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FROM THE ARCHIVES

Scientist as a Government Employee: Prepared for the President'S Scientific Research Board. (1947)

Pages
80

Size
8.5 x 10

ISBN
0309299632

Interdepartmental Advisory Committee on Scientific Personnel

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Chapter I

UNIQUE DEPENDENCE OF MODERN GOVERNMENT UPON SCIENCE

Established Functions

Since the rise of modern research gave birth to a great body of scientific knowledge and improved technology, the entire character of Government has necessarily changed. Modern Government increasingly depends upon science and scientists, and the specially trained expert has largely displaced the traditional nonspecialized employee in many agencies of the Federal Government, and works beside him in many others.

This is particularly true in such fields as those of improving and safeguarding the public health; conserving and developing our natural resources; providing standardization for industry; improving agricultural technology; the investigation and regulation of commerce, transportation, and communication; the study and analysis of economic and labor relations; the preservation of our national security, and preparation for war emergencies.

No longer is the individual of broad, general information and purely classical education sufficient. Modern Government also requires the services of scientific specialists of many kinds and must itself, if merely to fortify its mandatory regulatory activities, carry on scientific research upon a considerable scale.

Types of Scientific Endeavor

What, in more detail, is the character of the scientific services modern Government requires? Its functions in the field of control, regulation, standardization, appraisal, and evaluation imply its need for applied science, technology, development, and the support of informational or applied research, research of the type required to make its actions last. Government cannot, for instance, declare a drug mislabeled unless it has performed research to support and justify its contention. Some, however, would limit the function of Government to the more direct, tangible, and practical types of scientific activity; others are just as determined that it should pursue pure research only, leaving applied research in private hands.

But very good reasons may be advanced for a broader interpretation of the Government's role in the field of scientific endeavor.

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In almost every field the possibilities of a new approach invite research. Even investigation into more immediate problems, such as the depredations of a single insect pest, emphasize the need to enlarge the domain of related basic knowledge. The knowledge, judgment, and insight required for such governmental undertakings make necessary the employment of scientific personnel of the highest caliber. Such workers must have that freedom of thought and action which can alone enable them to perform fundamental research and original investigation.

Because of its great resources, Government support is also essential to many of the larger research enterprises. As the sole agency representing the common interests of the public at large, Government has a responsibility to prevent the exploitation of research by special groups or interests. Because of its geographical coverage, vast statistical and informational material, and common access to original sources, the Government is uniquely capable of undertaking many types of original investigation. Because of the continuing existence and responsibility of the Government, many research investigations of long duration should be under its supervision.

It is a natural function of Government to consider the over-all picture of scientific activity throughout the nation and the world, and to encourage work which will supplement the efforts of particular groups, thus balancing endeavors in various fields of science. It is also in a position to encourage the collaborative effort of scientific personnel with their diverse specialized backgrounds, and to focus them unitedly on problems of common interest.

Finally, the Federal Government is best able and most obligated to effect the widest dissemination of the knowledge developed by scientific research. As the paramount representative of the public interest, it must accept both the immediate and the long-range implications of its responsibilities, at least to the extent to which the public supports this.

Capacity of the Federal Government for Scientific Endeavor

Since the public demands that the Government take a more active part in scientific endeavor, both through its own agencies and by supporting scientific work in private institutions, and because there are excellent reasons for it to assume greater responsibilities in this field, we should examine its capacity to assume this role. Clearly the exercise of sound judgment, keen scientific insight, and courageous leadership is required. The cooperation and participation of the ablest scientific personnel is an absolute essential.

True, some scientists question the ability of Government to assume a more important role. Their outlook has sometimes

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been colored by recent war-time experiences in Government employment, or in Government-supported activities, when time limitations precluded careful planning, and every effort was directed at the achievement of immediate practical objectives. Yet much Government research has a long and distinguished history of outstanding accomplishment.

Many agencies have established their place and become notable in their fields of scientific work. They have demonstrated their capacity to perform both fundamental and applied or supporting research. Universities cooperate with them closely to mutual advantage. Industry respects them and relies upon the information they develop. There is a free and wholly advantageous interchange of personnel.

Certain governmental laboratories have on many occasions become the most active research units in the country, bringing together the keenest and most resourceful scientific minds in their field. This was true of the early Bureau of Animal Industry under Dr. D. E. Salmon, and of the units that later became the old Bureau of Plant Industry under B. T. Galloway, as well as of the Fixed Nitrogen Research Laboratory under the leadership of Dr. F. G. Cottrell.

In cases where Government agencies and laboratories have less impressive records and have failed to win the full respect of scientists, or to maintain public confidence in their ability to carry on good scientific work, they have invited failure to survive. Governmental laboratories, to be successful, must have sound objectives, proper administrative practices, and the ability to plan research programs well.

But, most important of all, it has repeatedly been demonstrated that, within the framework of the Federal Government, scientific agencies can function productively, having only the most broadly defined objectives. Sound judgment and personal initiative can replace dictation and rigid bureaucratic organization. Personal integrity can surmount regulations and surveillance. Moreover, the spirit and essential freedoms of research can develop where there is sufficient latitude for scientific personnel to pursue the course most suitable to evoke its highest productivity.

Later on we shall more thoroughly consider the factors which determine effective activity by scientific personnel. But a very casual study of the experience of Government agencies shows that their success and character have been determined by the quality and courage of their scientific administrative leadership. Hence the capacity of Government to undertake its new responsibilities is primarily based upon its ability to secure and maintain administrative leadership, illuminated by scientific knowledge, along with the insight, judgment, and courage required to follow effective courses of action.

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What factors control Government's ability to obtain able scientific administrators? While personal advancement is not to be altogether ignored, scientists of requisite administrative capacity are more influenced by fundamental and far-reaching considerations. Hence the Government's personnel policies as to the conduct and support of research are of great importance.

To gain active support, these policies must reflect the best judgment of scientific personnel throughout the nation. There must be evidence of sustained public support for them on a long-term basis. Plans for the various phases of the scientific work must be matured and fully publicized. Able scientific experts must participate in this planning at the legislative and policy-making levels, and must reflect the harmonious amalgamation of many and varied scientific interests. Finally, responsibility and authority must be delegated to scientific administrators to enable them to pursue the course of their best judgment. Conditions must be created peculiarly essential to the pursuit of research.

It is not the primary purpose of this report to recommend specific policies or to formulate definite plans; its object is to lay the foundation for making such decisions. Some possible policies will, however, be indicated. For it is our purpose to show that lack of established policy and appropriate long-time planning, particularly with respect to the support of research, is creating confusion and doubt as to the Government's capacity for wise scientific leadership. This is one of the prime factors influencing the distribution and productivity of scientific personnel.

Government Support of Research

Because of the large funds placed at the disposal of various Government departments and agencies by the Congress for the support of scientific endeavor in many fields, the Government has become an outstanding contributor to scientific research. This relatively new position involves serious responsibilities. Among them are the following:

First, there is the necessity to secure a wise and equitable distribution as between (a) the Government agency, with its broad responsibility; (b) the university, with its obligation for training and inspiration; (c) the private research laboratory, with its background of specialization; and (d) the industrial research laboratory, with its technical emphasis. Each enjoys certain advantages and must make its essential contribution to scientific progress. Each depends upon the other and profits most by a cordial relationship therewith. The interests of these institutions are not necessarily either conflicting or competitive; all gain by an appropriate distribution of financial support.

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The Government is obligated, secondly, to foster fundamental as well as applied research, whenever the special capacity for such work is found, and regardless of the type of organization. The Government should seek to maintain an advantageous balance of support in the various fields of research endeavor despite the fluctuating interests of the lay public.

Thirdly, it should look to the maintenance of research effort of high quality by accurately evaluating the needs, and the capacity of the individuals and institutions requesting support.

Fourth, Government should endeavor to secure continuity and long-term thinking on research programs, despite budgetary time limitations in appropriations.

If these ends are to be attained, there must be general over-all far-sighted Government planning of research support. The activities of the various agencies must be harmonized through consultation and adherence to common plans and basic policies. Above all, there must be reliance upon competent scientific judgment both in the matter of policy determination and in the detailed consideration of plans, projects, and programs.

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Chapter II

POLICIES NECESSARY TO FOSTER SUPERIOR RESEARCH AND OTHER SCIENTIFIC ACTIVITIES

The Situation

What environmental conditions evoke superior scientific activity? Clearly they are those which produce full fruition of the creative talents of gifted scientists. Hence, in developing policies for fostering superior research and other scientific activities, it is necessary to think in terms of the people needed. "The research laboratory....is an organization of human beings. Management too often confuses it with a beautiful building, Gothic columns, names of famous men of science on the facade, and rooms full of test tubes and balances." ("Management's-Eye View of Industrial Research", Chemical and Engineering News, Vol. 23, pp. 709-712, April 25, 1945, by M. Holland.)

Scientific organizations, of course, are not intended to be institutions for making scientists happy or for pampering a favored category of individuals who happen to have become research workers. But creative scientific accomplishment is not automatically assured merely by providing large budgets, elaborate facilities, and scientific personnel. The formulation of original ideas, the creation of new basic knowledge, and its applications important for health, prosperity, and security cannot be purchased on order. They are the products of men's minds. And not all men who pass through academic halls and emerge with academic degrees are equally capable of high achievement.

Furthermore, men of great native ability, excellent training, and fine previous accomplishment may become scientifically sterile if placed in an environment which thwarts and represses their creative talents. If courageous enough, they escape from such an environment; if not, they may remain as spiritless, mediocre jobholders. Dr. Frank B. Jewett, while president of the National Academy of Sciences, stated, "Government must necessarily be controlled by general and rather rigid rules, many of which we are commonly wont to describe as 'red tape' and which must be applied impartially over a wide variety of activities. Thus....the setting is one in which a large number of the best of our scientific and technical men are reluctant to operate. As a result, there is a large tendency toward the expenditure of huge sums of money for what is essentially second-rate work done by those less-than-best men who are content to spend their lives as poorly compensated civil servants." ("The Future of Industrial Research. The Physicist's

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View." Chemical and Engineering News, Vol. 22, pp. 1754-1755, October 25, 1944, by Frank B. Jewett.) Again, "It is no secret that our Government research agencies are viewed largely by private industry as training grounds for scientists; periodically a large part of the cream is skimmed off." ("Government Salaries". Editorial, Chemical and Engineering News, Vol. 23, p. 2309, Dec. 25, 1945, by Frank B. Jewett.) Dr. Irving Langmuir testified, "Although the public interest is well served by the application of the Civil Service laws to perhaps 90 percent of the Government employees now acting under them, such laws produce an almost disastrous effect on certain kinds of Government projects which require men of the highly specialized training which is needed among the leaders in Government scientific research laboratories. Some important Army and Navy postwar research projects must be assigned to private industrial laboratories because of the known impossibility of carrying on this work in Government laboratories under Civil Service restrictions." (Testimony before a Senate Committee. Reprinted in Chemical and Engineering News, Vol. 23, pp. 1995-1996, November 10, 1945, by I. Langmuir.)

These quotations merely illustrate opinions widely held in scientific circles. It may be shocking, but it is nevertheless true, that many of the abler scientists in the country refuse to enter the Government scientific agencies. Even more revealing is the fact that many of the more talented scientists who were in Government service have been leaving because they found conditions unsatisfactory.

Obviously, Government agencies must do something to make Government service more attractive to talented scientists, or else fail to carry out properly the responsibilities assigned them by the Congress and expected of them by the public. What Mr. Lilienthal said about atomic research is equally applicable to other scientific activities under Government aegis, viz., the programs "will be exposed to all kinds of petty frustrations. Top scientists will abjure it; good administrators will have nothing to do with it. It will become a fine meeting place for industrious mediocrity." (Address before the American Society of Newspaper Editors. Reported in The Sunday Star, P. A-4, April 27, 1947, by D. Lilienthal.)

Recent Progress

Recognition of the dilemma facing the scientific agencies of the Federal Government led the Civil Service Commission to appoint an Advisory Committee on Scientific Personnel which, in turn, set up an Auxiliary Committee on Policy. The evils complained of in many quarters were studied and evaluated, and policy recommendations were formulated and submitted to the Civil Service Commission. These aimed at eliminating the numerous obstacles which hampered the recruitment and retention, by the scientific agencies of the Government, of superior scientific personnel in the numbers needed

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for effective prosecution of the work.

Insofar as the Civil Service Commission is concerned, it is gratifying to record that it has taken a "courageous and forward position" ("Minimum Educational Requirements for Civil Service." Editorial, Chemical and Engineering News, Vol. 24, pp. 891-2, April 10, 1946 by M. J. Shear) not only on minimum educational requirements but on other important matters as well. The Commission received these recommendations with sympathy and understanding; it has worked together with these committees and has already acted favorably on many of the more important of the policies recommended.

For example, these committees were invited to submit suggestions during the formulation of the new Civil Service Rules and the new Civil Service Regulations. Both of these documents become effective May 1, 1947. Among the important features in these basic documents are:

1. Delegation of authority to the scientific agencies for recruiting, examining, rating, and certifying for appointment, candidates for scientific and technical positions. This authority has been delegated to Committees (or Boards) of Expert Examiners composed of qualified individuals in the departmental and field agencies.

2. Exclusion from apportionment considerations of positions in the scientific service for which the entrance salary is over $3,000 per annum.

3. Selective certification and, when appropriate, re-rating of eligibles on a register on the basis of the requirements of a particular position.

Furthermore, there has been established within the Civil Service Commission the position of a high-ranking executive to be responsible for all matters involving scientific personnel, to provide the necessary liaison for cooperation between the Commission and the scientific agencies of the Government in the establishment and implementation of personnel policies relating to scientific work, and to have no duties other than those relating to scientific personnel. This is an important forward step.

The foregoing shows that encouraging progress has been made, and that the outlook is bright for further advantageous changes in policy as they are justified and effectively presented. Federal agencies increasingly seek to break away from the jurisdiction of the Civil Service Commission in an effort to avoid the difficulties and delays they have experienced in the past in matters concerned with scientific personnel. Improved policies and regulations for scientific personnel are urgently needed, as well as their more intelligent application.

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"But breaking away from the Commission will not, in itself, improve matters, for the agencies so freed will be required to formulate their own rules and regulations and, in effect, set up a number of independent little civil service commissions of their own. This would open the way to the introduction of many types of undesirable developments." ("Scientists Study Their Personnel Problems, III. Personnel Policies for Scientific Work." Personnel Administration, Vol. 9, pp. 15-20, Sept. 1946, by M. J. Shear.) The merit system, operating under the central Civil Service Commission, should be strengthened, not weakened. It has been demonstrated that appropriate revision of the policies and of the regulations can be expected within the framework of the Commission. Such revision can provide the mechanisms needed for the satisfactory solution of the existing problems of scientific personnel.

Major Needs

It is unnecessary here to set forth the many policies and principles regarded as essential to remedy existing shortcomings. They are not all of equal importance and, in fact, most of them could readily be instituted, if a few major needs are recognized and properly met. Instead of dissipating attention over a large number of personnel problems arising from the bulk of the scientific workers in the lower grades, it seems more helpful to concentrate on improvement in the functioning of the relatively small number of upper-grade positions.

Young graduates just out of the colleges and universities, who desire to develop scientifically, eagerly seek opportunities to work under the inspiration and guidance of noted scientists. They travel any distance, even to foreign countries, and reject "jobs" with good remuneration, in favor of a chance to catch some of the imaginative fire, critical judgment, and specialized techniques at first-hand from the leaders in science. The finest single recruiting attraction, insofar as brilliant and promising youngsters are concerned, is the presence on the staff of brilliant scientists. In turn, really able and experienced scientists are more capable of making sound judgments in the initial selection of junior personnel, and in selections for promotion, than mediocre men who have gradually advanced by seniority.

