mars, 27° 57'; the ascending node of the equator of Mars upon the terrestrial equator 50° 29', and the inclination 39° 14'.

But the determination which has been generally relied upon as the best yet available is that made by Dr. Oudemans, now director of the Observatory at Batavia, from measures by Bessel with the Königsberg heliometer, 1833–37. For about 1834·0 he found the longitude of the north pole of Mars 349° 1', and its latitude 61° 9'. The node of the orbit of the planet in the ecliptic being at this time in 48° 16', and the inclination 1° 51', we have for the ascending node of the equator of Mars on his orbit, 80° 50', and for the obliquity of the Martial ecliptic, 27° 16', and therefore for the ascending node of the equator of Mars upon the terrestrial equator, 47° 34', and its inclination, 39° 56'. Assuming these figures to apply to 1834·0, we get for 1877—

$$N = 47^\circ 55' \quad I = 39^\circ 46'.$$

A SOUTHERN COMET (?).—The *Wanganui Herald* (N.Z.), of January 20, says:—"What appeared to be a small comet was visible in the south, in the constellation of Argo Navis, for about two hours last night, the rising moon rendering it invisible. It was very small, and appeared to be rapidly moving towards the east." The summary number of the *Melbourne Argus* of January 25 has no reference to the visibility of a comet, and the above notice at present requires confirmation.

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXISTING MAMMALIA¹

VI.

THE order *Cetacea* is one of peculiar interest, having many specialities of structure, and being sharply defined from all other groups, with no outlying or doubtful forms at present known. Being purely aquatic animals, and all of considerable size, their remains are more readily preserved than those of some other orders. None, however, have been met with in the well-explored deposits of the cretaceous seas, or indeed in any European strata (with the doubtful exception of the cervical vertebrae of *Palæocetus* from Ely), earlier than the Miocene. Abundant remains are, however, found in various Miocene and Pliocene marine beds, notably at Antwerp, in many parts of France, Germany, especially the Vienna basin, Italy, and South Russia. They are also found, though in a less perfect condition, in the crags of the east of England. In the Eocene deposits of the eastern states of America, the strange and gigantic Zeuglodon occupies the place of the ordinary *Cetacea*, which occur in the Miocene and later ages.

Among the existing members of the order there are two very distinct types, the toothed whales or *Odontocetes*,

¹ Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from p. 410.