M. Laisant sets out with the assertion that even mathematics is an experimental science, that consequently the beginnings of mathematics should be concrete, to be followed later by abstractions, and deplores the fact that the reverse order is at present followed. "I hold that all the sciences without exception are experimental, at least to a certain extent; in spite of certain theories which attempt to treat mathematics as a sequence of operations of pure logic based upon pure ideas, it can be asserted that in mathematics, as in all other scientific domains, there exists no notion, no idea, which could penetrate into our brain without the previous contemplation of the exterior world and of the facts which this world presents to our observation. . . . . From this exterior world the first mathematical notions must be obtained, to be succeeded later by abstractions . . . . Now, how are things done to-day? Primary instruction, so far as it relates to the first notions of arithmetic, seems modelled on that of grammar; and one might just as well say that the latter is modelled on the teaching of arithmetic. That is to say, in the one as in the other the child is taught a number of abstract and confused definitions which he cannot comprehend; under pretext of giving him good practical directions, he is burdened with a set of rules; and these rules he learns and retains by dint of memory only, and applies them thereafter well or ill, as may be." After some discussions, relating more particularly to French conditions, comes the following pregnant passage: "The elementary acquisitions in mathematics—and they are of considerable extent—are no less useful, no less indispensable, than the knowledge of reading and writing. I will even add—and this may perhaps seem paradoxical—that these first elements can be assimilated with much less fatigue than the first notions of reading and writing; on one condition always: that is, instead of persevering in the present system of primary teaching, instead of giving an instruction bristling with rules and formulæ, appealing to the memory, causing fatigue and producing only disgust, the teaching should be inspired by the philosophic fact that it is necessary in the first place to produce images in the child's brain by means of objects presented to his senses."

M. Le Bon takes up some interesting phases of the agitation in France which culminated in the new curricula of 1902. Only the chapter on the teaching of mathematics is of direct interest here, and its tenor is sufficiently exemplified by the following quotation: "Mathematics is a language, and acquaintance with it no more develops the intelligence than that of other languages. One does not learn a language to exercise the intelligence, but because it is useful to know. Now, the habit of writing the simplest things in mathematical language is to-day so widespread that it is necessary for the pupils to learn this language, just as it would be necessary for them to learn Japanese or Sanskrit if all the books of science were written in these languages. The only important thing is to know how one can learn rapidly to comprehend and then to speak this special language of mathematicians. Like those of all languages, the beginnings only of this study are difficult. They must be made in the most tender infancy, at the same time as reading and writing, but by a method diametrically opposed to that which is used to-day. The teaching must be by experiences, substituting direct observation of quantities that can be seen and touched for reasoning about symbols. What makes the mathematical instruction of the child so difficult is the ineradicable habit of the Latin race always to begin with the abstract without first passing through the concrete. If ignorance of the psychology of the child were not so widespread and so profound all the pedagogues would know that the child cannot comprehend the abstract definitions of grammar, arithmetic, and geometry, and that he recites them as he would the words of an unknown language. Only the concrete is accessible to him. When the concrete instances have been sufficiently multiplied he will unconsciously deduce from them the abstract generalities. Mathematics ought therefore to be taught experimentally, especially at first, for, contrary to current opinion, it is an experimental science."

G. Hogben,
Inspector-General of Schools.

14th October, 1905.