The grades and salaries of talented investigators should not be contingent upon those of administrative superiors, nor should the only avenue for material advancement open to such scientists be that of abandoning scientific work to become administrators. The E. I. du Pont de Nemours Company has announced the creation of a "new series of research positions designed to make science as a career as attractive as the administrative field...Senior research associates will be chosen from men of long service, distinguished scientific attainments and high creative potential, with capabilities

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for originating, organizing, and conducting their own research programs. They will have substantial freedom in selection of work and in the selection of assistants....and will have considerable latitude for exploratory work in unpredictable directions." (Science, Vol. 103, p. 141, Feb. 1, 1946, by M. J. Shear.) The Standard Oil Development Company has initiated a program which recognizes that "certain professional employees should receive salaries as high as those paid other members of the division who carry major administrative loads." (Chemical and Engineering News, Vol. 25, p. 242, January 27, 1947, by M. J. Shear.)

Genuine leadership can be provided only by outstanding individuals who command the respect of their associates and assistants. Leadership is not to be confused with paternalism or with neglect, disguised as "complete freedom of action", but consists of inspiration, encouragement, stimulation, and guidance. The intangible qualities of leadership and inspiration are most valuable qualifications for a university scientist and give him "an ability through personality, force of character, and enthusiasm for his subject to attract to him and to the subject he represents neophytes eager to join him in enjoying the beauties of his field. These qualities of leadership also make him a desirable man for an industrial research post." ("An Industrial View of Research Trends.", Science, Vol. 103, pp. 95-99, January 25, 1946, by M. L. Tainter.) This type of leader is invaluable not only in the university and industry, but also in Government.

Whether in the selection of responsible investigators, or in the training of young scientists, "it must be borne in mind that quantity can never take the place of quality. New ideas, or new applications of old ideas, do not arise from oceans of minds. They come from a few superior minds in which inquiry, knowledge and imagination are compounded in favorable proportions." ("National Responsibility for Research", Journal of Washington Academy of Sciences, Vol. 36, pp. 101-10, April 15, 1946, by J. E. Graf.) With high-quality leadership provided by top-notch scientists in the upper grades, many of the burdensome problems now encountered in the lower grades should be solved easily.

Highly Qualified Scientific Directors

Even the foregoing will not alone assure the recruitment and retention of superior scientists in the Government services. The man bubbling over with ideas, and eager to try them out experimentally, should not be bothered with shuffling papers in quintuplicate, filling out property returns and special forms, and writing monthly, quarterly and annual reports, and special memoranda on this, that and the other subject. Nor does he willingly take valuable time from his scientific program for interminable intramural meetings and conferences. Intolerable red tape, delays in the procurement of apparatus and supplies, and exasperating procrastination in the

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completion of personnel actions are enough to drive an enthusiastic scientist out of Government service. But worse than that, the worker frequently lacks an understanding and a helpful superior in whose lap he can dump such wearisome distractions from the actual researches with much hope of effective remedy, or with whom he can have intelligent discussion of his scientific ideas and plans.

All too often the scientific director has comfortably adjusted himself to the limitations imposed by the system and would prefer that the aggressive scientist relax and wait patiently or shrug off the imperfections of life in Government service. When the so-called scientific director is a military man with only an undergraduate mastery of engineering, or a hospital administrator with only a medical student's grasp of medical research, or an administrative official with no research background whatever, he frequently does not know what the scientist is talking about, and makes important scientific decisions on the basis of trivial or irrelevant considerations.

"Blessed is the scientist who serves under considerate and understanding administrators" wrote the great Walter B. Cannon, shortly before he died, in "The Way of an Investigator". (W. W. Norton Company, 1945.) As Graf ("National Responsibility for Research", Journal of Washington Academy of Sciences, Vol. 36, pp. 101-10, April 15, 1946) stated "The selection of wise administrators of research, the determination of when and how to provide support, and how much to provide will always hold the key to success in any expansion of the research of the nation." Shepherd, Chemical Director, American Cyanamid Company, wrote, "A research laboratory is usually the shadow of a man and that man is the chief of research....technical knowledge and skill (and broad research experience) are prerequisite to successful research management. However, without the ability to handle men I doubt that a truly efficient research group can be created or led by even a highly proficient scientist....To bring out the best of his men, the director must stimulate, inspire, encourage, and lead his men." ("How Can We Build Better Teamwork Within Our Research Organization", Chemical and Engineering News, Vol. 23, pp. 804-807, May 10, 1945, by N. A. Shepherd.)

Some practices of delegating responsibility (and authority) for the direction of scientific work have given rise to acute dissatisfactions, particularly in agencies conducted under the commissioned-officer system. One report says that the Army and Navy "wish to rid themselves of the complaint that the services are putting 'science in khaki'". ("Potomac Postscripts", Chemical and Engineering News, Vol. 25, p. 653, March 10, 1947, by A. Leggin.) Says E. U. Condon, "We must regain for all scientists that freedom from military domination which is so necessary if science is to be used for peaceful ends" as well as for military ends. This is essential in the interests of the military themselves. Because

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the scientific spirit is so completely opposite to the military spirit, science simply will not go forward under domination.... Military operations and scientific research are two quite different kinds of human activity, and neither should be subordinated to the other....Physicists....can communicate only through official channels involving censorship of their communications by Army officers without knowledge and so without understanding." ("Science and Our Future", Science, Vol. 103, pp. 415-17, April 5, 1946, by E. U. Condon.)

An editorial ("Navy Promotions", Editorial, The Washington Post, Nov. 10, 1945, by E. U. Condon) stated "Officers dependent for advancement upon the affection or esteem of their superiors are likely to be wary indeed of expressing any doubt that everything is as it should be in the best of all possible naval worlds. The virility of any service stems from its capacity for internal criticism, from freedom throughout the hierarchy to suggest changes in accepted ways of doing things and to find fault with maladministration above. Any promotion system which lends encouragement to sycophancy is certain to produce sterility."

Nevertheless, the fact must be faced that, in an officer corps, there is instilled respect for authority and obedience to orders from above. The atmosphere is, of course, hostile to the creative scientific approach which requires constant questioning of established ideas and practices, and which renders only that respect to authorities that the evidence shows they deserve. The blighting effect of an officer system on creative scientific work has been most evident in the military departments, but it also exists in other Government services where officer corps are dominant. Cognizance has been taken of such situations and Admiral Furer, for example, has said that study is warranted of "The relationships between the professional officers of the Army and Navy and the civilian scientists. The degree to which the parallel attack under independent direction is desirable, especially insofar as it affects the morale of the laboratory worker, is deserving of much thought." ("Post-War Military Research", Science, Vol. 100, pp. 461-464, November 24, 1944, by J. A. Furer.)

In order to attract and retain the services of top-flight investigators, scientific directors must have the requisite capacities. The Chairman of the Executive Committee, Pacific Division of the American Association for the Advancement of Science, wrote ("The Magnuson Bill", Science, Vol. 102, p. 524, Nov. 23, 1945, by H. S. Reed) "I am not in favor of having the research funds spent in the existing laboratories of the Federal Government because I do not believe that there are not men in those laboratories who are capable of directing basic scientific researches, expect in a few cases." The executive committee endorsed this letter. How may highly competent scientific research directors be selected by the Government services, and how may the overlapping of responsibility and authority between officers and research directors be resolved?

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For one thing the vast difference between administration of research and administration for research is not widely recognized. The securing of appropriations, the provision of buildings and facilities, the procurement of supplies, the keeping of payroll records, etc., are administrative necessities in scientific organizations. These activities are necessary to keep the organization going as a machine, and yet they are administrative services, hence, administration for research. On the other hand, the development of research policies, the selection of appropriate personnel, the evaluation of current projects, the planning of future investigations, the guidance and leadership in the actual research programs, the allocations of research funds among the various projects which are to be expanded or contracted, etc., constitute the administration of research. Administrative officials or subordinates may operate properly in the former area, but the administration of research must be in the hands of highly qualified research directors to be successful.

Salary Schedules

Like many other matters in Government, salary schedules are often viewed through the wrong end of the telescope. Relatively good schedules prevail in the lower-bracket scientific positions, but the remuneration for top positions is too low. This is false economy. Since the whole spirit and the accomplishment of an agency may depend upon the policies, capacities, and character of a handful of men in the top research positions, the creative achievements of the outfit may be stultified by mediocrity or incompetence there.

In view of the general recognition that our destinies now depend upon developments in the sciences, it seems essential to offer salaries for the more important scientific positions which are similar to those paid individuals holding important posts in the Federal Judiciary.

But scientists also insist on conditions in which their creative talents can function most freely. However, highly competent scientists are rare and Government salary schedules should be adjusted accordingly.

Better Administration for Research

Research and other scientific activities have not usually been planned in advance in Government agencies. They grew up, more or less gradually, as a natural adjunct to legislation in the fields of agriculture, military security, public health, etc. Consequently, procedures have never been developed specifically designed to foster the effective functioning of research and other scientific activities. Many of the policies and procedures have obviously been ill-fitting, and a better fit is urgently needed. Policy Principle No. 1, as approved by the Advisory

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Committee on Scientific Personnel, states "Scientific work is a highly specialized function of great importance which, for satisfactory performance, requires separate organizational treatment with specially designed procedures administered by persons with special qualifications in the operating departments, the Civil Service Commission, and the Bureau of the Budget."

The Civil Service Commission has authorized decentralization of its activities with respect to scientific and technical personnel, and has delegated the recommended authority to the scientific agencies. It has also provided the aforementioned high-ranking executive to devote himself exclusively to matters affecting scientific personnel. His duties should be expanded until all the activities of the Civil Service Commission which involve scientific personnel come under his jurisdiction and, in effect, constitute a Scientific Branch of the Civil Service Commission.

Similarly, there should be evolved, in the Bureau of the Budget, a group of properly qualified experts who would devote themselves exclusively to the budgetary problems of the research and scientific agencies. Such a group could act with more discernment than is available at present in formulating the budget requests of the agencies.

However, should all these recommendations be adopted, there would still be the great gap between top policy and day-by-day implementation. Routinized personnel and procurement clerks may unnecessarily complicate procedures, either oblivious of new policies and regulations, or else disposed to ignore them as unnecessary innovations.

There must be administrators who understand the objectives of their scientific agency, who realize that the new rules and regulations of the Civil Service Commission are designed to promote efficient conduct of the Government's business, and who are enterprising, energetic and courageous enough to expedite what needs to be done, even if inertia or antiquated procedures in other parts of the agency's machine must be overcome.

Such policies are continuously open registers in the upper brackets of scientific positions, a longer probational period than one year for research positions in the higher grades, a more widespread use of the fellowship system in Government agencies, greater speed in personnel actions, greater participation of scientists in the formulation, defense and allotment of budgets, more suitably qualified classification analysts, etc., need not be discussed here. With the authority granted in principle by the Commission to the scientific agencies, with better selection of research and scientific directors, and with

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highly competent administrators for research, it would be possible for top people to recruit and retain superior scientists on their staffs, and to successfully operate their scientific enterprises.

We cannot, of course, expect that sometime the major personnel problems in this area of Government operations will all have been solved. Certain types of problems will always exist, and new ones will probably arise. We can, however, provide continuous study of such problems. This should lead to a continuing program of recommended improvements on a Government-wide basis. This might be done by continuing the life of the Advisory Committee on Scientific Personnel and its auxiliary committees, or in other ways (e.g., under the proposed National Science Foundation, or an Inter-Departmental Science Committee or Board).

The cardinal principles in getting and keeping superior scientific people throughout the Government scientific agencies might be listed as follows:

1. Put leading scientists at the top of these scientific agencies.
2. Place experts, qualified for scientific personnel work, at the top of a special branch of the Civil Service Commission.
3. Place specialists in the management of scientific affairs at the top of a special branch of the Bureau of the Budget.
4. Provide these experts with all the necessary authorization to tackle the problems and work out solutions.
5. Provide highly competent administrators for research (not merely of research) to the scientific directors in the agencies so that the policies adopted at top levels receive sound, vigorous, and prompt action.

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Chapter III

RESEARCH ADMINISTRATION

Why Research Administrators are Needed

The term "research" has come to carry such prestige that there is a strong tendency to group under it a series of activities, ranging from the most erudite and free scientific inquiry known as pure or basic or fundamental research, through applied research to development, testing, and even design. The dividing lines between these types of effort are neither well defined nor definable, and they all frequently take place in one organization and perhaps under one roof.

This is true in Government, as in industry, and to an increasing extent applies in technical schools and universities. The prosecution of this extended series of activites in a single large group or establishment emphasizes the need for adequate and sometimes rather elaborate organization, and for administrators to make the organization function. In addition to the variety of work carried on, the magnitude of even single enterprises in modern research is so great as to require large groups of specialists combined into research teams, with the resulting need for defining their relations, and for the solution of organizational and administrative problems.

What Research Administrators Do

Research administration is of little concern to the lone worker in a university laboratory prosecuting a problem in which he does all the work himself, or with a few assistants. But, if his enterprise is one of the type becoming increasingly common, wherein several score of workers are required, the project leader is very likely to find himself much more concerned with how to make his group work together effectively than with the technical problems that arise in the work. If, beyond this, an institute or establishment exists which is handling several such problems simultaneously, the top two or three levels in the organization, together with a substantial staff, will be very largely occupied with the problems of administration.

The more important activities of these research administrators will be the following:

1. Provision of adequate funds for prosecution of the work, be they obtained from a private donor, a board of trustees,

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a board of directors, a State legislature, or the Federal Congress.

2. Guidance of the program of the establishment within the limitations set by those who provide the funds, or their agents.

3. Payment of the employees, with the time-keeping, bookkeeping, accounting, and all that is necessary to have each worker paid on time.

4. The provision of space, or the equitable division of that available in accord with the real needs of the various competitive groups.

5. The provision of laboratory equipment adequate for the solution of the problem, and apportionment of available funds to provide that which is essential to all, before any receive that which is superfluous.

6. The provision for expeditious purchase of supplies. This is particularly difficult in Government because of the multiple checks required by public accountability, and the necessity of protecting the Treasury from the unfortunate but too common paralysis of private conscience in the presence of public funds.

7. The establishment and enforcement of recruitment, employment, promotion, and separation policies.

8. The balance of manpower and funds between services, such as clerical, housekeeping, drafting, machine work, report preparation, and library, and technical productive effort within the activity, and the equitable division of available services among those competing for them.

9. Selection of projects which his establishment undertakes, which require that he be able to:

   (a) Determine whether his establishment is capable of carrying them out satisfactorily.

   (b) Judge whether they are of sufficient importance to warrant the expenditure of time and effort involved.

   (c) Know what fraction of the total effort they merit, if undertaken.

   (d) Justify refusal, when necessary.

   (e) Recognize progress or lack of it, and decide whether to increase, diminish, or cease effort.

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The Type of Person Required for Research Administration

In order to function effectively, the research administrator must possess a variety of characteristics and must have had broad qualifying experience. Among the things required are the following (not necessarily in order of importance):

1. He must have a good presence.

2. He must be able to analyse, organize, write, and orally state his thoughts in a clear and persuasive manner.

3. He must inspire confidence and loyalty, with well-trained scientists and engineers, as well as with clerical personnel, members of the trades including their unions, administrators, and sometimes legislators, and military personnel.

4. He must know enough about the requirements of research to decide correctly in a contest for space, equipment, subprofessional or mechanical assistance, or other required facilities.

5. He must possess a certain impatience with the restraints of the system under which he works, particularly in Government, and the energy necessary to improve it continuously.

