

ments, which really may be the cause. But, probably, in future times it be found by improved methods and instruments that the law does not hold, it would be advantageous to proclaim by definition the conservation of energy and to deduce from it the measurement of time. Then we should have the analogon of the absolute scale of temperature of Thomson.

If any one after the perusal of this article asserts that my views are at variance with the historical development of science, I answer that often in the reasoning of man there are gaps, which by contemporaries are not perceived; but that we must try to find them out and to fill them.

I hope my readers will not be too much annoyed by the defective manner in which I may have expressed myself in English; it is always difficult to make use of a foreign language.

Before closing I am bound to state that I have particularly mentioned the assertions of Sir W. Thomson, Prof. Tait, and Prof. Clerk Maxwell, because in their works I found most emphatically stated what in my opinion is erroneous. These eminent men stand so high that it is unnecessary for me to express my profound respect for them.

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OUR ASTRONOMICAL COLUMN

THE D'ANGOS COMET OF 1784.—Encke's investigation relating to this reported comet appears in Zach's *Correspondance Astronomique*, as an "Imposture Astronomique grossière du Chevalier D'Angos, dévoilée par J. F. Encke, à Gotha." Olbers, in a letter addressed to him, had, as already stated, asked his attention to the subject, saying, "I would invite you to the examination of a doubtful comet of which the result will be either the knowledge of the yet unknown orbit of a very remarkable comet, or the discovery of a most shameful imposture," and adding particulars to which allusion is made in our previous note.

Encke remarks at the outset that, contrary to all general usage amongst astronomers, D'Angos had given the Malta observations with mean times for Paris, and the comet's positions expressed in longitudes and latitudes, which confirmed the suspicion that he had computed from the elements of an imaginary orbit and had not taken the trouble to convert the results into right ascensions and declinations, in which astronomers are accustomed to present them. If it is demonstrable that according to the observations (at least without supposing them erroneous to the amount of many minutes) the comet could only have moved in a very improbable orbit, in fact almost as a satellite of the earth and at a distance less than that of the moon, and if further it can be shown that by a very simple error of calculation D'Angos was misled in deducing the places of the comet from the imaginary elements, then, Encke urged, there remains no longer the smallest doubt that he had invented all these observations. Making use of the positions given for April 15, 22, and 29, Encke assuming arbitrarily a value of the comet's curtate distance from the earth at the first date, finds the corresponding value for the same at the third date in order to represent precisely the longitude on April 22, and compares with the corresponding latitude. Thus if the curtate distance on April 22 be taken as 0.42 (we somewhat contract Encke's figures) the third distance is 0.55, the error on the middle latitude, - 16', and the resulting conic section is a hyperbola; the same form of orbit is deduced when the comet's distance on April 22 is diminished to 0.25. If this distance be further diminished to 0.146, the orbit becomes an ellipse, but the error on the middle latitude is still - 12'8, and it was found necessary to reduce the curtate distance to 0.00126 in order to represent this latitude with no greater error than - 2'5; the resulting orbit being also an ellipse. Taking the solar parallax at 8"86, this distance corresponds to 116,000 miles, or about half the moon's distance from the earth, and under the condition named above, on April 29 it would still be less than 160,000 miles. Thus Encke found

it was necessary to assume the comet's distance from the earth, almost incredibly small if the errors of calculation are to be brought within the limit assigned by D'Angos to the differences between the places computed from his elements and his observations, or about 1 1/4'; and, he continues, a celestial body under such circumstances remaining for so long a time in immediate proximity to the earth, would assuredly have been retained within its sphere of activity, and D'Angos if he were the first would certainly not have been the only observer of this second moon. Rejecting then as beyond probability the conclusions necessarily drawn from an investigation in the manner here briefly described, Encke proceeded to examine the calculation of geocentric longitudes and latitudes of the comet from the elements assigned by D'Angos.

Taking for example the observation of April 15, the logarithm of the radius-vector calculated from the orbit of D'Angos is found to be 9.8208333, and continuing the computation the resulting position differs from the observation 47° in longitude and 15° in latitude, but supposing that by an error of the pen D'Angos had used a log. radius-vector ten times greater, or 0.8208333, with the same heliocentric longitude and latitude, the errors are reduced to 56 seconds and 34 seconds respectively, and making the same change in the log. radii-vectores at the other dates of observation, Encke arrived at the extraordinary result that the whole of the reputedly-observed places were represented within about the limit of error mentioned by D'Angos, and he insisted that with such proof there could be no possible doubt that the observations and the orbit of the comet, "ne soient entièrement fausses et controuvées, et que par conséquent il faut les rayer de tous nos catalogues des comètes, comme un astre chimerique qui n'a jamais existé;" while at the same time he acknowledged himself ready to do justice to the accused and to make the most ample satisfaction if he could be opposed by arguments as strong and apparently conclusive as those upon which he had founded an adverse verdict.

THE TOTAL SOLAR ECLIPSE, 1889, DECEMBER 22.—In continuation of notices of future total eclipses of the sun which have appeared in this column, the elements of the eclipse of 1889, December 22, are subjoined:—

G.M.T. of Conjunction in R.A. Dec. 22, at oh. 24m. 50s.

R.A.	271 0' 10.4"
Moon's hourly motion in R.A. ...	41 20.7
Sun's " " " " " " " " " "	2 46.6
Moon's declination " " " " " "	23 14 1.8 S.
Sun's " " " " " " " " " "	23 27 10.3 S.
Moon's hourly motion in decl. ...	3 4.2 S.
Sun's " " " " " " " " " "	0 1.1 N.
Moon's horizontal parallax " " " "	61 17.1
Sun's " " " " " " " " " "	9.1
Moon's semi-diameter " " " " " "	16 42.0
Sun's " " " " " " " " " "	16 16.1

The central and total eclipse commences in long. 78° 52' W., lat. 15° 22' N., and ends in long. 60° 55' E. and lat. 6° 53' N., and it occurs with the sun on the meridian in long. 6° 27' W., lat. 11° 5' S.

At a point on the coast of Africa in 10° 6' S. lat., totality commences at 2h. 8m. 55s. local time, and continues 3m. 34s. At Bridgetown, Barbadoes, totality begins at 6h. 47m. 6s. A.M. local time, and continues 1m. 48s., but the sun's altitude is only 6°. The following are points upon the central line, which will show that with a fair duration where the sun is near the meridian, the course of the eclipse is not a favourable one for observation:—

Long.	Lat.	Long.	Lat.
59° 22' W.	13° 30' N.	5° 5' E.	11° 23' S.
47 39	7 37 N.	14 0	9 45
32 28 W.	0 23 S.	18 32 E.	8 27 S.