foreigners, but consumes a great deal of the time of English-speaking children and an appreciable amount of the nervous energy of adults. If a sufficient number of letters were added to the alphabet to make English completely phonetic, much time and energy could be saved for all concerned.

For streamlining and otherwise improving our educational procedures, I suggest:

(1) Elimination of the requirement of every subject in the school curriculum which is not indispensable. Foreign languages, dead or living, for example, are not indispensable as required subjects. It is not necessary to read a book in the original language in order to become effectively acquainted with its contents. It is true that the "flavor" peculiar to the original language is lost in translation. But its price in terms of time has become too high for the majority of students.

(2) Elimination from text-books of every topic which is not indispensable to further progress in the subject or which could be treated more effectively in advanced texts. The methods for finding square roots of numbers and the distance from a point to a line, which are given in text-books on arithmetic and analytics, are cases in point. These highly special methods are not necessary to the student for further progress in the subjects, and their purposes are better served by the more general methods of logarithms and of maxima and minima.

(3) Improvement of the order in which subjects appear in the school curriculum in order to secure better timing and to bring into play the pupil's interest and incentive.

(4) Teaching of the physical and biological sciences continuously from kindergarten through high school. 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. The elements of science interest children. Science deals with the tangible and the concrete; therefore it is well adapted for training children to make use of their common sense in their studies.

In colleges and universities, the majority of students avoid science courses whenever possible, because they find them difficult. As a result, most of our leaders in education, in religion, in industry and in other controlling fields are generally ignorant of science and of the scientific method of approach to problems of life; they are untouched by the scientific spirit. Most of the major ills of our age can be ascribed to this cause.

If science were taught continuously throughout the school years, college freshmen would be familiar with many of the scientific terms and concepts. Consequently they would not find college courses as difficult as they do now.

(5) Greater use of the laboratory method in school science. The laboratory method could be introduced even in the lowest grades. In teaching the multiplication table, for example, the child could be asked to place blocks in rows and columns of 4 and to count the resulting number of blocks. Thus he could not only discover that $4 \times 4 = 16$, but he could also be helped to see that multiplication is a short cut to repeated addition of equal numbers. He could at the same time learn what the square of a number and the area of a square mean.

(6) Greater use of the historical and philosophical approach to scientific subjects in college. The college student may now take a course in the calculus without knowing the problem which led Newton to the discovery of the method of the calculus. He may go through a course in physics without learning how Galileo happened to come to the concept of inertia. He may major in a science, yet may not know what is meant by the scientific method.

(7) Placing greater emphasis on understanding general principles and on learning general methods. Some text-books are more in the nature of hand-books than text-books. Trigonometry books are about the worst in this respect. Some of them give three, even six, formulas to express the Cosine Law, when one would be sufficient. Most of them give dozens of formulas for the functions of large angles, when a simple rule is all that is needed. Most mechanics books, on the other hand, make the subject appear unnecessarily complicated, by classifying forces into a large number of types and giving them different names. Problems may be classified into types, but forces can not be so classified, because the latter have no types. Furthermore some of the names given are patently absurd—for example, "imaginary," "fictitious" and "lost" forces.

It is not necessary to extend this list any further. The important point I want to stress is this: There is a crying need and a great opportunity for creating conditions which would make it possible for the future scientist to reach the frontiers of his specialty earlier in life and at the same time to obtain a broader education.

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## THE SHORTAGE OF SCIENTIFIC PERSONNEL

MUCH has been said[1] about the scarcity of trained

[1] M. H. Trytten, *The Scientific Monthly*, January, 1945, p. 37.

scientific personnel. Continued military research as well as the great peace-time industrial undertakings on the horizon will together demand more technologists than have ever been available, and this at a time when we have allowed our scientific personnel resources to dwindle seriously. This promises to become one of our large post-war problems. The promotion of the general technological welfare is at stake.

Anything that can be done, no matter how small, to accelerate the reaccumulation of this important human resource is worth doing and should be done.

Several efforts are now under way to encourage the return of young scientists and others to school. The encouragement being given veterans to return to school has been given wide publicity. The American Council on Education has facilitated the academic recognition of military in-service training through their evaluation[2] of large numbers of military training programs. Although the effect of these efforts should be great, they do not particularly stress the training needs in science and technology.

Recently, the National Research Council announced[3] a plan for granting fellowships for competent young scientists to study toward the doctorate. This will be an important step toward replenishing the supply of scientific personnel.

Another step would be to enlarge the opportunities for young scientists to continue their training on a part-time basis. This is something that can be done at once without waiting for the cessation of hostilities and the release of scientific workers from their present jobs. At the present time, a graduate student wishing to carry on his studies must look to local part-time educational facilities. Although the Office of Education's E.S.M.W.T. courses have been of considerable service, this student must usually look to evening classes at the nearest university. These facilities are frequently meager and inconveniently situated. Although there may be a wide choice of evening classes from a liberal arts standpoint, the choice in technological subjects may be slight and primarily at an elementary level. Furthermore, the campus on which these courses are given may be far from the place of employment of the student, and with long working hours and with overcrowded or slow transportation facilities the obstacles to this student taking the course he needs become very great.

In order to facilitate the attendance of these scientific personnel at the courses they need, it is proposed that universities and institutions employing scientific personnel together make a concerted effort to provide the courses needed at a convenient place. It would be necessary to find out what courses are needed by the employees of particular institutions and then to provide these courses at a convenient time and place—say, within the institution immediately after working hours. The students would then register with the university just as if the course were given on the campus.

Students who are able to pursue their studies on a part-time basis now are more likely to return to university campuses to complete their graduate requirements when the time comes for them to leave their present jobs. Not only would the students and universities benefit, but in the long run the institution would also benefit through the increased competence and value of their employees.

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# SPECIAL ARTICLES

## CRYSTALLINE REINECKATES OF STREPTOTHRICIN AND STREPTOMYCIN

STREPTOTHRICIN, the antibiotic agent produced by *Actinomyces lavendulae*,[1,2,3,4,5] and streptomycin, a closely related substance from *Actinomyces griseus*,[5,6,7,8,9] have been intensely studied recently in view of their possible utility for the control of infections resistant to penicillin. As a result, both substances have been characterized with regard to their antibacterial spectra, protective and toxic effects and other biological properties. However, published information concerning their chemical nature is scant and is in essence confined to the statement that they are both water-soluble bases; as to purification methods, only the preparation of crude concentrates has been described.[1,6]

[2] American Council on Education, "Guide to the Evaluation of Educational Experiences in the Armed Services."

[3] SCIENCE, March 30, 1945, p. 322.

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