agilis, and in the species now introduced it is, so far as I have been able to ascertain, as conspicuously absent. In this absence of a contractile vesicle *Triconympha* assimilates itself to many Opalinidæ. While commenting upon the apparent position of *Triconympha*, with relation to other Infusorial forms (Manual of Infusoria, Vol. II., p. 553), it was suggested by me that, with respect to the great length of its cilia and characteristic movements, it to some extent resembled the multiflagellate genus *Hexamita*. Though the more abundant evidence since adduced has sufficed to demonstrate that it belongs essentially to the Holotrichous Ciliata, the great length of the cilia, the manner in which they are employed, and the habits the animalcules exhibit of anchoring themselves to foreign substances by their long posterior cilia, is suggestive of the remote derivation of these White Ant parasites from a flagelliferous type allied to *Hexamita*.

Of the two remaining Infusoria found by me in the Tasmanian White Ant the one is apparently referable to Dr. Leidy's genus *Pyrsonympha*, while the other belongs to Stein's multiflagellate genus *Lophomonas*, so far recorded as a parasite only of the Orthopterous insects *Blatta* and *Gryllotalpa*. Several important points in their organisation not having yet been clearly ascertained, descriptive details of these two new forms are reserved for a future communication.

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ON A METHOD OF DETERMINING THE TRUE MERIDIAN.

BY H. C. KINGSMILL, M.A.

[*Read November* 17, 1884.]

I propose to describe a method of obtaining the true meridian by observation, which, so far as I am aware, has not been tried in this colony. The method is theoretically simple, but many ideas which are simple in theory, are found to have practical difficulties which render them useless in actual work.

I do not think that this objection will apply to the case in question, but I shall be glad to have the opinion of some one who has had experience in taking observations.

Public attention was called to the meridian question some time ago by Mr. McIntyre, a New Zealand surveyor, who gave much valuable information in a paper which he read before this Society.

He pointed out that magnetic bearings were not sufficiently accurate to form the basis of a permanent survey; that numerous errors had been caused by depending on the compass; and that the true meridian ought to be the datum line, from which all the bearings of a survey should be reckoned.

These views have been generally accepted as correct, and it becomes a matter of interest to know, what means a surveyor has at his disposal for ascertaining the true bearing of his lines.

No doubt the best and easiest way is to connect with some line, the bearing of which has been ascertained with accuracy. But such a line is not always accessible, and a surveyor should have it in his power to establish his bearings by independent observation. This can be done, within a very small limit of error, in fact as near as the theodolite can be read, which is sufficiently accurate.

Observations to ascertain the variation of the compass are being constantly taken at sea, but the same degree of accuracy is not required as in a survey on land. The altitude of the sun or a star is used in most of these methods. In using altitudes we are liable to error from refraction; moreover the theodolite, the land surveyor's instrument, is better suited for measuring horizontal angles or azimuths than altitudes. For these reasons it is desirable to use a method, equally good, in which altitudes are not required. Again, it will be well if we can dispense with a knowledge of the latitude.

It is not a very difficult problem to find the latitude; still there is advantage in having one problem to solve instead of two, and if the surveyor can find the meridian without first finding the latitude, so much the better.

There is another point to be considered in estimating the values of different methods; that is the amount of time consumed in observing. At an observatory this is a secondary consideration. The main point is to obtain perfect accuracy, and for this purpose transits are observed, day after day, and corrections made by the help of the clock. But a surveyor requires something more expeditious.

There are three well-known methods available for him, and I propose to consider them, with reference to the tests already mentioned; and then to apply the same tests to a fourth method, which is the subject of my paper.

The first method is by a single observation of the sun or a star. For this an altitude is required, also a knowledge of the latitude. It is, therefore, open to objection on both accounts.

The second method is by equal altitudes. This requires two observations at an interval of several hours, and is therefore inconvenient in point of time. It often happens, moreover, that when you have taken the first observation, you cannot get a favourable opportunity for the second.

The third method is by observing a single circumpolar star at its greatest elongation. This is a very accurate method and recognised as one of the best, still it requires a knowledge of the latitude.

The fourth method is by observing two circumpolar stars at their greatest elongation, and taking the difference of their azimuths at the time of observation. From the observed difference of azimuths of the two stars, and their declinations as given in the almanac, the azimuth of each star can be obtained. From either azimuth the position of the true meridian can be ascertained at once.

Two stars can be selected which do not differ much in the time of their elongations, consequently there need not be much time spent in observing.

A knowledge of the latitude is not required, and as the only angle observed is horizontal, there is no error from refractions, and the method suits the theodolite.

