EFFICIENCY IN EDUCATION.[1]

BY

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WE are living at a time in which the question of securing the highest efficiency in every form of business enterprise has become a dominant one. No man would undertake a business unless he could assure himself at the very outset that every department of it could be conducted both economically and efficiently.

For a man to take such precautions is not only an evidence of good common sense, but the stand is one that must be taken as a matter of self-protection.

There have been times in the progress of almost any kind of business when it was possible to keep it alive, and even prosperous, in spite of the careless and wasteful methods employed; but at the present time, when our excellent systems of communication have brought all parts of our country together and when manufactured products can be quickly delivered to the places where they are needed, however remote, any manufacturer is almost as keen a competitor of another a thousand miles away as though they both lived in the same city.

Space and time have been annihilated, from the business stand-point, and the man who does not meet the standards of economy and efficiency set up by his competitors will be crowded off the course by their inertia of motion or left stranded far in the rear by his own inertia of rest.

Since there is such a demand for high efficiency in the business world it may be well for us to inquire whether there can be efficiency in education, and, if so, how it may be secured.

At the very beginning we are met with fundamental differences in the conditions. In the factory one has to do with inert

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matter; in the school with individuals whose actions are governed by their own wills. In the factory we deal with a piece of automatic machinery which does the thing for which it was made, or, if it does not and refuses to work at all, it is largely our own fault in allowing it to get out of repair and become useless. In the school we deal with separate personalities, no two of which are alike and no two of which are sure to do the same thing under exactly the same conditions; while, if the results obtained are not what we want, we are limited to the giving of advice, which is accepted or not according to the mood or fancy of the one who receives it.

It would seem, then, by this comparison of the material with which we have to deal, that the problem becomes a much more difficult one when we bring it into the field of education.

When a man designs a piece of automatic machinery he must, in order to be at all successful, have very definitely in mind the purpose for which the machine is being designed: what it is that the machine is to do. To take any other course would stamp the attempt with failure from the start.

To secure efficiency in education, should there not be the same clear-cut, definite knowledge of the result to be obtained? There is in both cases a groundwork of that which is fundamental. In the case of the designer it is his knowledge of the physical qualities of the materials to be used. He must know what the limit of elasticity is, of the material that he proposes to use in every part. He must know whether it will be able to stand the strains that will be put upon it in the work that it has to do. He must know whether there is a choice in this material, and he must make choice of the very best, or the next man who takes up the problem and who can profit by what he has done will so far surpass him in his design that the work shall be a failure through the very competition that it invited, by not being the best machine that could be made. Not only must the designer have this fundamental information, but this fundamental strength, this fundamental elasticity, this fundamental adaptability must have been put into the material by the maker, or the machine will be a failure through his lack of this fundamental knowledge.

The same thing obtains in efficient education. There are, first of all, the fundamentals to be obtained and to be made such a part of the every-day life of a child that they seem to him things that have always been known.

At the very foundation of these fundamentals I would place the ability to think straight. Perhaps you think that I am beginning at the wrong end and that the ability to think straight is the aim and end of education and cannot be had at its beginning. Well, there may be some reasons for your opinion, but I really believe that in order to secure efficiency in education it must be founded upon the ability to think straight, to have the moral sense of what is right and what is wrong, and, moreover, I believe that this ability is common to most men and women.

To the man who does not think straight or who will not, an education brings at most the ability to succeed in things in which it would be better if he should fail. There is another phase of thinking straight, and that is to have one's thoughts clear and well defined. This, too, seems to me to be one of the fundamentals in education.

If we are to have any hope whatever of being of service to those about us, or of being influential among them, we must be able to present our opinions to them in a clear and forceful manner, and this we cannot do unless we are able to think them out clearly to ourselves. It is a pleasure to listen to a man who has a definite purpose in his mind and also has the ability to express that purpose in fitting words, and so I would include, as another fundamentally important thing, an ability to use one's native tongue forcefully.

