DISCUSSION

PRESSURE DUE TO MOUNTING SCIENTIFIC KNOWLEDGE

IN his recent communication concerning the pressure due to mounting scientific knowledge, Professor H. M. Dadourian[1] fails to make clear whether the suggestions he advances apply to all students or only to those who intend to become professional scientists. Such a distinction is essential to the understanding of his proposed program. If his plan is intended for only the prospective scientists, may we point out the difficulty of identifying these students while they are still at the grade-school level. But whether his remarks are directed toward all or only to a select group there are various practical considerations of which little note is taken.

If only the phonetic English is taught to future generations all the great English literature of the past, both scientific and otherwise, must be translated or become inaccessible to our grandchildren. Such translation would obviously entail much effort and expense. Is not Dr. Dadourian overly optimistic in his prediction that the adoption of a phonetic alphabet would save "much time and energy for all concerned"?

The streamlining of the curriculum presents certain difficulties. Who is to decide what subjects in the curriculum are "indispensable" and by what criteria? Many scholars would differ with the opinion that "foreign languages, dead or living, are not indispensable." One may well ask, also, which languages are dead and which living. Are Latin and Greek which inescapably confront us not only in scientific terminology but also in English of common usage less dead than a modern language which many students "take" for three or four years and still can not speak?

Moreover, in eliminating from text-books every topic which is not "indispensable to further progress in the subject or which could not be treated more effectively in advanced texts" are we not losing sight of the student who does not intend to major in science? The fact must be recognized that most students do not make science their profession.

Professor Dadourian states that "Somehow the natural curiosity of the child is being destroyed and the common sense of the pupil is being bred out of him, as applied to his studies. The teaching of science continuously in primary and secondary schools would help correct these conditions." Does he wish to imply that other subject-matter can not be taught in such a way as to achieve the same end? It is perhaps true that the natural curiosity and logic of the child are too often subjected to the erosive influences of uninspired and thoughtless pedagogy, but it is also true that extending the period of time over which a subject is taught does not necessarily augment the insight of the teacher.

Has Dadourian also overlooked the fact that science is now taught in at least nine years of the twelve-year-curriculum offered by most present-day public schools?

We must take care that in our zeal to turn out efficient scientists we do not produce instead what Jacques Barzun[2] terms the single-track expert and the scientific ignoramus. For, as he quotes it, "What do they know of science who only science know?"

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LET us consider the points raised by Professor and Mrs. Craft in the order in which they appear in their communication.

I believe that the adoption of the suggestions made in my note would result in the improvement of the education of all—non-scientists as well as scientists. This belief was definitely implied in my remarks about the ignorance of science and of the scientific method on the part of our leaders and the vast majority of educated people.

It is true that if only phonetic English were taught to future generations, there would be some difficulty in reading books printed in the old spelling. It is not true, however, that all the great English literature would become inaccessible to our grandchildren. First, because old books, which are constantly being reprinted, would be printed in the new spelling and the reprinting in the new spelling would be accelerated. Secondly, because a person brought up in the new spelling would have less difficulty in reading old books than one has now in reading Chaucer, for the simple reason that changes in spelling do not involve changes in the meanings of words. If necessary both types of spelling could be taught until most of the old books have been reprinted in the new spelling.

It is difficult to estimate the time lost in having to learn spelling. The equivalent of one school year does not seem to me to be too high an estimate. But, however small the amount of time and energy lost by an individual may be, it becomes enormous when multiplied by the hundreds of millions who learn English in one generation, and by the uncounted number of future generations.

I fully appreciate the difficulty in deciding what is indispensable in a curriculum or in a text-book.

[1] H. M. Dadourian, SCIENCE, 101: 611, 1945.

[2] Jacques Barzun, "Teacher in America." First ed. Page 94. Boston: Little, Brown and Company, 1945.