6. He must be acquainted at the sources of trained manpower and have a sufficiently sound reputation at those sources to enable him to draw from them. He must be able to select accurately the best qualified applicants for the more important positions in his organization.

7. He must understand his personnel well enough to establish and maintain policies for professional improvement and advancement, and to provide a cooperative atmosphere which will encourage the growth of interest in professional achievement, and enthusiasm for the work being done.

It is fairly obvious that only a person trained for and experienced in research can possess the necessary technical requirements. Without these, he cannot gain the confidence nor will he be likely to retain the services of able research workers. It does not follow that, given success in research, a man will also be successful in research administration. Many of our most brilliant researchers are not well qualified for administration, and should not be burdened with it.

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The Administration of Research in the Government

The Government is not, for many reasons, in a good competitive position for the employment of research administrators. One of the first is salary limitation. When industry asks the scientist to lay aside his technical work to guide the efforts of his colleagues, it provides him with a relatively handsome reward in the way of salary. Government makes no such provision, the top administrative pay being the same as the top pay in straight technical work. This would be no serious handicap if governmental establishments were limited to groups of perhaps a dozen workers. But when a Government scientist demonstrates the ability to lead a group of several hundred researchers, his services are likely to be sought by industry or even the universities at a considerably higher salary level. The lack of enough high-grade administrators is one reason for the multiplicity of rules and regulations in Government, with the resulting inflexibility which is so hampering to an ever-changing research program. The remedy is obvious, and there is every reason to believe that it would pay large dividends.

In the provision of funds for research, the Government suffers serious handicaps. First, the needs of any one group may have to filter through three or four levels of administration not very well equipped to understand them, and may reach the Congress in a form which fails adequately to present the true situation. This results from the detailed consideration of expenditures by Congress, despite the great size of our governmental organization. Second, arbitrary over-all limitations may be so decreed as to permit no consideration of the relative merit of various programs. These limitations are often imposed by political pressure generated by failure of the electorate to understand the problem. Third, year-to-year appropriations hamper the planning of long-term programs. Efforts are being made to provide long-term appropriations for research.

In the guidance of programs the research administrator may be too hampered by nontechnical limitations imposed by such things as budget considerations, lack of understanding in higher echelons, or inflexible rules and regulations. In the Government, the machinery involved is too cumbersome to permit easy adjustment of such matters and particularly where funds are concerned, the machinery involves too many levels of organization. The solution lies in the choice of better administrators and the delegation to men of sufficient authority to permit them to operate more effectively.

In pay, the Government range at present and under current classification procedures, competes fairly well with nongovernmental rates in the lower grades and for straight technical work. However, any widespread down-grading, such as has been threatened,

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can only result in the loss of more of the Government's best talent than has already occurred. The administrator's difficulty, in most cases, lies in the complex procedure of establishing a pay rate. The Navy moved toward decentralization of this procedure in its larger research and development establishments, but the full advantage has not accrued, because the central office still reviews all actions in such detail and requires so much in the way of detailed justification, that no simplification of procedure results. It is to be hoped that time and experience will extend and improve this practice.

The governmental establishments, especially military agencies, possess some of the finest equipment now extant. However, with the current contraction of funds, this condition may not long persist, and many establishments may find themselves using 1947 equipment long after it has become obsolete. The research administrator must combat this danger vigorously by clearly indicating the high cost of operation which results when manpower and equipment are out of balance.

The research administrator faces a probable reversion to prewar procedures in the purchase of equipment. The bid system, when applied to small purchases, becomes tremendously expensive to operate, and its slowness is a serious handicap in the prosecution of research, where long-range purchase plans, adequate to cover all possible contingencies, cannot be made. Efforts are being made to retain some of the advantages of the emergency methods, without undue risk of accountability. It is important that these efforts be supported.

Personnel administration will probably continue to be the research administrator's most pressing problem. It is aggravated by the present serious shortage of trained personnel, resulting from a short-sighted war-time training policy. A dim view of Government scientific service as a career is still held by many, though there is some evidence of improvement. The decentralization of the functions of the Civil Service Commission is making it easier to put the vital element of personal contact into recruiting scientific and technical personnel, and this may yield a substantial improvement in quality of applicants. The adaptation by some of the better industrial firms of some of the Civil Service methods, such as the requiring of applicants to take a written examination, will make competition somewhat easier. The Navy's decentralization of classification in field stations, if allowed to function without too much interference, may fall into administrative hands of strength adequate to make it work, with a very great benefit to all concerned.

Research and Development in the Armed Forces

Up to 1940 research and development in the armed forces was a minor activity. With the demonstration in the war of the

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advantages of research in military activities, came a very substantial effort to continue it at a much higher level in the future. This has emphasized a basic difficulty which formerly was of great importance in connection with research in the armed forces and may yet be a serious threat to its effectiveness; namely, the tendency to embody all authority and responsibility in the military personnel. This practice leads to an organization which is essentially amateur in its approach to its problems, and the results obtained before 1940 in many military agencies strongly reflected its disadvantages.

During the war, the military and the scientific professions learned to work together rather effectively, and the lessons learned in this process are persisting. In the more effective military research agencies, there is a clear-cut recognition of the partnership basis which must exist if research and development are to be prosecuted successfully. The scientists must and do have an adequate recognition of the trained experience, function, and prerogatives of the military, and the military in turn must and does have adequate recognition of the function, responsibility, and prerogatives of the scientists. During the war, in the organizations where this mutual responsibility was recognized, some very good and very useful weapons were developed at relatively small cost. There was less production of devices and equipment which could not be used because of the failure to give adequate consideration to the military requirements in its design.

These considerations lead to certain points of major importance in the future conduct of research in the Government. These points are deemed especially urgent in view of the rising importance and scope of research in the Government, the need for such work as a fundamental of reasonable preparedness, and in view of the shortage of scientific personnel generally which requires highly competent personnel management in research, not only to economize on funds but on manpower as well. They are as follows:

1. The research administrator assumes increasing importance as work expands.

2. He must be outstanding as an administrator and also especially gifted as a scientist.

3. The Government must be able to secure such personnel by having adequate pay scales and particularly by giving scope to the director to function independently as scientific needs dictate. The director must not be hampered by restrictions imposed by nonscientific administrators at a higher level.

4. Particularly in the armed forces, research must not be so handled administratively that unqualified

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personnel excerise judgment and impose restrictions which will hamper effective accomplishment.

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Chapter IV

BUDGETARY PROBLEMS

Introduction

Current discussions in Congress clearly demonstrate that personnel management of Government scientific employees is intimately connected with budgetary problems. Much time is lost from his career when a scientist changes his place and type of work. Hence, he is especially sensitive to the stability of his employment. It is, therefore, of paramount importance to good research work that a stable budget situation be assured for a reasonable future period. Without this, good scientists are unlikely to be interested. Hence, budgetary problems are vital to discussion in this report.

Justification for Research Budgets

Need for better understanding of the efficient level of budget justification is basic to reconsideration of the proper roles of the research agency, the Bureau of the Budget, and the Congress in the field of Federal budgeting for research. The research agency, which is generally a constituent unit in a larger departmental structure, must formulate its budgetary needs in terms of the costs of doing specific jobs. The research budget is justified through the process of convincing successive evaluating groups within the department, the Bureau of the Budget, and the Congress, of the merits of the various projects. Whereas the reviewing agencies may approach, let us say, a construction program, by considering the merits of building this bridge or that dam in one State or another, such procedure has crucial weaknesses when applied to research. The deferable or nondeferable nature of research projects can be determined only in relation to the total program of which they are the elements.

Thus, it becomes important to decide whether research budgets are to be appraised by reviewing agencies at the project or at the program level. Initially, the distinction between the project and the program must be understood clearly: 1) A program usually consists of more than one project, and 2) the purpose and nature of a program can be expressed in general terms which can be understood without a background of scientific training, whereas, an understanding of a project, together with an estimate of its value to the program, calls for special skills. The annual budgetary process is a useful medium for policing the distinction.

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Conceived broadly, the justification level should include an evaluation of the projects which comprise the total research program within the bureau or office of the department having the necessary technical resources to judge the projects expertly. Justification to fiscal officers, however, should not go below the program to the individual projects.

The department makes the primary decision as to the emphasis to be placed upon alternative programs in terms of budgetary allowances. The Bureau of the Budget reviews the department's recommendations to determine shifts in program emphasis, and requires a justification at the program level. In addition, the Bureau of the Budget is interested in detecting duplications of research programs among various agencies, and in securing a reasonable balance among them. Finally, the Bureau of the Budget has a legitimate function in appraising the effect of proposed research programs upon the fiscal and administrative program of the President, and in formulating advice to the Chief Executive as to the desirable level of expenditures for each of the classifications of governmental activity, of which research may be one.

The Congress then reviews the President's budgetary program to decide whether or not funds are to be appropriated or authorized in greater or less degree than requested by the President, both for broad functions and general programs. In addition, Congress sets the final limits of annual expenditure for the Government as a whole, and may, through its actions on appropriation estimates, effectively establish expenditure levels on programs.

Long-term Programs Instead of Short-term Projects

Current budgetary procedure calls almost inflexibly for estimates of future appropriations on a one-year basis. Yet relatively few of the research programs actually undertaken by Government agencies can be planned adequately, or their probable value appraised, in terms of less than three, five, or ten years of work.

It would be helpful if all research programs could be presented to the Bureau of the Budget and to Congressional appropriation committees on a basis of their long-term or ultimate objectives, and if appropriations were granted for that part of the program to be undertaken in the next fiscal period. In other words, a program should be projected three-to-ten years into the future; it should be reviewed, modified to meet changed conditions, and approved each year by the Bureau of the Budget, and Congress. There should be combined with the projected program a statement of previous activities and accomplishments. The primary purpose of such a combined statement would be to put next year's budget request into the proper perspective. The pattern of each year's budget justification would be:

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1. To consider the long-run program approved in the previous year as the base; the long-range program would also project the expected rate of expenditure.

2. To set forth any change in the conditions upon which the previous year's long-range program was based.

3. To agree upon any modifications in the long-range program and insert this program as a part of appropriation committee hearings.

4. To determine the appropriation for the next fiscal year in accord with the long-range program.

Actually this pattern is partially used in certain specific cases. The practice should be made general.

Appropriations should be in lump sums for broad programs instead of in specific sums for detailed projects. This would give needed flexibility to research operations and permit administrative heads of scientific bureaus to modify projects in the light of sudden and unexpected scientific discoveries. The very nature of scientific research involves unpredictability of the outcome. If the outcome were known, the project would not be research. As previously noted, the formulation of specific projects to contribute to a general program requires scientific knowledge and therefore should be left to the scientist for decision.

Appropriation for Overlapping Biennial or Longer Periods

Sustained support is desirable for programs which should be planned over a period of years. For example, ship, aircraft, and dam construction have been planned and funds made available until spent, rather than on an annual piecemeal basis. Much development work is of the same nature since it is known from the very beginning that a given program or project cannot be completed within one year. For example, research programs on the effects of radiation on human beings should be continued for many years. The radiation effects may not become apparent in less than 20 or 30 years. The principle of guaranteeing funds for more than one year is recognized in contracting for research work with outside agencies. Funds once obligated by contract, under certain statues, remain available for expenditure for three years after the appropriation is made. In the Office of Naval Research and the Atomic Energy Commission, funds obligated for contracts remain available for expenditure for five years after the appropriation.

The justification for such authority is that commercial or university laboratories are reluctant to undertake a research job unless there is a guarantee that funds will be available over a period long enough to complete it. From the point of view of the

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university or commercial laboratory, it does not pay to build up a research staff and facilities which may be disbanded at the end of one year and before the job is finished. For similar reasons, funds transferred from one agency to another on a working-fund basis remain available for obligation for three years.

If university and commercial laboratories do not find it efficient or worthwhile to accept research programs unless funds are guaranteed for the expected duration of the program, why should not Government research funds be similarly guaranteed?

The desirability of guaranteeing funds for more than one year must be reconciled with the Congressional responsibility for determining the proper level of research activity, its rate of increase or decrease, and its relation to the financial condition of the country. The guiding principle should be that sudden enforced changes in the rate of activity are undesirable. Too rapid expansion of contraction of a research activity is wasteful. It takes more than one year to build up a successful research organization. Even during wartime it required more than one year to build up the Radiation Laboratory. There is probably a maximum rate of expansion or contraction which should not be exceeded.

Some research activities require field work that can be done only during the summer months. The fact that the fiscal year begins July 1 means that summer field activities cannot be planned coherently. A triennial appropriation would make the planning of such activities more efficient.

Many of these difficulties would be overcome if appropriations were made available for obligation and expenditure for overlapping periods longer than the fiscal year for which appropriated, e. g., three years. If obligated, such funds should be available for expenditure five years after the initial appropriation, as is the case now for funds obligated by contracts made by the Atomic Energy Commission and the Office of Naval Research.

The effect of such a system would be to average out sudden fluctuations in research programs. A 30% curtailment in one year and a 100% curtailment in three years would be the maximum rate of change. Appropriations for overlapping triennial periods would be a distinct improvement over present practice. Certainly there are many research programs under the National Advisory Committee for Aeronautics, the Bureau of Standards, and the Department of Agriculture to which both political parties would be willing to apply the principle of an overlapping appropriation. Clearly, the decision of whether to apply the principle of overlapping triennial appropriations to a given research agency is a matter for Congressional decision.

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If Congress determines that a given research activity should be decreased, the agency can plan the diminishing activity in an orderly fashion over a 24-month period rather than in the few weeks that may remain before the end of the fiscal year. Frequently, an agency will not know what future level of activity it can support until immediately prior to or even after the beginning of the new fiscal year. Planning on such a basis is all but impossible. Appropriations available for three years would alleviate this problem. Furthermore, the unfortunate situation of hurriedly obligating funds in June to forestall their lapsing would not arise as frequently as at present.

Special Authorizations and Exemptions

A number of normal procedures and legal limitations are necessary for the routine procurement of supplies, construction of public works, regulation of mass operations, etc. In specific cases such procedures are inapplicable to research activities. For example, research agencies should be granted special authority with respect to:

Publication: Adequate funds should be provided in appropriations so that the results of discoveries made during the course of federally financed research can be made known to those persons who will benefit from such new knowledge, as well as to taxpayers who finance its creation.

Contract authority: It should be possible to make contracts for research without advertising for competitive bids, without legal consideration, without performance or other bonds; to make advance and progress payments.

Voluntary services: Authority should be granted to contract for personnel services without compensation.

Scholarships and fellowships: Authority should be given to grant fellowships and scholarships in the special field of activity of the given agency.

Simplifying auditing procedures: Auditing procedures should be simplified with the approval of the Comptroller General.

Attendance of meeting: The expenses of scientists attending scientific meetings should be adequately provided for in appropriations.

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Elimination of Personnel Ceilings

Personnel ceilings provide an additional unnecessary control which may foster inefficient operation. In the first place, personnel ceilings should be consistent with budget limitations. If not, an agency may be forced to contract for research which could have been executed at less cost within a Government laboratory. If, however, personnel ceilings and budget limitations are consistent, the establishment of the personnel ceiling provides no further check than is already provided by the budget limitation.

It is recommended:

1. That research programs be formulated on a three-to-ten year projection, that these programs be reviewed, modified, and approved annually by the Bureau of the Budget and the Congress.

2. That research apprcpriations be made for programs and not specific projects.

3. That research appropriations lapse at the end of three years rather than one year.

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Chapter V

THE EMPLOYMENT OF SCIENTIFIC PERSONNEL

Introduction

The whole problem of scientific research and development being carried on directly by the Government or privately, under Government sponsorship, revolves around the acquiring and the retention of able scientific personnel for the Federal service. Government funds and elaborate and expensive Government facilities are useless unless the work is directed and carried out by superior scientific personnel. If the result of work accomplished in research contracts is to be applied to specific Government needs, it must be coordinated and sometimes specifically directed by Federal scientists or engineers who are familiar with its possible application. Very superior scientists with highly specialized qualifications are essential.

