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TOWARDS ADEQUACY OF SCIENTIFIC MANPOWER

A SHORTAGE of scientists and engineers is being felt almost in every country, and a number of articles* have appeared recently dealing with the question and suggesting possible remedies for it. The one by Lee A. DuBridge in *Science* is particularly commendable, as the author has dealt with the problem both on a short and long range basis. Some of his conclusions are here presented for the light they may throw in the matter of ensuring an adequate supply of scientific manpower in our own country.

As causes for the shortage, DuBridge points out: (*i*) The technologic age, for the world as a whole, has only just now arrived. Perhaps it is necessary to remind ourselves that in 1900 there were almost no automobiles, there was no radio telephone, there was no long distance telephony, no aviation and of course no television. (*ii*) As science marches on, more research and development will be needed to produce more technologic equipment, which in turn will need still more trained men to manufacture, maintain and use it. This spiral will continue upward, limited only ultimately by the supply of human brain power. While the population of the U.S.A. has just doubled during the last fifty years, the number of scientists and engineers has increased 10 times. (*iii*) As industrial society progresses, the raw materials that are more easily available are being used up at a faster rate, so that we must dig deeper for our coal, iron, copper, oil and other materials, or alternately find more materials—all which call for a more and more liberal supply of scientists and engineers. Edward U. Condon, in a recent article† on "Physics and the Engineer", indeed clinches the issue by emphasising that in the near future we shall see a progressive reduction in the

* *Science*, 1956, **124**, 299; *Nature*, 1956, **178**, 877 and 887; *J. Sci. Indust. Res.*, 1956, **15A**, 301.

† *Recent Advances in Science—Physics and Applied Mathematics.* New York University Press, 1956, p. 349.

time lag between basic discoveries in science and their industrial application, say from an average of 30 years or more as it is at present, to something like 10 years or less. Such tempo in regard to the utilization of basic scientific knowledge makes new demands on the system of education for science and technology, and these demands are to be met rather squarely if further progress is not to be hampered in any way by dearth of quantity or quality of scientific manpower.

By way of dealing with the shortage on a short-range basis, DuBridge observes that one way of reducing the shortage substantially is to improve the efficiency of utilisation of such scientific manpower that already exists. For instance, he points out that many engineers in the U.S.A. complain that their employers often fail to recognize the difference between engineers and draftsmen. As a result, the desks of hundreds of engineers are jammed side by side in warehouse-type buildings, amid all the clutter and clatter of typewriters, computing machines, and jangling telephones. It has been estimated that to provide each engineer with his own small office would cost less than 1 year's salary, and it would improve his output and that of his successors, for a score of years or more. Such being the case, we must never forget that the kind of engineering we are short is not routine drafting but is hard, original intellectual effort—the kind of thinking that is elicited most fully only under the best of physical conditions. What would therefore seem to be necessary for more effective utilization is a very thorough and far-reaching change in the decision-making apparatus of Government as well as industry, in regard to research, development, engineering and production matters, with a view to eliminate the degree of waste that threatens to maintain the shortage rather perpetually.

But the problem, according to DuBridge, can be solved adequately only on a long-range basis, based upon a programme of education and propaganda more or less on the following lines:

Junior High School teachers in all subjects, especially mathematics and science, must be given more support and more rewards. They need higher salaries and better community recognition; they also need teaching aids (movies, laboratory equipment, and much more simulating text-books).

Counsellors of young students need re-education. Only too often students are advised away from science because it is said to be too technical, too vocational, or just too hard. Science as one of the liberal arts—as a necessary part of every liberal education—has been overlooked. Mathematics—an essential language of communication in the modern world—has been allowed to degenerate into endless routine solutions of meaningless problems.

Parents of children—and this means men and women in all walks of life—must be brought into touch with the frontiers of science through newspapers, radio, television, magazines. They must get a glimpse of the values, the thrills, the rewards, the opportunities, in careers in science and engineering. They must see that their children are tested for their aptitudes and then encouraged and stimulated if they have mathematical or technical talents.

