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Government of Madras.

Public Works

DEPARTMENT.

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Not to be folded or roughly handled

No. 311. Read the following letter from the Chief Secretary to the Government of Bombay, Revenue Department, to the Secretary to the Government of Fort St. George, dated Bombay Castle, 30th June 1871, No. 3,172 :—

In forwarding ten printed copies of a report on the trial of a new instrument, called the "Omnimeter," by the Superintendent of the Bombay Survey, I am directed to request that, with the permission of His Excellency the Governor in Council, they may be distributed among the Engineer Officers serving under the Government of Madras.

From Major G. A. LAUGHTON, Superintendent, Bombay Revenue Survey, to the Survey and Settlement Commissioner, N. D., dated Bombay, 22nd March 1871, No. 150.

I HAVE the honour to enclose a copy of letter from the Secretary of State for India, sanctioning an application I made, while lately on furlough in England, to be allowed to bring out for trial a new instrument called the "Omnimeter," and requesting me to submit a report upon the working of the instrument to the Government of Bombay.

2. This instrument was not ready when I left England in the end of last August, but was subsequently forwarded to me, and arrived in Bombay towards the end of January last.

3. Having given the instrument a thorough trial, I have now, in terms of the above letter, to submit for the information of Government the following report :—

4. The "Omnimeter" is an instrument which effects several operations, namely, it measures vertical and horizontal angles; it determines altitudes, and can consequently be used as a level; and, lastly, it measures linear distances, whether inclined or horizontal. In fact, with this instrument, work combining the use of the chain, level, and theodolite, can be done more expeditiously than with the latter instruments at one and the same time, and consequently in a great measure supersedes the necessity of using them.

5. This instrument professes to measure—

Distances	...	...	...	of 100 feet to within 0.001.
"	...	...	...	of 1,000 feet " 0.050.
"	...	...	...	of 1,000 yards " 1 foot. "
Heights at a distance...	...	...	...	of 300 feet " 0.0005 of a foot.
"	...	...	...	of 1,000 feet " 0.002.

6. The principal parts of the "Omnimeter" are—

- (1.) A powerful telescope.
- (2.) A powerful microscope.
- (3.) A scale fixed on the horizontal plate and divided into half-millimètre.
- (4.) A micrometer screw, turning a circular disk, which is divided into 500 equal parts, one whole turn of which moves the above scale half a millimètre.
- (5.) A graduated circle for measuring horizontal angles.
- (6.) A level to adjust the horizontal plate.
- (7.) A second level placed upon the telescope.
- (8.) An arc for measuring vertical angles.—*N.B.* The one on this instrument is not divided, and consequently is useless for the above purpose.

7. The instrument is formed by combining the powerful microscope with the telescope, and the micrometer, which gives measures on the scale fixed on the horizontal plate, and which is divided into half-millimètres as fine as 0.0000002 of a metre, or 0.0002 of a millimètre. The microscope is perpendicular to the telescope, and both move on the same axis.

8. The perpendicular distance from the centre of the axis to the scale on the horizontal plate can be found to any required degree of accuracy; it is a constant quantity in each instrument.

9. The bases and the perpendicular of any number of triangles may be taken, by use of the microscope, micrometer, and scale, with accuracy; which triangles will be similar to corresponding ones taken by the telescope. The most important triangle given by the telescope, is that formed by supposing two lines to pass through the telescope, one to the head and the other to the foot of a staff of known length, held perpendicularly in the direction of a required height.

10. Accompanying the instrument are two or more staves, of an invariable length; those used with this instrument are about 11 feet long, having two white lines on a black ground exactly 10 feet apart, and as all the measurements are of a decimal character, this length is the best that could be adopted.

11. The above is the description of the instrument, and of what it professes to be able to perform. It is altogether as portable as any ordinary theodolite. I may here state that I am mainly indebted to "Pon's Dictionary of Engineering" for the description I have given of the "Omnimeter."

