Diophantus as the Father of Algebra

At the beginning of his major work *Arithetica*, Diophantus lays out a symbol system that he uses throughout the book to signify what we would call equations. An example shows the major components of the system.

Here is an equation in our modern form:

$$x^3 - 2x^2 + 10x - 1 = 5$$

And here it is as Diophantus writes it:

$$K^\gamma \overline{\alpha} \zeta \tau \cap \Delta^\gamma \overline{\beta} M \overline{\alpha} \cdot \overline{i} \sigma \overline{M} \overline{e}$$

Here, the symbols $\overline{\alpha}, \overline{\tau}, \overline{\beta},$ and $\overline{e}$ are Greek numerals, standing for, respectively, 1, 10, 2, and 5. The bars over the Greek letters indicate that they are being used for numbers. The $\overline{\iota}$ is short for $\overline{\iota} \sigma \zeta$, which means “equals.” The inverted trident (and the closest I could come with my font set was $\cap$) indicates subtraction of everything that follow it, up to the $\overline{\iota} \sigma$. Thus, we can begin to translate Diophantus’ equation:

$$K^\gamma 1 \zeta 10 - \Delta^\gamma 2 M 1 = M 5$$

This leaves four symbols to explain, and they all deal with the unknown quantity of the equation, what we could call the variable. The $\zeta$ is the unknown, while $K^\gamma$ stands for the cube of the unknown (from the Greek word κοβος, “a cube”), $\Delta^\gamma$ the square of the unknown, and $M$ the “zeroth” power of the unknown. Thus the literal translation now becomes:

$$x^3 1 \times 10 - x^2 2 \times 0 1 = x^0 5$$

Or, with parentheses and some implied plus signs,

$$(x^3 1 + x 10) - (x^2 2 + x^0 1) = x^0 5$$

And finally, writing the coefficient before, rather than after, the variable, letting $x^0 = 1$, and rearranging in decreasing order of degree, we get

$$x^3 - 2x^2 + 10x - 1 = 5$$

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So at least one sense in which Diophantus is the “Father of Algebra” has to do with a symbol system that considerably shortens the verbal descriptions of equations that had been in use up to that time.

Another reason might be that he performed some very “algebra-like” calculations in solving equations. In his writings, he solved third- and fourth-degree equations in one unknown, systems of equations in two, three, and four unknowns, and a problem that is equivalent to solving a system of eight equations with twelve unknowns.

In calculating what amounts to the product of binomials such as \((a + b)(c - d)\), he knew how to handle the minus signs:

“Wanting [i.e., negativity] multiplied by wanting yields forthcoming [i.e. positivity]; wanting multiplied by forthcoming equals wanting.”

This is evidence that even though Diophantus did not recognize what we would call a negative integer as a number, he did nevertheless know how to deal with them in some sense, during calculations. Another indication that this is so is his ability to subtract, for example, \(2x + 7\) from \(x^2 + 4x + 1\) to obtain \(x^2 + 2x - 6\). The -6 didn’t make sense as a number, but it was clear to Diophantus that subtracting 6 in the expression was the correct thing to do. Thus, at some level, it seems he understood that \(1 - 7 = -6\).

Further, he showed evidence of combining like terms to simplify, and moving a term from one side of an equation to the other, changing the sign appropriately.

Finally, he was the first of the Greek scholars to break away from geometry and move toward a focus on number.

It is not clear that he was the first to use a symbol for the unknown; if not, the name of that person is lost in antiquity. Certainly if Diophantus is not the “Father” of Algebra, he remains a “Dear Old Uncle” to Algebra, and a pretty good one at that.