

## A Map of the World on Flamsteed's Projection

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the errors are considerably less than those of Rankine's equation in his paper of 1850. The data are all from Regnault.

Alcohol :—

$$\log p = 7.448 - \frac{8784}{t^{1.29}}.$$

Ether :—

$$\log p = 6.9968 - \frac{3047}{t^{1.153}}$$

Mercury :—

$$\log p = 9.8651 - \frac{597.5}{t^{0.69}}.$$

Carbonic acid :—

$$\log p = 8.4625 - \frac{302.8}{t^{0.77}}$$


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#### IV. *A Map of the World on Flamsteed's Projection.*

*By* WALTER BAILY, M.A.\*

[Plate I.]

IN Flamsteed's *Atlas Cœlestis* the projection used is one invented by him and described in the Preface to that work as follows :—

“Conceive the globe or sphere to be compassed about with an infinite number of infinitely fine threads all exactly parallel to the equator. Let all the circles usually drawn upon the globe, as the equator, the ecliptic, the meridians, &c., be supposed drawn and divided, and let the constellations also be formed upon them, and the stars laid down in their proper places. Let also the meridian passing through the middle of any constellation be conceived drawn on the globe, and covered with a fine thread with as many of the adjacent circles as you may think convenient. Conceive the threads on which the constellation is painted to be cut off from the surface of the globe; and that which passes through the middle being extended straight on the middle of some paper or perfectly plane superficies, let the rest be placed on it at right angles to the middle meridian, but reverted.”

\* Read February 27, 1886.

Flamsteed used his projection only for maps of portions of the celestial sphere, and he did not apply it to the polar regions, as the distortion which would otherwise have been produced would have been inconvenient to an astronomer.

The Preface points out the advantages of the method as follows:—"So will you have the picture of the Constellation projected upon it, in which the parallels of declination will be straight lines and their distances exactly equal, the same as they are on the globe, as will also the distances and differences of the right ascensions of any two stars that are equally distant from the pole." The advantage in Geography of a map in which the parallels of latitude are equidistant straight lines parallel to the equator is obvious, as the position with regard to latitude is seen at a glance. There is, moreover, a property of this projection which is evident at once from the way in which the projection is constructed, viz. that the area of every part is preserved unaltered. The imaginary threads have simply slipped over one another, like the cards in a pack, without altering their distances, so that only a distortion of form has occurred. This property is not referred to by Flamsteed, either because he did not notice it, or because it was of no importance in Astronomy. I venture to submit, however, that in Physical Geography it is a property of considerable importance, and that it would be advisable in many physical maps to use this projection. For instance, in maps showing rainfall, depth of the sea, height of the land, ocean currents, prevailing winds, distribution of plants and animals, &c., it is essential to take account of the area occupied, and maps in which this is correctly shown could not fail to be of use. In Plate I. is shown a map of the World on Flamsteed's projection, the small square at the side representing 1,000,000 square miles on the same scale.

The formulæ for constructing the map are readily obtained. Take the equator as the axis of  $x$ , and the central meridian (say the meridian of Greenwich) for the axis of  $y$ . Let  $x, y$  be the coordinates of a point  $m^\circ$  of longitude from the central meridian, and  $n^\circ$  of latitude from the equator. Then if  $\alpha$  is the length of a degree of latitude in the scale adopted,

$$y/\alpha = n, \quad x/\alpha = m \cos n^\circ.$$

Hence the equation to a meridian  $m$  degrees from the central meridian is

$$\frac{x}{a} = m \cos \left( \frac{y}{a} \cdot 1^\circ \right).$$


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V. *Note on a "Relation between the Critical Temperatures of Bodies and their Thermal Expansions as Liquids."* By T. E. THORPE, Ph.D., F.R.S., and A. W. RÜCKER, M.A., F.R.S.\*

A PAPER bearing the above title was published by us in the Journal of the Chemical Society of London for April 1884, and has recently been discussed by MM. A. Bartoli and E. Stracciati†. As these gentlemen have done us the honour to make use of a formula deduced by us from the simple expression given by Mendelejeff for the expansion of liquids, we should like to state exactly the position which we ourselves think ought to be assigned to it, and the use which may legitimately be made of it.

Prof. Mendelejeff has shown‡ that the expansion of liquids under constant pressure between  $0^\circ$  C. and their boiling-points may be expressed by means of the very simple formula

$$V_t = \frac{1}{1 - kt};$$

where  $V_t$  is the volume at  $t^\circ$  (that at  $0^\circ$  C. being unity), and  $k$  is a quantity which differs for different substances, but which may for any one substance be considered invariable between  $0^\circ$  C. and the neighbourhood of the boiling-point.

The great merit of Mendelejeff's law is that it is proved by him to express the law of expansion to within the limits of the differences between the results of different observers experimenting on the same liquid. Thus, if the results of any one observer alone are considered, they may no doubt be most

\* Read April 10, 1886.

† *Ann. Chim. Phys.* Mars 1886, p. 384.

‡ *Journ. Chem. Soc.* April 1884.