

Is there anything in this? Unfortunately, we don't know how to compound two currents or two magnetised cylinders.

8. There is a remarkable letter in last week's Nature (letter n° 1) on the conditions of passage from the solid to the liquid state, in wh. the author says that he has proved the impossibility of this in certain cases. In these cases, the solid passes directly into a gas.

See this letter.

9. I think that I have written about enough to you, so wishing you merry Christmas and a Happy New Year, I am

M.

Should you entertain a low opinion of this communication, then—

"This truth within thy mind rehearse,
That in a boundless Universe,
Is boundless better, boundless worse."

$$\begin{aligned} \rho &= \frac{(1-\gamma)\cos(\alpha+\gamma)\sin\alpha}{1+\gamma\cos\alpha} + \rho' \cdot \frac{(1+\gamma)\cos(\alpha-\gamma)\sin\alpha}{1-\gamma\cos\alpha} = \\ &= \frac{\rho(1-\gamma)\cos(\alpha+\gamma)\sin\alpha + \rho'(1+\gamma)\cos(\alpha-\gamma)\sin\alpha}{1+\gamma\cos\alpha} = \\ &= \frac{\rho(1-\gamma)\cos\alpha\cos\gamma + \rho(1-\gamma)\sin\alpha\sin\gamma + \rho'(1+\gamma)\cos\alpha\cos\gamma - \rho'(1+\gamma)\sin\alpha\sin\gamma}{1+\gamma\cos\alpha} = \\ &= \frac{\rho(1-\gamma)\cos\alpha\cos\gamma + \rho'(1+\gamma)\cos\alpha\cos\gamma}{1+\gamma\cos\alpha} = \end{aligned}$$

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Φ,

J. Leonardt,

Sussex,

Sept. 19.

Still prostrated by the effects of your Red Sea Dinner, you are unable to write. At least, I presume that you have not written, since no letter has been forwarded to me here. I shall be at Cooper's Hill tomorrow, and, no doubt, after you have sufficiently recovered, I shall receive some communication.

I have, while here, fiddled with Clerk-Maxwell and I was sending you some inharmonious tunes, the results of the fiddling process. [By the way, get Mark Twain's "Roughing It", price 1/- . It contains a good deal of information about Western America in its early stages, and several things which have kept me laughing for days.]

1. The surfaces of constant magnetic potential of any closed electric current are surfaces at whose points the circuit subtends constant solid angles. If one surface corresponds to the solid angle ω , and another to ω_2 , they cut at a constant angle all along their common edge (wh. is the circuit) and this angle is $\frac{1}{2}(\omega_2 - \omega)$. [Vol II., p. 134.]

Can you prove this geometrically? I have proved it in a few words.

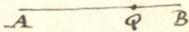
2. Let the circuit be a plane triangle. Determine the degree of the surface of constant magnetic potential, & its equation in any rectilinear co-ords.

I find it to be of the 12th degree.

3. If it's allowable to assume surfaces normally magnetised — not with constant intensity, as Maxwell always does, but — with varying intensity, you can make a number of easily soluble problems for your Moderationship men.

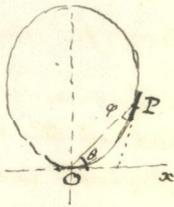
Thus, for instance, if the surface is a rectangular area of finite breadth and infinite length in wh. the intensity at any point in it is represented in magnitude and sign by the distance of the point from the middle line of the area (H.C. to its length), the surfaces of constant pot.^l are very easily found.

Again, if AB represents the breadth of the rectangle, Q any point in it, and if the strength of magnetisation at Q is prop.^l to QA x QB, the surfaces are easily found.



4. A very easy little problem.

The curve $r^2 = a^2 \sin \theta$ is such that if a very short magnet, P, is moved along it tangentially, another short magnet at O will keep dipping constantly in the same direction, Ox.



This follows at once since

$$\tan \phi = 2 \tan \theta,$$

the well-known result.

The above curve is also such that if a very short straight current parallel to Ox be moved along it, and kept H.C. to Ox, the force of it on a magnetic pole at O is constant.

5. If M is the magnetic potential of any closed circuit (plane or tortuous) at a point (α, β, γ) , we have

$$\frac{d^2 M}{d\alpha^2} + \frac{d^2 M}{d\beta^2} + \frac{d^2 M}{d\gamma^2} = 0.$$

I don't see this mentioned; but mind having written it down, it seems perfectly evident, because M can be regarded as consisting of two gravitation potentials of attracting matter, one portion placed on the outside of the magnetic shell, and the other on its inside, there being a small normal distance between the two layers.

However, let it stand.

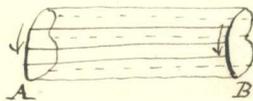
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6. To determine, in any integrated form, the solid angle subtended at a point by even a plane circuit seems to me to be a desperate business. I can't invent any circuit that will work. Maxwell works a lick with harmonic expansion.

7. Why should we not have some manageable system of "Electro-Magnetic Statics"?

Thus, we know that a force at A = the same force at B + a Couple; and, analogously,

a current at A = (magnetically) the same current at B



+ a normally magnetised cylinder (or surface).

Conceivably we might have a system in which "force" could be replaced by "Circuit", & "Couple" " " " " "normally magnetised surface".