toward the general and the abstract instead of condemning it. Certainly no one can know much of what is going on around us without this process of generalization. Some word to represent all the pushes and pulls in one's experience tends to economy of time and thought. But how if there are no particulars behind the general? And, moreover, it is easy to see how this tendency to extensive use of general terms comes about. The text-books all begin this way; they must do so. Their order is necessarily deductive; the order of holding and stating truth rather than of discovering truth. They must begin with the most general terms and proceed in the course of the treatise to analyze them into particulars. And it is so easy to follow the order of the texts instead of getting the appropriate material for study.

But, however, it comes about, this tendency toward the very early introduction of general terms is apt to be deprecated. When a boy sees a locomotive hauling a loaded train and discovers a third thing, called force, as real as the other two, and, dismissing the locomotive, affects to haul the train by it, he is on the road that leads straight to the hell of confusion and vacuity. Generalization is not only proper and important, it is necessary to the progress of inquiry, only one does so long to find some stage of education where the pupils deal with things in particular.

THE MEANING OF THE FORMULA $F=ma$.

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A recent article in the May number of this magazine by Professor Crew, "A Neglected Point in the Teaching of Elementary Dynamics," has no doubt been read with interest by many teachers. He says, "In terms of the usual algebraic symbols the defining equation of force is

$$F=ma.$$

But if this be granted how is one to justify himself in saying that force is required to maintain a constant elastic deformation, where no acceleration of any kind is involved? This is the difficulty alluded to in the title of this note."

I have just examined twelve books, selected at random. Six of these were written for colleges, and six for secondary schools. In only one of them do I find the difficulty eradicated, and in that one, a college text, the explanation of the equation lacks sufficient emphasis. I am quite sure that this laxity in our texts must needs mean a lack of clearness of conception on the part of many teachers and pupils. The student learns from the text book that any force F acting on a mass m will produce an acceleration a , the relation being expressed by the formula $F=ma$. Let him apply this conception to the case of an elevator of mass m , descending with an acceleration a , the tension T to be found, and he is at once confused. The confusion is caused by wrong teaching. The student has not the meaning of the equation. His idea of m and a are probably correct, but the exact meaning of F is the stumbling block.

F is the force that actually produces the acceleration, *i. e.*, it is the *unbalanced* or *resultant* force.

As simple as is this interpretation of F , I fancy most students must either flounder upon it or never understand the use of the equation. On the other hand, a student that has been correctly taught will at once search for the *resultant force* in a problem presented him. For example, the solution of the elevator problem resolves itself into finding the resultant force, *i. e.*, the difference between the force acting downward, mg , and that acting upward, T , and then equating this resultant force, $mg - T$, to the mass times the actual acceleration. From this equation T is easily found. (Here $g=980$ dynes, and mg is the number of dynes acting on m grams.)

Probably the writers of the text books I have examined expect the student to assume that the force F is free to act, that is, is not opposed by another force. However this may be, I am sure that most students are unable to apply the formula correctly without an interpretation similar to the one I have given.