entering into the water in cell. This is done by using mordants (such as solution of Borax, Chloride of Aluminium, &c), & then depositing a layer of Collodion. Hope to do a good day's experimenting Tomorrow (Sunday)

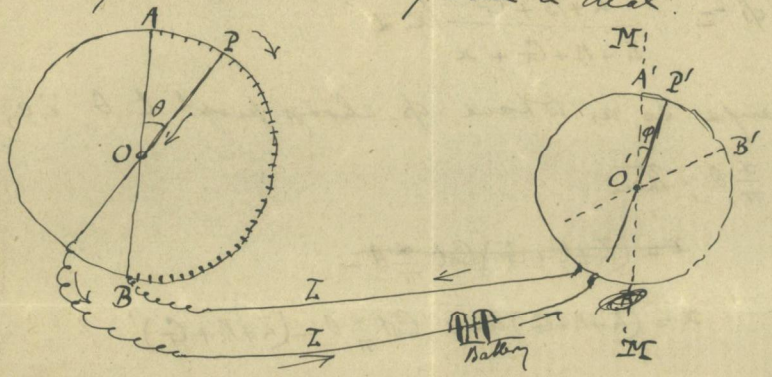
So there are lots of Saints & Miracles in Galway!
Poor Ireland! Poor England! Poor 19th Century!

M.

Φ, 10/105 June 26.

You egregious fool! You said that the principle of my telethermometer – barometer – anemometer – &c. would not work. Why, I have since found out that it is exactly the principle of the Crookes Telescope!!!

I now explain the general arrangement of ~~an instrument~~ a Tele-indicator, the indications being received in a tangent galvanometer, and sent by a needle moving over a dial.



Let OP be the sending needle [vane, Breguet thermometer needle, Aneroid needle, &c]. Begin by supposing it to move continuously in the sense ↓. Let O'P' be the receiving (tangent) needle [grossly exaggerated in length, I perceive; but let that pass]. Let MM be the trace of the Magnetic meridian in wh. O'P' lies when no current is passing. Let this happen ~~and~~ when OP lies along OA. so that the resistance of the ½ circle APB = ∞. Let O'B' be position of O'P' when OP ~~lies~~ lies along OB, there being no resistance between B and the line wire I_L. In this last case the current is at its greatest, being $\frac{E}{I_L+B+G}$, where I_L = line resistance, G = Galv^{m} resistance. B = battery "

Let the ½ circle APB be graduated into 180 degrees, and between

each adjacent pair of degree divisions let a special re… be inserted. [The divisions are made in an ebonite plate… and the division marks are made with thin brass strips].

Let x be the whole amount of resistance between P and B,

θ = angle A'O'P', φ = A'O'P'.

Then $\tan\varphi = \dfrac{E}{L+B+G+x}$; 10|106

and if when $x=0$, $\varphi = A'O'B' = \alpha$, $\tan\alpha = \dfrac{E}{L+B+G}$

$$\therefore \tan\varphi = \frac{L+B+G}{L+B+G+x}\tan\alpha$$

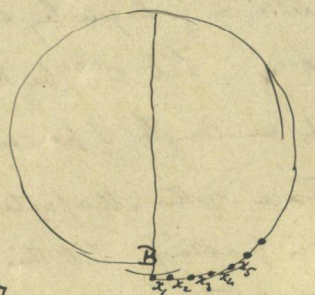
Let us arrange so as to have φ always proportional to θ, i.e., let $\varphi = \frac{\alpha}{\pi}\theta$; Then

~~$x = (L+B+G)\cot\frac{\alpha}{\pi}\theta -$~~

$$x = (L+B+G)\tan\alpha \cdot \cot\frac{\alpha}{\pi}\theta - (L+B+G).$$

This gives the successive magnitudes of the resistances interposed between the divisions.

Let $x_1, x_2, x_3, \ldots$ be the resistances interposed between the degrees measured from B.



Then

$x_1 = (L+B+G)\tan\alpha\left[\cot\frac{\alpha}{\pi}179° - \cot\frac{\alpha}{\pi}180°\right]$

$x_2 =$ " $\left[\cot\frac{\alpha}{\pi}178° - \cot\frac{\alpha}{\pi}179°\right]$

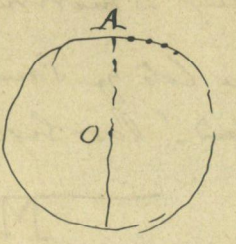
$x_3 =$ " &c. — —

— —

…of a rough estimate, suppose 40 miles of telegraph line to be the line resistance (400 ohms, say);

Let B = 600 ohms, G = 100 ohms,

and let the max^{m} current deflect the receiving needle thro' 60°. Then I find that



the resistances interposed between the degree A and the next degrees are

163,742 Ohms
54,579 "
&c. (growing much less)

The EMF and resistance must remain constant.

But now arises the question, where are all these great resistances to come from? I answer, from bars or lines of carbon. My instrument maker showed me a little carbon bar whose resistance = 10,000 ohms; by suitably diminishing its section (ch. was about that of an ordinary lead pencil) we could get much larger resistances. But he also showed me lines of carbon traced out on glass which had resistances of hundreds of thousands (or even millions) of ohms. So that there is no difficulty in producing the necessary resistances without resorting to immense numbers of resistance coils.

I have hit off the principle of a "Self-adjusting Sine Galvan…", but it is more complicated than the tangent arrangement. Try if you can suggest a method of making one.

I seem to have obtained some queer results with Naphthaline Red, but they must be repeated. I have completely succeeded …fixing Eosine, &c., &c., on the Silver plates, so trace of them