AN EASY INTRODUCTION TO THE HIGHER TREATISES ON THE CONIC SECTIONS

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CONIC SECTIONS.

BY THE

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PREFACE.

THE PRESENT INTRODUCTION has resulted not from theorizing on what may be expedient, but from long experience of what is needful. The author has, from time to time, had applications for assistance in the study of such treatises on the Conic Sections as those of Salmon, Hymers, Puckle, and Todhunter. He has accordingly ascertained the nature of the difficulties that perplex and discourage many readers of those treatises, and has endeavoured in this publication to provide a first course of lessons and exercises which, he thinks, cannot fail of qualifying the young student for reading with intelligence and profit the masterly works referred to. Todhunter's book is especially recommended as the most appropriate sequel to this Introduction.

It should be remarked that the name *Conic Sections* chiefly refers to the Ellipse, Hyperbola, and Parabola, as curves that can be obtained by means of a right cone variously intersected by a plane.

LONDON: *October*, 1866.

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EASY INTRODUCTION

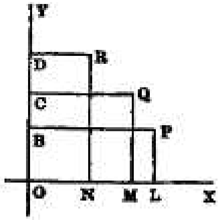
TO

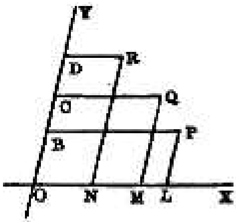
CONIC SECTIONS.

Coordinates of a Point.

1. In Plane Geometry the term *Ordinate* means one of any number of parallel lines drawn from successive points in one plane, to meet a straight line in the same plane perpendicularly or at any angle.

In the following diagrams, OX and OY are intersecting straight lines. The successive lines PL, QM, RN, YO are



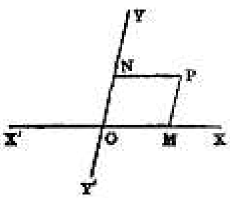


drawn *ordinately*, or in parallel succession, to meet OX; and the lines DR, CQ, BP, OX are drawn *ordinately* to OY. In one of the diagrams the parallels are perpendicular to the line they meet; in the other they are oblique.

2. The lines PL, PB, being both drawn from P, are together called *Coordinates* of that point; in like manner, QM, QC are coordinates of the point Q; and so forth.

But the term *ordinate* is usually restricted to the lines that are parallel to OY; and instead of those parallel to OX we use the equivalent magnitudes OL, OM, ON, which, as being portions of OX *cut off* by the ordinates, are called *abscissæ*, and each of them an *abscissa*. Thus, QM is the ordinate and OM the abscissa of the point Q; and OM, QM are the coordinates of that point.

3. If, in one plane, two unlimited straight lines, X′X, YY′, be drawn intersecting, at any angle, at the fixed point O, the position of any other point in the plane may be referred to these lines, and expressed in terms supplied by them. For a point must be on the right or on the left of YY′, or else in the line YY′; and must also be above or below X′X, or else in the line X′X. Thus, the



point P is situated on the right of Y′Y, and above X′X; that is, it is within the angle YOX; and if the lengths of PN and PM be known to be, respectively, 4 and 3, then, measuring OM=4 from O towards X, and ON=3 from O towards Y, we shall have indicated, by means of X′X and YY′, the position of P, viz. that P's position is at the intersection of lines drawn respectively parallel to OY and OX from the points M and N.

4. The lines YOY′ and X′OX are called the *Axes of Coordinates*; the former, by itself, the axis of ordinates, as being the line on which ordinates are measured; the latter, by itself, the axis of abscissæ, as being the line on which abscissæ are measured.

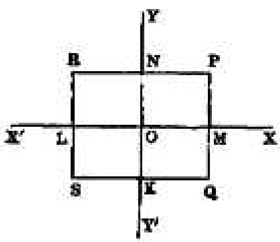
But, in general reasonings, an unknown or variable abscissa is denoted by the letter x, and its corresponding ordinate by the letter y; and therefore it is usual to call the axis of abscissæ the axis of x, and that of ordinates the axis of y.

The point O, where the coordinates intersect, is called the *Origin of Coordinates*, because we are to suppose the lines OX, OX′, OY, OY′ all to be drawn from O; OX to the right, OX′ to the left, OY upwards, OY′ downwards.

The coordinates are called *Rectangular* or *Oblique*, according as they do or do not intersect at right angles.

In the following part of this introductory treatise, we shall always suppose the axes to be *rectangular*.

5. The position, then, of P is known, if OM and PM are known. Suppose that the lengths of these coordinates are, respectively, a and b; we characterise the position of P thus, $x=a$, $y=b$, which are called equations to the point P.



For shortness, we often speak of the point (a, b), meaning the point which has a for the length of its abscissa, and b for that of its ordinate. So, the point (4, 3) means the point whose coordinates are $x=4$, $y=3$.

6. Suppose it is required to determine the geometrical position of the point $(-10, 7)$.

Here, since $x=-10$, and $y=7$, we take ON=7 *upward* from the origin, and OL=10 to the *left* of the origin; and, completing the parallelogram OR, we obtain R, the required position, which is within the angle YOX′. This procedure will be readily understood by the student who has read Chap. I. of the Author's *Treatise on Trigonometry*. The point O being the fixed origin of coordinates, an abscissa measured to the right of O, viz. along OX, is accounted positive; one measured to the left of O, viz. along OX′, is therefore negative; and, in like manner, an ordinate measured upwards from O, along OY, being accounted positive, one measured downwards from O, viz. along OY′, is to be accounted negative.