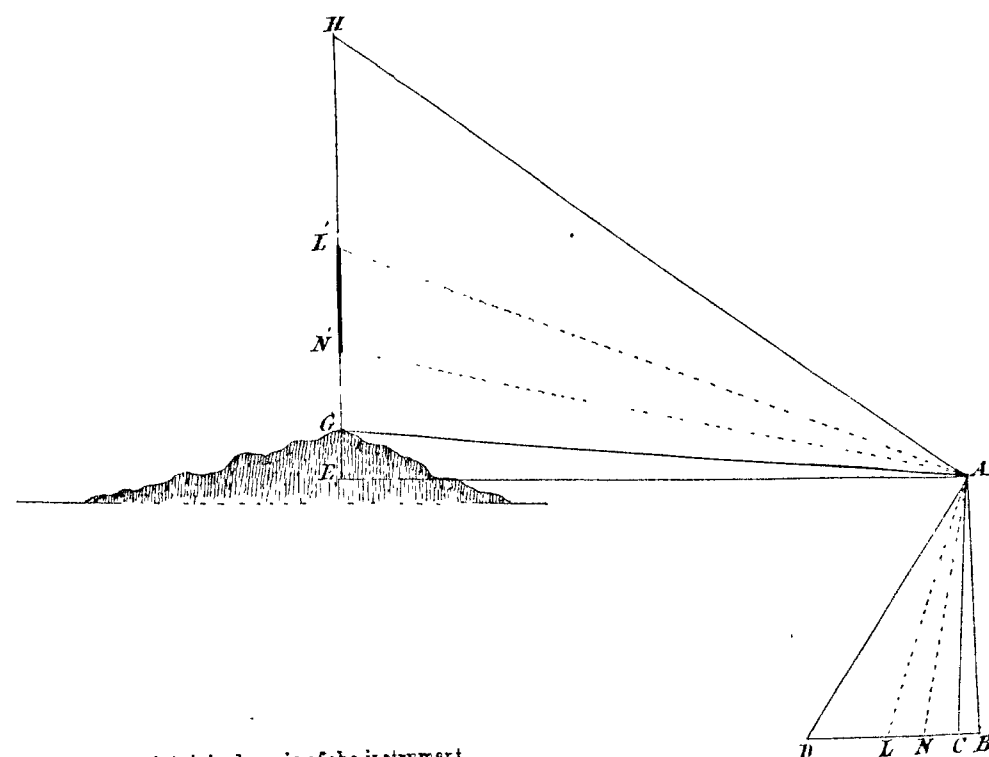
12. I now proceed to show to what degree of accuracy I have been able to work with the instrument.

13. As the Omnimeter professes to perform five things, as stated in paragraph 4, I will take them in the order therein mentioned.

14. The arrangements for measuring vertical and horizontal angles are similar to those of an ordinary theodolite, and require no explanation; the horizontal plate in this instrument is $5\frac{1}{2}$ inches in diameter, and is divided into divisions of $20'$ —the vernier reads to $30''$ —the vertical arc, as stated before, is not divided, and thus one of the principal parts is wanting; for without it, the finding of the distance from the axis to the surface of the scale fixed on the horizontal plate, as also the "stationary point" of the scale, required for levelling purposes, is a laborious operation.

15. To determine altitudes: the staff is placed in a vertical position alongside of the object the height of which is required. The instrument being placed at a short distance away from the object, duly adjusted; a reading is taken to the upper line of the staff, and then to the lower line, after which the telescope is directed to the top and bottom of the object, the altitude of which is required.

16. The distance from the object being ascertained, as will be described hereafter, the height of the object is obtained by the proportion, thus: Let AB = the distance from the axis to the surface of the scale, CD = the difference of readings between top and bottom of object as read off the scale, AE = the linear distance between the instrument and object, LN = the difference of readings between top and bottom of staff, and GH = the required height of the object;—then as $AB : CD :: AE : GH$ $\therefore GH = \frac{CD \times AE}{AB}$; AE , may be put = 1, 10, 100, 1000, and so on, the calculation becomes extremely easy:—



N.B.—The point A is the axis of the instrument.

17. In practice the above has been found to be exceedingly accurate; the heights of several buildings and portions of buildings in Bombay have been taken, and subsequently the same have been measured by a plumb-line; both measurements have been found to coincide almost exactly.

18. The manner of levelling consists in determining the lines LN and NB on the scale; the first is in proportion to the staff, and the other to the height over or under the level of the instrument. The first of these lines, LN , is found, as before described, by reading the top and bottom lines of the staff. The second, NB , by finding out the point B , called the stationary point of the scale, which is obtained by the optical axis-line of the microscope, when the telescope is brought horizontal by means of the level attached to it; the point B is constant, and serves for all calculations in levelling operations. The line NB is thus found to be the difference between the number N , obtained by sighting the staff, and the number of the stationary point B . The proportion is then as follows:—

(Vide the same figure.)

$$LN : NB :: LN : NE \therefore NE = \frac{LN \times NB}{LN}$$

19. In levelling the "Omnimeter" has been found to be wonderfully accurate—quite equal to what, as is shown in paragraph 5, it professes to be able to do.

20. The principal tests I have put it to are as follow: A series of points were fixed in a direct line, from 150 to 900 feet; the levels of these were accurately determined by an ordinary level twice over;—this operation of course took considerable time. The Omnimeter was then adjusted, and without being moved from that spot, observations were taken to the top and bottom lines of the staff, at each point, a work which occupied only a very short time, for, as there are only two well-defined lines on the staff, there was not the same hesitation in reading as with an ordinary levelling staff, with which there is an element of guesswork not found in using the staff of the "Omnimeter;" on the levels being calculated from the data thus obtained, the greatest difference between the results obtained by the two instruments, viz., Ordinary Level, and Omnimeter, was 0.01.

21. As the linear distance obtained by this instrument is the principal element in determining the level of any given point, for experiment it was supposed that a mistake of 3 feet existed in a distance of 900 feet; but on calculating the level with this error—that is, the distance being known to be 900 feet—the numbers 897 and 903 were taken in calculating the height of the point—in each instance the level thus obtained differed from the true level by ∓ 0.02 .