In the past the conditions obtaining in Federal employment have received much unfavorable publicity. Unlimited and highly unnecessary red tape, restriction of effort, poor salaries, little chance for advancement, and political interference have been proclaimed as objections to Federal service in general. During the war many scientists joined the Federal service for patriotic reasons and served either as civilians or in military status. The existing confusion and distraction, largely unavoidable because of the enormity and suddenness of the war effort, they, nevertheless, accepted as generally representative of Government service. On the other hand, the war experience focused attention on the weak points of the Civil Service System, many of which are now being corrected, but it must be recognized that the personnel policy of a democratic Government faces certain problems not met by private employers.

Conditions Governing Federal Employment

Formalized Rules and Regulations Essential.

When a private individual wants to employ other individuals he is usually free to base his decision on any particular qualification or set of qualifications he cares to establish. Whether it be the applicant's ability, or the way he combs his hair, the employer is within his rights. If his choice is poor, he bears the consequences. The same is, to a lesser extent, true in all private industry, although the larger organizations are now adopting competitive systems.

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Conditions are quite different in public employment. There is no profit motive and the head of a department is not spending his own money. Without definite rules, there is nothing except the administrator's inherent honesty to prevent him from allowing favoritism and partisanship to guide him in his choice of employees and in their promotion. Unfortunately, the Government must be an impersonal employer. Rules and regulations have to be established and enforced to cover every possible contingency since every employee has a legal right to complain to his Congressman concerning any treatment he may receive.

The Civil Service Act.

To remedy this condition, Congress passed the Civil Service Act in 1883 establishing a Civil Service System for the Federal Government. The Civil Service Commission was established by the act and was authorized to promulgate the necessary rules and regulations to ensure that all Government administrative officials would carry out the law as Congress had intended. In the intervening years Congress has attempted to keep the original act up-to-date by frequent modifications. The Retirement Act was added to provide remuneration to superannuated employees, in 1920. The Classification Act was added to the Civil Service laws in 1923 in the attempt to establish criteria for classifying positions, so that everywhere in the Government employees would receive equal pay for equal work.

With all of its shortcomings, the system is an entirely workable plan for carrying out Government personnel policies. During the past few years some of the large industrial organizations of the country have adopted certain of its provisions. The system is designed to acquire for the Government those who are best fitted for the particular positions it has to fill; to protect the individual applying for or holding a position, against favoritism or other injustices to which he might otherwise be subjected, and to give him such opportunity of advancement as he merits. Most of the loudly voiced criticisms of the system are really criticisms of administrative officials, and might apply equally well to non-Government activities.

Simplification of Rules and Regulations.

Even though rules and regulations are essential, care must be taken to keep them few in number and as simple as possible. New regulations are usually placed on the books to meet new contingencies and, as the years go by, these often become overlapp-

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ing and confusing. Recognizing this, the Civil Service Commission has recently reviewed all existing regulations, cancelled those no longer necessary, and reissued only those now in force.

Decentralization of Commission Operations.

The Commission has also realized that diversities of positions in the Government and of conditions under which individuals are employed are too great to be handled intelligently by remote control. It has decentralized its operations and delegated many of its responsibilities to the managements of the various Government activities at the operating level; it has established boards or committees of U. S. Civil Service Examiners to carry out the examining responsibilities of the Commission from a point much closer administratively to the positions being filled than was formerly the case.

Can The Federal Service Satisfy Superior Scientific Personnel

This question can only be answered by reviewing the factors which the superior scientist would consider desirable in a proposed position. A number of those factors are listed below, together with comments as to how Federal employment meets the need.

Invisible Censorship.

While not peculiar to Federal Government employment, a sort of invisible censorship does in a measure overshadow scientific activities therein and to some extent determines what may or may not be undertaken. Whereas projects may suddenly be dropped by industrial research departments because they do not lead to sufficient or immediate profits, or because they have become for some reason offensive to an individual executive of the concern, or member of its board of directors, Government research may end abruptly at times for purely political reasons. There have been instances where Congress ruled that certain investigations be summarily discontinued; in one case the animals used in a biological project had to be killed and the records destroyed. These things vitally affect the scientist's attitude in selecting and in working on research projects.

Very often the results of scientific investigations conflict with the preconceived notions of those who pass on funds to support them or of others whose pecuniary profit they menace. Scientists face this sort of censorship quite generally. It certainly occurs in industry; it can occur in universities and in private foundations; it is not, as some have held, peculiar to Federal Government research. But special interests or groups do from time to time exercise political pressure to curb research when its results might prove undesirable or to forbid the dissemination of scientific information which proves disagreeable, and this

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is a factor to be considered when the Government's employment of scientific personnel is under discussion.

Opportunity for Advancement in His Field Through Experience and Advanced Study.

This is of particular interest to the young college graduate who feels that he is not choosing a lifetime job when he accepts a given position. The Government encourages its employees to continue their education, and many graduate courses are at present available in the Washington area.

Opportunity for Achievement in His Field.

In general, the Government's scientific problems are broader in scope and the facilities available for solving them are more adequate than would be found in the laboratories or universities or even in large industrial organizations. When necessary, the Government can command almost unlimited funds and facilities.

Assurance of Adequate Facilities, Capable Assistants, and Ample and Continuing Funds.

For specific problems, it is the responsibility of the administrator in charge to see that these conditions are met before a problem is undertaken. Funds, of course, are appropriated only by Congress, but the administrator can spread them thin over a large number of assignments, or restrict the efforts of his laboratory to a relatively few well-supported projects. The problem of "continuing appropriations" is the responsibility of the Congress and is discussed in more detail elsewhere in this report.

Freedom of Action in Solving Problems Assigned.

This is also the responsibility of the directing administrator, just as in private research laboratories. It is true that most Government research is of the so-called "target type", and will probably continue to be so since the expenditures of Government laboratories are always vulnerable to Congressional committees who wish to "protect" the taxpayer.

Opportunity for Working under Able Administrators.

This again is an administrative problem not confined to Federal employment. Civil Service rules may be too liberal in this area. Depending on the echelon of administration, Federal administrators may be political appointees, or may derive their authority from military or naval rank. The Civil Service Commission, in concert with other agencies, should strive to es-

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tablish definite qualification standards which would have to be satisfied before an individual could be appointed as a research and engineering administrator.

Opportunity of Professional Association with and Interchange of Ideas Among Colleagues.

This involves attendance at meetings of professional societies, working on their committees, or serving as officers on official business. Again the administrative officers have considerable authority as to policy, but available funds and the wording of appropriation acts may prevent the payment of traveling expenses. At present, there is a great variance in the policies of different agencies. The matter should be clarified by Congressional action.

Opportunities of Obtaining National Recognition for Superior Accomplishment.

Except in the military departments, the Government employee enjoys as much freedom in the publication of accomplishments as the university worker, and, even in the military departments, the percentage of confidential results is probably no greater than in an industrial laboratory.

Assurance of Adequate Remuneration, Promotion when Merited, and Reasonable Provision for Old Age.

Here Government opportunities compare favorably with non-Government, except in the higher administration positions, when the Government salaries are limited by a definite ceiling.

Freedom from Interference by Rules, Regulations, and Red Tape.

Except for burdensome classification procedures and some limitations on procedures for spending Government funds, individuals in nonadministrative positions are not particularly concerned with "rules and regulations." Classification problems and purchase procedures are discussed elsewhere herein.

There appears, therefore, to be no inherent reason why superior scientific personnel should not be happy in Government service. Certainly the advantages more than atone for the few disadvantages when conditions are fairly compared with non-Government positions.

Acquiring and Holding Superior Scientific Personnel

The acquiring and maintenance of superior scientific personnel naturally breaks down into the following steps:

1. Interesting possible applicants: Scientific personnel must first be interested in the opportunities which the

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Government offers. The greater the degree of interest and the broader the scope the better.

2. Choosing the best candidates: The method of choosing the best candidate should be scrutinized. All factors which will contribute to satisfactory performance should be considered.

3. Appointment: Various types of appointment are available; the type used should be chosen after considering the position, its future, and the characteristics of the applicant.

4. Keeping Employees Happy and Productive: Conditions must be such that employees enjoy their work and are encouraged to maintain their enthusiasm in their chosen field of endeavor. (This is discussed in more detail elsewhere in this report.)

How to Arouse Interest.

Pre-War Policy: Prior to the war all recruiting, i.e. publicity programs to interest people of the country into applying for Government positions, was carried on by the Civil Service Commission itself. Its recruitment policy appeared to be based on the premise that the number of people who wanted to work for the Government far exceeded the number of positions to be filled, and that satisfactory publicity could be accomplished by merely posting examination announcements in post offices and other public places as prescribed by law. To meet the rapidly expanding needs of the Government during the war, this system proved hopelessly inadequate and recruiting by individual agencies was encouraged, preferably in cooperation with the Civil Service Commission, although much recruiting was done entirely independently.

Present Recruiting Authority at Operating Levels. With the decentralization of the operations of the Civil Service Commission, various boards and committees of the Civil Service Examiners were authorized to act for the Commission in recruitment and examining operations, the Commission still holding final responsibility. This was an important forward step. It put the recruiting in the hands of the operating agencies who are able to discuss the type of work being carried on in the agency and to give detailed information to possible candidates.

The Board of Examiners of the Potomac River Naval Command has recently conducted a recruiting campaign for P-1 chemists, engineers, and physicists and sent teams of two or three persons to colleges in various parts of the United

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States. Reports of the teams indicate very satisfactory cooperation from the colleges visited and the building up of considerable interest among this year's technical graduates. Over 1900 applications were received for the examination, a much larger response than was expected. It therefore appears that, when the opportunities and advantages of Federal employment along scientific lines are properly presented, many young scientists and engineers become interested in at least starting their career with the Federal Government.

Increasing the Prestige of Federal Scientific Service. The problem of building up interest among scientific and technical people in what the Government can offer is a long-range one, and programs similar to the one outlined above represent only the beginnings of what can be done. In this long-range program emphasis should be placed on the general opportunities offered for carrying out interesting and worth-while projects for the Federal Government. A well-considered program of articles, of both general and technical interest, to appear in scientific, technical, and semi-technical journals should be worked out. Speakers should be provided to present the nation's scientific and technical needs to meetings of scientific and technical societies, and to university colloquims or assemblies, interesting literature describing Government activities should be provided and distributed widely. Government employees should be encouraged or, if necessary, directed to prepare opposite papers for presentation to scientific meetings and articles for publication in scientific magazines. It is only by such means that interest in Federal scientific work can be stimulated and the prestige of Government scientific work enhanced. Such publicity will also prepare the way for recruiting for specific examinations or specific positions.

The Selection Process.

Competitive Examination. As has already been pointed out, certain rules and regulations must be established and followed in the operations of the Federal personnel system where every citizen has a right to expect equal consideration. So in the examining process, the rules must be set up and publicly announced. The Civil Service Commission has established such regulations and worked out adequate methods of implementing them. A public announcement is made of each and every examination to be held for Government employment; these announcements are distributed as required by law. The Commission considers each examination announcement a contract with the public. It must list all conditions pertinent to the examination described, the subjects to be covered and, if the examination is to be a

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written one, the notice includes samples of the types of questions to be used.

The actual examinations may be of the assembled (i.e., written examination) or of the unassembled type; in the latter the rating is based on experience and education only, or on combinations of the two. Interviews may also be included in the examining process, providing the examination announcement so states.

Examinations may be held open indefinitely or closed on a definite date, as desired. With the closed type, no additional candidates can be examined until a new examination is announced. With the open type, new candidates may be examined at any time and assigned an appropriate grade. The Commission favors closed examinations unless the supply of applicants is known to be smaller than the demand. The examining process should not be considered completed until the employee has served a probationary period of one year. If unsatisfactory, he can be summarily dismissed during that year.

Register of Eligibles. Upon completion of the rating procedure, the Civil Service Commission establishes lists, or registers of eligibles, and an appointing agency can choose, under certain specific conditions established by law, any one of the top three names on the list. The specialization in scientific work which has developed over the years has recently been recognized by the Civil Service Commission, and provision has been made for so-called "selective certification", where applicants listed on the register can be re-rated for specialized positions. In the higher ratings, the Commission establishes no general register, but permits a special register to be established for each particular position.

Preferential Treatment of Certain Groups. While the register is in general supposed to list applicants in the order of their ability, veterans are by law given preferential treatment, and it is quite possible that the top three applicants on the register may be veterans and that the most able applicants, as evidenced by an examination rating, may not appear among them. The wisdom of this provision, as applied to scientific workers, is open to question. Certainly the Government owes a debt to war veterans, especially to those who have experienced disability from their war service, but the question arises, could not this obligation be otherwise fulfilled than by forcing scientific activities to accept for employment others than those who have the very best talent available.

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Desirable Improvements. The over-all purpose of the selecting procedure is to pick the best available candidate for each position, and every effort should be made to allow it to accomplish its purpose. Recent modifications have made its operation more effective, as applied to scientific personnel, but additional changes are desirable.

To Summarize:

1. All examinations, at least above P-1, should be kept open continuously to permit able candidates to place themselves on the register at any time; a partially used closed register may prevent the appointment of the best available candidate.

2. The utilization of local Boards of Examiners should be continued and encouraged.

3. The use of "selective certification" and of special registers for special jobs should be encouraged and applied if at all desirable.

4. Veteran's preference should not be applied to scientific positions.

5. Funds should be provided to pay the expenses of promising candidates reporting to appointing officers for interviews, especially in positions of P-4 grade or above.

6. The number of candidates from which the appointing agency must select one, should be increased from three to five because of the high degree of specialization existing in scientific work.

The Appointing Process.

Normal Appointments. Once a register is established and the examination closed, all appointments to positions in the classified service must be made from this register. Normally the appointment is "probational" and leads to a so-called "permanent" status. Temporary appointments may also be made from the register, but if a register is not available, all appointments are temporary, and appointees must be subjected to competitive examinations, at a later date, and meet the same conditions as a new applicant.

In order to make an appointment to the classified service a properly classified position must first be made available. This involves the submission of a detailed

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description of the proposed position to the classifying authorities and their establishment of its name and grade level. This process is discussed in more detail elsewhere herein, but at best, a considerable period usually elapses between the time the need for a new position arises and its final classification.

This done, it is only necessary to pick from an established register a satisfactory employee to fit this particular job. The naive reasoning back of this procedure is based on the premise that applicants can always be found to fit any particular position. In scientific work this is rarely the case. Frequently the jobs have to be fitted around the available appointees. The applicants come ready-made, but the work can be cut and modified to some extent. While present regulations make some provision for this, the process is indirect and involves considerable delay and extra work.

Apportionment Restrictions. The appointing process is made still more restrictive by the "apportionment regulations" established by Congress. These provide that preference shall be given to candidates from States, the number of whose citizens currently employed by the Federal Government is below certain apportionate figures fixed by the law and based on the relative populations of the several States.

Veteran's Preference. The veteran's preference laws affect appointing procedures as well as relative position on registers.

Special Types of Appointments. A number of Government departments are permitted to appoint specialists on a personal services contract at rates up to $[illegible] per day, without recourse to Civil Service regulations. It was this provision which enabled the Army and Navy to expand their technical activities rapidly during the war, but its wide application in peacetime is not encouraged for fear it may undermine the competitive system.

