The Shortage of Scientific Personnel

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AS A LAWYER, UNFORTUNATELY I AM no authority on the history of science or the history of support for science; but since my early days at the Foundation, beginning in 1924, I have been aware of the fight made and won for financial support for science in the United States. After World War I the discussion centered about the worth-whileness of support of science. Would it pay out in social return? In the light of what has happened, the labored arguments of those days have the appearance of insisting upon the obvious; but it is worth remembering that it was a real issue then.

No one in this day needs to argue the necessity for a healthy and adequate science in this country. We need, however, to put into the record now *why* the situation in respect to scientific personnel in the United States is a serious one.

It is partly because, in our usual way when we set out to do a job, we do it to the exclusion of everything else—the long-term considerations always can go hang. We set out to do the job of winning the war to the whole extent of our ability to contribute to victory, and that is the job we did. We stopped almost completely the training of men not only in fields of science and technology but in all fields. With the exception of students of medicine and engineering in Army and Navy programs and some 2,400 men on the reserve list who were taken from their studies for civilian war research, all physically fit students, graduate and undergraduate, and those ready for college over 18 years old, were taken into the armed forces and were kept there. This went on for five years. What you take five years to undo in reference to training people for a vital function in the Nation's interest, you cannot make up in any lesser amount of time. And unless you do twice as much training for five years following the five blank years as you were doing before those years, you are going to lose up to five years of production of scientists. This is just elementary arithmetic and, furthermore, serious as arithmetic shows the situation to be, there is no doubt that a higher calculus, if it could be made, would show it to be still more serious.

Those of us who wrote the report on the fourth question of President Roosevelt's letter to Dr. Bush, concerning the discovery and development of scientific talent, looked long and hard at a lot of figures concerned with the Nation's future needs for personnel in science and technology. In the end we confessed that we knew no way to calculate the Nation's future needs for scientists and engineers. We all were convinced, however, that the needs would be greater in the future than they had been in the past.

In 1919 George Ellery Hale quoted with approval a statement by De Tocqueville in *Democracy in America*: "The French made surprising advances in the exact sciences at the very time when they were completing the destruction of the remains of their former feudal society; yet this sudden fecundity is not to be attributed to democracy, but to the unexampled revolution which attended its growth." And Dr. Hale himself similarly concluded: "The intellectual stimulus accompanying great upheavals, however they originate, finds expression in unusual achievements in science."

However valid these theories may be, the situation, here and now, is, in short, that we stopped for five years doing what it takes six years to do—that is, taking an 18-year-old and training him to the point where he is a producing scientist—and then, at the end of the five-year stoppage, we are faced with an increased and increasing demand for the product.

My Committee on the Bush Report, if I may use a convenient shorthand, concluded that the magnitude of the problem was such that the best prospect for solving it was through the Federal Government. We proposed both short-term ways and a long-term way of doing something about the problem. The short-term ways all were related to what the Army and Navy ought to do following V-E Day. None of these, we judged, would in any way weaken the war effort against Japan. But none of those things was done, and that water is all under the bridge, although I am going to say for the record that those short-term plans look, in retrospect, even better than they did at the time they were made. We pointed out that, in our judgments and in that of all patriotic informed citizens—at least we could discover no contrary views—amelioration of the scientific deficits then piling up was necessary for military security, good public health, full employment, a higher standard of living after the war, and, indeed, from whatever angle anyone looked at the situation. But, as indicated, we drew a blank on any results from those recommendations.

Long-Term Proposals

We studied the evidence concerned with the Nation's future needs for scientists and engineers, and, having

Based on an address delivered before the Symposium on the Shortage of Scientific Personnel, AAAS Boston Meeting, December 28, 1946.

regard to what appeared to be reasonable prospects for assistance in training them from colleges, universities, private sources, foundations, and local and state governments, we concluded that provision of scholarships for about 24,000 students of science and technology with 6,000 entering a year would be about right, with additional provision for about 300 graduate fellowships annually. There was not in our minds any sense of sacredness of these figures: the future might revise them down or up without objection from us; nor were we so naïve as to think that these scholarship and fellowship provisions would increase the supply of scientists and engineers by the annual figures of recommended scholarships and fellowships, for we knew that Federal money in the area of science and technology would drive other money, or at least some of it, into other areas. This, in my view, would be a good thing.

