



XXXV. Further demonstration of the existence of a real or imaginary root for any proposed equation

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coating of oxide, was gained, on the other hand, by the reduction of the alkaline stratum; and the consequence was a singular steadiness of action, the needle continuing for an hour within a degree or two of its maximum deflection.

This durability of action offers the means of a new class of voltaic researches, on which I am not yet prepared to make any report.

23. From multiplied experiments of the kind above quoted, it may be inferred that the metals partake of the electrical character of the liquids in contact with them; their electric condition being exalted if that liquid is similar, and depressed if it is of the opposite kind. And hence the fact observed by Morichini, that an addition to the quantity of copper increases the power of a voltaic pair, the charge being always negative, and therefore homo-electric with copper.

24. Whatever be the nature of electricity, it would seem to be connected with material particles by something analogous to affinity; inducing bodies which are naturally positive, to withdraw positive electricity from those which are naturally negative, when brought into mutual contact. In what way they do this I am unable to conceive in a manner consistent at once with the phenomena, with chemical analogy, and with probability; nor are experimental indications very easily found. I may perhaps venture the surmise, that repulsion is the stimulative, attraction the suppressive, principle of voltaic agency.

[To be continued.]

XXXV. *Further Demonstration of the Existence of a real or imaginary Root for any proposed Equation. By R. MURPHY, Esq., M.A., Fellow of Caius College, Cambridge.*

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,

IN your Number for January, you favoured me with the insertion of a simple demonstration relative to the existence of a real or imaginary root for any proposed equation. I beg leave to reproduce that proof in a more distinct point of view in the present Number.

When the equation $f(x) = 0$ is of odd dimensions, it is known from the simplest principles that there exists a real root.

When the function $f(x)$ is of even dimensions, put $p + q\sqrt{-1}$ for x ; where p and q are real quantities, the result R will evidently be of the form $P + Q\sqrt{-1}$. Where

P, Q are real functions of p and q , and the latter of odd dimensions in Q ; therefore a real value of q corresponding to any proposed real value of p may always be found so as to make $Q = 0$, and then we have $R = P$, a quantity always real.

By assigning to p real values indefinite in number, the real values of R thus obtained must either pass through zero, or else some one result is nearer to zero than any other.

In the latter case putting $p + h$ for p , and supposing such a value assigned to q that $Q = 0$, we should obtain a result

$$R = P + A h^h \dots\dots\dots (1)$$

in which the lowest power of h alone is included, since we may suppose h very small.

But if we put for $p, p + h \left\{ \cos \frac{\pi}{n} + \sqrt{-1} \sin \frac{\pi}{n} \right\}$ this substitution will lead evidently to the same result as if we put for $p, p + h \cos \frac{\pi}{n}$; and for $q, q + h \sin \frac{\pi}{n}$, and a real value may therefore be found for $q + h \sin \frac{\pi}{n}$, and consequently also for q such that Q shall still vanish, and we get

$$\begin{aligned} R &= P + A h^h \left\{ \cos \frac{\pi}{n} + \sqrt{-1} \sin \frac{\pi}{n} \right\}^n \\ &= P - A h^h \dots\dots\dots (2) \end{aligned}$$

One of the real values of R marked (1), (2) must necessarily be nearer to zero than P , contrary to supposition. \therefore Hence it follows that R passes through zero; that is, the equation $f(x) = 0$ always admits a root of the form $p + q \sqrt{-1}$ where p and q are real quantities.

Caius College, Jan. 11.

R. MURPHY.

XXXVI. *Suggestion regarding the Improvement of Lighthouses.* By JOHN ROBISON, Esq. Sec. R.S. Ed.

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,

AS there are some circumstances which make it probable that a light of large volume, though of moderate intensity, should be recognisable at a greater distance *during foggy weather*, than one of small extent, though more brilliant, and capable of penetrating further in a clear atmosphere, it appears to be desirable that some person who has the means of doing