Other departments are permitted to appoint "fellows", who are employed for definite periods of time without recourse to Civil Service. These fellows are usually assigned to special research jobs, but the system is valuable in that it gives the agency great flexibility and, if desired, the opportunity of transferring "fellows" to the classified Civil Service.

If a position is so highly specialized that there is none other like it in the Federal Service, and the appointing agency can convince the Civil Service Commission that

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there are very, very few individuals in the country who can qualify, then the Commission may authorize the appointing agency to fill the position without a competitive examination.

Agencies Authorized by Congress to Ignore Civil Service Regulations. There has been considerable criticism of the Civil Service System by members of the Congress and a number of Government activities have been given authority to wholly disregard Civil Service laws and regulations in making their appointments. It appears that this is a dangerous procedure and may lead to serious abuses of the authorities delegated to these agencies.

More Flexibility in Normal Appointments desirable. Most of the exceptions to normal appointments listed above have been obtained through special clauses inserted in laws covering the operating procedures of certain departments or individual agencies. The purpose of each has been to give the agency wider appointment authority. The authorities are not uniform throughout the Government and result in confusion, abuse of authorities and petty jealousies.

The normal appointment regulations should be so liberalized that the various special procedures would be largely unnecessary.

1. Continuously open registers and free use of "selective certification" would go far to give desirable flexibility.

2. Administrators should be permitted to make appointments limited to a few months or a year, to definite grade levels in the classified service, without use of a Civil Service Register, providing appointments meet minimum Civil Service qualification requirements.

3. Administrators should be permitted to appoint candidates from the register to new positions, and after appointment, but prior to the position classification, to adjust the positions to fit the incumbent.

1. If the Federal Government is to succeed in making worthwhile accomplishments in research and engineering development, it must acquire and retain the service of superior scientific personnel.

2. A study of the conditions obtaining in Federal employment indicates that there is no substantial reason why it cannot employ able scientists. Some limited modifications are desirable as outlined above.

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3. An informational program should be planned to acquaint the scientists and engineers of the country with the Government's problems and personnel requirements.

4. The opportunities offered by Federal employment should be publicized and the working conditions explained to combat past unfavorable publicity.

5. The prestige of the Federal scientific service can be raised or lowered by the policies established and actions taken by the administrators of Federal scientific agencies.

6. Federal scientific administrators should be selected with care to ensure that they will meet the special qualifications which such positions demand.

7. Regulations should be adopted and enforced to prevent the appointment of scientific administrative officials solely because of political consideration or military rank.

8. The Civil Service System should be so modified as to give administrators ample authority in their routine selection and appointment problems.

9. The Civil Service rules should be further simplified insofar as can be done without fostering abuse of the system.

10. The appointing procedure should be made flexible enough to allow an administrator to appoint individuals with special qualifications when necessary.

11. The decentralization of Civil Service operations should be continued and should include not only examining and appointing procedures, but also position classification, the Commission holding a post-audit authority and the final responsibility.

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Chapter VI

CLASSIFICATION

General Considerations

The Classification Act of 1923 is a landmark in personnel administration in the Federal Government. It was designed to set up a system throughout the Government, upon which could be based an analysis of jobs so that equal pay for equal work and responsibility could be achieved. The concept was basically sound and has done much to bring order into administration. It provided a measuring stick so that judgments as to appropriate salary in individual cases could be based on over-all policy and practice.

This does not mean that serious problems are nonexistent. Nature abhors classification as any classifier can testify. This is as true in the classification of botanical specimens as in that of books in a library. It need not be assumed, therefore, that classification of Federal jobs into categories can ever be wholly satisfactory. Furthermore, the more the position departs from the established pattern, the more difficult classification becomes. In Federal employment the work of the scientist seems to depart most of all from the characteristics making for easy classification. Scientific work, therefore, presents a continuous need for special study to improve the effectiveness of classification in contributing to the productivity of science as a Government activity.

The uses of classification have been several, and they are very important. It is perhaps primarily a systematic method of arriving at appropriate bases for pay scales. It is, however, also useful in recruitment, in that it facilitates the offering of a specific job opportunity at a salary on other than ad hoc bases. It is useful as a management tool in setting up operating units and it facilitates financial and budgetary operations. It specifies the employee's specific duties. The use of job classifications provides a system of unit blocks to build organizations for specific tasks. Other uses might be specified, such as spelling out lines of promotion, facilitating transfers, etc.

Obviously no system can serve three or more masters. There must be some sort of compromise so that the system may serve all purposes best. Such compromise may mean failure to achieve maximum suitability for each purpose. Furthermore, the fact of serv-

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ing several purposes tends to impart rigidity and permanence to the system, so that continuous adjustment to the needs for any one purpose may be more difficult. The system tends to exist by itself as an institution, and to assume more importance than the purpose it was set up to serve.

Recognition of these facts is in no sense to question the need for the classification system itself. It is intended to call attention to the necessity for continuous study of the classification system to ensure that it best serves its purposes, that sight is never lost of the fact that classification is only a management tool and should never become an end in itself, and that adequate adjustments in classification practice should constantly occur where jobs exist that do not lend themselves to standardized practice.

Classification in Scientific Work

The Issue.

The difficulties that arise in applying the provisions of the Classification Act to scientists are primarily due to the nature of scientific work itself. The preponderance of jobs classified under the Federal system are homogeneous in character, whether they are at low or at high levels. Usually their nature and extent can be foreseen over fairly long-time spans. The organizational structure of whole divisions can then be developed and the various units in the organization planned with sufficient clarity to permit quite accurate descriptions of tasks and allocations of responsibilities, in terms of the jobs to be done regardless of the incumbents.

It is natural that classification officers whose major experience has been with jobs of this type, fall into the general habit of attempting to rate a job in terms of its routine tasks. Furthermore, since in this type of work higher positions are created primarily for administration, it is natural to associate grade with administrative responsibility. Unconsciously, perhaps, the classification officer tries to apply to scientific work the pattern used in evaluating grade levels in other work. The result usually destroys the effectiveness of scientific work.

Scientific research is essentially exploratory. Some research may be so completely exploratory that no other job description is possible than to state the field of investigation. Job routines vary with the method of attack seen as best at the moment.

This is especially true in the fields of fundamental or basic research. In some fields of research, where work falls into a pattern, it is subject to classification by job descrip-

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tions analogous to those used for nonscientific work. Chemical testing, field work in biology, routine mapping in geology, and other examples might be cited. But the nature of most scientific work is to some extent exploratory. Classifications must reflect the real nature of the scientist's work. They should not attempt to apply to it a preconceived pattern.

The issue between the Federal scientists and the personnel classification technician is this: At one extreme is the personnel classification technician who points out that the Classification Act requires that jobs, not men, be classified--and carries out that mandate rather mechanically. At the other extreme is the Federal scientist who insists that he wants to have trained men, not abstract jobs, classified. The former attempts to consider the duties and responsibilities of the position as separate from the man in the job. The latter looks at the obverse of the shield and wants to consider the knowledge, imagination, initiative, skill, experience, and daring of the man, and to pay for that rather than for preconceived products.

Peculiar Nature of Scientific Work.

It is well recognized that scientific work requires a great background of information and training. Frequently, a scientist is called upon to make decisions drawing upon a whole lifetime of preparation in college or university and in later experience. Were the information and experience among Government scientists, on which to base such a judgment or decision, unavailable, great expense in experimentation or in consultant fees might be needed to obtain it.

Possibly in no other field does productivity occur at such an early age as in scientific work. Many of the greatest scientists achieved their major successes in their early twenties. Industry and the universities can identify and reward great achievement by appropriate recognition and pay, in spite of age or seniority. To compete for scientists of this caliber the Federal Government should provide for similar recognition and reward.

The qualities which produce great scientific work are frequently difficult to identify. Mental ability of a high order is generally supposed to be a basic necessity. But less tangible qualities are important, such as imagination, initiative, daring, and perhaps others, not clearly defined nor isolated. Colleagues are usually able to recognize real research competence even though no tangible measures of such ability seem possible. Judgment of results by usual standards is fallible. Some research problems are so simple that results appear to be abundant. A higher order of work on other problems may produce meager results if judged superficially. Only the judgment of experts in the field familiar with his work is adequate to approximate the true worth of a given

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research worker. If the classification system is designed to provide a rational basis of pay, it must be administered so as to permit such judgments.

It is a corollary of these simple considerations that the usual administrative pyramid so typical of other organizations does not apply in research. The scientist's value has little direct relationship to his administrative duties or the number of subordinates under his supervision. He may work alone and produce results of incalculable value, as did Einstein, the Curies, Urey, etc. Or he may have supervision over extensive staffs which carry on systematic researches, such as the purification of uranium in the Manhattan District, or such as field work in petroleum exploration. It must be recognized that there are two distinct phases of the scientist's work. One is the bringing to bear of his scientific knowledge, experience, and creative imagination, whether working alone or assisted by others. The other is the supervision of others whether on work of his devising or on independent projects. If it is to be a base for salary determination, classification must recognize these independent aspects and unite them in an appraisal of the job.

What is Required.

It is possible to reconcile the extreme positions taken by some personnel classification technicians on the one hand and the Federal scientist, on the other. The objective of both groups is to pay for the quality of the work done. The problem to be mastered is: How can we achieve the objective in a field so difficult to classify? The modern, well-trained personnel experts in close cooperation with the scientists are finding the way.

The first step is to make careful but broadly conceived studies of the work being performed in each scientific field. This obviously means that the persons making such a survey must have 1) a sound knowledge of the principles of position classification and 2) a detailed knowledge of the subject-matter field. Where this cannot be obtained in one person, a team must be formed.

The second step is to abstract from the information so obtained those elements of the work of the research scientists that are common to a related group of scientific workers, and to spell out carefully the elements which distinguish each group from other groups of workers.

The third step is for the scientists and the personnel technicians jointly to describe the elements which comprise the work of the scientists in the different fields, and those factors which differentiate the levels of difficulty and importance of their assignments in each field.

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With these broad guides, classification standards can be prepared for the use of research administrators. Under this classification plan, the position description for the scientist can be made realistic for the first time.

In those jobs wherein the incumbent is hired for his thorough mastery of a field of science, and is expected to blaze a trail into its frontiers, it would be as futile to try to define the job in detail as it would be to try to describe the job of creating a symphony or of developing a new form of architecture.

Clearly, as a basis for pay determination, the detailed job description is in this case artificial and unsatisfactory. With a classification plan of the type needed for scientific positions, research jobs can be measured against a scale of values previously agreed upon. Their worth can be appraised against other similar assignments in the same field or related assignments in other fields. A reasonable basis for classification of each position can be reached.

Under this system, the broad research objectives assigned to a scientific worker become the basis for his classification. As he proceeds, his work toward those objectives can be reflected in new assignments which form the basis for his future classification. The classification system becomes a part of the plan for administration of research.

These considerations lead to certain general conclusions which seem sufficiently important to be emphasized as basic to good and useful classification of scientific positions.

Classification Principles

1. In classifying scientific jobs the special nature of the work must at all times be recognized.

2. Classification of personnel in this category should be performed by persons specially trained for classification of scientific workers, and with backgrounds in science and research.

3. Collaboration is necessary with trained scientists familiar with the work to be done.

4. The purposes of classification should always be borne in mind, so that job descriptions are adequate, but no more detailed than necessary to achieve the objectives of classification.

5. The pattern of job descriptions resulting should not be judged by the patterns of other Federal activities.

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6. Classification should reflect the scientific competence required, as well as the administrative responsibility of the incumbent.

Finally, it should be emphasized that ultimate success in adjusting Federal job classification to the needs of science, instead of vice versa, like success in adjusting so many other personnel actions, will more likely be attained when science is recognized to be an activity requiring both special administrative techniques and special budgetary handling. Most of the problems scientific work faces stem from the interweaving, in the administrative structure of the Government, of essentially exploratory with essentially routine administrative functions. Clear separation of such dissimilar activities would permit readier adaptation to each of the peculiar type of administrative techniques it required.

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Chapter VII

RECOGNITION AND PROMOTION

Professional Recognition

The "Intangible Increment" of Reward.

Since salaries paid to Federal scientists are in most cases, particularly in the higher grades, below those paid by industry and some universities for similar positions, some means must be devised to make Government scientific work sufficiently attractive to recruit and retain the abler man. Fortunately, scientists of all kinds, whether physicists, chemists, biologists, geologists, or those of any one of several dozen different disciplines do not work for money alone. Various forms of the "intangible increment" constitute a significant part of their reward, and, in many cases, the most important part.

This intangible increment may take the form of the opportunity to do scientific research in an intellectual climate free from petty restraints and without the endless frustrations characteristic of some bureaucratic organizations. Some other requirements are adequate space, equipment, assistants, and other facilities without which the research man is so hampered in the scope of his activities that a disproportionate amount of his time is spent in doing work of subprofessional grade. When such requirements are met and the mature scientist is allowed to produce to his utmost on his own initiative, he is able to merit and receive the professional recognition, not only from his colleagues in the same organization, but from all scientists in his field.

High Standards Necessary.

It is axiomatic that the professional prestige of a scientific organization is a function of the professional competence and productivity of its men. Therefore, every effort should be made to maintain high standards in recruitment and appointment. This applies not only to the mature scientists in the higher grades, but also to those in the beginning grades. In selecting and appointing a P-1 scientist, his potential for advancement to a research scientist or a scientific administrator should be considered. Furthermore, the young scientist should be watched during his probationary period to determine his capacity for professional growth, and those who do not demonstrate such capacity should be eliminated. If a mediocre man is allowed to remain he rarely improves and, by occupying the position that

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should be filled by a competent scientist, he reduces the prestige of the whole organization.

This professional prestige of a scientific organization is an integration of the individual qualifications, competence, and productivity of its men. In turn, the professional recognition achieved by each individual is augmented by the prestige of the organization, and thus becomes a real factor in the recruiting and retaining of superior scientific personnel. A Government research organization which is a leader in the field obviously is in a much better position to compete with industrial and university laboratories for such personnel than one whose second-rate position reflects the collective mediocrity of its men.

Publication of Scientific Research.

Another factor contributing to the professional recognition of the scientist is a ready means of publishing the results of his research. Some Government scientific bureaus publish a regular series of their own, such as the National Museum, Bureau of Standards, and the Geological Survey, to name only a few. Such agencies should include ample funds for printing in their budgets and should make every effort to secure approval for such funds by the Budget Bureau and Congressional appropriation committees. To be effective, such printing funds must be adequate to take care of current needs at least. Otherwise manuscripts ready for printing may pile up into a backlog which makes the effort on the part of the scientists futile and denies the results of their work to the public.

Other agencies, not having such facilities, permit or encourage their scientists to publish the results of their research in various scientific and technical journals. Whichever way this is done, the passage through the various internal channels for editing, obtaining approval, etc., should be sufficiently rapid for the work to appear in a reasonable time. In military organizations, such as the Army and the Navy, the maintenance of adequate security may slow down or even eliminate publication of results. Often some phase of the work could be published without endangering security and this should be done whenever possible.

Attendance at Scientific Meetings.

A very real factor in the professional recognition of a scientist is his attendance of and participation in meetings of professional scientific societies. Use of official time for attendance at meetings should be allowed, and in addition traveling expenses should be provided for meetings occurring at a distance. Both the individual and the organization gain prestige and recognition by adequate representation at such meetings. Separate funds should be provided in appropriation bills for such attendance, as otherwise its operation becomes erratic. For example, some Govern-

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ment bureaus pay a scientist's expenses to meetings only if he presents a paper. In some instances this results in a hastily and often poorly prepared paper to meet the requirements, from which neither the organization nor the scientists gain distinction. Therefore, standards of excellence should be maintained rather than the requirement of merely a paper.

Exchange of Scientists Between Government and Other Laboratories.

