116. Note on the Graphical Solution of Quadratics

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tations of the remaining five words, we have to reject all in which *tibi* comes earlier than the remaining monosyllable—half of the whole number.

∴ II. gives $\frac{6|5}{2}$ arrangements.

III. Line ends in *tibi* followed by dissyllable: from the possible permutations of the words we have to reject those in which *sidera* comes second or fourth of the words *tot sunt quot sidera*.

∴ III., like I., gives $\frac{3|6}{2}$ arrangements.

IV. Line ends in *tibi* followed by two monosyllables: from possible permutations reject those in which a monosyllable comes earlier than *sidera*.

∴ IV. gives $\frac{6|5}{2}$ arrangements.

∴ Whole number of arrangements is $2\left(\frac{3|6}{2} + \frac{|6}{2}\right) = 4|6 = 2880$.

W. E. HARTLEY.

116. [X. 4. b. a.] *Note on the Graphical Solution of Quadratics.*

The general quadratic, $ax^2 + bx = c$, is satisfied by the values of x which are common to the equations $y = x^2$, $ay + bx = c$.

The first of these represents a fixed parabola which is easily graphed for permanent use, and the second represents a variable straight line which is easily graphed for particular values of a, b, c . Thus the only requisites for approximating to the roots of a quadratic are the possession of a good printed, or accurately drawn, graph of the above parabola on squared paper and a little ingenuity in the manipulation of the straight line.

Two points only on the line $ay + bx = c$ are wanted, and these are generally to be obtained by selecting simple integral values for x and y .

E.g., convenient points on $3y + 5x = 4$ would be $\left. \begin{matrix} x=2 \\ y=-2 \end{matrix} \right\}, \left. \begin{matrix} x=-1 \\ y=3 \end{matrix} \right\}$.

In practice it will be found convenient not to draw the line, but to place the straight edge of a sheet of paper on the points selected (which are usually two of the corners already marked on the squared paper), and prick on the parabola the points where it is cut by the straight edge.

In this way the original graph can, with care, be used for a considerable time. Of course any parabola would do, but $y = x^2$ has the additional merit of providing a rough table of squares and square roots.

In a similar way the graph of $y = x^3$ can be used to get solutions to any cubic equation if the cubic be first thrown into the form $x^3 + ax = b$.

A. E. WYNNE.

[The reader may remember the semi-graphic solution of a quartic equation by Prof. G. B. Mathews in *Nature*, Nov. 16, 1899. In Mr. Hall's supplementary chapter on "Graphical Algebra" to Hall and Knight's elementary treatise (6d., Macmillan), we find: Plot the graphs of $y = x^3 - 3x$. Find the roots of $x^3 - 3x = 0$, with several similar questions, pp. 22, 23. W. J. G.]

REVIEWS.

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