I have been asked *why*, since we had gotten as far as we had scientifically and technologically, and *why*, if the greatest war of all time was won on the basis of scientific advance, we need to discover and train x thousand more scientists a year.

The question may not sound sensible to readers of *Science*, but it makes sense, I assure you, to lots of people. Personally, I have respect for the question, and to the askers of it I respond as thoughtfully as I can.

It is a wholly safe assumption that in the United States, before the present overloading of all institutions of higher learning, practically all young people of brains and character who knew what they wanted and who could afford to pay for it could get a scientific or technological or any other education. It is also reasonably safe to assume that the total number of those who wanted and who could pay for a scientific or technological education got that education. But now, on all the evidence we can find, that prewar total will not be enough to satisfy the Nation's needs for scientists and engineers. Hence, we must increase the prewar total.

You will have noted that there are two conditions to my statement about the total number of persons who got a scientific or technological education in prewar days: first, that they knew they wanted a scientific education and, secondly, that they could afford to pay for it.

The first of these conditions is tantamount to saying that somewhere they must have been in touch with science, and that means usually in a good secondary school. But it is painfully true that in some parts of the country good secondary schools are rare. Where this condition holds, there will be much loss of high ability to training, simply because that high ability does not get interested in further training—in science or in any other field of the mind and spirit. Although I recognize this, I am not a perfectionist, and I would propose that before we, as a nation, tackle this situation we take first an easier road to producing more trained minds.

That easier road, which is also cheaper and quicker, is to select those young persons who want to go on in their studies, who have shown that they have the brains and character for it, but who cannot afford it—select them on their merits and pay for their education on a modest scale of payment. There are reliable studies which show that the probability of college attendance for a high school graduate who is the child of a professional father is several times higher than for the child of a laborer. Other studies show that a large percentage of superior high school students do not get higher education simply because their parents cannot afford to pay for it.

The intelligence of a country's citizenry is obviously its greatest natural resource. Yet here we are wasting an appreciable part of ours by not giving it a chance to develop through higher education. We provide higher instruction at a very low charge to the student; but we pay very little attention to the important question of what he is going to use for subsistence money while obtaining the instruction. We provide board, lodging, and institutional care for our feeble-minded; but lots of people have the idea that to provide food and lodging for our best young minds during the period of their education somehow is wrong, or at least is not a proper function of government.

However, we who wrote the report on scientific personnel in the Bush Report saw it as an entirely proper function of government, and we proposed to select 6,000 of these fine young minds each year and stake them, with modest subsistence money, to a scientific or technological education that they otherwise probably would not get. This would cost about $20,000,000 a year; but if anyone has figured out how better to spend such a sum annually for the long-term good of our country, it has not come to my notice. Also, if there is anything wrong with spending Federal money for such a purpose, I have not yet heard where the wrong lies.

My Committee on the Bush Report was charged with formulating a plan for the discovery and development of scientific talent in American youth, and we did what we were asked to do: we confined our recommendations to scientific talent. We also pointed out[1] that:

> The statesmanship of science . . . requires that science be concerned with more than science. Science can only be an effective element in the national welfare as a member of a team, whether the condition be peace or war.
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> As citizens, as good citizens, we therefore think that we must have in mind while examining the question before us—the discovery and development of scientific talent—the needs of the whole national welfare. We could not suggest to you a program which would syphon into science and technology a disproportionately large share of the Nation's highest abilities, without doing harm to the Nation, nor, indeed, without crippling science. The very fruits of science become available

[1] See Vannevar Bush. *Science: the endless frontier*. Washington, D. C.: 1945. Pp. 135 f.

only through enterprise, industry and wisdom on the part of others as well as scientists. Science cannot live by and unto itself alone. . . .