Much can be gained by permitting Government scientists to be assigned with pay to work for definite periods in university or industrial laboratories. New ideas, processes, or techniques developed in such laboratories could thus be made more effectively available for use in Government organizations. This practice is followed by some Government scientific laboratories through the device of maintaining a number of university professors in W.A.E. (When Actually Employed) status. These men obtain Civil Service status by passing the appropriate examination for the position, and are paid for the time actually employed, usually up to some fixed maximum number of days per year.

The Geological Survey, for example, is thus able to secure the services of many outstanding university professors for field work during the summer school vacation period whom they would not be able to employ for full-time work. In addition, these university professors, who are teaching the younger generation of geologists, are thus in a better position to impart what they will need to know to do the work of the Geological Survey, thereby improving their preparation for subsequent Government work. It is an arrangement whereby both the Government and the individual gain far more than the actual dollar value of the transaction might indicate.

Some Government bureaus, such as the National Institute of Health, provide postdoctoral fellowships for promising young men for one-to-three years, after which the bureau may place them on permanent status or, by simply not renewing the fellowship, let them go. Under this arrangement, the research may be carried out anywhere, either at the National Institute of Health, or at a university laboratory. The method has much to commend it, and should be more widely adopted.

Promotion

Need for Reasonable Speed in Personnel Actions.

In spite of the fact that the work itself is often more important to the scientist than his rate of pay, the standard of living of himself and his family is clearly dependent upon it. Therefore, the personnel policy of the Government as a whole and of its constituent bureaus and agencies should be such that promotions are determined only by the justification of the particular action, and not by the whim of some personnel officer. Once manage-

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ment has decided upon a promotion, the paper work necessary for its final execution should be expedited. Many able scientists have left Government service because of interminable and unnecessary delays in such actions. Personnel men should realize that once a promotion is initiated, every day that they delay the final approval of the action represents one day's loss of the pay increase to the scientist.

Need for Greater Uniformity in Personnel Actions.

One of the cardinal principles of the Civil Service System, that of equal pay for equal work is, obviously, very difficult to achieve in all professions. Although this problem more properly belongs in the field of classification, the principle must be considered here briefly in connection with promotion and recognition.

For example, is a P-4 biologist in one bureau the equivalent of a P-4 chemist in another, and are both the equivalent of a P-4 engineer in still another? Many factors must be considered in any attempt to evaluate the complex details of this problem. Some bureaus are traditionally more conservative than others. Thus it may require a better man in one bureau for a P-4 position than it does in another for a P-6 position. This is unfair to both the individual and the Government, as it is quite as conceivable that the P-6 is classified too high as it is that the P-4 is classified too low.

There are, furthermore, very real differences in the way promotions are handled in the field and in the departmental service in Washington. These differences are often unfair and should be corrected. It appears probable that much greater uniformity in all personnel actions involving scientists will be achieved when the Civil Service Commission establishes a separate branch for scientific personnel.

Efficiency Ratings.

All employees of the Federal Government receive an annual efficiency rating. Many differences of opinion exist regarding the usefulness of such ratings and there is a real need for more effective application by many agencies. Through the evaluation of a selected list out of a total of 31 elements such as "skill in applications of techniques and procedures", "attention to pertinent detail", "ability to organize his work", "ability to make decisions", etc., an individual's value can be indicated in a fairly objective way. Each item is marked as outstanding, adequate, or weak, and through a simple summation process, the individual is graded either: Excellent, Very good, Good, Fair, or Unsatisfactory.

Careful use of the efficiency rating can do much to improve the morale of a scientific organization. While it is obvious that

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top-flight productive scientists will get an "Excellent" efficiency rating, and be little influenced by it, nevertheless, it is a commendation from the management and tells a researcher that he is on the right track and his work is appreciated. A low rating of "Fair" or "Good" may at least jolt the mediocre man--the most difficult one to handle--into better performance. The really unsatisfactory worker can be most quickly eliminated from the Government by giving him an "Unsatisfactory" efficiency rating, as this requires mandatory dismissal. A scientific organization with much deadwood in it quickly loses prestige; the good men feel this loss and resent it, with a consequent lowering of morale. The effective use of the efficiency rating requires that the administrator have a good stock of that priceless commodity--intestinal fortitude.

Within-grade Promotions

Three forms of promotion are in current use in Government. One, a change in grade, as from P-2 to P-3, which actually represents a change in duties with increased responsibility. The second is the so-called "Ramspeck" automatic increase in salary within a grade, which is based upon the efficiency rating being "Good" or better, and which occurs at stated intervals of 12 or 18 months as set by law.

The third form, the meritorious within-grade increase in salary is used administratively to reward exceptionally able men, and thus is more a mark of distinction and valuable as a morale builder. The automatic salary increase indicates merely that the scientist has lived another 12 or 18 months and that his efficiency rating is "Good" or better, whereas the meritorious within-grade salary increase is initiated by his immediate superior, approved by management, and is thus a mark of distinction and a boost in morale. It should be used much more widely than at present.

Equal Pay for Research and Administrative Positions

In many Government scientific bureaus, scientists are forced to undertake administrative work in order to obtain adequate pay. This frequently results in the loss of a good research man and the creation of a second-rate administrator. Scientific research should be administered by scientists, but the fact that a particular man is an outstanding research scientist is no guarantee that he will be an equally good administrator. Yet, in order to advance a scientist into grades P-6, P-7, and P-8, he is forced to take an administrative position.

According to Civil Service Regulations, research positions can go as high as P-8 without any administrative load being carried by the scientist. Therefore, it appears that this difficulty can

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be solved by the agencies themselves.

Probably more top-flight research scientists have become dissatisfied and left Government service for this reason than for any other.

Extra Compensation

The average Government employee who is temporarily disabled, for more than a few days, in line of official duty, finds it impossible to meet living costs if limited to compensation at the rates now allowable under the United States Employees' Compensation Act. This is because such allowable compensation is not based on current standards of pay or living costs. In view of such meager compensation, the disabled employee is, in most cases, compelled to forego such allowable compensation in lieu thereof, to continue on wages or salary as long as he can by using leave now allowed him by law for vacation purposes or for disabling injuries or illnesses not incurred in line of duty.

Specifically this inadequacy of the compensation now allowable under the Compensation Act means that, in most cases, before applying for compensation, the disabled employee will during continuance of the disability find it necessary: 1) to use to the extent required accumulated and advanced sick leave which the law grants for use in connection with an injury or illness not compensable under the Act; and 2) when such sick leave is exhausted, to use accumulated annual leave which the law grants for vacation purposes.

In addition, if an employee after having consumed his sick and annual leave, because of a duty-connected injury or illness, should then become disabled by an injury or illness that is not compensable under the Employees' Compensation Act, or wish to take the vacation which Congress intended him to have, he must take leave without pay.

This constitutes a serious hardship to the employee. In all fairness his employer, the Government, should make more adequate provision than is now authorized for aiding him during temporary disability. It is believed that with few exceptions, temporary disability cases will not continue more than 60 administrative work days. It is desirable, however, that the Bureau of Employees' Compensation be authorized to extend that period in any exceptional cases that occur.

The Advisory Committee on Scientific Personnel has recommended that appropriate provisions of the United States Employees' Compensation Act be amended so as to provide compensation at the following rates to any civil employee of the United States while he is temporarily disabled by an injury or illness resulting directly from performance of his official duties.

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1. Monthly compensation in case of temporary total disability to be at the basic rate of pay of the disabled employee for an initial period of not to exceed 6 administrative work days, with the Bureau of Employees' Compensation empowered to allow like compensation for such additional period or periods as may be necessary during continuance of temporary total disability.

2. Monthly compensation in case of permanent total disability to be at a rate equal to two-thirds of the basic rate of pay of employee so disabled.

3. Monthly compensation in cases where the permanent disability is only partial shall be at a rate equal to two-thirds of the difference between employee's monthly pay before injury and his monthly wage-earning capacity after partial disability, as determined by the Bureau of Employees' Compensation.

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Chapter VIII

PROFESSIONAL DEVELOPMENT AND ADVANCEMENT

To enable the people of this nation to enjoy the health, welfare, and security derived from discovery and application of previously unknown facts and laws of nature, the Government must maintain research of the highest order in its laboratories.

Our national supply of outstandingly able scientific talent is always insufficient. This country cannot afford to be second-best in research and development. It is clear that decisive steps are necessary.

Training Needs of Federal Scientists

Professional development and advancement, as here used, refers to the increased competence of scientists derived from the usual processes of formal and informal learning, and not to rank, position or compensation. The employer's purpose in considering the need for increased competence of scientists is solely that of insuring a maximum return in terms of those values and outcomes which are consistent with the mission of the employer. There is no thought expressed or implied in this discussion that the Federal Government should interest itself in the education or training of its scientists as a philanthropy or gratuity to the scientists themselves.

While the needs of the individual Federal agencies will differ, in general these needs may be represented by a combination of such requirements of its scientific personnel as: 1) Keeping abreast of and advancing one's knowledge of subject-matter fields of science and technology which are directly related to one's work; 2) increasing specialization in the particular phase of the subject field in which one is working; 3) acquiring specific information for use in carrying out new and special assignments; 4) becoming better informed within certain areas of newly-developing hybrid sciences; and 5) developing and improving certain new and special skills required in performance of assigned responsibilities. (An example of this last need may be technical reading skill in a foreign language which has become an important tool in one's special field.)

To improve the competence of the scientific personnel of the Federal Government two approaches are desirable: 1) Retain the best scientific talent already available, and increase their usefulness by further training; and 2) aid the educational in-

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stitutions in training an adequate oncoming supply of the most capable and most thoroughly prepared younger scientists.

Continuous Training of Mature Scientists

No real scientist is ever satisfied with his present knowledge. He is impelled to probe into unexplored realms. This urge must be encouraged and facilitated by the Government, for it is the essence of creative endeavor.

Formal education culminating in the doctorate degree is only the beginning of a career in scientific research. Life-long study and unrelenting investigation is the only means by which the research worker may expand his usefulness. Because continued study is the life blood of productive research, no organization can permit its scientists to stagnate through isolation or restrictive opportunity for study. Mediocrity in scientific research and development might easily result in national suicide. It is therefore imperative that the Government, as an employer of scientific personnel, not only permit but actively encourage its scientists to continue their educational development throughout their careers.

Given a reasonable opportunity, which means adequate time and funds, the serious scientist pursues post-doctorate studies in universities or laboratories in this country or abroad; he participates in national and international meetings of scientific societies; he collaborates with other scientists at laboratories of world-wide repute; he reports his own research in the scientific press and at scientific meetings, and secures in exchange the suggestions, ideas and matured judgments of fellow investigators; he keeps abreast of knowledge of recent developments by systematic reading of the technical journals, monographs, bulletins and abstracts in his field, through attending lectures by recognized leaders, and by participating in seminars and colloquia.

Government agencies must facilitate continued training and participation in such professional activities if its scientists are to become increasingly valuable as research specialists. Mature scientists of recognized leadership, developed by these processes, act as nuclei for the attraction and development of younger research workers anxious to benefit from association with them and to learn from them.

There are several methods by which the Federal Government can and should provide for the continued education and increased competence of its senior scientific staff. Some may require legislative authority. Others can be facilitated by provisions within the administrative jurisdiction of the agency heads.

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Independent Research Studies

Universities have recognized that self-development of a high order, as well as significant discovery, results from the opportunity of its scientists to pursue independent research studies of their own choice while carrying forward assigned duties, such as the teaching and guidance of graduate students. A certain amount of similar opportunity for Government research workers would earn rich dividends without decreasing the overall productiveness on prescribed duties.

Post-Doctorate Study

Post-doctorate study is highly significant as a means of increasing the competence of mature scientists. Such study opportunities are provided in part by the scientist's own research in his own laboratory, but this is not enough. He is likely to deepen the ruts of his own patterns of thought unless he can raise himself out of them by study and investigation in environments where different methods, fresh viewpoints, and new approaches are being developed or used by other leading investigators.

Sabbatical Leave

Sabbatical leave has been an effective method of facilitating the rejuvination of the creative mind. Its values should be made available to Government research scientists by legislative provision for subsidized leaves to restricted numbers, for nine-month leaves at five-year intervals, or leaves of one year in seven.

Detail to Other Laboratories

Assignment of scientists to short tours of duty at other laboratories, Government or private--university, industrial, or foundation-supported--where advanced work of direct bearing on their own fields of knowledge are being conducted, provides an opportunity to accelerate their own research achievements by eliminating the need for unknowing repetition of methods and experiments already tested elsewhere.

Exchange of Personnel

Exchange of personnel, whether on a fellowship or scholarship arrangement, or as a man-for-man trade of scientists, each to work in the other's place for a few months, is another means of securing new approaches, new ideas, and fuller understandings of frontier knowledge. Some Federal agencies now enjoy the benefits of fellowship appointments for one or two year periods. This same provision should be extended to other agencies conducting research.

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Professional Collaboration

Collaboration between professional colleagues for short intensive periods is a substantial economy of precious time. A few hours, or occasionally a few days, spent in earnest discussion of one's own scientific problems with a fellow investigator of repute, may save months of individual work and thousands of dollars of payroll time and materials, in research and development projects. Because appropriate collaborators are few and widely scattered it is highly important that scientists have opportunity to travel as needed to places where such consultations can be held. Travel regulations of scientific activities should recognize this special need and provide funds for the purpose. Experience seems to indicate that a minimum of $50 to a maximum of $150 per year per scientist is an appropriate allowance.

Attendance at Scientific Meetings

Attendance at scientific meetings is a further economy in collaboration with professional colleagues. Scientists from widely scattered points congregate at such meetings. One trip of a few days to an important meeting might provide a number of face-to-face deliberations on problems of mutual concern in the time that one contact only could be made by direct visit to another scientist's laboratory. It must be recognized however that one does not take the place of the other. Both are essential to a leading or developing researcher. Visits to other scientists in their own laboratories provide for intensive study of individual problems. Conferences at scientific meetings furnish a broad survey of activities and identification of places where the most advanced and fruitful work is being done. They also provide opportunity for penetrating exchange of information among investigators as to the most promising and revealing developments in their researches.

Freedom of Publication

Collaboration among scientists can be most effective when the reputation and researches of each participant are known to the others for the advanced knowledge and seasoned judgment demonstrated by his own reports and published papers. For this reason the utmost freedom to publish is essential. The Federal Government often has been less than liberal in: 1) the release of scientific information with only a remote relationship to security, 2) the funds for printing the results of scientific research, and 3) the identification of the authors of technical papers which have been published. While the national security must be protected, for example in military laboratories, it is primarily in the developmental stages that such precautions are needed. Properly administered, required security will postpone

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but not eliminate eventual publication. There is no sound reason for a general practice of concealing the identity of investigators and authors of reports once released.

The Development of Younger Scientists

The younger and less experienced scientists have, in general, the same urge as their seniors toward further education which can be utilized to the advantage of the laboratory in which they are employed.

College seniors and graduate students the country over have expressed interest in obtaining employment in establishments such as research foundations, universities engaged in research, and Government or industrial laboratories, where at the same time they can carry on studies and thesis work for higher degrees. At those Government laboratories where graduate study courses have been arranged and made available the response has been prompt. At one large aeronautical center the loss by resignations of scientific and technical personnel was immediately and materially reduced as soon as graduate courses acceptable for university credit were set up.

It is clear, therefore, that the Government has much to gain by facilitating the offering of such educational advantages to employees in its laboratories.

University Study Program

In metropolitan areas and at educational centers where graduate schools are available, the problem of satisfying the educational needs of laboratory scientists is less difficult than in outlying or isolated districts. In such areas local educational institutions offer graduate courses leading to advanced degrees in a number of scientific and technical fields.

