Philosophical Magazine Series 2

ISSN: 1941-5850 (Print) 1941-5869 (Online) Journal homepage: http://www.tandfonline.com/loi/tphm13

LIII. On the symmetrical functions of a specific number of the roots of an equation

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To cite this article: Rev. R. Murphy (1831) LIII. On the symmetrical functions of a specific number of the roots of an equation , Philosophical Magazine Series 2, 10:60, 413-414, DOI: 10.1080/14786443108674298

To link to this article: http://dx.doi.org/10.1080/14786443108674298

Published online: 14 Jul 2009.

coexistence of unequal elasticities is not only possible, but must be the case; for if the æther be an elastic fluid uniformly diffused through space absolutely devoid of other matter, it follows that wherever it penetrates a space filled with any medium, such as air, it must necessarily be attracted round each particle of air, and form *spheres of a density increasing towards their centres.* Amongst an infinite number of such spheres uniformly diffused, a succession of vibrations communicated in a given direction, will of course give rise to vibrations propagated with various velocities, according to the particular elasticity of different parts of the disseminated medium: thus we shall have a number of coexistent vibrations producing undulations of different lengths which, when they are incident upon a new medium, will cause a deviation in position proportional to the unequal lengths of their undulations, according to the well known and established explanation of the general law of simple refraction as expressed by the undulatory theory.

November 1st, 1831.

LIII. *On the Symmetrical Functions of a specified Number of the Roots of an Equation.* *By* the Rev. R. Murphy, *Fellow of Caius Coll. and of the Camb. Phil. Soc.*

To the Editors of the Philosophical Magazine and Annals.

Gentlemen,

IN a paper published in the last Number of the Transactions of the Cambridge Philosophical Society, I have given a few simple rules relative to the solution of algebraical equations, with their demonstrations. The sum of any *specified number* of the roots taken in order from the least, upwards, and the sum of any given function of such roots, may be thence found, for any proposed equation $\phi(x) = 0$, containing only positive and integer powers of x. The coefficients of the different terms of an equation are, as is well known, the sums of symmetrical functions of *all* the roots; and my present object is to show a simple method of obtaining the corresponding sums of the symmetrical functions of a *specified number* of the roots; and as general investigations relative to a specified number of the roots are I believe new in analysis, this paper may not be unacceptable to your mathematical readers.

Let $\alpha_1, \alpha_2, \alpha_3 \ldots\ldots \alpha_m$ be the m least roots, taken in order, of the equation $\phi(x) = 0$, and λ any arbitrary quantity. Then by a rule given in (§ 3) of the paper above referred to, we get

log

$\log(1+\lambda\alpha_1) + \log(1+\lambda\alpha_2) + \ldots\ldots \log(1+\lambda\alpha_m) =$ coefficient of $\frac{1}{x}$ in $\frac{-\lambda}{1+\lambda x} \cdot \log \frac{\phi(x)}{x^m}$. This coefficient is a function of λ, suppose $\psi(\lambda)$. Hence $(1+\lambda\alpha_1) \cdot (1-\lambda\alpha_2) \ldots\ldots\ldots (1+\lambda\alpha_m) = \varepsilon^{\psi(\lambda)}$ ε being the base of Napier's logarithms.

Let $\varepsilon^{\psi(\lambda)}$ be expressed in powers of λ, the general term being $u_p \cdot \lambda^p$, and suppose we equate the terms involving like powers of λ, on both sides of the equation; then

First; When $p < m$, u_p is evidently the sum of the products of the m least roots, taken p and p together.

Secondly; When $p = m$, $u_p =$ the product of the m least roots.

Thirdly; When $p > m$, u_p is zero,

From the third case, it follows, that in applying this method we may always reject from $\psi(\lambda)$ all the terms after that which involves λ^m.

A process exactly similar will give the combinations p and p together, of any *functions* of the m least roots or their continued product. I am, Gentlemen, your obedient Servant,

R. Murphy.

LIV. Decas tridecima Novarum Plantarum Succulentarum; *Autore* A. H. Haworth, *Soc. Linn. Lond.—Soc. Horticult. Lond.—Soc. Cæs. Nat. Curios. Mosc.—necnon Soc. Reg. Horticult. Belgic. Socius: &c. &c.*

To the Editors of the Philosophical Magazine and Annals.

Gentlemen,

After a longer space than usual between my communications to your valuable Magazine and Annals, I send you hereunder my thirteenth Decade of New Succulent Plants, for insertion, if you please, in an early Number of that useful work.

As heretofore, I have carefully stated the native countries of every species,—detailed, but with due precision, their botanical characters; and not failed to record the rich gardens from whence I have received them. And to all these particulars I have added such contrasting and other characters as may enable the gardener to grow them, the botanical tyro to understand them, and every able author to appretiate and blend them with their old affinities in a scientific way.

I remain, Gentlemen, yours, &c.

Chelsea, Aug. 30th, 1831. A. H. Haworth.

Ord.