ALGEBRA TO QUADRATIC EQUATIONS

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EDWARD ATKINS

ALGEBRA TO QUADRATIC EQUATIONS

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ALGEBRA

TO

QUADRATIC EQUATIONS,

FOR

Elementary and Middle Class Schools.

BY

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ALGEBRA.

CHAPTER I.

ELEMENTARY PRINCIPLES.

1. Algebra treats of numbers, the numbers being represented by letters (symbols of *quantity*), affected with certain symbols of *quality*, and connected by symbols of *operation*.

It is easy to see that these symbols of quantity may be dealt with very much as we deal with concrete quantities in arithmetic. Thus, allowing the letter a to stand for the number of units in any quantity, and allowing also $2a$, $3a$, $4a$, &c., to stand respectively for *twice*, *thrice*, *four times*, &c., as large a quantity as the letter a, it at once follows that we may perform the operations of addition, subtraction, multiplication, and division upon these symbols exactly as we do in ordinary arithmetic upon concrete quantities. For instance, $4a$ and $6a$ make $10a$, $9a$ exceeds $5a$ by $4a$, $15a$ is 5 times $3a$, and $7a$ is contained 8 times in $56a$.

Neither is it necessary in these operations to *state*, or even to *know* the exact number of units for which any symbol of quantity stands, nor indeed the nature of these units; it is simply sufficient that it is a symbol of *quantity*. Thus, in the science of chemistry, we use a weight called a *crith*; and a person unacquainted with chemistry might not know whether a crith were a measure of length, weight, or capacity, or indeed whether it were a measure at all, yet he would at once allow that 6 criths and 5 criths are 11 criths, that twice 4 criths are 8 criths, &c.

The Signs + and − as Symbols of Operation.

2. In purely arithmetical operations, the signs + and − are respectively the signs of addition and subtraction. In this sense, too, they are used in algebra.

Thus, $a + b$ means that b is to be *added* to a, and $a - b$ means that b is to be *subtracted* from a.

Hence, as long as a and b represent ordinary arithmetical numbers, $a + b$ admits of easy interpretation, as also does $a - b$, when b is not greater than a. But when b is greater than a, the expression $a - b$ has no arithmetical meaning. By an extension, however, of the use of the signs + and −, we are able to give such expressions an intelligible signification, whatever may be the quantities represented by a and b.

Positive and Negative Quantities.—The Signs + and − as Symbols of Affection or Quality.

3. Def.—A **positive** quantity is one which is affected with a + sign, and a **negative** quantity is one which is affected with a − sign.

Let BA be a straight line, and O a point in the line; and suppose a person, starting from O, to walk a miles in the

direction OA. Suppose also another person, starting from the same or any other point in BA to walk a miles in the direction OB. These persons will thus walk a miles each in *exactly opposite* directions. Now, we call one of these directions *positive* (it matters not which) and the other *negative*. Let us take the direction OA as *positive*. We then have the first person walking a miles in a *positive* direction, and the second walking a miles in a *negative* direction. We represent these distances algebraically by $+a$ and $-a$ respectively.

It will therefore be seen that the signs + and − have no effect upon the magnitudes of quantities, but that they express the *quality* or *affection* of the quantities before which they stand.

Again, suppose a person in business to get a profit of £6, while another suffers a loss of £6. We may express these facts algebraically in two ways. We may consider *gain* as positive, and *loss* as negative gain, and say that the former has gained + 6 pounds, while the latter has gained − 6 pounds. Or we may consider *loss* as positive, and *gain* as negative loss, and say that the former has lost − 6 pounds, while the latter has lost + 6 pounds. We hence see that the gain of + 6 is equal to a loss of − 6, and that a gain of − 6 is equal to a loss of + 6.

The Sum of Algebraical Quantities.

4. Let a distance AB be measured to the *right* along the line AX. And let a further distance BC be measured from B in the *same* direction. By the *sum* of these lines we mean the resulting distance of the point C from the original point A, that is to say, the distance AC.

(It may be remarked that we *add* the line BC to the line AB by measuring BC in its *own proper direction* from the extremity B of AB. It is hardly necessary to remind the student that both lines are in the same straight line AX.)

Let us represent the distances AB and BC by $+ a$ and $+ b$ respectively; then the *algebraical sum* of the lines will be represented writing these quantities side by side, each with its *own proper sign* of affection.

Thus the sum of the distances AB and BC is expressed by $+ a + b$, or, as it is usual to omit the + sign of a positive quantity when the quantity stands alone or at the head of an algebraical expression, the sum of AB and BC is expressed by $a + b$.

Hence, the interpretation of $a + b$ is that it represents the distance AC.

Again, taking as above $+ a$ to represent the distance AB along the straight line AX, and measured to the *right*, let a distance BC be measured from B in the same straight line AX, but this time to the *left*.