Credit Courses

Two types of offerings by universities and graduate schools should be recognized. First, there are the regular course offerings of the institution. To be of maximum availability to employed workers, a substantial variety of these courses must be scheduled at out-of-working hours, in late afternoon, evenings, and on non-work days made possible by the five-day work week. Such offerings attract only a fraction of the number who take advantage of the second type; which is, special courses set up to meet the specific needs of groups of employed workers, and offered at times and places convenient to these workers. These courses are given out of working hours, are financed by regular tuition fees paid by the students to the sponsoring university, and hence are practically self-supporting.

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It is clear, however, that full utilization of such educational opportunities does not automatically result from the mere availability of the courses, however widely they may be advertised. In addition, there should be, within each agency and each laboratory, a coordinator who can devote a part of his time to determining needs, arranging for courses to be offered, advising and counselling students, facilitating registration, and acting as information center for students, university officials and laboratory administrators. This coordinator will be materially assisted, and his work made more effective, if he has a carefully selected advisory committee of representative scientists and administrators who meet, on call, to decide on training and educational needs and arrangements, and who give active counsel on the program.

These precepts will be clearer, and more convincing, if the experience of Federal agencies in the Washington, D. C., area is cited. Here a cooperative solution to the continued training of scientists has been worked out between the Federal agencies and local educational institutions. An interdepartmental committee was formed, in this case called the Science Training Group, a special committee of the Advisory Committee on Scientific Personnel. It agreed on general policies and procedures under which each Federal agency could function as it wished. This interdepartmental group was supported, and its policies carried into an active working program primarily by the training staff of one department which had a large number of scientists in the area who would benefit from the program. A central clearing house for such arrangements seems to be essential, and when no central staff agency is able to offer such service, one of the principal beneficiaries may substitute.

One of the first activities of this group was to compile a list of the graduate courses offered by the seven graduate-level educational institutions serving the Washington area. Some 600 copies of this list were distributed to scientists and technical personnel in all Federal agencies, before the opening of the fall term. Of the approximately 300 courses on the list were 28 off-campus classes organized to meet the needs of scientists and scheduled by the universities for teaching at seven Federal bureaus and laboratories, immediately after working hours.

There were 833 subsequent registrations for these off-campus classes, 732 or nearly 88% from one department. The fact that this percentage is entirely disproportionate to the number of scientific personnel, to the need for education, and to the interest of the scientific personnel in that department is explained by 1) the support given the program within the department by scientist-administrators, training directors, and the coordinating staff, and 2) the extent to which several other agencies had established programs of this type already in operation. The determination of needs, liaison with graduate schools, organization of the courses,

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provision of class-rooms and registration of students could not have been done without the coordinating staff, nor without the cooperation of training officers and committees in the various bureaus and laboratories.

Degree Sequences and Thesis Credit.

Further progress in the Washington area is directed at increasing the range of subject-matter fields offered, the introduction of planned sequences of courses leading to advanced degrees, and the accreditation of properly supervised research work as meeting these investigation requirements of local and distant institutions.

For the most part undergraduate courses offered in these programs have been designed primarily as refreshers for those who need mastery of the skills involved to embark upon specialized graduate courses. It is generally assumed that a scientist, engineer or technician will present himself for employment in the Federal scientific service only after he has completed his undergraduate study, and frequently after he has earned an advanced degree.

Laboratories that are at some distance from educational centers face a more difficult problem but one not usually beyond practical solution. As in the Washington area, laboratories so located as to make travel to classes inconvenient and inordinately time-consuming have arranged for off-campus classes held at the laboratory. Some of these classes are taught by high-ranking staff scientists appointed, for this out-of-hours duty, to the staff of the graduate school and instructing under the supervision of the school.

Similar arrangements are being made at laboratories considerably outside the Washington area, and can be duplicated at almost any location where a class of sufficient numbers can be assembled. The most important factor in these arrangements is the existence at the laboratory of a coordinator or educational director to handle the details and to consult with others who have faced and solved the same problem.

And endorsement of this type of employer interest in facilitating the formal education of its employees appeared recently in a help-wanted advertisement of a smaller industrial concern. It said, "The company also offers the following advantage to those desiring further education. Any employee may study any course, or courses, at a university in or near the city and the cost will be refunded on the basis of the final grade received."

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In-Service Training

Highly Specialized Courses.

In addition to university study courses for scientists and technicians who wish to work for a higher degree, another means of providing further education is through in-service training. Whereas the university courses, while usually fundamental to or closely related to the work of the scientist in the laboratory, are not necessarily directed toward that end, in-service training courses are designed specifically to fill gaps in experience or education and to provide such additional information as will enable the scientist better to perform his assigned task. The fact that this education is provided, not primarily because the student wants it, but because the laboratory feels he needs it in his work, indicates the necessity for conducting the classes at no expense to the student and usually during working hours. These courses are important in building both skill and morale because they satisfy the scientist's desire for further knowledge.

In one Federal department having several laboratories, need was evidenced for a course covering the most advanced knowledge on jet propulsion for scientists and technicians who were engaged in allied research work, for the dual purposes of extending their knowledge of basic principles and bringing them up-to-date on recent developments. Despite the fact that the courses as finally arranged required three hours of class work per week for three semesters, two-thirds of it out-of-hours, and required ten hours per week of outside preparation, there were 115 highly qualified applicants for a class that could accomodate only 35. This illustrates, first, the interest of scientists in further study, and second, the need for such instruction, because each applicant was sponsored by his superior who certified that the course would help him in his work.

In-service courses have been offered or are scheduled in such subjects as recent developments in electronics, nuclear physics, scientific report writing, and lens grinding, and recent scientific developments. In addition, many lectures, seminars and colloquia on highly technical subjects are held.

Organizing meaningful and effective in-service courses requires cooperative effort and involves considerable technical skill. It can be done best when a laboratory director, a committee of scientists who are in close touch with the work and therefore know the in-service training of the laboratory, and a training specialist skilled in working out the essentials of sound training programs, form a team, each contributing his special skill and efforts. Because in-service instruction is usually given during working hours, and by a member of the laboratory staff, little outlay of funds is necessary. The

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expense to the Government lies in the value of the time of those involved, and it is the duty of the director and of the committee to make certain that the results achieved justify the cost.

Obviously, such courses should not be organized if they are readily available from educational institutions adequately staffed and equipped to present the course at a place and time suitable for the scientists to attend.

Many in-service courses, however, are of such a special nature that they must be set up independently. This is particularly true when confidential or secret information is involved, or when the course is so closely directed to the employee's situation and needs as not to be of interest to the educational institutions.

Orientation of Newly Appointed Scientists.

So obvious a matter as orientation of a scientist to the mission and the operations of the laboratory in which he is newly employed is frequently overlooked. Under tight security regulations this is excusable, but situations should be avoided which compartmentalize scientists to such an extent that one has no idea what the other is doing. Rotation of scientists and technicians from one division to another within the laboratory will serve to correct this condition, will broaden the scope of their knowledge, and will allow them to acquire a greater variety of skills and techniques.

Other In-Service Training Opportunities.

In addition to cooperative university-study courses, and in-service training programs specially suited to the process of developing a young or inexperienced scientist into his full potentialities, all the educational and training provisions proposed for mature scientists also apply. The opportunity to work with scientists who are leaders in their field; attendance at scientific meetings, lectures, seminars, colloquia, symposia; assistance in the preparation of technical papers; writing of reports on his own investigations; systematic reading of the technical literature of his field, discussion of problems with his associates and his superiors; increasing independence and responsibility for more and more complex and difficult assignments; preparation and presentation of papers at local meetings; preparation of articles for the press; and all other means of self-development are particularly important in developing scientific talent. Indeed, great scientists, who have left a heritage of younger men following in their footsteps, have used all such devices. Administrators of laboratories should facilitate all such constructive efforts.

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Needed Legislation

Authorizing legislation, at once broad and definitive, is necessary before some of these practices can be followed. This legislation should give to the head of each Federal agency authority to provide essential training to meet the five types of needslisted in the first pages of this chapter, and to authorize study at educational institutions, in-service courses and instruction, detail to other laboratories, travel to meetings and conferences, and purchase of books, periodicals and technical reports; and should authorize appropriations or budgeting of sufficient funds for these training purposes.

Each agency and laboratory should develop, within its own legal restrictions, a specific training or educational policy for professional and scientific personnel, which will clearly fix the authority and responsibility for training, and which will make plain what sort of training may be given on Government time without cost to the employee (in-service training) and what sort of training or education should be provided outside of working hours and paid for in full or in part by the employee. An example of the last might be graduate work not closely related to one's work assignment.

By these legislative and administrative means it would be possible to advance the development of scientific personnel, to avoid disputes regarding propriety of budget provisions for training, and to forestall disagreement as to "who pays for what", due to absence of clearly defined and legally sanctioned objectives and methods.

The development of such legislation and policy statements has been proposed by various groups and in various forms. It is urgently necessary that agreement be reached on the essential provisions, and that enactment and implementation be expedited, if certain Federal agencies are to insure the quality of their scientific programs.

Encouragement of Potential Scientists

It has been noted that college seniors in science, engineering, and mathematics are not well informed on the processes of research nor are they aware of the professional possibilities in that field. The situation calls for a well-organized plan which will involve periodic contacts with college professors to enlist their cooperation in presenting to students, beginning at the junior college level, the knowledge that research is a desirable calling for which many of the more talented should consider preparing. Federal laboratories should keep these professors informed of the scientific work under way at their laboratories; should circulate reports to them; should invite them to visit the Federal

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laboratories. Certain obsolete equipment could be distributed to the colleges if suitable for instructional use. If this were done, the customary "recruiting" visits to colleges near the end of the senior year would draw not necessarily more, but undoubtedly better, applicants for research work in Government laboratories.

There should be an organized plan to induce a larger number of talented secondary school students to choose high school and college courses in the sciences. There is no way of knowing how many research scientists have been lost to the world because of faulty or neglected guidance during the formative years of secondary schooling. Few students at this stage have their sights trained on a definite profession; they are guided into a general field of work by 1) the example and influence of their parents and immediate associates, 2) the advice and counsel of their teachers, and 3) impressions gathered from the things they read and hear.

These three spheres of influence should be cultivated. Through them the student can be given a better knowledge of the work performed by the scientist, and of the things he needs to know to become a scientist.

Much could be accomplished by news items stressing the part the research scientist plays in the accomplishment of technological and scientific advances, by documentary motion pictures of the "This is America" type, by radio programs such as "Cavalcade of America", by articles and stories in popular magazines, and by books on science and research for the lay reader.

The assistance of high school science teachers, vocational and educational counselors, and educational administrators should be enlisted through talks to their professional groups, by publication of items and articles in educational periodicals and science journals, and by distribution of pamphlets and bulletins written for their information and for school use.

Many secondary schools are ill-equipped to teach scientific subjects, and some have little or no science in their curricula. The Government should influence the extension and improvement of secondary education in the sciences, and should render such financial aid as is necessary to further such education, to provide adequate training for science teachers and to assure essential laboratory facilities.

Much effort has already been expended on many of the activities mentioned and much has been accomplished. The weakness has been that the efforts have been spasmodic and uncoordinated. The objective cannot be accomplished unless all practicable ideas and

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means are woven into a comprehensive and systematic program, flexible enough to be adaptable to the varying circumstances that arise, but persistently and aggressively followed in principle. It is only in this way that the Government can be assured of an adequate continuing supply of high calibre scientific talent, and can secure, retain, develop, and effectively utilize that talent in its laboratories for the benefit and security of the nation.

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Chapter IX

SEPARATIONS

Generally bureaucratic systems, whether in Government, industry, or education, tend toward undue protection of incompetence. This condition results from the necessary regulations aimed at protecting employees from capricious administrative actions or transitory influences which would result in unwarranted dismissals and thus ruin morale. However, it is just as important to provide for justifiable dismissals of incompetent or unduly complaisant employees. Scientific work is especially sensitive to the competence of the staff. Separations and retirements, therefore, are important personnel actions in the effectiveness of scientific work. But voluntary separations also need careful study by administrators to determine their causes and implications for the scientific work itself.

Turnover

Figures are not now available which show the turnover among Federal scientific and professional workers. The Civil Service Commission reports monthly the total number of new employees and the number of employees leaving each agency. Current figures give little information about voluntary separations as the figures are greatly affected by the current reduction-in-force programs.

Low turnover appears to be desirable in normal times as the departing employees leave room for promotion of those who remain. The correct evaluation of this loss of employees is not simple. Interviews with employees about to resign will help in this analysis. What employees are leaving--the best and most ambitious or the slower and those not so stable emotionally? What are the reasons for well-trained employees leaving--can changes in working conditions, living conditions in the community, pay, regulations, or some adverse but correctable condition be made to reduce this loss? Recommendations made in other sections of this report on such matters as training opportunities, professional recognition, and pay cover matters which have been shown to have a direct bearing on the attrition of the Federal scientific corps through loss of capable workers.

Turnover statistics serve as a gage which can show when pent-up employee resentments have reached the blow-off point. Before the danger-point is reached, scientific program administrators should take preventive steps. Employees' opinions as to

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the causes of turnover should be checked. If their opinions have a sound basis, corrective steps should be taken. If their opinions as to what is wrong apparently lack basis, these opinions should be analyzed to find out what lies behind them.

Supervisors of scientists are sometimes fine scientists and weak supervisors. Research administrators should see that their supervisors are thoroughly grounded in the principles of supervision, are educated to recognize symptoms of lowered morale, and trained to avoid conditions which lead to undesirable separations.

Separations for Cause

In some parts of the Federal Government there has grown up a superstition that it is impossible to fire an incompetent employee. This belief has absolutely no basis in fact. Thousands of Federal employees are fired for cause every year.

The head of a Federal agency has the power to remove any of his career service employees for cause. The procedure for separating incompetent nonveteran employees who have completed their one-year trial period is exceptionally easy and clear. The only requirement is that the person to be removed shall be given a statement in writing of the charges against him and that he be given a reasonable time to reply personally to those charges. No trial or hearing is required. The Civil Service Commission cannot require an official to reinstate an incompetent employee once removed.

Employees who are serving their trial period following their original appointment, whether veteran or nonveteran, may be removed without even this simple procedure. It is, however, desirable that any professional and scientific worker removed during this period be given an advance notice of his separation.

An incompetent veteran an agency desires to separate for cause who has completed a probationary period must be given a written notice which contains: 1) nature and date of notice; 2) statement that dismissal is proposed; 3) employee's status pending final action; 4) reasons for proposed dismissal; 5) a statement of his right to answer the notice.

The separation action of such a veteran may not be made effective for at least 30 days after he receives the notice. The official issuing the notice must give the veteran reasonable time to reply in writing to the charges. The official should consider the veteran's reply before taking final action.

If the dismissal is then to be carried out, the veteran must be notified in writing and be told of his right to appeal

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the agency's action to the Civil Service Commission. Upon appeal, the Commission investigates. It then notifies the agency official of its findings. At present, the Commission has no power to order reinstatement of a dismissed employee. The President, however, has asked the agencies to follow the recommendations of the Commission. A bill is pending which would require agencies to follow the Commission's recommendations.

Administrators of scientific programs should take vigorous steps to remove incompetent workers from their staffs. The Civil Service Commission has said (Annual Report, 1943, p. 24) that the keeping of an incompetent employee lowers "the morale of competent employees in the same organization who from day to day see him, though undeserving, keeping his job and in many instances getting the same pay that they do."

The long, drawn-out procedures provided for the protection of the veteran about to be separated from the Federal service fit lower-grade office workers better than scientific workers. It is, however, manifestly unfair to the nonveteran that his rights are not equally defended--if defense is needed.