The uses to which high ability in youth can be put are various and, to a large extent, are determined by social pressures and rewards. When aided by selective devices for picking out scientifically talented youth, it is clear that large sums of money for scholarships and fellowships and monetary and other rewards in disproportionate amounts might draw into science too large a percentage of the Nation's high ability, with a result highly detrimental to the Nation and to science. Plans for the discovery and development of scientific talent must be related to the other needs of society for high ability: science, in the words of the man in the street, must not, and must not try to, hog it all. This is our deep conviction, and therefore the plans that we shall propose herein will endeavor to relate the needs of the Nation for science to the needs of the Nation for high-grade trained minds in other fields. There is never enough ability at high levels to satisfy all the needs of the Nation; we would not seek to draw into science any more of it than science's proportionate share.

And we further said:

As emphasized, this report is concerned with discovering and developing scientific talent, but in its proper setting and relationship to other needs for talent for the Nation's welfare. In the report we shall suggest, as befits our mandate, the appropriation of Federal funds to be applied only to the purpose of discovering and developing scientific talent; but, as we have pointed out, we recognize that there is need for the discovery and development of talent in all lines and we point out that most of the plans and procedures recommended herein for science are equally applicable to the discovery and development of talent in other fields.

Some of you will now be thinking: "Just why does he think he has to drag this social science controversy in? Doesn't he know that he is supposed to be writing about the importance of the problem of the shortage of *scientific* personnel?" To those I say, if you lessen a shortage by taking material from a field where the supply is limited, you necessarily affect others' needs for that material. If others' needs for that material significantly affect your own operations, you would be unwise to lessen your own shortage by increasing theirs. In the context of this paper, it is clear to me that our problem of lessening our scientific shortages is bigger than the particular problem, and that is why I consider a discussion of the needs for high ability in fields other than science to be germane to my topic.

For our observations on this subject—those quoted above from the Bush Report—we were at first let off scotfree. But when the President, in his message recommending science legislation, added five words, "and in the social sciences," we were told by some scientists that we, or somebody, had very much gummed the works.[2] I have no way of knowing how you, or a majority or a minority of you, stand on this proposition, but I should like to state two truths which ought to convince you, I think, that the President was right in including the social sciences in his proposed science legislation—at least in so far as the need for discovery and development of talent in American youth is concerned.

First, science is not properly a game, played by its participants for their own benefit and satisfaction. Science, like anything else paid for out of the public's purse, is justifiable only in so far as it results, as a long-term proposition, in a more full and fruitful life to the people at large by the improvement of standards and satisfactions of living, by the creation of new enterprises, by bringing in new jobs, etc. But these results are not merely matters for science; they are also in very important ways matters of economic organization, of systems of taxation, of fair public administration, of resistance to pressure groups, and of many other social science factors. We shall not get the benefits of science in the best manner in our national life unless really scientific studies are developed in connection with many broad economic, social, and political items in our national organization. For these studies we need to develop more and better social thinkers than we now have. Not only do we as a nation need them, but the world also needs them; and science as socially useful science needs them. Without these studies, free science is going to be something your successors may read about but will not have.

Moreover, as we increase the tempo of scientific advance, the more shall we need to better the quality of thought over the whole spectrum of the human mind and spirit. For this reason I devoutly hope that, if support for scientific training comes from government, and no governmental support goes to other training, funds now used for science training will be driven into other fields.

Secondly, there is a very elementary and self-evident reason for not restricting to the sciences a program for the discovery and development of talent in American youth. The reason is that in youth—at the end of high school, for example—it is too early to say whether or not a boy or girl should be committed to a career in science and be given a scientific education. It is true that certain tests can be given to youth which show with some degree of accuracy whether or not they are oriented toward scientific pursuits, but it is also true that those same tests point to success in fields other than science. Science for the Nation's good or for its own good, should not try to grab too large a share of the available brains.