The formula to be used is given below, and an example is worked out, but I shall not trespass further on your time by reading them.

Let the stars observed be X and Y, X at its greatest eastern elongation, and Y at its greatest western elongation.

Let the azimuth of X be A
,, azimuth of Y ,, B
Declination of X ,, D
Declination of Y ,, E.

Then it may be proved that—

$\text{Tan.}\ \frac{1}{2}\ (A-B) = -\text{Tan.}\ \frac{1}{2}\ (D+E)\ \text{Tan.}\ \frac{1}{2}\ (D-E)\ \text{Tan.}\ \frac{1}{2}\ (A+B)$, which is a formula adapted to logarithmic computation from which A—B can be obtained.

A + B is the difference of readings of the theodolite obtained by directing the telescope first to the star X, and then turning it round to Y, supposing X to come into position first.

When we know A + B and A — B, it is easy to determine the separate values of A and B.

If the stars X and Y are both on the same side of the meridian, the observed angle is A—B, and the same formula may be used by making A + B and A—B change places as follows :—

$$\text{Tan.}\ \frac{1}{2}\ (A+B) = \text{Tan.}\ \frac{1}{2}\ (A-B)\ \text{Cot.}\ \frac{1}{2}(D+E)\ \text{Cot.}\ \frac{1}{2}\ (D-E)$$

To illustrate this formula an example is added, which has been worked out by Mr. A. G. Tofft :—

The following stars were observed at their greatest elongation on the evening of October 11, 1884 :—A Trianguli over its western elongation at

8h. 4′ 57″ p.m., and Achernar at its eastern elongation at 8h. 49′ 40″ p.m., and the differenee of their readings was 76° 10′ 34″. To find their azimuths A and B.

$$\text{Tan. } \tfrac{1}{2}(A-B) = \text{Tan. } \tfrac{1}{2}(A+B)\ \text{Tan. } \tfrac{1}{2}(D+E)\ \text{Tan. } \tfrac{1}{2}(D-E)$$

$$\begin{aligned}\text{Log. Tan. } \tfrac{1}{2}(A-B) &= \text{Log. Tan. } \tfrac{1}{2}(A+B) + \text{Log. Tan. } \tfrac{1}{2}(D+E) + \text{Log. Tan. } \tfrac{1}{2}(D-E)\\ &= \text{Log. Tan. }(38^\circ\ 5'\ 17'') + \text{Log. Tan. }(63^\circ\ 19'\ 10'') + \text{Log. Tan. }(5^\circ\ 29'\ 35'')\\ &= 9{\cdot}8941851 + 10{\cdot}2987972 + 8{\cdot}9830243\\ &= 9{\cdot}1760066\end{aligned}$$

$$\begin{aligned}\text{Tan. } \tfrac{1}{2}(A-B) &= 8^\circ\ 31'\ 45''\\ \tfrac{1}{2}(A+B) &= 38^\circ\ 5'\ 17'' \text{ as observed}\\ \tfrac{1}{2}(A-B) &= 8^\circ\ 31'\ 45'' \text{ as above.}\end{aligned}$$

Therefore by adding and subtracting these equations we get—

$$A = 46^\circ\ 37'\ 2'' \text{ and } B = 29^\circ\ 33'\ 32''$$

A REJOINDER TO MR. A. B. BIGGS'S CRITICISM ON OBSERVATIONS MADE IN RESPECT OF THE "OBSERVED PERIODICITY OF THE DEATH RATE," ETC.

BY R. M. JOHNSTON, F.L.S., ETC.

[*Read November* 17, 1884.]

I am glad to see that so able a critic as Mr. Biggs has taken up the important subject of the "Death rate in its observed coincident relation to super-terrestrial phenomena," which was recently introduced by me in a paper read before this Society; although, at the same time, it is to be regretted that he has based his remarks upon a brief abstract from a newspaper rather than upon the paper itself, for it has greatly misled him as regards the nature and scope of my argument.

It appears to me to be very clear that Mr. Biggs's difficulty is caused chiefly by erroneously assuming that the relations commented upon are *simple* instead of *complex,* and that belief in a more or less striking observed *coincidence* seems to be regarded by him as synonymous with a like belief in a corresponding *mutual inter-dependence* between the matters which have been observed to coincide.

Now there is a very wide difference between the conception or conviction of a known agreement or *coincidence* and the conception of an underlying causal relation. We can fairly conceive and admit of identity of movement or action between several phenomena for a limited space of time without prejudice, even when we assume that such coincidence is not uninterrupted for a longer period, or that it may be due (1) to mutual inter-dependence alone; (2) to causes