The Civil Service Commission lacks sufficient funds to give the prompt service which separation appeals should have. If Congress wishes this centralized review of dismissals to be continued, it would be desirable that adequate funds be given the Commission to carry out its responsibility speedily and efficiently.

Reductions in Force

When it becomes necessary to curtail a scientific program because of lack of funds, completion of a project, reorganization, decrease in available work, or similar cause, the Federal agency is required to utilize reduction in force procedures established by the Civil Service Commission.

By law, veterans with service ratings of good or better are retained longer than nonveterans. The procedures provide that employees who lack the competitive status which is usually obtained through passing a Civil Service examination (and being reached for appointment) must be separated before those who have this competitive status.

Within a group of employees who have similar rights in a reduction in force, the order is determined by giving one credit point for each year in the Federal service, five points for an excellent service rating, three points for a very good rating, and one point for a good rating. No credit is given for a fair rating.

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Notice of 30 days is required by the regulations, but occasionally Congress has cut off funds so abruptly that this notice is not possible.

Considering the legal rights of veterans, the necessity of protecting those with long service, and other complex factors too involved to be discussed here, the system as worked out appears as reasonable as possible for normal times. (See, however, criticism of service ratings in another section of this report.)

A special problem affects some current Federal scientific programs. Many of these are relatively new, having been developed during the war. They are staffed largely with persons who lack competitive status. The hue and cry being raised over reductions in force and the significance being placed on competitive status in these reductions is having an adverse affect on professional morale. The Civil Service Commission, though hampered by lack of funds, is proceeding as rapidly as possible to hold examinations for scientific workers in order that the question of their status may be cleared. The Commission has also obtained a special rule from the President which permits persons of outstanding competence in professional fields who came into the service during the war to be granted this permanent status in the service through noncompetitive examination. The Commission has been using this rule very sparingly and only for the most outstanding persons.

It is essential for the morale of the scientific service that the Commission proceed as rapidly as possible to give examinations for the scientific and professional positions.

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Chapter X

ADMINISTRATIVE REGULATIONS

Some scientists in the Federal Service have in the past felt thwarted by Federal regulations. They charge that regulations supposedly designed to smooth operations have become red tape slowing action. The complaint seems at times justified. Federal laws, rules or orders appear to address their controls primarily to Washington office employees. It is not surprising that they are unsuited to professional personnel.

Policies and procedures intended to cover the whole Federal service must be broad and general since they must cover practically every type of employee. They must be broad enough to cover the work of doctors in hospitals, physicists in laboratories, foresters in the woods, lathe operators in gun factories, clerks in offices, and several thousand other types of employment found in Government. They must also cover employees working in diverse localities. While a large percentage of Federal workers are engaged in routine clerical office operations, the majority are not. Only one worker in nine is located in Washington, D. C.

If over-all Federal policies and procedures are kept broad and general, it should not be necessary, as has been proposed, to draft a separate set of rules and regulations for Federal professional, scientific, and technical workers. As departments and agencies supplement such rules and regulations, they must keep in mind, however, the effect on laboratory and other scientific workers. It is possible that at the departmental level, separate, reasonable rules are needed to guide this specialized group.

Each department should review carefully and in detail the rules and regulations that it has promulgated to determine their effect on professional and scientific workers. The questions to be answered are: How effective are the regulations in assisting professional and scientific workers to attain their objectives? What are the deficiencies in the present rules and regulations? What are the objectionable features? What modification should be made in the rules, regulations and management practices which would effect an improvement?

While the Advisory Committee on Scientific Personnel has considered such questions, a much more extensive study would be profitable, if made by full-time personnel. It requires the investigators to get out into the laboratories and into the field where the professional and scientific employees are working. Objective facts and figures should be obtained. Unsupported opinions

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and uninformed guesses should be avoided.

There is no doubt that top management officials of the Federal Government want their rules, regulations, and policies to expedite the work of their agencies. Their mere desire for improvement is not enough. Improvement will be brought about only when authority to carry out a critical survey of existing practices has been specifically delegated to top officials who have the time and skills necessary to do the job. Top management must make it clear that corrective action will be taken when the findings indicate the need for change. In surveying the needs of scientists, a committee, to direct the survey, should be set up with officials on it who can command their respect. Persons known to be sympathetic to the needs of scientists and who understand their specialized problems should be members of such committees.

Policy Statements Needed

It would be enormously helpful to professional workers if the agencies in which they work would adopt clear-cut policy statements in support of their scientific programs. Such a policy statement should be guiding, rather than restrictive; it should be designed to release the creative talents of the scientists.

The policy statement should set forth in the most general terms the research objectives to be accomplished by the agency. Then the agency rules, regulations, and procedures could be redesigned to accomplish these objectives.

The policy statement should indicate the support of the head of the agency for the research program. It should place upon the scientific divisions the primary responsibility for the day-to-day operations of the research programs.

This policy statement should be made available to all the employees, especially those working in the scientific programs and in the staff programs of the agency.

It is obvious that so important a document should be discussed carefully with the scientists who are to work under it before it is adopted. After its adoption, it should be discussed anew with them from time to time in order to make certain that the policy is up-to-date and realistic.

It is equally important that the scientists periodically have an opportunity to discuss and make recommendations on the procedures, organization, and assignment of work that develops from the issuance of such a statement of policy.

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Causes of Complaint

There is a general feeling among some scientists that much can be done to bring agency personnel practices more closely in line with the objectives of scientific research programs. They believe that personnel workers on professional and scientific programs must be thoroughly familiar with the special needs of the laboratories and research programs, and must be thoroughly trained in modern personnel practices. Only through the joint efforts of such competent personnel technicians and scientific program directors can personnel rules and regulations be adapted to facilitate the scientific research work.

Personnel regulations are of great importance to scientific programs. They are, however, far from being the only source of complaint.

Budgets have been defined as plans of action for future periods. As research projects often take years to complete, one would think that research program directors would have to be continuously consulted in the preparation of agency budgets. In some agencies, it is reported that this consultation is quite inadequate.

The research director needs the help of budget officials. The research director may need assistance, for example, in preparing a budget document which laymen can understand. The budget official who uses his position to usurp control over operating programs may be an inconvenience or a real hindrance to effective operation, depending on the kind of support top management gives to the research program.

In other sections of this report, recommendations are made on the staff activities of the Federal Government. In general, there is a feeling among Federal professional workers that there is too much centralization of authority in some agencies in matters such as budgeting, purchasing, and personal actions. This centralization has too often led to delay in the operation of research programs. Worse than that, it has divorced the scientific program directors from important responsibilities.

The Civil Service Commission and the Bureau of the Budget, two central staff agencies, have each taken steps which show that they are aware of the importance of working out sound relationships with the operating agencies.

The Commission, for example, has displayed a real desire to have its rules and regulations meet the personnel needs of Federal laboratories and other scientific programs. A number of recent changes made by the Commission in its recruiting procedures have been made specifically to expedite professional

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and scientific recruiting.

In summary, it may be said that the need for regulatory agencies is obvious. But the rapid growth of scientific work in the Government has made acute the problem of adapting these regulations to scientific work. Regulatory practices arising mainly from experience in dealing with operating agencies are not likely to fit specialized scientific work. There is need for a systematic study of this problem along the lines discussed in this report. Competent scientists should participate in such a study. The alternative is placing scientific work under separate regulatory groups leading possibly to a variety of practices and general confusion as more and more exceptions are made.

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Chapter XI

RETIREMENT PROVISIONS

Scientific workers constitute a segment of the population whose economic status has for many years remained consistently between the level of industrial employees on the one hand, and those operating private industry or holding executive positions in business on the other. Income during their working years has constituted a comfortable livelihood, but until retirement systems were established, scientists found it difficult to protect themselves against the hazard of dependence in old age, and their dependents against the hazard of the premature death of the head of the family.

Beginnings

The movement for retirement pay for professional groups began about 1900. By that time, several universities had each instituted definite plans for the retirement of superannuated members of their own faculties. In 1905, Andrew Carnegie established a foundation with an original endowment of $10,000,000, to which an additional $5,000,000 was later provided, for the purpose of providing retirement pensions to teachers in universities, colleges, and technical schools in the United States and Canada. Institutions supported by State governments and religious denominations were excluded.

It was first thought that this endowment would be adequate to cover the liabilities, but it was soon found that the cost would far exceed the income from such a fund. Accordingly, the Carnegie Foundation, after a preliminary exploration, set up the Teachers' Assurance and Annuity Association of America, a company incorporated under the laws of the State of New York and conducted under the control of the Department of Insurance in the State. The annuity contracts written by this Association require regular payments into the fund by the teacher and by the college.

Several other plans for the retirement protection for professional groups are, or have been, in use. "Group annuity" programs constitute one type, but the earlier plans of this kind had the disadvantage that the employee usually retained no vested rights in the investment he had made. In recent years, it is becoming more common in the case of the pension plans of industrial concerns to permit the employee to retain title not only to his own deposits in such group annuity funds but to the company's contributions in his behalf also. The inclusion of such a vested

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right in the group annuity plan enables the worker to change jobs without sacrificing the annuity already purchased in his behalf.

Civil Service Retirement Laws

The Federal Civil Service was first covered by retirement legislation on May 22, 1920, when the original Civil Service Retirement Act was approved. The Retirement Act, as subsequently amended, now covers all civilian employees of the Government (about 2,000,000 in 1947) with a few specified exceptions, such as part-time employees, unpaid collaborators, consultants working on a fee basis, and employees of Government-owned corporations. From 10,000 to 25,000 employees retire each year, the number in fiscal year 1946 being 25,483.

Under the original Act, employees' contributions to the retirement fund amounted to 2½ percent of their basic salary. These retirement deductions were increased to 3½ percent on July 1, 1926, and to 5 percent on July 1, 1942. The Government meets its share of the annuity plan through regular appropriations to the retirement fund. Such appropriations have, so far, not equalled the deductions from payrolls, but the Government's share in the cost of the system will eventually exceed that of the employees.

The hazards covered by the Civil Service Retirement Act are primarily disability and age. An employee who becomes physically or mentally unable to carry on his duties is eligible for retirement on an annuity after having completed at least five years of service. The annuity continues throughout the period of disability, and repayment is not required in case of recovery.

Retirement for age is compulsory at 70, after 15 years service, except by Executive Order in individual cases, although under some conditions former workers may be re-employed after reaching 70. The employee may retire on a full annuity at his own or the Government's option at age 60 if he has had 30 years of service, or at age 62 after 15 years of service. Optional retirement at age 55 after 30 years service is also authorized, but in this case the annuity is reduced.

The amount of the annuity varies under several different formulas, but for workers in the professional and scientific service it usually amounts to the employee's highest average basic salary for any five consecutive years of service divided by 70 and multiplied by the number of years of service rendered, not exceeding 35. Scientific employees who have been in the Government service for 35 years or more, therefore, usually retire at about half salary.

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The act does not provide unemployment compensation, as such, but partially fulfills this need by providing a larger deferred annuity for employees who are involuntarily separated from the service due to reduction in appropriations than for those who resign. Such involuntarily separated employees are entitled to a deferred annuity starting at age 55 if their Government employment has exceeded five years.

While the retirement annuities and the regulations governing them applicable to service in the Federal Government are not as liberal as those of some States, such as New York and Pennsylvania, the principal hazards are covered by substantial protection. The most publicized lack has been failure to provide for dependents of employees who die before reaching retirement age, a protection which is usually secured privately through life insurance policies.

In general, it appears that the Government's retirement plan is sufficiently inclusive to constitute an attraction to Government service, in comparison with other possible employers. Most of the changes that have been proposed for consideration are at least of equal interest to other large groups of employees, and their absence probably does not constitute a serious deterrent to the recruitment of scientists.

New Provisions Required

One serious feature of primary interest in the administration of research, however, is the extent to which retirement plans in various organizations tend to freeze scientists in one institution or concern, especially after they have been employed long enough to enable them to make substantial contributions to scientific research and to build up a reputation. By that time their retirement status in the organization of which they are a part may make it most difficult for them to consider offers of appointment in other organizations in which they might be of greater value or receive greater remuneration.

This is now the principal remaining retirement problem with respect to scientific and professional personnel. The number of individuals with scientific training and research ability in the country or the world at any given time is limited, and yet the world's technological advance depends almost entirely on this small group. It is clearly in the public interest to enable men with scientific training to occupy those positions in which the need for them is greatest. Any retirement plan which requires or induces the scientific worker to continue in the employment of the same organization throughout his entire productive life in order to maintain protection for his later years is, therefore, disadvantageous to both employee and public.

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If the various organizations and institutions which employ scientists would all recognize their employees' vested rights to retirement credit gained during the period of employment, it would help solve this problem. In the Federal Civil Service an important step was taken in this direction in 1942, through the provision made for deferred annuities in the case of employees who leave the Federal service after they have been so employed for five years and before reaching retirement age. If an employee resigns or is discharged for cause, his retirement credit is held until he becomes 62, after which he is given the full retirement pay to which both his own and the Government's contributions entitle him. As previously indicated, where the separation is due to a reduction in force, an employee who has worked for the Government five years may elect to receive a reduced annuity beginning at age 55.

Therefore, it is now possible for a Federal employee to transfer to a State or private educational institution or commercial establishment without losing his retirement credit. Upon reaching retirement age he can receive not only any annuity to which he may be entitled under the subsequent non-Federal employment but also the retirement pay he had earned while in the Federal Government.

There still remain a number of retirement systems in State and private educational institutions and industrial laboratories which make no provision for deferred annuities of employees who leave the service of the institution. If such employees join the staff of one of the Government departments, they are unable either to obtain retirement credit under the Civil Service retirement system for the period of such prior service, or to hold retirement annuity rights under their former employers. Even where the employee is entitled upon resignation to withdraw his deposits from the institution's retirement fund, he would lose his rights to any deposits the institution had made to his credit in that fund. This condition tends to freeze employees in their current positions and to make a transfer difficult or unduly expensive to the employee. Growth in the direction of providing deferred annuities for employees who resign, or of simplifying transfer of creditable service between employers would be helpful to scientific work in this country and, therefore, in the public interest.

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Chapter XII

VOLUNTARY COOPERATION

The Advisory Committee on Scientific Personnel, under whose auspices this report has been prepared, is an example of informal voluntary cooperative effort on the part of Government scientists to solve the problems of management in this line of Government work. Set up by the Civil Service Commission as an official advisory group, it has nevertheless been effective, mostly because of the genuine interest in and devotion to the problems referred to it.

Experience has demonstrated the effectiveness of the experiment. It would be difficult to employ the services of a comparable group of experienced scientists with long careers in the Government and with intimate knowledge of Government as an operating branch of a regulatory agency. Funds would be inadequate and it would not be possible to interest enough men of high competence to serve. Furthermore, they would not remain operating scientists in intimate contact with operating problems.

There is unquestionably a role for such an organization in close working relationship with Federal regulatory agencies. It will be more effective the closer it is able to work with top personnel in such agencies. It should be composed of persons at the highest level possible, who can yet be induced to give the necessary time. It should have some facilities from agencies utilizing its services so that its effectiveness is not hampered by lack of routine clerical help. It is an advantage to have the chairman outside the Government service, but closely associated with its problems, so that no Government agency or bureau may be placed in the position of primary sponsorship.

The major role of such a committee is to channel to the regulatory agency reliable first-hand advice from those intimately associated with the operating units in the scientific program of the Government. In this way the regulatory agency can be kept continuously aware of the effect of its regulations on the vitality of the scientific work. It is difficult to secure this kind of information through routine observations.

It would be well if the various regulatory agencies gave serious thought to the possibilities for good inherent in an extension of the practice.

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