Some may think that the foregoing statements lead to the logical conclusion that all high ability should be included in the talent search and its development and that potential literary critics, poets, composers, painters, theologians, and all those who can profit from higher training should be included. I think that this is the case, for I agree with Dr. Raymond Fosdick, president of

[2] For such a view, see Paragraph 8 in the letter to President Truman from the Committee Supporting the Bush Report (*Science*, 1945, 102, 546).

The Rockefeller Foundation, who said recently: "Certainly in our search for the means to control our own fate we must not overlook the possibility that the unity of mankind may be achieved by art or music, a poem or or song, perhaps more effectively and lastingly than by engineering, medicine, or economics."

The point of view that poets, painters, composers, humanists, and social scientists have as strong claims to support as scientists in any plan for the development of those who will lead mankind is the point of view of the John Simon Guggenheim Memorial Foundation, and for more than 20 years we have made our appropriations in that belief.

But, having said this with respect to the Foundation's funds, I shall go on to say that while I hope I am pure—in a mathematician's use of that word—I also hope I am not too pure and that I am not so politically simple, where the question is on the use of government funds, as to insist upon ultimates or end-of-the-road conclusions.

Time brings many innovations, as the founders of early state and other universities would see if they could see now the present breadth and inclusiveness of their institutions. They might not be content with what they would see; but, as for myself, I should be content to wait for many logically foreseeable developments and not be distressed if they did not work out according to my or anybody else's logic. "The life of the law," Mr. Justice Holmes said, "has not been logic: it has been experience." Likewise, experience ought to govern here. He went on to say: "The felt necessities of the time, the prevalent moral and political theories, intuitions of public policy, avowed or unconscious, even the prejudices which judges share with their fellow men, have had a good deal more to do than the syllogism in determining the rules by which men should be governed . . . ."[3]

In this constitutional republic it cannot be otherwise, and it should not be otherwise. Whatever scientists may think of the importance of the problem of the shortage of scientific personnel, they will get no amelioration of it by government unless and until amelioration is one of "the felt necessities of the time." If we get it, we shall get it only in accordance with "the prevalent moral and political theories" of this country at the time of legislative enactment, in accordance with "intuitions of public policy" and in accordance with the prejudices which members of Congress share with their fellow men. Those prejudices—and neither Mr. Holmes nor I are using the word invidiously but in its primary sense—will not now permit poets to be educated by Federal funds; but I hope and believe that in any science legislation the wisdom of the Congress, which I believe in, will demand the development of social science concomitantly with the natural sciences. If not, you or your successors will some day wish the Congress had.

John Stuart Mill, in *On liberty*, has written my conclusion: "The worth of a State, in the long run, is the worth of the individuals composing it; and a State which postpones the interests of *their* mental expansion and elevation, to a little more of administrative skill, or that semblance of it which practice gives, in the details of business; a State which dwarfs its men, in order that they may be more docile instruments in its hands even for beneficial purposes, will find that with small men no really great thing can be accomplished . . . ."

[3] From O. W. Holmes, Jr. *The common law*. Boston, 1881. Pp. 1, 2.

The organization meeting of the new Inter-Society Committee on Science Foundation Legislation will be held at Hotel 2400, 2400 16th Street, N.W., Washington, D. C., on February 23, beginning at 10:00 A.M.

Almost 100 delegates are expected to take part in the day-long discussion under the leadership of Kirtley F. Mather, who has made the preliminary arrangements for the meeting and who is chairman of a Council committee which called the organizational meeting of the new group.

The delegates are to be guests of Science Service for luncheon. It is expected that the occasion will provide an opportunity for scientists to meet with the principal backers of science legislation on Sunday evening.