Too frequently, none of the things that I have mentioned are considered as a necessary part of an education at all. In addition to the ability to understand and use the English language, there is one other department of knowledge that lies at the very foundation of daily life, and that is mathematics. Now, do not think of the kind of mathematics that delights the mathematician, for what I mean is the fundamentals—that is, the elementary mathematics, such as arithmetic, algebra, and geometry. If we consider for a moment that the great discoveries of Nature were most of them made with just these branches of mathematics applied to the questions in hand, possibly adding trigonometry for the use of the astronomer, we shall see that the essentials are elementary.

No one can live in our times, surrounded as we are by the most striking applications of science, without feeling that a study of the natural sciences is required in order to consider that we may be entitled to the name of educated people. Here, again, the fundamentals are of the greatest importance. Take, for example, electricity, which has so general an application in lighting, heating, and furnishing us a means of transportation. As a matter of fact, the essentials are few. It is in the applications that there is so great a divergence. Let a man be thoroughly grounded in the elementary principles of magnetism and electricity: it is a simple matter of diligent application of these principles that solves the most intricate problems to be met.

When we calculate the efficiency of an electric generator, for example, we find that it is the ratio of the power output to the power output plus the *losses*. How are these losses made up? Why, there is the loss in the shunt field, and this we expect and are willing to allow, because if there were no shunt field there would be no lines of magnetic force for the armature wires to cut and there would be no voltage generated for delivery at the brushes. Then there is the armature loss, and this we expect, for there must be wires to cut the lines of force, and they all have some resistance; hence there is a heat loss in the armature that increases as the current increases. Then there are the stray losses—those heart-breaking losses that the designer tries to cut down and generally fails: losses that have no compensation; that have no redeeming feature; that are only detrimental to the machine, and that cut down its efficiency ten per cent. How are these losses made up? Why, there is the friction between the shaft and bearings, between the brushes and commutator, between the rotating armature and the air. There is the time-lag or hysteresis loss, and there is the eddy current loss which is due to currents set up by the cutting of the magnetic lines by the armature core or the pole pieces, and which only serve to heat up the machine and increase its resistance. Now, how does this apply to education? What I would say is that if we wish to increase efficiency in education we must cut down the losses. Perhaps there are some of them that are really so connected with the system or method that they cannot be avoided. But there are certain others—the stray losses—that are wholly harmful, and these should be eliminated. The friction losses between teacher and taught should disappear. The system should be so changed that friction between both teacher and taught and the system should not be possible. And, greatest of all, the eddy currents, those vampires that destroy uselessly, caused by inattention, lack of interest, lack of enthusiasm, should be themselves destroyed.

To insure efficiency in education there must be a greater saving in another great loss, and that is in the loss of time. This requires that one shall know without question what it is that he wants to inform himself on, and not flounder along helplessly for months or years with no definite goal in view. You who have had the opportunity of taking the courses that the Franklin Institute offers have had the advantage of knowing definitely what it was you wanted to study. You have had the opportunity placed before you of applying yourself directly to the problem in hand, and if you have taken advantage of these opportunities you have the consciousness that the education so secured has brought with it something that has been of real and lasting value. I believe we should never look upon our education as a thing of the past. I greatly admire the point of view of the centenarian who had completed his hundredth year in this year 1912 who went to a shoemaker to have a pair of shoes repaired and was very insistent that they should be made strong enough to last a long time. The shoemaker said to him, "Why, you are a hundred years old, and still you seem to be as anxious that these shoes shall last as though you were to live another hundred years." "Well," said the old man, "perhaps I shall. I am a great deal stronger than I was when I started out in 1812." That is the kind of optimism that I like.

Refractories. F. A. J. FITZGERALD. (*Med. and Chem. Eng.*, x, 129.)—*Alundum (fused alumina)*.—Pyrometer tubes of alundum are now made; they are more refractory and have a higher heat conductivity than porcelain or fire-clay tubes. As a roof for electric steel furnaces alundum bricks resist the high temperature, but show a tendency to break off in layers, owing to the action of lime vapor arising from the basic slag.