

(I) *Principles are more important than methods and formulæ.*

Mathematics are built upon a certain number, not very large, of axioms and conventions. The axioms give rise to no difficulty, except to the metaphysician; all believe them as soon as they understand the language in which they are expressed; but it is necessary for the teacher to see that the pupil does understand this language.

The conventions must be laid down authoritatively; the pupil must, here as elsewhere, understand what they mean; but he is not, in most cases, an adequate judge of their propriety. He will often think them inconvenient and improper: but he is not in a position to set his judgment against that of the scientific world.

A pupil may think, and, judging from what I have seen, many seem to think that the absence of a sign between two letters ought to denote addition instead of multiplication, that $a\ b$ should mean a and b and not a times b . An algebra could no doubt be built up with this convention instead of the usual one. We will listen to any qualified person who may develop such an algebra, and show us, if he can, its greater convenience. But we will not listen to our pupils who are not qualified. We may try to give them some reasons for the convenience of the notation we ask them to adopt, but we cannot be sure that we can convince them; for they have not the knowledge, even if they have the power, to form a judgment on the question.

We should not disguise from them, however, that this is a convention, the convenience of which we ask them to take upon trust from us. We do wrong if we lead them to think that these conventions are on the same footing of necessity as axioms. I fancy that a mistake of this kind is

sometimes made in the early teaching of arithmetic. If we allow our pupils to believe that 12 must mean twelve and could not possibly mean seven or ten, we confuse in their minds the distinction between the necessity of axioms and the arbitrariness of conventions.

Upon axioms and conventions are based certain doctrines which we call *principles*, such as the fundamental propositions of algebra. These principles, few in number, in their turn form the bases of methods and processes innumerable.

To teach each of these latter separately without system or co-ordination is an impossible task; the task of teaching mathematics is rendered feasible by referring to general principles. This should be done, not only at the outset, but also whenever mistake or misunderstanding occurs. A mistake other than a mere slip, to which all are liable, generally implies a misunderstanding or confusion about some fundamental principle; for its correction the fundamental principle should be referred to.

The object of teaching being to give power, not merely to impart a knowledge of facts, or facility in the conduct of process, a mistake which shows a defect of reasoning at some point, whether in the understanding of the principle or in the application of it—even slips arise from a momentary eclipse of the reasoning faculties due to a want of concentration—such a mistake should be made the opportunity of endeavouring to give a firmer grasp of fundamental principles so as not only to prevent the same or similar mistakes in future, but even to prevent dissimilar mistakes by strengthening the mental power.

Methods, therefore, do not constitute arithmetic, nor is algebra a system of formulæ; behind these are the general principles of the subject: