SHORTAGE OF SCIENTIFIC PERSONNEL AS SEEN IN GOVERNMENT

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When the inevitable day on which I tried to put together some random thoughts for this paper arrived, this speaker was appalled. A session and a subject which sounded so attractive in July from the honeyed lips of the program arranger, Professor Hauser, suddenly presented all kinds of difficulties. The topic, as presented on the program, appeared much too broad to be adequately covered by a representative of a minuscule agency with a rather narrowly specialized interest in Government personnel. I therefore determined to exercise a speaker's prerogative and to select for my discussion those limited segments of the topic with which I am most familiar rather than attempt a balanced presentation. These deal with the Government first as an employer, and next as an instrument through which public policy becomes expressed.

While most of this audience is generally aware of the fact of "Big Government's" influence on employment of scientific manpower, recital of a few measures may serve to frame our subsequent remarks. Unfortunately, our statistics relate almost entirely to the Federal Government. Data on the hundreds of scientists and thousands of engineers employed by State and local governments are almost entirely lacking. (Parenthetically, this situation should not last much longer; a National Science Foundation sponsored survey will be undertaken by the Bureau of Labor Statistics to secure data from a representative sample of State governments at least within the coming year.)

The Federal Government is the direct employer of approximately 140,000 civilians in its engineering, physical sciences, biological sciences, and mathematics and statistics job series. About 100,000 of them are considered to be professionals as distinguished from engineering assistants, laboratory helpers, and other support personnel. They are engaged in all types of scientific and other activities with about one third of the professionals engaged in research and development. Most of them are employed in the three military departments, or in such civil departments as Interior, Agriculture, and Commerce. Their professional duties cover the widest possible range from research and field exploration through development, testing, teaching, technical writing, contract and procurement supervision, weather forecasting, production, etc., to management and administration. They are stationed in all States and in many foreign countries.

As a direct employer of scientists, the Federal Government employs about one in every six. Their fields of specialization reflect the areas of public concern: the extent to which Government is a major employer measures alternative employment opportunity. For example, about two out of every three meteorologists are employed by Government, but only about one in every 20 chemists is so employed. About one out of every 12-15 engineers works directly for the Federal Government. It can readily be seen that conditions of Government service are a major determinant of salary scales and working arrangements of American scientists and engineers.

Another aspect of Government service worthy of comment is its character of a "closed system." Many of its employees will be continuously employed in Government, while changing agencies for which employed. Government service is apparently attractive to many who are perhaps overly impressed by its job security aspects; others are attracted by its less competitive character; still others are influenced by its unique opportunities for research. Many will spend their working lives in Government service without ever seriously considering alternative employment. All of which suggests that the working conditions under which Government scientists and engineers are employed do not have to be strictly competitive with outside employment in terms of financial rewards, since the jobs themselves do not compete in the view of many Government scientists. (The "closed system" characteristics should not be overemphasized, and may well be less influential with the scientists than with others. The increase in scientific personnel in Government, and the growing intercourse between Government and industry and university scientists will tend to reduce this situation over time.)

Salarywise, the averages usually show the Government scientist as commanding more than the university and college faculty scientist, but less than the industrial scientist. The averages obscure experience, training, quality, and differing kinds of responsibility. This is another area sadly in need of better statistical measures. Available fragmentary evidence shows beginning Government salaries lagging behind industrial--although approaching them in selected fields where special incentives have been authorized. For positions at the higher levels of responsibility, Government does not try to compete seriously in salary terms with private industry. A recent survey by the Engineers Joint Council, for example, shows engineers' salaries at the top decile as $16,300 after 20 years of experience. Only a handful of Government engineers--less than one percent--will have attained after 20 years even the GS-15 grade, which commands a $12,800-$14,000 salary range.

There are, of course, no quantitative measures of shortage of scientists and engineers in Government. Rather the supply-demand situation must be deduced from job openings, recruiting difficulties as found in testimony of personnel officers, non-existence of names on employment registers, adoption of new recruiting methods, quality of recruits, establishment of incentives, etc. Since there are not direct measures, it is not deemed particularly profitable to review possible definitions of shortage in order to select an appropriate one in the economic sense. If we

have not satisfactory measures to evaluate an ideal definition, it may be more enlightening to note some of the bits of evidence while devoting most of our energies to development of better basic data.

In terms of the ability of Government to fill existing science and engineering positions, the present shortage situation seems less severe than has been true for the past several years. The business decline of 1957-8 did not result in appreciable lay-offs of industrial scientific and technical personnel, but it did decelerate new recruiting. At the same time larger graduating classes have increased the supply of newly trained workers, for whom competition has been especially severe. Furthermore, salary differentials in the hard-to-fill classifications and a general 10 percent salary increase in 1958 were important factors in recruiting and retention of Government scientists. New recruiting methods and incentives, some of them long standard in industry, are contributing to putting Government in a better competitive position. Such factors include use of paid advertising, payment of transportation expenses, campus recruiting, etc.

Interestingly enough, the present business recovery is already displaying some signs of making the Government's scientific personnel problem more serious. Industrial salaries continue to increase; campus recruiting in 1959 will likely be back at 1956-57 levels. Currently, the new National Aeronautics and Space Agency is expanding and reports some difficulties in recruiting scientists and engineers at even its "supergrade" levels, i.e., at salaries of $19,000 to $21,000.

Before leaving the topic of Government employment, mention should be made of certain reporting developments, which may well improve our information in this area. One of the few hopeful results of a series of committees and activities immersed in problems of Government scientific personnel over the past few years has been recommendations for periodic reports by the so-called "Young Committee"--The Committee on Scientists and Engineers for Federal Government Programs. The Office of the President's Personnel Management Advisor has been instrumental in urging the adoption of some of them. Within the past few months the Civil Service Commission and National Science Foundation have developed a roster of scientists and engineers in Federal service, which should produce at least annual data on numbers, specialties, training, functions, level, etc., for those in the higher grades. Another development has been the review of data requirements by an interagency group of data consumers and producers. While it is too early to evaluate this review, it shows some promise of leading to a reasonably comprehensive body of data on Federal scientific personnel in terms of types, functions, accessions, separations, etc., in the not too distant future.

In addition to its concern for direct employees, Government is expected to assume the broader role of assuring that adequate personnel resources are available to carry out those activities in science and engineering which are deemed important. Whether we like it or not, the American people have accepted as a basis for action the conclusion that we face a serious and continuing threat to our existence as a free Nation. A threat, once considered primarily a military one, is more and more being accepted as a political and economic one as well. Our position of leadership in science and technology is challenged: Government, as the instrument through which public policy is expressed, is looked to for leadership in new and unfamiliar areas.

A heartening result is the prompt development of certain governmental programs which are already showing results. The classic debate on Federal-State relations in the field of education is disregarded. Under the threat of foreign difficulties, the Defense Education Act passed the Congress this year with scarcely a seriously expressed qualm that the Federal Government might detrimentally interfere with education in efforts --as the law states--"to insure trained manpower of sufficient quality and quantity to meet the national defense needs . . ." Even before this legislation, Federal appropriations to the National Science Foundation, the National Institutes of Health, the Atomic Energy Commission, and other Federal agencies were having a significant impact on education. A democracy can act promptly; under strong stimulus, the dogma of a hundred years has been swept aside.

The Federal education support program has been preceded by the phenomenal growth of Government support of research and development. Federal expenditures for this activity will exceed $5 billion this year; as recently as 1950 the total was little more than $1 billion. Most of these funds support industrial R & D, although significant amounts are expended through universities and other non-profit organizations.

Finally, public concern with the progress of science and technology is reflected in the spectacular achievements in missile and satellite developments and in programs designed to organize Government to emphasize more effectively particular branches of science. Millions more than ever called upon the gods of mythology follow the progress of their namesakes in Jupiter, Juno, Atlas, Hercules, Nike, Thor, etc. We eagerly listen for favorable news of our Explorers, Vanguards, and Space Probes. A Government agency is reorganized and becomes the National Aeronautics and Space Agency. These and other actions are indicative of an emerging public policy which holds that science and technology must be strengthened.

All of these developments have necessarily focused attention on the demand, supply and training of scientific personnel. The public official is overwhelmed with opinions, generally unsupported by quantitative facts, as to the availability of engineers. A cut back in an experimental missile program and accompanying plant layoffs are seized upon as evidence of a surplus of technical

personnel. An unprecedented volume of help wanted ads is dismissed as company advertising at the expense of the taxpayer. The problem is stated as one of labor hoarding and poor utilization. At the same time, fragmentary indicators show new engineering graduates are able to command substantial salary differentials over their fellow graduates in non-technical fields. Increasing numbers of job orders for engineers appear in the public employment offices, not exactly the traditional medium for placement of engineers. Surveys of employer hiring expectations continue to show openings which it is expected can not be filled. Salary rates continue to drift upward. In this melee of opinion and part truths, it requires indeed the wisdom of a Solomon and the leadership of a Moses to sort out the facts and formulate the appropriate program.

It is refreshing that a few statistical measures, which throw some light on the demand-supply situation of recent years are now becoming available. Preliminary findings of a sample survey by the Bureau of Labor Statistics show an increase of about 112,000 engineers and 55,000 natural scientists in industrial employment between January 1954 and January 1957. (This total increase of 167,000 scientists and engineers included about 65,000 reported in the function of research and development.) During this same period about 70,000 baccalaureate degrees in engineering were awarded according to U. S. Office of Education data. In other words the employment of professional engineers by industry increased by 42,000 more than the additions to the supply through normal training channels without any allowance for death, retirement from the labor force, etc. Nor can the excess be assumed to have been drained from competitive employments. Fragmentary--again--evidence indicates that both public and educational institution employment of engineers slightly increased during this period. We conclude that industry continues to upgrade technical personnel into engineering jobs, even though the emphasis over the past 20 years has been on recruiting the more formally trained engineer. It is further hazarded that this condition has been forced upon industry through inability to recruit graduate engineers in the numbers sought.

Public policy has accepted the premise that scientific training should be expanded and its quality improved. The answer to the question of "how much" is still debated. At one extreme are those who believe there are vast resources of unexploited talent which should be so trained. No over supply of trained engineers is feared, since such training is considered useful in many pursuits and--as they say--"why be concerned that training in engineering ought to lead to employment in engineering when we do not hold forth a similar standard for majors in history, languages, or literature." On the other hand are those who sincerely feel that an adequate expansion in numbers will be attained through normal population growth, and that maintenance of quality training is most important. In between are those who fear overemphasis on technical training at the expense of other occupations. Say they, "True we need qualified engineers, but we also need high quality teachers, statesmen, social scientists, etc." It is in this welter of opinion that a Government department proposes a program to expand training, the Budget Bureau imposes a further judgment, and the Congress disposes.

We are all generally aware that a complicating factor in the production of scientific personnel is a long "lead time." Secondary school curricula now virtually require a decision in favor of scientific training in the ninth or by the beginning of the tenth grade, if college entrance deficiencies are to be avoided. Add a four year college course for a total of seven years for a minimal professional training. If graduate work leading to the Ph.D. degree is pursued--as is increasingly necessary in the basic sciences especially--another 4-5 years is required. It seems reasonable to conclude that the junior high school years are the critical ones from the standpoint of the supply of newly trained scientific personnel becoming available some 7-12 years later. Implications for Government programs are serious. When such usual automatic controls, as prospective salaries, innate inclination, social status, prestige, etc., become subordinated to Government policy in vocational choice, it becomes especially important that Government exercise the greatest wisdom in its appraisal of requirements a decade in the future.

In concluding these rather disjointed remarks, certainly the scientific and technical occupations have been growing at tremendous rates, although not evenly in all fields. We do not know the extent of present shortage, if one can be said to exist. But perhaps this is not the relevant question. From the standpoint of Government, the critical question relates to the future. It centers on the likely future requirements for scientists and engineers in terms of programs public policy accepts as important. It asks what is likely to be our supply on the basis of demographic trends, training facilities, alternative opportunities, etc. The gaps between these estimates 10 years or more in the future should be the measure of public concern and the basis of remedial Government programs. It is in this area that the Government is currently most concerned and in need of the tools which will permit development of better measurements.

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