22. Again, in a distance of upwards of 6,000 feet, working through a crowded city with constant interruption, the last reading on a bench-mark, from which the work was commenced, was found to differ from the first, by only 0.22.

23. Another test was as follows: The height of a hill of about 90 feet was determined by carefully levelling both up and down with an ordinary level—a work which occupied us nearly two hours; the same height within 0.29 was obtained within five minutes after adjusting the "Omnimeter," by observing a staff at the bottom of the hill, in the manner before described, and another at the top of the hill. This was done without moving the instrument.

24. I now come to the last operation performed by this instrument, namely, that of measuring linear distances, and I would be glad indeed were I able to report as favourably on this, as on the others.

25. The operation in determining the distance from the instrument to the staff is similar to the others—that is, the staff is held vertically on the point, and the top and bottom lines are observed as before; the proportion is as follows, vide last diagram:—

$$LN : AB :: LN : AE \therefore AE = \frac{LN \times AB}{LN} = \text{the required distance.}$$

26. Another case can be taken where LN is placed partly below the horizontal line AE , as

*Proceedings of the Madras Government, Public Works Department,
19th July 1871.*

37. There is one more improvement I would beg to propose, and it is one that not only applies to this instrument, but also to all theodolites, and this is, instead of employing spider's webs, for the hairs in the eye-piece of the telescope and microscope, fine lines photographed on glass should be inserted. These lines can be made finer than any hair; also the glass can be taken out and cleaned, and the risk of breaking the hairs and the trouble required to re-insert them be entirely done away with; in like manner the divisions on the scale of the Omnimeter should be photographed instead of being engraved.

38. I ought to apologize for this long report, but when I came to think what a vast amount of trouble and expense can be saved by universally employing such an admirable instrument as the "Omnimeter," I feel I cannot say too much.

39. For City surveying, in laying down traverse lines, all chaining is done away with, horizontal angles and levels are taken at one and the same operation.

40. For surveying and levelling in rough, hilly and thickly wooded country, only those who have been obliged to use theodolites and chains in such places can understand what a boon this instrument will be to others similarly employed.

41. For Railways and Irrigation purposes it is equally if not more useful.

42. In conclusion, I would beg to propose that my report upon the Omnimeter be printed, in order that not only Government Engineers and Surveyors in this and in other Presidencies, but the public in general, may have an opportunity of discussing the merits of this instrument.

From the Under Secretary of State for India, to Major G. A. LAUGHTON, dated India Office, S. W., 6th August 1870.

With reference to your letters dated the 7th and 14th of last month, I am directed to inform you that the Board of Trade has been requested to give instructions to Sir Henry James to furnish you with the maps and papers specified in your list.

2. The Duke of Argyll is willing to sanction the supply to you for experimental trial in India of the new instrument for taking linear measurements, which is considered by Colonel Strange to be worthy of a fair trial, and that Officer will be directed to furnish you with one to take with you to Bombay. The payment of the cost of carriage and of the custom dues is also sanctioned. I request that you will submit a report to the Government of Bombay after trial of the working of this instrument.

No. 312.

ORDER THEREON 19th July 1871, No. 1,898.

ESTABLISHMENT, No. 33.

COMMUNICATED to the Superintending Engineers.

(True Extract.)

Colonel, R.E.,

Secretary to Government..

To the Acting Chief Engineer for Irrigation.
To Superintending Engineers.
,, Major R. B. Kennedy.
To the Superintendent of Revenue Survey.

Exd. S. T. Augustin.

N. 3172 of 1871.

Revenue Department,

Bombay Castle, 30th June 1871.

To
The Secretary to the Government of
Fort St. George.

Sir,
In forwarding 10 printed copies of a report on the trial of a new instrument called the "Omnimeter," by the Superintendent of the Bombay Survey, I am directed to request that, with the permission of His Excellency the Governor in Council, they may be distributed among the Engineer Officers serving under the Government of Madras.

I have the honor to be,

Sir,
Your most Obedient Servant.

For Chief Secy to Govt.

Public Works 1891 Department.

No. 3161

From

Asst. Secy to Government
of Bombay

For L. S. George
19 July 1911

To
Chgo for investigation
of
Public Works
Dept of Co. Survey

At 20° 30' 1891
Period 4° July

No. 3172.

Received

No. 1898.

Communicated to the
Public Works

Forwarding
for distribution, copies of
a report on the trial of
a new instrument called
the "Inclinometer" by the
Superintendent of the
Bombay Survey -

No. 1898 - 26 July 1911
With an order

[Signature]

to L. S. George

C/p 3161

NOV 1871 230015.

PUBLIC WORKS.

Chief Engineer for
Irrigation

19 July 1898.

311/312

Omniometer. Letter from
the Chief Engineer, Fort, Bombay
Commanding, for distribution
of a report on the
trial of a new instrument
called the "Omniometer"
by the Major, the Bombay
Survey, and the Chief
Engineer.