I do not advocate, however, determining what is indispensable once and for all time, because this problem does not admit of such a unique solution. What I am suggesting is that educators, learned societies and text-book writers be aware of this problem and deliberately attempt to give it progressively better solutions in the light of experience.

The question "What is a dead language?" is not relevant to my suggestions and was not raised in my note.

In advocating the elimination of some topics from text-books, I have not lost sight of the student who does not intend to major in science. The examples I have given indicate that these students could dispense with the kind of topics I have in mind even more profitably than students who are to become specialists in science.

In advocating the teaching of science continuously through primary and secondary schools, I did not intimate that other subjects can not be taught so as to produce the desired results; neither did I refer to augmenting "the insight of the teacher." I claimed, first, that sciences are better adapted than some other subjects to stimulating the interest and maintaining the curiosity of the pupil and, secondly, that continuous and longer exposure to science is necessary for imparting the scientific outlook and for making science more palatable to college students.

In stating ". . . science is now taught in at least nine years of the twelve-year curriculum offered by most present-day public schools," the writers either include mathematics or use the word "taught" to mean "offered"; otherwise it would not be true. I should, perhaps, have stated explicitly that by "science" I meant the physical and biological sciences and by "teaching" I meant teaching as required subjects. These meanings of the words are clearly indicated by the context of my note.

I have before me a copy of the program of studies at the Hartford Public High Schools which are considered some of the best in the country. In this program the required and elective subjects are tabulated for each year and for each of the curricula designed for pupils who follow the courses preparatory to "Liberal Arts College," "Scientific College," "General Education," "Commercial," "Prevocational" and "General Industrial." *Not a single subject in* the physical and biological sciences is required in any of these courses, not even in the one preparatory to "Scientific College." So far as requirements are concerned, therefore, pupils could, and many of them do, graduate from Hartford high schools without having a single course in science. As to the Hartford primary schools, I am told that even the offering of a science subject is purely a matter of the discretion of the teacher and her enthusiasm for science.

The warning against producing "single track experts and the scientific ignoramus" is the old cry of "wolf, wolf" usually sounded by "liberal" educationists who ignore the fact that science has become the major source of new ideas and that the few scientifically trained men and women have done more than all the rest of mankind, during the past three hundred years, in liberating the human race from the fear of want and pain and in broadening our outlook.

To do full justice to the last paragraph of the communication of Professor and Mrs. Craft, one would have to write a book or at least a pamphlet, because it represents the epitome of a great deal of the material of articles and books on education written by "humanists" and "liberal" educationists. In these writings a single-track expert or an ignoramus is, almost invariably, a scientist. One might take the position that this is as it should be and take a criticism of this type as a compliment to men of science. For, after all, an ignoramus among scientists should be very rare and striking, in view of the fact that they not only know something about science but also perforce become conversant with a great deal of the non-scientific fields of knowledge and experience through their formal education and by virtue of being members of non-scientific communities.

The quotation from Jaques Barzun, "What do they know of science who only science know," deserves special comment. If the word "science" in this quotation is replaced by the name of any other subject the validity of the statement would not be changed. Yet, for some strange reason, only science and scientists are made the butt of this type of criticism. I should like to know the name and address of the zoo where the *only*-science-know bird is kept.

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SIR ISAAC NEWTON AND THE SENSITIVE RADIOMETER

IN SCIENCE of March 9, I have read with interest Dr. C. G. Abbot's letter (pp. 244–245) describing how he was led to find a remedy for electrostatic disturbance of a sensitive radiometer by a recollection of Newton's famous proof that a uniform shell of matter exerts no gravitational force upon any *body placed within it.*

The corresponding theorem in electrostatics, namely, that no electric field exists within a hollow conducting spherical—or, as in Dr. Abbot's two-dimensional case—cylindrical shell is, of course, well known and in fact comprised in the more general theorem that no field—due to external charges—can exist within a hollow conductor of any shape whatsoever. The proof of this is usually given as a particular case of Green's Reciprocation Theorem (*vide,*