The scientist and engineer should be presented to the whole community in his true light—not as the absent-minded professor intent on blowing up the world; not as the cold-blooded technician who would be glad to see his machines crush men into extinction; not as the man who, if allowed to gain control, will lead civilization into soulless decay and physical destruction. Why not, instead, present the scientists and engineers as the men who have lifted civilization from dark-age feudalism and slavery to 20th century liberty and enlightenment? The scientist and engineer, as human beings and as benefactors of the race, must be brought to the people and to the schoolroom—in person wherever possible.

These measures will help to motivate and encourage students of talent. But how do we discover the talent in the first place? We do not know! A competent and comprehensive programme of research should at once be begun—or enlarged if already started—aimed at developing more satisfactory ways of discovering aptitudes in young people. Mathematical aptitudes are especially important. They are sufficiently specific to be detectable at an early age. When such aptitude-measuring techniques are developed, they should be used on a nation-wide scale to discover every youngster with potential technical abilities.

Also, we must find more cogent inducements to persuade boys and girls of talent to enter the study of mathematics and science, to prepare themselves for careers. Local and national college scholarship programmes are excellent, but often do not reach down to the eighth or ninth grades. Contests, prizes, awards, science fairs, exhibits—may be even comics and TV programmes—could help. But the critical need is for more and better teachers.

Finally, we must recall that we have almost completely failed in the physical sciences and engineering to make use of the talents and services of women. Psychologists tell us that there is, statistically, no essential difference between the kind of mental aptitudes found in men and in women. Why are there not just as many female engineers as male, thus doubling the potential supply ? Why indeed ? There are some good reasons involving home-making, motherhood, and the social custom that requires little girls to play with dolls instead of electric trains. But these reasons are not enough, and a nation-wide effort must also be made to secure and utilise the scientific talents of our womenfolk.

The discovery of even a fair percentage of the scientific talent available in any country must in itself be regarded as a major step, since on that will depend ultimately an adequate supply of manpower, through higher education and advanced training.

NOBEL AWARD FOR PHYSIOLOGY AND MEDICINE—1956

THREE pioneers in the development of cardiac catheterization have been chosen to receive the Nobel Prize in Physiology and Medicine this year. One of these, Dr. Werner Forssmann, of Bad Kreuznach, West Germany, is the first man known to have inserted a catheter into the living human heart through a blood vessel in a limb. The other two are Professors André F. Cournand and Dickinson W. Richards, of New York, prominent among those various workers who in the last 15 years have added greatly to our knowledge of cardiac function by means of this technique.

At the age of 25, Dr. Forssmann, who is now 52, described how with the help of a colleague he inserted a cannula into his own right antecubital vein, and passed through it a well-lubricated ureteric catheter for 35 cm. At this point the colleague, considering the experiment to be dangerous, ended it. A week later Forssmann by himself undertook a second experiment, this time inserting a catheter for 65 cm. into the left antecubital vein. He walked from the operating-room where he carried out this manœuvre to the X-ray apparatus, and a radiograph was taken. This was reproduced with his article, and clearly shows the catheter lying in the right auricle. At the conclusion of the article, Forssmann referred to the "many prospects of new possibilities for research into metabolism and heart function" that his experiments had opened up.

Professor Richards, aged 60, and Professor Cournand, 61, of Columbia University, and the Bellevue Hospital, New York, were encouraged by Forssmann's experiments to try cardiac catheterization in their studies of cardio-respiratory physiology. Their work, begun on chimpanzees in the later 1930's, and soon continued in the human subject, confirmed the safety of the procedure and showed the wealth of new information to be gained by it. Their studies of gaseous exchange and blood pressure in the heart and pulmonary arteries from about 1940 onwards have greatly extended the benefit, especially by surgery, which it is now possible to offer to patients with heart diseases.

Cardiac catheterization consists of passing a radio-opaque nylon catheter directly into the heart from a vein in the arm. This allows of that accurate diagnosis which is essential to successful surgical treatment of heart disease. In addition it has provided much additional useful information on the behaviour of the heart and circulation in a great variety of drugs. Indeed, Professor J. McMichael, of London, another pioneer in this field, has described catheterization of the heart as the most significant advance in cardiological method in the present generation. As a diagnostic procedure it is now performed as a routine in all the larger cardiac clinics.—***British Medical Journal*, 1956**, p. **990.**
