these being taken as positive in sign so long as O lies within the region selected (*i.e.* within ABD), then:

$$\triangle OAC - \triangle OAB = \triangle OAD.$$

For $\quad \triangle OAD + \triangle OAB + \triangle OBD =$ half the parallelogram.

But $\quad \triangle OAC + \triangle OBD =$ half the parallelogram.

(seen by drawing the line POQ)

From these equals, removing the $\triangle OBD$ we have

$$\triangle OAD + \triangle OAB = \triangle OAC$$

or, $$\triangle OAC - \triangle OAB = \triangle OAD,$$

if AB, AC, AD represent two forces and their resultant, becoming:

moment of AB
+ moment of AC
= moment AD, all about O.

This is the moments theorem, and involves the usual attribution of signs.

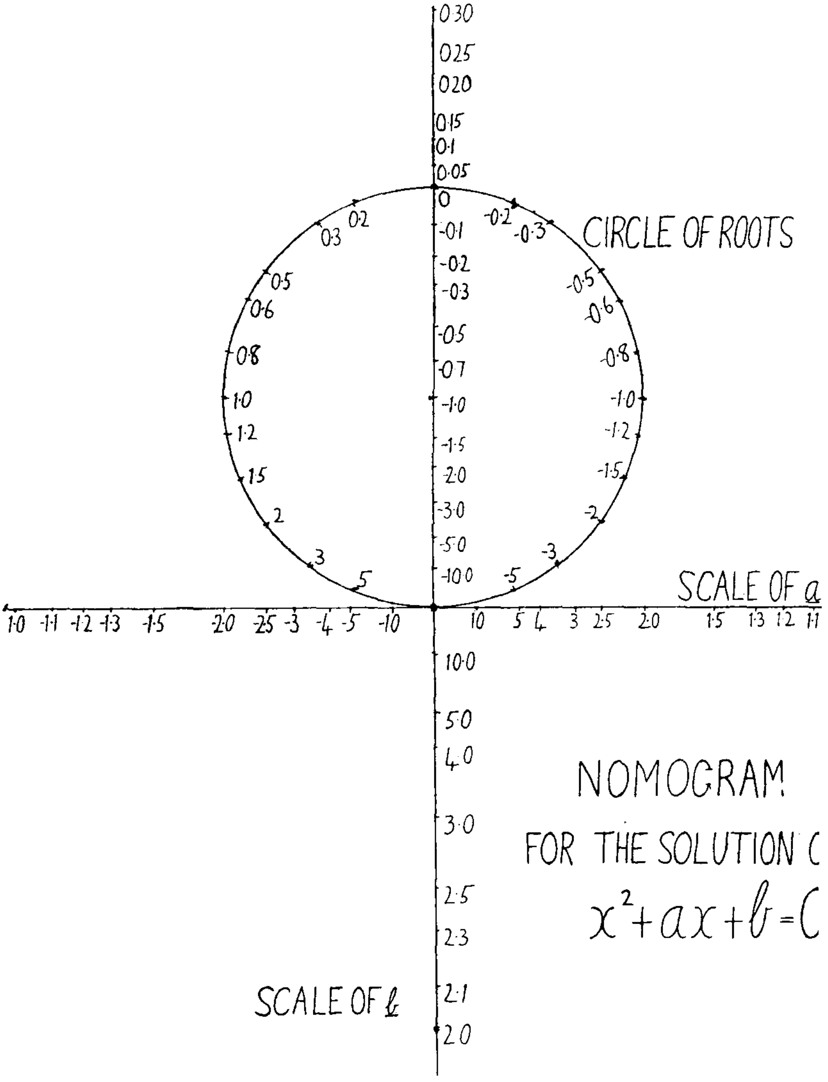
If O moves away so as to cross either a diagonal or a side of the parallelogram, it in so doing makes one of the moments vanish, the sign of that moment changes thereby, and the moments theorem is confirmed in all positions.

G. E CRAWFORD.

A simple nomogram for the solution of quadratic equations.—There are many well-known graphical solutions of the quadratic equation, in which the roots are obtained as the intersections of a circle with a straight line. The practical objection to these solutions is that a fresh diagram has to be drawn for each equation that is to be solved: and the time occupied in constructing the diagram is greater than the time required to solve the equation by the ordinary arithmetical method.

This objection no longer applies if the diagram is of such a nature that, when once constructed, it can be used for *any* quadratic, whatever be the values of the coefficients. Such a diagram, in which the construction is made once for all and is applicable to any number of special cases, is called a *nomogram*. A nomogram for the solution of the quadratic has been devised by Monsieur d'Ocagne, which depends on the intersection of a straight line with a hyperbola.

The accompanying diagram represents a nomogram for the solution of the quadratic which is easier to construct than d'Ocagne's



nomogram, inasmuch as it consists of nothing more than two rectangular axes and a circle touching one of them at the origin.

https://doi.org/10.1017/S1757748900001523 Published online by Cambridge University Press

By means of this diagram, quadratic equations can be solved at sight.

The method of using the nomogram is as follows: *Let the equation to be solved be*

$$x^2 + a\,x + b = 0.$$

Find the point on the horizontal axis at which the reading is a, *and the point on the vertical axis at which the reading is* b. *Imagine these two points joined by a straight line* (*e.g.* by stretching a thread between them, or by laying a straight-edge across). *Where the line meets the circle, read off the graduations on the circle: these are the required roots of the quadratic.*

If the line is not conveniently situated on the diagram, we may replace the given equation, *e.g.* by the equation whose roots are the roots of the given equation with signs reversed, or the equation whose roots are the roots of the given equation multiplied or divided by 10 or some power of 10.

The circle can be of any arbitrary radius R. The graduation p on the scale of a is then at a distance $2R/p$ from the origin, and the graduation p on the scale of b is at a distance $2R/(1-p)$ from the origin. The graduation at any point of the circle is the same (with sign reversed) as the graduation at that point of the horizontal axis which is derived from it by projection from the highest point of the circle.

The proof may be left to the reader.

It is obvious that this diagram may also be used as a graphical multiplication-table, division-table, addition-table, and table of reciprocals. For if α and β are two numbers, we have only to take the points on the circle whose graduations are α and β, and lay the straight-edge across them. Where it meets the vertical axis we can read off the product $\alpha\beta$, and where it meets the horizontal axis we can read off $-(\alpha+\beta)$. The reciprocal of any number is found (with sign reversed) at the point diametrically opposite from it on the circle, and also (without sign reversed) at the point where its ordinate meets the circle again.

E. T. WHITTAKER.